2021 Hazardous Waste Scanning Project

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Report.HW.932106.1991-09-01.Remedial_Design.pdf

GZA
GeoEnvironmental
of New York

Engineers and
Scientists

AFB - 1991 - 5 - 128

WORK PLAN

Remedial Design for
Building 202 Drum Storage Yard -
IRP Site 8 and 4,000 Gallon Underground
Tank Pit - IRP Site 13
Niagara Falls Air Force Base
Niagara Falls, New York

PREPARED FOR:

Duchscherer Oberst Design, P.C.
Buffalo, New York

PREPARED BY:

GZA GeoEnvironmental of New York
Buffalo, New York

September 1991
File: R5957

SR

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 914th TACTICAL AIRLIFT GROUP
NIAGARA FALLS INTERNATIONAL AIRPORT, NEW YORK 14304-5000

FROM: CEE (Niver,2043) 3 Oct 1991

SUBJECT: NGF 91-0550 Remedial Design - Building 202 Drum Storage Area IRP Site 8 and 4000 Gallon Underground Tank Pit IRP Site 13

TO: NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ATTN: MR. SCOTT MENRATH
50 WOLF ROAD
ALBANY, NEW YORK 12233

UNITED STATES ENVIRONMENTAL ENVIRONMENTAL
PROTECTION AGENCY
REGION 2 OFFICE
HAZARDOUS WASTE FACILITIES BRANCH
ATTN: CAROL STEIN
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, NY 10278

1. The Work Plan for the subject project is being submitted for your review and comment as you requested during the 12 March 1991 meeting.

2 It is the government's desire to proceed to the next phase of this project in a reasonable amount of time.

3. We request that all comments be returned by 12 Nov 1991. A non response means that we will proceed ahead with the Work Plan as written after this date.

4. If you have any questions please contact Mr William Niver at 716-236-2043.

Kenneth H. Collins

Kenneth H. Collins
Chief, Eng & Env. Planning

1 atch
1. Work Plan dated
September 1991

cc: NYSDEC (S. Radon)
HQ AFRES/CEPV
Duchscherer Oberst w/o
GZA Geo Environmental w/o

GZA
GeoEnvironmental
of New York

Engineers and
Scientists

September 25, 1991
File: R5957

GZA

364 Nagel Drive
Buffalo, New York
14225
716-685-2300
FAX 716-685-3629

Duchscherer Oberst Design, P.C.
2320 Elmwood Avenue
Buffalo, New York 14217

Attention: Mr. Julian Snyder, Ph.D., P.E.

Re: Remedial Design for
Building 202 Drum Storage Yard - IRP Site 8 and
4,000 Gallon Underground Tank Pit - IRP Site 13
Niagara Falls Air Force Base
Niagara Falls, New York

Gentlemen:

GZA GeoEnvironmental of New York (GZA) has prepared this work plan to address the proposed field work including sampling and analysis, geotechnical laboratory and analytical laboratory testing in conjunction with the remedial design services for Building 202 Drum Storage Yard - Installation Restoration Program (IRP) Site 8 and 4,000 Gallon Underground Tank Pit - IRP Site 13 at the Niagara Falls Air Force Base, Niagara Falls, New York. The work plan also includes a Quality Assurance Project Plan and Health Safety Plan. Comments prepared by the 914th Tactical Air Lift Group, United States Air Force Reserve dated September 3, 1991 have been incorporated in the work plan.

The work will be done by GZA for Duchscherer Oberst Design, P.C. (DOD) and the 914th Tactical Airlift Group, United States Department of the Air Force Reserve (USAFRES). DOD has an architectural/engineering services contract with the United States Department of the Air Force Reserve that names GZA as a subconsultant.

GZA notes that the work plan includes taking water level measurements in existing wells in August and September 1991. This work has begun, as discussed and approved by the 914th Tactical Airlift Group, United States Air Force Reserve.

Please call with any questions.

Very truly yours,

GZA GEOENVIRONMENTAL OF NEW YORK

Thomas R Heins

Thomas R. Heins, P.E.
Project Manager

Raymond L Kampff

Raymond L. Kampff
Project Reviewer

Irvine G. Reinig II

Irvine G. Reinig II, P.E.
Associate Principal and General Manager

IGR/cac

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1.00 INTRODUCTION

GZA GeoEnvironmental of New York (GZA) has prepared this work plan to address the proposed field work including sampling and analysis, geotechnical laboratory and analytical laboratory testing in conjunction with the remedial design services for Building 202 Drum Storage Yard - Installation Restoration Program (IRP) Site 8 and the 4,000 Gallon Underground Tank Pit - IRP Site 13 at the Niagara Falls Air Force Base, Niagara Falls, New York. The work plan also includes a Quality Assurance Project Plan and Health Safety Plan. A location plan is shown on Figure 1. Reference to IRP Site 8 in the report means the Building 202 Drum Storage Yard and IRP Site 13 means the 4,000 Gallon Underground Tank Pit. Also, reference to the Niagara Falls Air Force Base means that the base is located at the Niagara Falls International Airport.

The work will be done by GZA for Duchscherer Oberst Design, P.C. (DOD) and the 914th Tactical Airlift for Group, United States Department of the Air Force Reserve (USAFRES). DOD has an architectural/engineering services contract with the United States Department of the Air Force Reserve that names GZA as a subconsultant.

2.00 BACKGROUND

This section presents a description of the Niagara Falls International Airport and describes past waste management practices at IRP Site 8 and IRP Site 13.

2.10 DESCRIPTION OF INSTALLATION

Niagara Falls International Airport is located approximately 15 miles north of Buffalo, New York and 6 miles east of the City of Niagara Falls in Niagara County, New York. See Figure 1.

The Niagara Falls International Airport was established in 1942 when 468 acres of municipal airport land was leased by the United States Government for use by the Army Air Corps. In 1946, approximately 132 acres of land was returned to the City of Niagara Falls, reducing the area of the base to 336 acres. The United States Air Force also shares joint ownership of the runway facilities with Niagara Falls International Airport, raising the total acreage of the base to 985 acres. The Air Force Reserve command and the 914th Tactical Airlift Group are currently responsible for the base operations.

2.20 PAST WASTE MANAGEMENT PRACTICES AT IRP SITE 8 AND IRP SITE 13

IRP Site 8 was previously a gravel pad located north of Building 202 at the Niagara Falls IAP. The location of IRP Site 8 is shown on Figure 2. It is understood that the gravel pad was used between 1978 and 1982 for short-term storage of hazardous waste drums prior to disposal off site. The gravel pad was subsequently paved over with asphalt concrete. A new asphalt concrete overlay was placed in 1988. The drums were reported to have been stored on the asphalt pavement also. Minor spills from the drums were reported in this area and evidence of the spills were observed during a Phase I site investigation.

IRP Site 13 is the location of a former underground motor fuel storage tank, which was converted to a general slop waste tank. The tank has since been removed and the pit backfilled. The location of IRP Site 13 is shown on Figure 2.

Conditions at IRP Site 8 and IRP Site 13 are further described in reports of previous investigations made at the Niagara Falls IAP. They include:

-- Phase I records search made by Engineering Science in 1983.

-- Phase II, Stage 1 Confirmation/Quantification Report made by Science Applicants International Corporation (SAIC) in April 1986.

-- Installation Restoration Report (IRP) Remedial Investigation/Feasibility Study (RI/FS), SAIC October 1990.

2.30 SUBSURFACE AND GROUNDWATER CONDITIONS AT IRP SITE 8 AND IRP SITE 13

Based on available data, the geology at IRP Site 8 and IRP Site 13 generally consists of lacustrine sediments and glacial till overlying massive to thinly bedded dolomite bedrock (Lockport Formation). The lacustrine sediments generally form the uppermost portion of the overburden and overly a silt, clay, sand, gravel, glacial till. The glacial till rests directly on the bedrock surface. It is reported that the overburden soils at IRP Site 8 average about 14 feet in thickness and at IRP Site 13 average about 8 feet in thickness. The top of bedrock ranges between elevation 583 and 585 feet across IRP Site 8 and between elevation 586 and 588 feet across IRP Site 13.

Nine groundwater monitoring wells were located in the area of IRP Site 8. They consist of six shallow wells constructed in the overburden (i.e. 8-1, 8-2, 8-3, 8-4, 8-5 and 8-6) and three deep wells constructed into the bedrock (i.e 8-1D, 8-2D and 8-3D). See Figure 3 for their locations. SAIC reports that well 8-5 was destroyed. The overburden or (shallow) wells are generally screened from the top of rock up to about the top of the glacial till layer. The bedrock or deep wells are generally screened through the bedrock and up through the glacial till/bedrock interface. Groundwater levels measured on October 4, 1989 show water levels to be present in the range of elevation 585 to 586 feet in the shallow wells and in the range of elevation 586 feet at one of the deep wells. The levels were approximately 1 to 2 feet above the bedrock surface at the time these measurements were made.

Four groundwater monitoring wells have been installed in the area of IRP Site 13. They consist of four shallow wells constructed in the overburden soil (i.e. 13-1, 13-2, 13-3 and 13-4). See Figure 4 for their locations. No deep wells have been constructed in the bedrock at this site. The shallow wells are generally screened from the top of rock up through the glacial till layer. Groundwater levels measured on October 4, 1989 show water levels to be present in the range of elevation 589 to 590.5 feet. These levels were approximately 1.5 to 4 feet above the bedrock surface at the time these measurements were made.

Groundwater analysis, as part of the October 1990 RI/FS, reported elevated levels (in excess of New York State Drinking Water Standards) of organics, including toluene, trichloroethene (TCE) and 1,1-dichloroethane in downgradient wells at IRP Site 8. Groundwater analysis at IRP Site 13, as part of the October 1990 RI/FS, reported elevated levels of organics, including vinyl chloride, TCE, toluene and ethylbenzene in wells directly adjacent to the site. At both sites, the elevated levels of organics were reported to be in the overburden groundwater. A copy of Table 4-75, Site No. 8: Analytical Results vs. ARARs: Groundwater and Table 4-110 Site No. 13: Analytical Results vs. ARARs: Groundwater from the RI/FS is included for information. See the section titled Tables.

2.40 RISK ASSESSMENT RESULTS

A baseline risk assessment made at both sites by SAIC, as part of the RI/FS, concluded that the elevated organics present in the groundwater are a potential health hazard and therefore, it was recommended that the groundwater be remediated. A hazard index of 4.97 was reported for Site 8 - Hazardous Waste Drum Storage Yard. A hazard index of 3.55 and a cancer risk of 2×10^{-3} were reported for Site 13 - 4,000 Gallon Underground Tank Pit. Refer to the RI/FS by SAIC for additional information. The baseline risk assessment also concluded that the soil material itself did not pose a potential health hazard at either site and therefore, it does not require remedial action.

2.50 PROPOSED REMEDIATION AT IRP SITE 8 AND IRP SITE 13

Based on the results of the RI/FS, it was recommended by SAIC that a subsurface drain be installed at both sites to capture the lateral groundwater flow from the overburden soil. The groundwater would then be collected in a sump and treated off site. SAIC proposed that the drain pipe be installed at the top of rock (approximately 14 feet at IRP Site 8 and 8 feet at IRP Site 13 below ground surface) and drain to an 8 foot diameter manhole at each site, which would act as the collection sump. The manhole is proposed to be constructed about 6 feet into bedrock. SAIC estimated that the flow rate of the groundwater collected will initially be about 100 to 115 gallons per day and it will stabilize in about two months at about 11 to 15 gallons per day at each site.

The USAFRES has requested that a remedial design be initiated by DOD for each site, based on the results and recommendations of the October 1990 RI/FS made by SAIC. However, the actual design by DOD will be based upon the information collected during the work described herein.

3.00 PURPOSE

The purpose of GZA's work is to make additional studies (i.e. monitoring well installations, groundwater measurements, sampling and analysis, permeability testing, evaluation of groundwater contours and flow modeling, site surveys, geotechnical studies, etc.) necessary for DOD to complete a remedial design for IRP Site 8 - Building 202 Drum Storage Yard and IRP Site 13 - Underground Tank Pit.

4.00 FIELD ACTIVITIES

This section describes the field activities that will be conducted at IRP Site 8 and IRP Site 13 to assist with remedial design.

4.10 TEST BORINGS AND GROUNDWATER MONITORING WELL LOCATIONS

Three test borings will be made at IRP Site 8. Two monitoring wells will be installed in the overburden and one monitoring well will be installed in the bedrock in the completed test borings. The purpose of the test borings and overburden wells is to supplement existing subsurface data, to evaluate the extent of contamination and aid in assessing the hydraulic conductivity of these soils. As such, they will be positioned south and southeast of IRP Site 8 at apparent downgradient locations. Refer to Figure 3 for proposed locations. Final locations may vary depending on access and existing utilities.

Additionally, the RI/FS report states that the bedrock groundwater flow direction was not evaluated due to minimal head difference between the existing wells. This may indicate that these existing wells fall along an equipotential line, as noted by the groundwater flow directions presented in the RI/FS. Therefore, the proposed monitoring well in the bedrock will supplement existing wells and evaluate the flow direction, evaluate the hydraulic conductivity of the bedrock for design, and aid in ✓ assessing the extent of bedrock groundwater contamination (if any). Currently, it is anticipated that this well will be positioned about 50 feet southwest of IRP Site 8 to aid in triangulation with existing wells.

Two test borings will be made at IRP Site 13. One monitoring well will be installed in the overburden and one well will be installed in the bedrock in the completed test borings. A true downgradient overburden well was not installed/sampled during the RI/FS. Therefore, GZA proposes to install one downgradient overburden well to aid in evaluating the extent of contaminant migration. The purpose of the bedrock well will be to aid in assessing the groundwater flow direction, hydraulic conductivity, extent of contamination, bedrock character, and elevation for design. The proposed locations will be determined after the water levels in existing wells are measured in July and August 1991 as stated in Section 4.60.

4.20 TEST BORING PROCEDURES

GZA will engage the services of a subsurface drilling company to make test borings and install groundwater monitoring wells at each site. Prior to drilling, GZA and its subcontractor will review utility locations at proposed monitoring well locations by contacting the Base Civil Engineer and local utility companies. A digging permit (AF Form 123) will be obtained from the Base Civil Engineer prior to commencing field work.

Overburden test borings will be completed using hollow stem auger drilling methods. Augers having a 4-1/4 inch inside diameter (ID) hollow stem will be used to advance boring where monitoring wells are installed in the overburden and 6-1/2 inch ID hollow stem augers will be used to advanced borings where monitoring wells are installed in bedrock. The auger will be advanced with a plug at the bottom of the lead auger to limit soils from entering the auger during drilling. The plug will be removed prior to taking each soil sample.

Subsurface soil samples will be collected using ASTM D-1586. Soil samples will be collected in consecutive 2 foot intervals beginning at ground surface using a 1-3/8 ID by 24 inch long split spoon sampler. The split spoon sampler will be advanced using a 140 pound hammer. The number of blows required to advance the sampler in 6 inch intervals will be recorded by GZA. The number of blows required to advance the sampler from 6 inches to 18 inches is the Standard Penetration Test (SPT) resistance for each sample.

Upon advancing the augers to refusal a 5 inch PVC casing will be installed. The casing will be grouted into the hole as discussed in Section 4.30. After the grout has set a minimum of 24 hours, bedrock will be cored and sampled for about 10 feet using a NQ double tube core barrel. Rock core samples will be placed in partitioned wood core boxes and they will be blocked showing the top and bottom of each run. The project, boring number, core run depth and length, recovery, rock quality designation (RQD) as appropriate etc. will be marked on the wood cover.

A GZA representative will observe the drilling operations and prepare test boring logs, describing soil and bedrock samples and to make field decisions regarding the work. Selected split spoon soil samples, based on GZA's observations, will be returned to GZA's soils laboratory for index property testing to verify field descriptions. It is anticipated that this work will be done using United States Environmental Protection Agency (USEPA) Level D personal protection.

Split spoon soil samples will be classified by GZA personnel according to GZA's method for describing and identifying soils. The test boring log documentation is discussed in further detail in the Quality Assurance Project Plan (QAPP) in Appendix A.

During drilling the ambient air will be monitored using a HNu (model PI-101) organic vapor meter. Soil cuttings and drilling water will be screened by passing the organic vapor meter over the cuttings/water to aid in determining relative contamination. The procedures are discussed in the QAPP.

Should HNu readings exceed background levels, as discussed in the Health and Safety Plan. GZA will stop the test borings and re-evaluate the situation (i.e. increase the level of personal protection etc.) prior to proceeding. Additional details are presented in the Health and Safety Plan.

Soil cuttings and well purge water suspected to be contaminated, based upon the field screening and/or visual observation will be containerized. Soil cuttings and purge water from each boring will be placed in separate containers. Containers will be transported to a location within the base, as designated by the contracting officer. All other cuttings will containerized until they are removed to an accumulation point designated by the contracting officer.

GZA will recommend disposal options to the Base Environmental Coordinator, based upon sample analysis conducted by the USAFRES under separate contract as necessary and screening/testing done under this contract. The base will be responsible for the proper disposal of contaminated soils and water.

4.30 MONITORING WELL INSTALLATION PROCEDURES

The procedures for installing monitoring wells in the overburden soils will be as follows:

1. Test borings will be advanced using hollow stem augers and split spoon samples will be collected as described in Section 4.20.

2. Upon reaching the appropriate depth, a polyvinyl chloride (PVC) well screen (2 inch I.D., Schedule 40 with slit bottom plug) and the appropriate length of PVC riser will be installed in the hollow stem auger and raised a minimum of 6 inches off the bottom of the hole.

   The screen and riser will be threaded flush joint. The screen slot size will be designed to limit migration of the silt and clay soil fines into the well in accordance with proposed ASTM methods (June 28, 1989). The schedule PVC screen will be factory slotted. The well screen and casing will be steam cleaned prior to installation in the borehole. The screen interval will be set at a depth to allow for fluctuation in the groundwater table elevation and will be set such that the approximate mid point of the screen is positioned at the observed water level measured at a depth to allow any free-floating petroleum, oils, and lubricants to enter the well during sampling. Approximate screened footage for overburden wells will be 2 to greater than 5 feet. The top of the casing may extend about 2 feet above ground elevation in most cases; however, some wells may be completed flush to the ground (i.e., pavement areas) so as not to interfere with normal activities.

3. The augers will be raised in 2-foot increments and silica sand of a grain size distribution compatible with the screen and the formation will be added. This process will be continued until the sand pack extends at least 1 foot above the top of the screen. See the QAPP, Section 4.44 for details.

4. After the sand pack is in place and measurements have been taken to ensure the proper location of the sand pack, about 2 feet of bentonite pellet seal will be placed on top of the sand pack.

5. After the bentonite seal is in place, has been allowed to set and measurements have been taken to ensure its proper location, a cement and bentonite grout will be tremied in place from the top of the seal to the land surface. This will be accomplished in such a manner that a tight, continuous grout seal is ensured through the entire interval. Cement and bentonite grout mixtures will consist of potable water, bentonite and Type I or II Portland cement. The grout will be allowed to set at least 24 hours before the well is developed.

6. Prior to development, the water level will be measured to the nearest 0.01 foot in feet below the top of the casing.

7. Each well will be developed by bottom-filling bailer, pumping until GZA's field representative determines that the well water is relatively turbid free and acceptable in clarity, pH, and specific conductance (i.e., where clarity, pH, and conductivity have stabilized and show no further improvement or reduction with continued development). Minimal development is expected as no drilling fluids are being used. The total volume of removed water will be estimated and recorded.

8. Based upon measured contamination from HNu monitoring results or visible signs of contamination, development water will be contained in 55 gallon drums. The contracting office will authorize the proper disposal of all containerized water based upon review of analytical results on water samples collected from the well as discussed in Section 4.60.

9. If the well is to be completed with a flush mounted casing, the casing will be cut 2 to 3 inches below the ground surface. A protective locking lid consisting of a cast iron valve box assembly then will be installed. The lid assembly will be centered in a 3-foot diameter concrete pad sloped away from the valve box. A slit casing cap also will be installed to prevent surface water infiltration. The well number will be marked on the valve box lid and casing.

   If the well is to be completed using above ground casing, the PVC casing will be extended 2 to 3 feet above the ground surface. An end plug will be provided for each well, along with a vented casing cap. The PVC casing will be covered by a steel casing with a locking lid which will be seated in a concrete surface pad. The pad will be sloped away from the steel casing. The well number will be marked on the steel casing using paint.

10. The general area will then be restored to its approximate former condition.

The procedures for drilling monitoring wells in rock are initially the same as those described for shallow monitoring wells (step 1) until the Lockport Dolomite has been reached. The following procedures then will be followed:

1. A 5-inch diameter PVC Schedule 40 casing will be lowered into the hole and raised approximately 0.5 feet from the bottom of the hole. Cement-bentonite grout will be tremied into the bottom of the hole until it reaches the surface in the annulus between 5-inch casing and the borehole. The casing then will be lowered to the bottom of the hole and grout will be pumped out of the inside of the casing.

2. The drill rig then will be removed from the boring and decontaminated.

3. After allowing at least 24 hours for the grout to set, a 4-inch NQ double tube core barrel will be used to drill to the desired depth in the Lockport Dolomite (about 10 feet). The upper 10 feet of the Lockport is presently targeted to be screened, as this is reportedly the most highly fractured zone and most susceptible to downward migrating contaminants.

4. The appropriate length of PVC screen, sand, riser, bentonite seal, and grout will be used to complete the well as discussed for the wells in overburden soils. However, the well screen will have 0.01 - inch slots. Finally, a protective casing will be installed and the well will be developed as discussed above (steps 3 through 10).

Monitoring well construction logs will be prepared by GZA for each borehole drilled and well installed. The logs will present and summarize details of the well construction (i.e., screened interval, water level etc.). This documentation is discussed in greater detail in the QAPP.

4.40 UNDERGROUND UTILITY INVESTIGATION

Field gas chromatograph (GC) screening will be done to assess the potential for preferential containment migration along underground utility lines beneath the site. This will include the collection of groundwater samples by advancing a small diameter sampling probe down to the water table (anticipated at less than 7 feet) at various locations along the buried line and withdrawing a sample for field GC analysis. Based upon the field GC analysis samples will be chosen for laboratory analysis as discussed below.

To determine potential sample locations, base records will initially be reviewed to estimate the location, depth and construction of the utility(s). Sample locations will flow then be selected such that the groundwater near the utility line's bedding are collected. It is currently anticipated that samples will be collected from five locations at IRP Site 8 and five locations at IRP Site 13.

Samples will be collected by advancing a pre-cleaned 3/4 inch diameter hollow galvanized steel probe into the water table (estimated depth less than 7 feet) and withdrawing a 40 ml groundwater sample. The sample will be collected by inserting a high density polyethylene tube into the probe and withdrawing the sample using a suction lift pump. The sample will immediately be placed in a 40 ml septum vial.

A headspace will then be created in the vial by withdrawing 10 ml of water using a syringe. The sample will then be warmed to 40°C and the headspace will be screened in the field using a Photovac Model 10S50 GC. Benzene, toluene, ethylbenzene, and xylene standards (compounds previously detected at the site) will be used to identify and quantify specific compounds. Two groundwater samples from each site will also be submitted to the analytical laboratory for total petroleum hydrocarbons, purgable hydrocarbon and purgable aromatic analysis.

4.50 SURVEYING

Upon completion of monitoring well installations and the field gas chromatograph screening along the buried fuel line, GZA will subcontract a land surveyor licensed in New York State to locate monitoring wells and probe holes vertically and horizontally. Locations will be referenced to the on-site geodetic datum.

4.60 GROUNDWATER SAMPLING AND WATER LEVEL MEASUREMENTS

Groundwater samples will be collected from new and selected existing wells at IRP Sites 8 and 13. The number of samples to be analyzed from each site include eight wells at IRP Site 8 and six wells at IRP Site 13.

Quality control samples will be collected including one field blank, one rinsate blank, two duplicate (i.e. one from each site) and two trip blanks (analyzed for volatile compounds only).

Each sample will be analyzed by a subcontracted analytical laboratory for the compounds listed below:

- Common Anions (Chloride, Fluoride, Nitrate, Sulfate, Alkalinity)
- Common Cations (Calcium Magnesium, Sodium)
- Total Dissolved Solids
- Total (unfiltered) metals (Zinc, Chromium, Iron Manganese, Barium, Aluminum, Copper, Nickel, Silicon, Potassium, Lead and Boron)
- Total Petroleum Hydrocarbons
- Purgable Hydrocarbons
- Purgable Aromatics

The analytical methods and details on Quality Assurance and Quality Control procedures are stated in the QAPP.

Prior to sampling, the well will be purged a minimum of three well volumes, if possible. Groundwater collected during purging will be placed in a DOT approved 55-gallon drum and placed with other drums. Purging will be done using a pre-cleaned teflon bailer and/or centrifugal pump with dedicated high density polyethylene tubing. Sampling will be done using a pre-cleaned Teflon bailer.

Prior to the sampling event, sampling and field testing equipment will be prepared and cleaned as described in subsequent sections of this submittal.

Groundwater samples will be collected using the following procedures:

1. A sampling log (see QAPP) will be completed with the appropriate information including observations of the visible portion of the well (i.e. casing/cap, surface seal etc.).

2. The well will be opened and an organic vapor meter will be used to monitor the air quality at the top of the well casing.

3. The water level depth will then be measured to the nearest 0.01 foot from the monitoring point on top of the well riser pipe using a electronic tape water level indicator (SINCO Model S1453 or similar). The total depth of the well will also be measured to the nearest 0.01 foot from the monitoring point using the water level indicator. Measurements will be recorded on a well sampling record.

4. The standing water well volume will be calculated based upon the measurements in steps 2 and 3 and the diameter of the monitoring well.

5. The well will be evacuated of three times the volume of water calculated in Step 4 or until dry. This evacuation will be accomplished with the dedicated bottom loading Teflon bailer.

6. Measurements of pH, specific conductance, temperature and turbidity will be made at the start of purging and prior to sampling so that a representative groundwater sample is collected for testing. Prior to obtaining a test sample, groundwater will be purged until a turbidity of 50 NTUs or less, a pH within 0.5 standard units and a specific conductance within 5 percent is measured in two consecutive samples taken at two well volume intervals. However, in the event the above conditions cannot be achieved, (i.e., turbidities greater than 50 NTU) alternative sample collection procedures will be discussed with AFRES. Upon a decision regarding the appropriate course of action by the AFRES and in consultation with NYSDEC the sampling will be completed.

7. Following purging, the water level will be allowed to recover to within 10 percent of its original level prior to sample collection provided it recovers in the proper time. But, the samples will be collected within 24 hours of the purging of the well should it not recover accordingly within that time period.

8. The samples obtained will be placed in appropriate sample containers provided by the analytical laboratory and logged onto the sample log and the Chain-of-Custody Form (see QAPP).

9. Upon completing the appropriate documentation, the samples will be placed in an iced cooler(s) and transported to the analytical laboratory.

Work at IRP Sites 8 and 13 during the previous RI (SAIC, 1990) indicated elevated levels of metals in the samples. These levels were attributed to interference caused by sediment in the samples. As such, it is understood that USEPA has requested that one duplicate groundwater sample from each site for metals be filtered in the field prior to analysis. As such, one duplicate sample to be analyzed for metals will be field filtered using 10 micron pore size filter paper. This filter size has been suggested by USEPA for assessing mobile metals in groundwater (Puls and Barcelona, "Filtration of Groundwater Samples for Metals Analysis", Hazardous Waste and Hazardous Materials, Volume 6, No. 4, 1989).

In addition to the groundwater elevations measured during sampling, GZA will measure water levels on two other occasions. The purpose of these measurements will be to assess the seasonal low groundwater elevations at IRP Sites 8 and 13 (typically around July, August, and September 1991). This data is needed to design the subsurface drain, such that it is positioned below the groundwater table throughout the year (i.e. there is an inward gradient to the drain from both the soil and rock). These water level measurements will be made in the existing wells. The results will also be used to further evaluate the groundwater flow direction for locating the proposed new wells at IRP Site 13.

4.70 SAMPLING EQUIPMENT CLEANING

Sampling equipment (split spoon sampler, bailers, etc.) will be cleaned prior to the sampling event and between samples utilizing the procedures stated in the QAPP.

4.80 FIELD TESTING

Various field tests will be done during sampling. These tests will include:

- total organic vapor measurement;
- groundwater level measurement;
- temperature;
- pH;
- specific conductance; and
- turbidity.

The measurements obtained during these field tests will be recorded in the appropriate spaces of the sampling log and/or field reports/boring logs. The equipment calibration and test procedures to be utilized are presented in the QAPP.

4.90 HYDRAULIC PARAMETER ESTIMATE

GZA will conduct field studies and laboratory studies to evaluate the hydraulic characteristics of the overburden and bedrock at the site to aid in designing the subsurface drain system. These studies will include:

- Single borehole pump tests in bedrock wells,
- Variable head slug tests in overburden wells, and
- Laboratory measurement of overburden material hydraulic conductivity, discussed in Section 6.00.

This approach was selected for the following reasons. The glacial till aquifer at the site reportedly has a hydraulic conductivity on the order of 1×10^{-6} centimeters per second (cm/sec). The rate at which a well set in this material may be pumped is expected to be extremely low (e.g. less than a few gallons per day). The drawdown induced by this pumping would be minimal at distances more than a couple of feet from the well and the time for drawdown to occur is expected to be lengthy. Therefore, in order to conduct a multiple well pump test in the glacial till, it would be necessary to install an array of wells close to the pumping wells and run the test for an extended period of time which would be uncertain and costly.

Single borehole pump tests will be conducted in the three existing bedrock wells and the two bedrock wells installed during our work and will consist of pumping water from each well at a constant rate and monitoring the drawdown in the well with time.

The test will be continued until a constant drawdown is obtained. This data will be used to estimate the hydraulic properties of the bedrock by time-drawdown and by constant head methods. It should be recognized that well losses and casing storage affect this data. Thus, it will not be possible to calculate aquifer storativity from this data.

Slug tests will be done in each overburden monitoring well at IRP Sites 8 and 13 (e.g. 15 wells total). This testing will be done by placing a stainless steel slug of known volume into the well and measuring the subsequent fall in water level with time. The slug will then be removed and the rise in water level with time will be measured. These data will be used to estimate hydraulic conductivity by methods presented in Hvorslev, 1951 (Time, Lag and Soil Permeability in Groundwater Observations, Corps of Engineers, U.S. Army Bulletin No. 36).

5.00 ANALYTICAL LABORATORY TESTING

GZA will engage Recra Environmental Inc. of Buffalo, New York to complete analytical testing of the samples collected during this study.

The samples will be analyzed for the parameters stated previously within the required holding times. Method references and allowable holding times are shown in the QAPP. To the extent possible, low detection limits will be provided unless matrix interference or sample dilution precludes such detection limits. See the QAPP for additional discussion of the analytical laboratory testing.

6.00 GEOTECHNICAL LABORATORY TESTING

Geotechnical soil laboratory testing for physical properties will be done by the test methods stated in the QAPP by GZA's geotechnical laboratory located in Buffalo, New York. GZA will test selected soil samples for moisture content, grain size analysis and Atterberg limits as appropriate.

The permeability of the soil samples of glacial till will also be measured. A total of three permeability tests will be made (two from soil samples collected from IRP Site 8 and one from IRP Site 13). Disturbed soil samples will be reconstituted to a density representative of field conditions. Permeability will then be measured in a triaxial cell by falling head methods as shown in the QAPP.

7.00 QUALITY ASSURANCE

The Quality Assurance Project Plan (QAPP) for the field work is presented in Appendix A. Descriptions of data quality objectives and procedures associated with sample collection, laboratory analysis, sample custody, instrument/equipment calibration, internal quality assurance checks, performance and system audits, preventative maintenance, data measurement assessment procedures, corrective action, quality assurance reports to management applicable to this project are presented in this document.

8.00 HEALTH AND SAFETY

The Health and Safety Plan for the proposed field work is presented in Appendix B. GZA personnel engaged in the field work are required to become familiar and comply with the Health and Safety requirements stated in the plan.

TABLES

TABLE 4-75
SITE NO. 8: ANALYTICAL RESULTS VS. ARARs: GROUNDWATER

Parameter (Units)	Detection Limits	ARAR[L]	GW28 (MW-8-6)	GW29 (MW-8-3D)	GW31 (MW-8-5)	GW32 (MW-8-1D)	GW35 (MW-8-1)	GW36 (MW-8-3)
			Sample ID (Sample Description)					
EPA Method SW5030/8021								
Volatile Organics/Purgeable								
Halocarbons (ug/L)								
1,1,1-Trichloroethane	0.4	200[l]	ND	1.3	ND	ND	ND[a]	ND
1,1-Dichloroethane	0.5	5[l]	ND	1.7	ND	ND	1.3J[a]	ND
Trans-1,2-Dichloroethene	0.3	100[l]	ND[d]	1.1[d]	ND[d]	ND[d]	ND[a]	ND
Methylene Chloride	0.8	0.19[k]	3.3[b,c,d]	3.6[b,c,d]	0.65J[b,c,d]	1.2[b,c,d]	19[a,b,d]	ND[b,d]
Dichlorodifluoromethane	2.0	No ARAR	ND[d]	2.2[d]	ND[d]	ND[d]	ND[a]	ND
Trichloroethylene	1	5[l]	ND[d]	1.6[d]	1.7[d]	4.5[d]	190[a]	ND
1,4-Dichlorobenzene	0.3	75[l]	ND[c]	ND[c]	ND[c]	ND[c]	ND[a]	ND
Others	See Appendix F	-	ND	ND	ND	ND	ND	ND
EPA Method SW5030/8020 (µg/L)								
Purgeable Aromatic Organics			ND	ND	ND	ND	ND	ND
Toluene	0.3	2000[l]						
1,4-Dichlorobenzene	0.7	75[l]						
Others	See Appendix F	-						
EPA Method SW5030/8015 (ug/L)								
Non-halogenated Volatile Organics	See Appendix F	-	ND	ND	ND	ND	ND	ND
EPA Method E625 (ug/L)								
Semivolatile Organics								
Di-n-butylphthalate	10	No ARAR		<10*	<10*	<10*	<10*	<10*
Bis(2-ethylhexyl)phthalate	10	4200[l]		<10*	<10*	ND	<10*	10
Others	See Appendix F	-		ND	ND	ND	ND	ND
EPA Method E200.7*								NA
Total Metals (mg/L)								
Aluminum	0.1	No ARAR	2.13	ND[f]	18.0[f]	0.909[f]	67.0	56.8
Arsenic (E206.2)	0.005	0.025[l]	ND	0.005	0.005	ND	0.009	0.009
Barium	0.01	1.0[l]	0.040	0.069	0.283	0.095	0.547	0.547
Boron	0.01	No ARAR	0.208[d]	0.106[b,d]	0.212[b,d]	0.125[b,d]	0.400[d]	0.369[d]
Cadmium	0.005	0.010[l]	ND	ND	ND	ND	ND	ND
Calcium[f]	0.20	No ARAR	276	259	434	189	840	922
Chromium	0.010	0.050[l]	0.012	ND	0.026	ND	0.093	0.086

TABLE 4-75 (Cont'd)
SITE NO. 8: ANALYTICAL RESULTS VS. ARARs: GROUNDWATER

Parameter (Units)	Detection Limits	ARAR[L]	Sample ID (Sample Description)					
			GW28 (MW-8-6)	GW29 (MW-8-3D)	GW31 (MW-8-5)	GW32 (MW-8-1D)	GW35 (MW-8-1)	GW36 (MW-8-3)
EPA Method E200.7*								
Total Metals (mg/L) (Cont'd)								
Cobalt	0.010	No ARAR	ND	ND	0.015	ND	0.185	0.041
Copper	0.010	1.0[i]	ND	ND	0.041	ND	0.108	0.161
Iron	0.025	0.300[i]	5.16	4.17[f]	32.5[f]	0.816[f]	121	90.7
Lead	0.05	0.025[i]	ND	ND	0.080	ND	0.217	0.307
Lead (E239.2)	0.005	0.025[i]	0.007	ND	0.062	ND	0.184	0.534
Magnesium[f]	0.20	No ARAR	240	137	201	72.7	268	409
Manganese	0.005	0.300[i]	2.05	0.164	2.049	0.052	4.96	4.89
Mercury (E45.1)	0.0002	0.002[i]	ND	ND	ND	ND	ND	ND
Molybdenum	0.010	No ARAR	0.059	ND	ND	ND	ND	ND
Nickel	0.015	0.0154[j]	ND	ND	0.038	ND	0.145	0.104
Potassium[f]	0.4	No ARAR	7.54	3.67	6.04	3.50	12.2	12.9
Silicon[f]	0.020	No ARAR	8.69	6.07[b]	27.3[b]	8.02[b]	78.6	72.1
Sodium[f]	0.200	No ARAR	475	56.6	57.1	47.0	50.2	47.7
Vanadium	0.01	No ARAR	0.035	ND	0.036	ND	0.112	0.104
Zinc	0.01	5.0[i]	0.076	0.033[g]	1.04[g]	0.154[g]	4.47	2.68
Others	See Appendix F	-	ND	ND	ND	ND	ND	ND
EPA Method E418.1 (mg/L)								
Total Petroleum Hydrocarbons	1.0	No ARAR	ND	ND	ND	ND	ND	ND
Miscellaneous Inorganics (mg/L)								
Total Dissolved Solids (E160.1)	1.0	500[m]	4100	1900	1400	1200	1800	1400
Common Anions (A429)								
Fluoride	0.1	1.5[i]	0.58	0.58	0.54	0.61	0.54	0.60
Chloride	0.5	250[i]	29	82	54	68	83	59
Sulfate	0.5	250[i]	2500	940	780	510	810	610
Total Hardness (E130.1)	1.0	No ARAR	1800	1200	1800	830	2800	2600

TABLE 4-75 (Cont'd)
SITE NO. 8: ANALYTICAL RESULTS VS. ARARs: GROUNDWATER

Parameter (Units)	ARAR^{L}	Sample ID (Sample Description) GW38 (MW-8-4)	 GW39 (MW-8-2D)	 GW40 (MW-8-2)
EPA Method SW5030/8021 (ug/L)				
Volatile Organics/Purgeable Halocarbons				
1,1,1-Trichloroethane	200^{l}	ND	ND	ND
1,1-Dichloroethane	5^{l}	0.62	0.97	0.37J
Trans-1,2-Dichloroethane	100^{l}	ND	ND	ND
Methylene Chloride	0.19^{k}	ND^{b,d}	ND^{b,d}	ND^{b,d}
Dichlorodifluoromethane	No ARAR	ND	ND	ND
Trichloroethene	5^{l}	ND	1.0	11
1,4-Dichlorobenzene	75^{l}	ND	ND	ND
Others	-	ND	ND	ND
EPA Method SW5030/8020 (µg/L)		ND	ND	
Purgeable Aromatic Organics				
Toluene	2000^{l}			0.64
1,4-Dichlorobenzene	75^{l}			ND
Others	-			ND
EPA Method SW5030/8015 (ug/L)				
Non-halogenated Volatile Organics	-	ND	ND	ND
EPA Method E625				
Semivolatile Organics (ug/L)				
Di-n-Butylphthalate	No ARAR	<10^{*,h}	18^{h}	22^{h}
Bis(2-ethylhexyl)phthalate	4200^{l}	<10^{*,h}	20^{h}	38^{h}
Other	-	ND	ND	ND
EPA Method E200.7*				
Total Metals (mg/L)				
Aluminum	No ARAR	45.8	31.7	94.9
Arsenic (E206.2)	0.025^{l}	0.011	0.012	0.024
Barium	1.0^{l}	0.578	0.310	0.954
Boron	No ARAR	0.314^{d}	0.182^{d}	0.512^{d}
Cadmium	0.010^{l}	ND	ND	0.122
Calcium^{f}	No ARAR	949	392	1760
Chromium	0.050^{l}	0.062	0.025	0.180
Cobalt	No ARAR	0.037	0.010	0.071
Copper	1.0^{l}	0.143	0.033	0.419
Iron	0.300^{l}	76.5	30.9	148
Lead	0.025^{l}	0.302	0.226	1.03

TABLE 4-75 (Cont'd)
SITE NO. 8: ANALYTICAL RESULTS VS. ARARs: GROUNDWATER

		Sample ID (Sample Description)		
Parameter (Units)	ARAR[L]	GW38 (MW-8-4)	GW39 (MW-8-2D)	GW40 (MW-8-2)
EPA Method E200.7*				
Total Metals (mg/L) (Cont'd)				
Lead (E239.2)	0.025[i]	0.332	0.212	1.24
Magnesium[f]	No ARAR	442	174	509
Manganese	0.300[i]	4.76	1.08	9.08
Mercury (E245.1)	0.002[i]	ND	ND	0.0004
Molybdenum	No ARAR	ND	ND	ND
Nickel	0.0154[j]	0.087	0.027	0.194
Potassium[f]	No ARAR	9.31	13.6	14.4
Silicon[f]	No ARAR	58.1	57.2	84.9
Sodium[f]	No ARAR	44.2	78.0	13.3
Vanadium	No ARAR	0.080	0.032	0.158
Zinc	5.0[i]	2.29	1.40	6.12
Others	-	ND	ND	ND
EPA Method E418.1 (mg/L)				
Total Petroleum Hydrocarbons	No ARAR	ND	ND	ND
Miscellaneous Inorganics (mg/L)				
Total Dissolved Solids (E160.1)	500[m]	1400	1500	460
Common Anions (EPA Method A429)				
Fluoride	1.5[i]	0.60	0.50	0.14
Chloride	250[i]	64	81	20
Sulfate	250[i]	720	750	180
Total Hardness (E130.1)	No ARAR	2600	2000	4900

Footnotes:

a = Surrogate recoveries were above control limits for two compounds.
b = Compound also detected in associated method blank.
c = Associated MS/MSD analyses had recoveries above control limits for one or both spikes.
d = Associated field duplicate analyses exceeded 35% RPD for this compound.
e = Recoveries were below control limits for one or more surrogate compounds.
f = Accuracy data unavilaible; compound not spiked.
J = Estimated value below detection limit.
g = Assoicated lab replicate analysis resulted in RPD values which exceeded the control limit.
h = New York State Groundwater quality standard: "Not detectable".
i = New York State Water Quality Standard for class GA groundwaters. Federal MCLs are adopted by the state if state requirements have not been developed, or if MCLs are more stringent.
j = Federal Ambient Water Quality Criteria (FWQC) - Human Health: Adjusted for Drinking Water.
k = FWQC-HH for halomethanes as a class of compounds corresponding to the 10^{-6} risk level. Methylene Chloride (dichloromethane) is a member of this class.
L = Applicable or Relevant or Appropriate Requirements.
m = Federal Secondary Drinking Water Standard

TABLE 4-76
SITE NO. 8: ANALYTICAL RESULTS VS. ARARs: SURFACE WATERS

Parameter (Units)	Detection Limits	ARAR^{J}	Sample Field Identification (Sample Description) SW-2 (8SW-4)	SW-3 (8SW-5)	SW-4 (8SW-6)
EPA Method SW5030/8021 (ug/L) **Volatile Organics/Purgeable Halocarbons**					
Methylene Chloride	0.8	0.19^{K}	$1.6^{a,b}$	$1.4^{a,b}$	$1.5^{a,b}$
Others	See Appendix F	-	ND	ND	ND
EPA Method SW5030/8020 (µg/L) **Purgeable Aromatic Organics**	See Appendix F	-	ND	ND	ND
EPA Method SW5030/8015 (ug/L) **Non-halogenated Volatile Organics**	See Appendix F	-	ND	ND	ND
EPA Method E625 (µg/L) **Semivolatile Organics**	See Appendix F	-	ND	ND	ND
EPA Method E200.7* **Total Metals (mg/L)**					
Aluminum	0.1	No ARAR	0.874	1.86	0.894
Barium	0.01	1.0^{L}	0.037	0.045	0.032
Boron	0.01	No ARAR	0.726^{a}	0.743^{a}	0.638^{a}
Calcium^{f}	0.20	No ARAR	599	589	560
Iron	0.025	1.0^{M}	1.55^{g}	3.50^{g}	1.67^{g}
Lead	0.05	0.32^{M}	ND	ND	ND
Lead (E239.2)	0.005	0.32^{M}	ND	0.011	0.005
Magnesium^{f}	0.20	No ARAR	162	171	160
Manganese	0.005	0.05^{N}	0.093^{c}	0.180^{c}	0.099^{c}
Potassium^{f}	0.4	No ARAR	22.8	24.0	21.2
Silicon^{f}	0.200	No ARAR	4.39^{a}	5.90^{a}	4.24^{a}
Sodium^{f}	0.200	No ARAR	261	265	259
Zinc	0.01	0.047^{M}	0.051	0.143	0.060
Others	See Appendix F	-	ND	ND	ND
EPA Method E418.1 (mg/L) **Total Petroleum Hydrocarbons**	1.0	No ARAR	ND	ND	ND

TABLE 4-76 (Cont'd)
SITE NO. 8: ANALYTICAL RESULTS VS. ARARs: SURFACE WATERS

Parameter (Units)	Detection Limits	ARAR^{J}	Sample Field Identification (Sample Description) SW-2 (8SW-4)	 SW-3 (8SW-5)	 SW-4 (8SW-6)
Miscellaneous Inorganics (mg/L)					
Total Dissolved Solids (E160.1)	1.0	No ARAR	3300	3200	3300
Common Anions (A429)					
Fluoride	0.1	No ARAR	5.7	0.59	0.59
Chloride	0.5	No ARAR	400	380	460
Nitrate-Nitrogen	0.5	10^{L}	0.77	0.75	0.83
Sulfate	0.5	No ARAR	1700	1700	1700
Total Hardness (E130.1)	1.0	No ARAR	1900	2100	2000

Footnote:

a = Compound also detected in associated method blank
b = Associated MS/MSD analysis had recovery below control limit for this compound.
c = Associated field duplicate analysis exceeded 35% RPD.
d = One surrogate compound had a recovery below lower control limit.
e = Precision could not be assessed for this analysis; data unavailable.
f = Accuracy data unavailable for these compounds.
g = Associated lab matrix replicate analysis resulted in RPD value above the control limit.
h = Associated matrix spike had recovery above upper control limits.
J = Applicable or Relevant and Appropriate Requirements.
K = Federal Ambient Water Quality Criteria - for Human Health (FWQC-HH): Adjusted for Drinking Water Only.
L = Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act.
M = Federal Ambient Water Quality Criteria - Fresh Chronic Value for Aquatic Life.
N = Secondary Maximum Contaminant Level (SMCL) established under the Safe Drinking Water Act - Not an ARAR.

NR = Not Required.
* = Or as indicated if analyzed by an alternate method.

TABLE 4-110

SITE NO. 13: ANALYTICAL RESULTS VS. ARARs: GROUNDWATER

Parameter (Units)	Detection Limits	ARAR[g]	Sample ID (Sample Description) GW4 (MW-13-3)	GW5 (MW-13-4)	GW2 (MW-13-1)
EPA Method SW5030/8021 (µg/L)					
Volatile Organics/Purgeable Halocarbons					
1,2-Dichloroethane	0.4	5[i]	ND	2.3	ND
Methylene Chloride	0.8	0.19[k]	160[a]	2.3[a]	2.8[a]
Vinyl Chloride	0.8	2[i]	1600	2.9	ND
t-1,2-Dichloroethane	0.3	100[i]	ND	ND	ND
Trichloroethene	1.0	5[i]	ND	ND	ND
1,4-Dichlorobenzene	0.3	75[i]	ND	ND	ND
Others	See Appendix F	-	ND	ND	ND
EPA Method SW5030/8020(µg/L)					
Purgeable Aromatic Organics				ND	
Chlorobenzene	0.3	100[i]	9.1		ND
1,2-Dichlorobenzene	1.0	600[i]	3.6		ND
1,3-Dichlorobenzene	0.7	No ARAR	1.1		ND
1,4-Dichlorobenzene	0.7	75[i]	9.7		ND
Benzene	0.3	ND[h]	2.98		ND
Total Xylenes	0.1	10000[i]	7.6		ND
Toluene	0.3	2000[i]	15		1.3
Ethylbenzene	0.3	700[i]	3.6		ND
EPA Method SW5030/8015 (ug/L)					
Non-Halogenated Volatile Organics	See Appendix F	-	ND	ND	ND
EPA Method E504.1 (µg/L)					
Ethylene Dibromide	0.3	-	ND	ND	ND
EPA Method E608 (µg/L)					
Pesticides and PCB's	See Appendix F	-	ND	ND	NA
EPA Method E200.7*					
Total Metals (mg/l)					NA
Aluminum	0.1	No ARAR	60.6	35.5	
Arsenic	0.05	0.025[i]	ND	ND	
Arsenic (E206.2)	0.005	0.025[i]	0.015	ND	
Barium	0.01	1.0[i]	0.475	0.245	
Boron	0.01	No ARAR	ND[c]	ND[c]	
Calcium[b]	0.20	No ARAR	524	572	
Chromium	0.010	0.050[i]	0.100	0.050	
Cobalt	0.010	No ARAR	0.045	0.026	
Copper	0.010	1.0[i]	0.112	0.083	

TABLE 4-110 (Cont'd)
SITE NO. 13: ANALYTICAL RESULTS VS. ARARs: GROUNDWATER

Parameter (Units)	Detection Limits	ARAR[g]	Sample ID (Sample Description) GW4 (MW-13-3)	 GW5 (MW-13-4)	 GW2 (MW-13-1)
EPA Method E200.7*					
Total Metals (mg/l) (Cont'd)					
Iron	0.025	0.300[i]	106[c]	57.3[c]	
Lead	0.05	0.025[i]	0.102	0.102	
Lead (E239.2)	0.005	0.025[i]	0.063[c]	0.079[c]	
Magnesium[b]	0.20	No ARAR	185	412	
Manganese	0.005	0.300[i]	4.94	3.80	
Molybdenum	0.010	No ARAR	0.015	ND	
Nickel	0.015	0.0154[j]	0.125	0.062	
Potassium[b]	0.4	No ARAR	14.7[c]	10.6[c]	
Silicon[b]	0.020	No ARAR	69.2	63.1	
Sodium[b]	0.200	No ARAR	571	164	
Vanadium	0.01	No ARAR	0.122	0.064	
Zinc	0.01	5.0[i]	0.877	1.31	
Others	See Appendix F	-	ND	ND	
EPA Method E418.1 (mg/L)					
Total Petroleum Hydrocarbons	1.0	No ARAR	ND	ND	ND
Miscellaneous Inorganics (mg/L)					NA
Total Dissolved Solids (E160.1)	1.0	500[m]	4080	4250	
Common Anions (A429)					
Fluoride	0.1	1.5[i]	0.58	1.4	
Chloride	0.5	250[i]	140	200	
Sulfate	0.5	250[i]	2600	2600	
Total Hardness (E130.1)	1.0	No ARAR	2600	3300	

Footnotes:

a = Compound also detected in associated method blank.
b = Accuracy data unavailable; compound not spiked.
c = Associated lab matrix replicate analysis had RPD values which exceeded the control limit.
d = Comfirmation analysis exceeded holding time by one day.
g = Applicable or Relevant or Appropriate Requirements.
h = New York State Groundwater quality standard: "Not detectable".
i = New York State Water Quality Standard for class GA groundwater. Federal MCLs are adopted by the state if state requirements have not been developed, or if MCLs are more stringent.
j = Federal Ambient Water Quality Criteria (FWQC) - Human Health: Adjusted for Drinking Water.
k = FWQC-HH for halomethanes as a class of compounds corresponding to the 10^{-6} risk level. Methylene Chloride (dichloromethane) is a member of this class.
m = Federal Secondary Drinking Water Standards

* = Or as indicated for those metals analyzed by an alternate method.

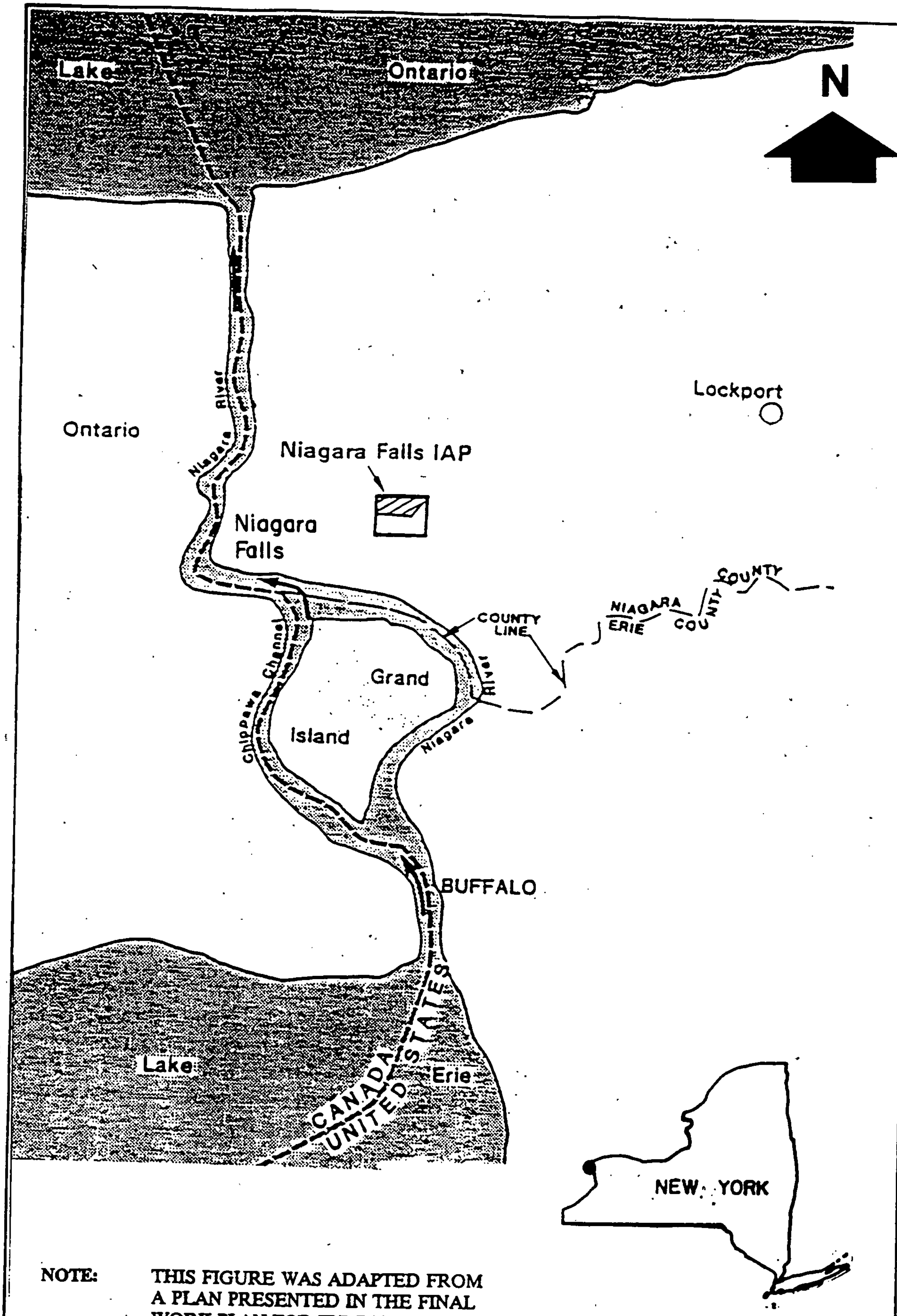
TABLE 4-110 (Cont'd)
SITE NO. 13: ANALYTICAL RESULTS VS. ARARs: GROUNDWATER

Parameter (Units)	ARAR[g]	Sample ID (Sample Description) GW102 (MW-13-1)	 GW103 (MW-13-2)	 GW104 (MW-13-4)	 GW105 (MW-13-3)
EPA Method SW5030/8021 (ug/L)					
<u>Volatile Organics/Purg. Hal.</u>		ND	ND		
1,2-Dichloroethane	5[i]			1.6	ND
Methylene Chloride	0.19[k]			2.0[a]	24[a]
Vinyl Chloride	2[i]			ND	450
t-1,2-Dichloroethane	100[i]			ND	4.1
Trichloroethene	5[i]			ND	14
1,4-Dichlorobenzene	75[i]			ND	3.1
Others	-			ND	ND
EPA Method (SW5030/8020)(µg/L)					
<u>Purgeable Aromatic Organics</u>		ND	ND	ND	
Chlorobenzene	100[i]				1.3
1,2-Dichlorobenzene	600[i]				1.1
1,3-Dichlorobenzene	No ARAR				ND
1,4-Dichlorobenzene	75[i]				2.6
Benzene	ND[h]				ND
Total Xylenes	10000[i]				1.7
Toluene	2000[i]				3.5
Ethylbenzene	700[i]				0.65

<u>Footnotes</u>:

a = Compound also detected in associated method blank.
b = Accuracy data unavailable; compound not spiked.
c = Associated lab matrix replicate analysis had RPD values which exceeded the control limit.
d = Comfirmation analysis exceeded holding time by one day.
g = Applicable or Relevant or Appropriate Requirements.
h = New York State Groundwater quality standard: "Not detectable".
i = New York State Water Quality Standard for class GA groundwater. Federal MCLs are adopted by the state if state requirements have not been developed, or if MCLs are more stringent.
j = Federal Ambient Water Quality Criteria (FWQC) - Human Health: Adjusted for Drinking Water.
k = FWQC-HH for halomethanes as a class of compounds corresponding to the 10-6 risk level. Methylene Chloride (dichloromethane) is a member of this class.
m = Federal Secondary Drinking Water Standards

FIGURES



NOTE: THIS FIGURE WAS ADAPTED FROM A PLAN PRESENTED IN THE FINAL WORK PLAN FOR IRP RI/FS PREPARED BY SCIENCE APPLICATION INTERNATIONAL CORPORATION (SAIC), JUNE 1990 AND ENGINERRING SCIENCE 1983.

DRAWN BY: ARH

DATE: JULY 1991

GZA GeoEnvironmental of New York

NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK
WORK PLAN REMEDIAL DESIGN FOR IRP
SITE 8 - BUILDING 202 DRUM STORAGE YARD
AND IRP SITE 13 - UNDERGROUND TANK PIT

LOCATION PLAN

PROJECT No.
R5957

FIGURE No.
1

NOTE:

THIS FIGURE WAS ADAPTED FROM A PLAN PRESENTED IN THE FINAL WORK PLAN FOR THE IRP RI/FS PREPARED BY SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC) JUNE 1990.

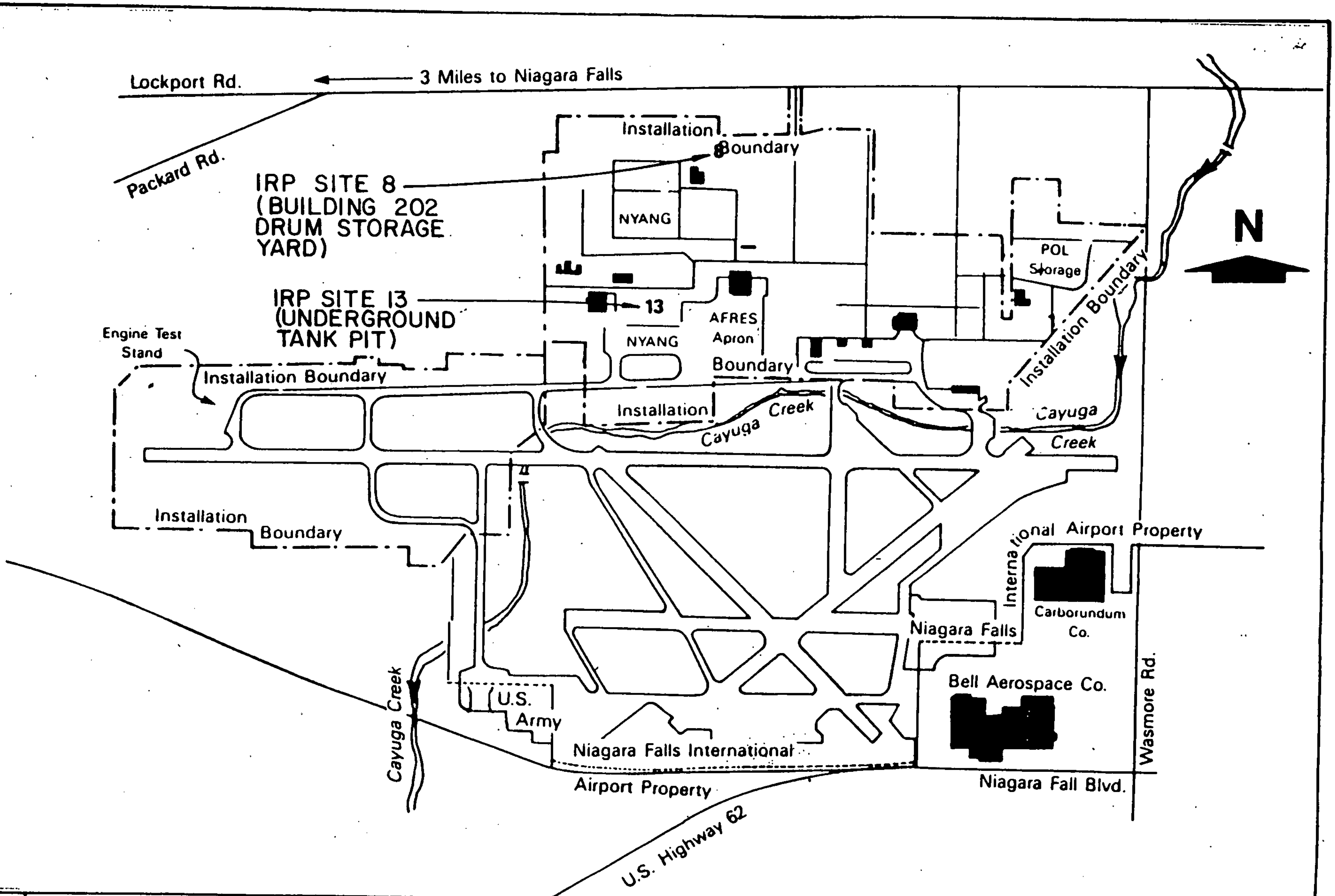


FIGURE No. 2	PROJECT No. R5957	NIAGARA FALLS AIR FORCE BASE NIAGARA FALLS, NEW YORK WORK PLAN REMEDIAL DESIGN FOR IRP SITE 8 - BUILDING 202 DRUM STORAGE YARD AND IRP SITE 13 - UNDERGROUND TANK PIT SITE LOCATION PLAN

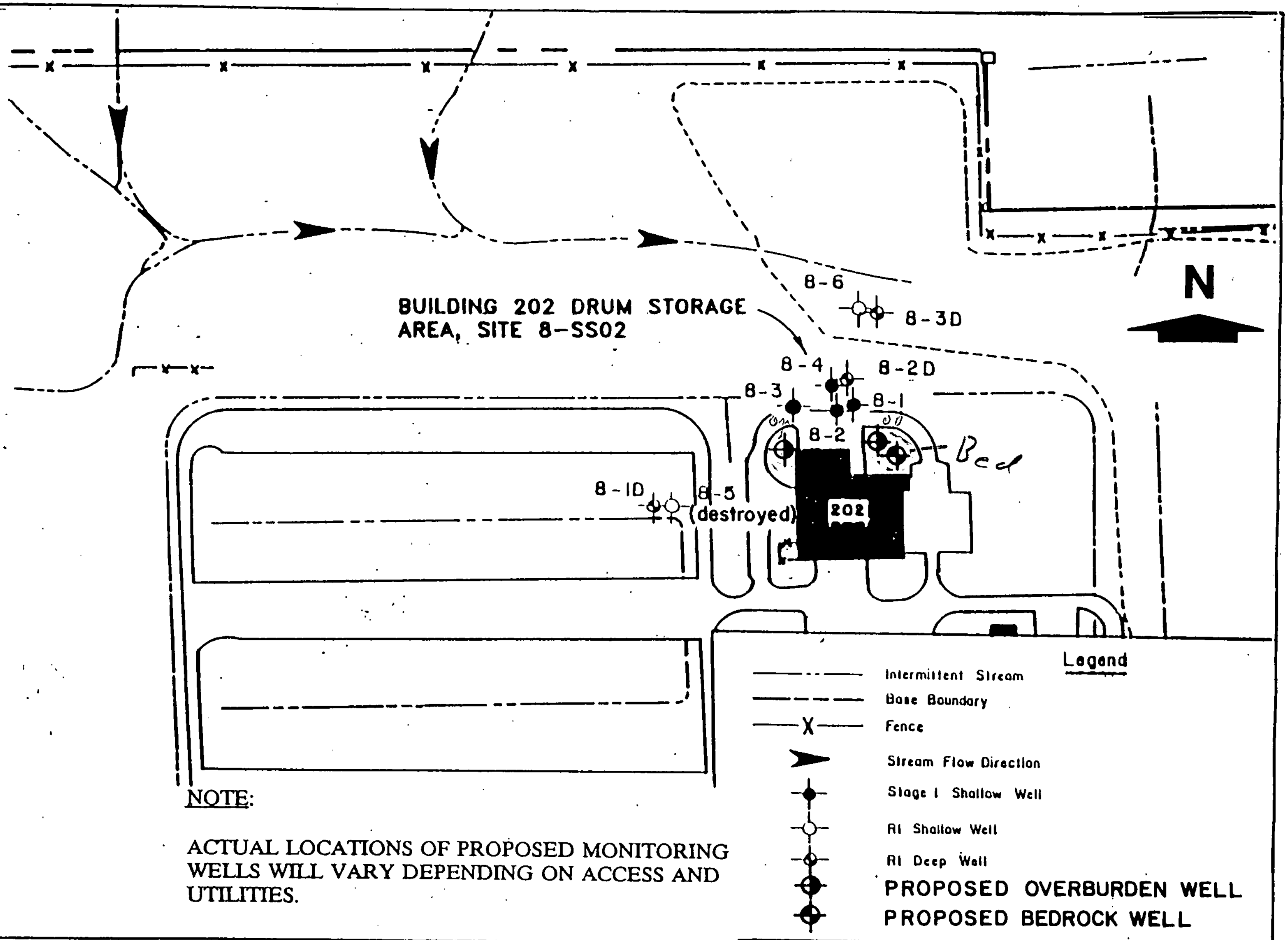
SCALE IN FEET
NOT TO SCALE

DRAWN BY: ARH

DATE: JULY 1991

GZA GeoEnvironmental of New York

THIS FIGURE WAS ADAPTED FROM A PLAN PRESENTED IN A REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) REPORT PREPARED BY SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC) OCTOBER, 1990.



NOTE:

ACTUAL LOCATIONS OF PROPOSED MONITORING WELLS WILL VARY DEPENDING ON ACCESS AND UTILITIES.

FIGURE No. 3

PROJECT No. R5957

NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK
WORK PLAN REMEDIAL DESIGN FOR IRP
SITE 8 - BUILDING 202 DRUM STORAGE YARD
AND IRP SITE 13 - UNDERGROUND TANK PIT

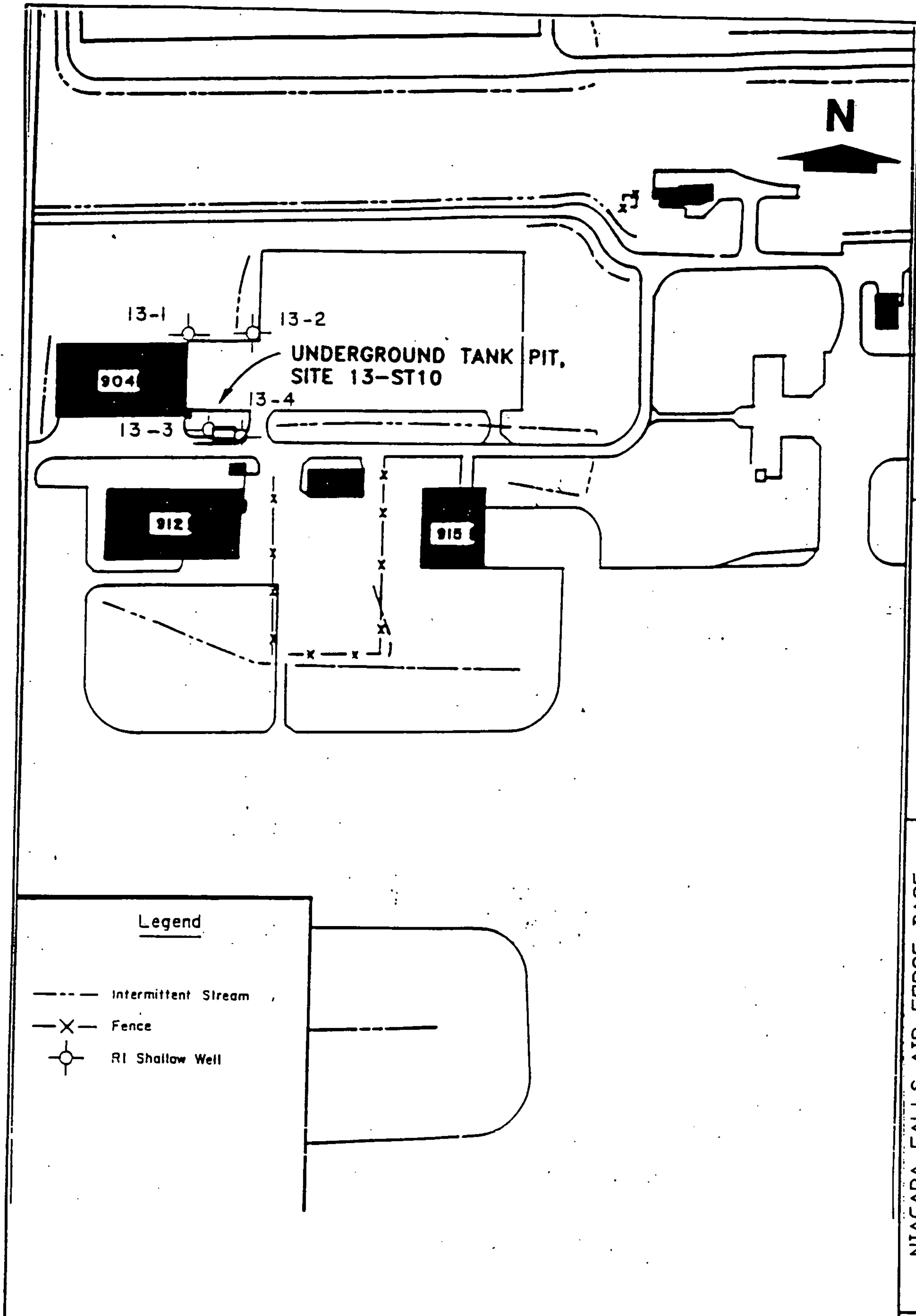
SITE PLAN - IRP SITE 8

SCALE IN FEET
0 200 400

DRAWN BY: D.E.W.

DATE: JULY 1991

GZA GeoEnvironmental of New York



THIS FIGURE WAS ADAPTED FROM A PLAN PRESENTED IN A REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) REPORT PREPARED BY SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC) OCTOBER, 1990.

DRAWN BY: D.E.W.
DATE: JULY 1991

GZA GeoEnvironmental of New York

SCALE IN FEET
0 200 400

NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK
WORK PLAN REMEDIAL DESIGN FOR IRP
SITE 8 - BUILDING 202 DRUM STORAGE YARD
AND IRP SITE 13 - UNDERGROUND TANK PIT

SITE PLAN - IRP SITE 13

PROJECT No.
R5957

FIGURE No.
4

GZA

APPENDIX A

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

Remedial Design for IRP Site 8 - Building 202 Drum Storage
Yard and IRP Site 13 - Underground Tank Pit
Niagara Falls Air Force Base
Niagara Falls, New York

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1.00 QUALITY ASSURANCE/QUALITY CONTROL

1.10 INTRODUCTION

During the course of field work described in the work plan for the Installation Restoration Program (IRP) Sites 8 and 13 at the Niagara Falls Air Force Base, Niagara Falls, New York, subsurface data, analytical and soils laboratory data will be used to determine the presence of environmental contamination and assist with determining design parameters. It is the primary goal of this Quality Assurance Project Plan (QAPP) to define procedures that will ensure the quality and integrity of samples, accuracy and precision of analyses, and representativeness of results for the field work.

Descriptions of data quality objectives and procedures associated with sample collection, laboratory analysis, sample custody, instrument/equipment calibration, internal quality assurance checks, performance and system audits, preventative maintenance, data measurement assessment procedures, corrective action, quality assurance reports to management applicable to this project are presented in this document.

The work will be done by GZA and DOD for the 914th Tactical Airlift Group, United States Air Force Reserve (USAFRES). DOD has an architectural/engineering services contract with the United States Department of the Air Force Reserve that names GZA as a subconsultant.

As a subcontractor to DOD, GZA has responsibility for setting data quality objectives and the corresponding QA standards by which sampling and analysis effort will be conducted. GZA will subcontract the required survey, subsurface drilling and analytical laboratory testing services to qualified and experienced firms. It is expected that Recra Environmental, Inc. will provide Analytical Laboratory testing services for GZA. The other subcontractors will be selected at the time of the work. In joining the team for this effort, each subcontractor will make a commitment to follow the procedures identified in the QAPP and to follow QAPP protocols for each assigned task.

1.20 PROJECT DESCRIPTION

A description of the installation, past waste management practices, subsurface and groundwater conditions, risk assessment results, and the proposed remediation at IRP Sites 8 and 13 are presented in Section 2.00 of the work plan.

1.30 INTENDED USE OF THE DATA

The purpose of these additional studies in conjunction with the results of previous studies is to provide the data necessary to, (1) identify the extent and magnitude of contaminants, and (2) provide data to determine the design parameters for the proposed remediation. The data which are required to fulfill this objective will be obtained through the implementation of the tasks described below. These tasks were selected based upon the current understanding of the site and the 914th Tactical Airlift Grove, United States Department of Air Force Reserve (USAFRES) guidance in preparing a work plan for remedial design. The tasks include:

-- Review of existing data
-- Test borings and monitoring well installations
-- Buried fuel line investigation
-- Groundwater sampling and water level measurements
-- Hydraulic parameters estimate

Each task is intended to develop a further understanding of the site. These tasks are discussed in the Work Plan. Sampling and analysis techniques necessary for the investigatory tasks are described in this QAPP.

2.00 PROJECT ORGANIZATION AND RESPONSIBILITIES

This QAPP is specifically for field activities at IRP Sites 8 and 13 on the Niagara Falls Air Force Base, Niagara Falls, New York. Table A1 shows the organization in terms of line of authority for the various management, technical and analytical components of the project. Table A2 provides a matrix of responsibility for the work and for QA/QC functions.

3.00 QA OBJECTIVES FOR DATA MANAGEMENT

The primary objective of the QA program for this project is to: 1) maintain the evidentiary value of the information produced; and 2) insure that field investigations, laboratory analysis, and reports are carried out in accordance with approved protocols. To this end, quality assurance objectives for field work and laboratory analysis are established. The quality of data generated by sampling, monitoring or analyses is defined in terms of precision and accuracy, completeness, representatives, and comparability.

Precision and Accuracy

The objectives for precision and accuracy are indicated in Section 12.00 and Appendix A-2. Results of field and laboratory quality control samples are evaluated against approved criteria which measures the precision and accuracy of a given measurement system.

Accuracy is monitored by the analyses of accepted reference samples (either reference control samples, spiked control samples or surrogate spikes). The use of reference samples is fully described in Section 12.00.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions. When comparing the amount of valid data obtained to that of a correct, normal condition, deviations may arise that are a result of the sample matrix. For instance, organic analysis requires an extraction and the proposed method may not fully recover the analyses of interest from the matrix. Dilutions may be necessary to reduce the effect of non-target species which extract with the target ones. These dilutions will raise detection limits above those for normal conditions. If this in fact occurs, the QA Officer will review the body of data to provide assurance that the data is adequate for the intended use.

Representatives

The degree to which data accurately and precisely represents a characteristic or environmental condition is it's representatives. In the work plan, the frequency and placement of sampling locations and method of sample acquisition have been designed such that data obtained will be considered representative of site conditions.

Comparability

This QA objective addresses the comparability of all data resulting from sampling and analysis. The use of published sampling and analytical methods, standard reporting units, and a program executed in accordance with this QAPP will aid in ensuring this comparability.

4.00 SAMPLING PROCEDURES

This section of the QAPP contains detailed descriptions of the field investigations to be performed and the procedures to be used in conducting the additional studies at IRP Sites 8 and 13. The following topics are addressed:

- Preparation for Field Entry;
- Preparation for Sampling On Site;
- Borings and Well Installation;
- Buried Fuel Line Investigation;
- Monitoring Well Sampling and Water Level Measurements;
- Field Testing; and
- Hydraulic Parameter Estimate

It will be the responsibility of GZA's project manager and on-site coordinator to maintain adherence to the following procedures during the course of field work.

4.10 PREPARATION FOR FIELD ENTRY

Preparation of sampling and safety equipment will occur prior to departure from the sampling team's home office. These procedures will include the following tasks:

1. Kick-off meeting between GZA staff to review scope of work, field forms, survey forms, and chain-of-custody procedures.

2. Review of the field exploration and sampling requirements.

3. Review of the health and safety plan.

4. Preparation and operational check-out and pre-calibration (if required) of all in-situ testing, sampling and safety equipment (see Section 6.00 and Appendix A-1). Records will be kept on calibration and operational checkouts.

5. Sample coolers will be inspected, checked for seal integrity, and opened. Cooler contents will be compared against the contents listed on the chain-of-custody form and against the site (event) specific parameter list. Irregularities regarding cooler condition and/or contents will be immediately reported by telephone to a lab representative and the project manager or his designee.

6. Pre-departure equipment checklist review.

Sampling equipment (hand augers, bailers, trowels, bowls, etc.) will be cleaned prior to field entry and between samples. The following cleaning procedures will be used:

1. Detergent Wash with Liquinox (non phosphate) Detergent or equivalent;
2. Potable Water Rinse;
3. Methanol Rinse;
4. Deionized Water Rinse (repeated twice);
5. Second Potable Water Rinse (for samples requiring metals analysis only);
6. Ten Percent Nitric Acid in deionized water rinse (for samples requiring metals analysis only);
7. Alternatively, the equipment will be rinsed with 10 percent nitric acid in deionized water followed by steam cleaning; and
8. Allow equipment to air dry.

Following this cleaning procedure, equipment will be wrapped in plastic bags for on-site usage. Sampling equipment that will be reused in the field will undergo the same cleaning procedures between sampling events.

4.20 PREPARATION FOR SAMPLING ON SITE

Prior to any field activity, the required health and safety procedures will be followed as specified in Appendix B. This will include the measurement of background and downwind organic vapors using a HNu Systems Photoionization Analyzer Model P1-101 with 10.2 ev detector bulb or equivalent. Readings will be recorded for site-specific work zones. Field calibration procedures are addressed in Section 6.00. In the event of adverse weather conditions, outside sampling events will be postponed such that the integrity of the samples is maintained.

4.30 BORINGS AND WELL INSTALLATION

4.31 Decontamination Procedures for Drilling Equipment and Reusable Tools

The purpose of these procedures is to help minimize the potential for the introduction of contamination into a test boring or monitoring well, or cross-contamination between borings and wells associated with drilling equipment and reusable tools.

4.32 Equipment Condition

A. Drilling equipment will be inspected for integrity of hydraulic and oil fluid handling systems and general overall cleanliness. Leaking hoses, tanks, hydraulic lines, etc., will be replaced or repaired prior to beginning work.

B. All well casing, screens and other construction materials will be in new condition. Used materials will not be permitted in well construction.

4.33 Equipment Cleaning and Handling

A. Initial Cleaning

1. Drilling equipment and associated tools will be steam-cleaned upon arrival at the site. Equipment will include at a minimum, but not be limited to:

   Drilling rods, bits
   Augers (clips, pins, and associated hardware)
   Samplers (i.e., split-spoon, shelby, etc.)
   Core barrels
   Casing materials (both temporary and permanent)
   Wrenches
   Hammers
   Other hand tools and tool boxes
   Mud tub/pan
   Hoses, tanks
   Cable clamps and other holding devices in direct contact with drilling rods
   Drill rig undercarriage, wheel-wells, chassis, which may be in contact with work area

2. During and following cleaning, equipment will be handled only with clean gloves. A new set of gloves will be utilized between each location.

3. Cleansed materials will be protected from contamination by such means as the on-site coordinator deems necessary.

B. On-site Cleaning Between Borings

1. Following use, equipment (listed above under "Initial Cleaning") with the exception of the carrier truck and undercarriage, will be steam-cleaned between borings. All equipment that contacts soil or groundwater will be cleaned between borings.

4.34 Disposal of Wash Condensate

Wash condensate will be containerized in appropriate containers and turned over to the 914th Tactical Airlift Group, United States Air Force Reserve for disposal.

4.40 TEST BORINGS MONITORING WELLS

Borehole advancement for the test borings and overburden monitoring wells will be done by hollow stem augering. Monitoring well holes will be advanced with 4-1/4 inch I.D. hollow stem augers. Figure A1 illustrates typical monitoring well installation details in overburden and Figure A2 depicts a typical bedrock well.

Additional information pertaining to test borings and construction of the monitoring wells are found in the work plan.

4.41 Split-Spoon Sampling

A. Split-spoon samples will be taken continuously in accordance with the procedures of the Standard Penetration Test (ASTM D-1586).

B. Soils will be visually classified in the field for color, grain size, lithology, relative density and moisture content.

C. An organic vapor meter reading will be recorded from each split-spoon as the sampler is opened.

D. Each soil sample will also be screened as described below:

1. First, fill driller's jar with seals on lids to between 2/3 and 3/4 of its volume with a representative sample of soil material. Use of tape around jar lid will be avoided.

2. Obtain a sample of the headspace above the soil by piercing the metal lid with a nail or punch and withdraw 30 cc with a plastic syringe. The entire lid will not be taken off. The hole will then be sealed with Teflon tape and non-volatile white marking tape.

3. The sample will quickly be injected into the organic vapor meter probe. Record the peak meter response on the boring log (Note: The meter needle may deflect negatively only; record this as N or Neg, not as no reading.).

4. If a significant result is recorded (i.e. >1 ppm), inject a blank of ambient air into the probe to ensure that syringe is not contaminated.

All samples will be screened at room temperature (approximately 68 to 72°F). One jar blank will be screened using some procedures.

E. Jars will be labeled with the following information: project number, well identification, depth interval represented by the sample, blow counts, and date taken.

F. Split-spoons will be decontaminated prior to each sample according to the procedure described in Section 4.10.

4.42 Overburden Wells

The drilling and instrumentation installation procedures are as follows:

A. No drilling fluids will be used unless prior approval is received from the USEPA, and in the case of fluid use, an approved water source will be utilized. A 4-1/4 inch ID hollow stem auger will be used to advance the hole.

B. The auger will be advanced in 2-foot intervals to permit the collection of continuous split-spoon samples.

C. All borings will be advanced to refusal at the suspected top of the bedrock.

D. Overburden wells will be constructed of 2 inch I.D., Schedule 40 PVC riser, and 5 slot PVC well screens.

E. Placement of the screen and selection of the screen length will be made that the screen straddles the water bearing material.

F. A sand pack composed of No. 1 QROK sand will be placed in the annular space surrounding that portion of the piezometer boring occupied by the well screen, and for a distance of about 1 foot above the top of the screen. The depth to the top of the sand pack will be measured during placement to accurately determine its thickness.

G. A minimum 2-foot bentonite pellet seal will be placed above the sand pack.

H. A cement-bentonite grout will be placed to 2 feet below ground using tremie method with a horizontal discharging tremie pipe.

I. A 4 inch I.D. protective steel casing and a locking cover and a concrete surface seal will be installed to complete the installation. All locks will be keyed alike.

J. All pertinent information including quantities of well construction materials and boring logs will be recorded by the observing GZA representative.

4.43 Bedrock and Wells

Bedrock wells will be installed in the uppermost bedrock water bearing zone. Core will be taken beginning at the bedrock surface. The NQ coring will be performed using rotary drilling methods and potable water for drilling fluid.

The drilling and instrument construction methods are listed below:

A. A 6-1/2 inch I.D. hollow stem auger will be used to advance the boring to refusal where the monitoring well is installed in bedrock. The auger will be advanced in 2 foot intervals to allow collection of soil samples.

B. Upon advancing the augers to refusal, a 5 inch ID PVC Schedule 40 casing will be lowered and grouted in the hole as discussed in the work plan.

C. The rock will then be cored and sampled using an NQ core barrel. Core runs will not exceed 10 feet in length.

D. Core samples will be examined and logged immediately upon retrieval, and stored in specially designed wooden boxes. Rock quality designation (RQD) will be recorded for all core samples.

E. Each core box will be labeled with the project number, boring/well identification number, depth of runs sampled, run number, core recovery, the top and bottom of the runs, and the date.

F. The cores will be stored for a two year period at the Niagara Falls Air Force Base.

G. The monitoring wells will be constructed using a 4 to 8 foot length of 2 inch I.D. PVC well screen and Schedule 40 PVC riser. Screen slot size will be 10 slot. The wells will be constructed with 2 inch Schedule 40 screen and riser. The sand pack will be No. 4 QROK.

H. A clean sand pack will be placed in the annular space surrounding that portion of the well occupied by the screen and for about 1 foot above the top of the screen.

I. A minimum 2 foot bentonite seal will be placed above the sand pack to seal the well screen into rock.

J. The remaining annular space will be filled to 2 feet below ground surface with cement-bentonite grout by the tremie method utilizing a horizontal discharging tremie pipe.

K. These wells will be completed by installing 4 inch diameter locking protective casings and concrete surface seals.

L. All pertinent information, including quantities of well construction materials and boring logs, will be recorded by a GZA representative.

4.44 Sand Pack, Bentonite Pellet Seal, and Cement-Bentonite Grout

A. Sand Pack

The No. 1 QROK sand pack used in overburden well construction will consist of uniformly-graded clean inert fine sand manufactured to generally meet the following gradation. The uniformity coefficient will be between 1.3 and 2.0.

Percent Passing	Diameter (mm)
30%	0.17 - 0.21
10%	0.14 - 0.17
1%	0.09 - 0.12

The No. 4 QROK sand pack used in bedrock well construction will consist of uniformly-graded clean inert sand manufactured to generally meet the following gradation. The uniformity coefficient shall be between 1.1 and 1.6.

Percent Passing	Diameter (mm)
30%	0.5 - 0.6
10%	0.4 - 0.5
1%	0.25 - 0.35

A sample of the sand pack material for overburden and bedrock wells will be retained and placed in an 8 oz. wide-mouth glass jar, sealed, labeled and stored for a one year period at the United States Air Force Base, Niagara Falls, New York.

4.45 Bentonite Pellet Seal

Bentonite pellets (90 percent Montmorillonite, 10 percent feldspar biotite and selenite) will be used, and the diameter will be less than one-half the width of the annular space into which they are to be used.

The pellets will be placed in the annular space, and a minimum of a 30-minute set time will be required to allow for proper swelling and activation of the pellets before placement of the grout. If pellets are placed above the water table, potable water will be added to permit hydration.

Grout will be placed by the tremie method utilizing a horizontal discharging outlet.

4.46 Cement-Bentonite Grout

Cement shall be Portland Cement Type I, in conformance with ASTM C-150. Bentonite will be a powdered Wyoming sodium bentonite.

Proportions of cement/bentonite/potable water in the grout mix will be approximately 94 pounds/3 to 5 pounds/7.0 gallons respectively.

4.47 Boring Logs and Recordkeeping

A typical boring log form is shown on Figure A3. During the drilling of each borehole, a log will be kept and include the following:

- Date and time of drilling, driller's and helper's names, and GZA representative.
- Drilling method utilized.
- The reference point for all depth measurements (i.e., ground surface and elevation).
- The depth at which each change of formation is identified.
- The depth at which the first water bearing zone is encountered based upon the observed moisture content of overburden samples.
- The thickness of each stratum.
- The number of blows required to drive the standard spilt spoon sampler every 6 inches.
- Amount of sample recovered.
- The description of the material of which each stratum is composed, including:
  - Depth, sample number
  - Grain size description
  - Color
  - Degree of weathering cementation, and density
  - Other physical characteristics
- The depth interval from which each formation sample was taken.
- The depth at which hole diameters (bit sizes) change.
- The depth to the static water level (SWL) and changes in SWL with well depth, if possible.
- Total depth of completed well.
- The depth and description of the well casing materials and lengths.
- The sealing off of water-bearing strata, if any, and the location thereof.
- Depth or location of any lost drilling materials or tools.
- The depth of the subsurface seal, if applicable.
- The nominal hole diameter of the well bore above and below the casing seal.
- The amount of cement and bentonite (number of bags) installed for the seal, if applicable.
- Screen materials and design.
- Casing and screen joint type.
- Screen slot size/length.
- Pack, seal, and grout material used.

-- Type of protective well cap.
-- HNu readings.
-- The depth at which hole diameters (bit sizes) change
-- Coring run length
-- Recovered core
-- Structural discontinuities within the rock.
-- The RQD value.
-- The volume of well construction materials entering the hole.

4.48 Well Development

The purpose of well development is to prepare monitoring wells for future sampling activities. This will be achieved by bailing/pumping the well until such time as the water quality obtained from the well is consistent with water quality in the formation from which the water is obtained, determined by measurement of pH, specific conductivity, temperature. Additionally, turbidity will be measured. Well development shall be performed in the following fashion:

A. Inspect locking casing and/or street box assembly, and surface grouting for integrity.

B. Open the well.

C. Measure static water level, well bottom depth, and calculate standing water volume.

D. Depending upon the response of the well, either a bailer or pump will be utilized to develop the well.

E. If a bailer is used, it will be lowered to the bottom of the well and raised and lowered repeatedly. Following surging, the well will be excavated to remove any fines which have accumulated in the well.

F. If a pump is utilized, the inlet should be placed approximately 2 feet below the water table and activated.

G. "Prior to, during, and at the completion of bailing/pumping, record temperature, pH, specific conductance turbidity and purge volume."

H. Development will be considered complete when the following conditions are achieved:

- Temperature and conductivity have stabilized to within 5 percent, and pH to ± 0.5 pH units
- A degree of clarity measurable of 50 NTU or less. If not achievable, NYSDEC will be contacted.

4.50 UNDERGROUND UTILITY INVESTIGATION

4.51 Equipment Cleaning

The equipment will be decontaminated (tubing, soil gas probes, etc.) prior to delivery to the site. The probe and any other metal parts will be washed with laboratory detergent, rinsed with water, steam cleaned, and allowed to air dry. Any plastic or glass parts will be washed with laboratory detergent, rinsed with distilled water, and allowed to air dry. Following analysis of a sample, each syringe will be rinsed with distilled water three times, and dried in an oven.

Probes (i.e., 1/2-inch galvanized steel pipe) and HDPE tubing will be used at one sample location and discarded following each test. As such, on-site decontamination should not be required. Should analysis of blank samples indicate potential contamination the effected equipment will not be used until appropriately cleaned as indicated by subsequent blank sample testing.

4.52 Groundwater Sample Collection

Water samples will be collected by first driving (by slide hammer and/or vibratory rotary hammer) a 1/2 inch diameter galvanized steel probe with a removable tip to the desired depth. Where asphalt or concrete is present, an electric drill will be used prior to driving the probe. When driven to the required depth, the probe will be pulled back slightly to free the removable tip. The probe will then be sealed at the ground surface with bentonite clay.

A length of polyethylene tubing will be inserted just past the bottom of the probe. The tubing will be sealed into the probe, so that ambient air is not introduced into the system. Tubing will be discarded between samples and a new piece of tubing inserted each time a water sample is collected.

4.53 Quality Control/Quality Assurance

The following quality control/quality assurance measurers will be taken during the buried fuel line investigations.

A. Independent Lab Analysis

Two split samples will be collected at each site for analysis by an independent laboratory for USEPA method 602 parameters.

B. Blank Samples

Approximately one blank sample per site will be run to evaluate the presence of residual contamination within the probe, sampling equipment, etc. These samples will be obtained by assembling the probe and sampling equipment (e.g. pump, tubing, etc.) at ground surface away from suspected contaminant sources. A "blank" sample will be collected using the sample pump to pull distilled water through the sampling equipment and injected into the GC for analysis.

C. Spike Samples

A spike sample will be collected and analyzed at a rate of one per day. Spiked samples will be prepared by placing a known quantity of several of the listed compounds in 40 ml vials. The spiked sample will be passed through the probe and the sampling manifold to monitor for system losses.

D. Duplicate Analysis

Duplicate analysis will be done at a rate of one per site. Duplicate analysis will be analyzed by making two injections (i.e., two injections in each GC).

4.60 MONITORING WELL SAMPLING

Groundwater samples will be collected using the methodologies stated in the work plan and the following quality assurance procedures.

-- Identify the well and complete appropriate information on the sampling log (Figure A4) and Summary of Field Water Quality Tests (Figure A5).

- All field chemistry equipment will be calibrated every four hours or as necessary during sampling. Details on the calibration and calibration frequency will be recorded as described in Section 6.00.
- Chain-of-Custody forms will be completed and will include the custodian's name and signature, the sample date, time, and locations along with sample ID number and analysis required. The Chain-of-Custody forms will be shipped with the coolers (see Section 5.00). Refer to Appendix A-2 for the Chain-of-Custody form.
- At the end of the sampling day, the coolers will be taped shut with the custodian's initials placed on the tape at points of entry. Samples will be shipped via overnight carrier for morning delivery.
- The laboratory will be contacted within 24 hours after each sampling event to ensure that samples arrive safely and with proper integrity preserved.

4.61 Sampling Labeling, Preservation and Handling

Samples collected for analytical testing will be assigned a unique alpha-numeric code. This code will be used to label sample containers and to identify the samples on the sample logs and chain-of-custody documentation. The alpha-numeric code will include the following information:

- site code; SITE 8
- date sampled; 07 (month), 01 (date), 91 (year)
- sample location; (13-1)
- sample type; GWS (groundwater sample)

A typical code will be as follows: Site 8-09-0191 - (13-1)-GWS

Sample container types and preservatives are specified in Appendix A-2. Immediately following sample collection and labeling, the filled sample containers will be placed in an iced cooler and chilled to about 4°C.

The sample coolers will remain in the possession of the sampling team throughout the sampling event. The sampling team will be responsible for securing the sample containers and coolers. The sampling team will transport filled sample coolers to the analytical laboratory via overnight mail.

Chain-of-custody documentation will be maintained during and following the sampling round to serve as a record of the transfer of samples from the field to the analytical laboratory. Each time samples are transferred, signatures of the person relinquishing and receiving the samples along with the date and time will be recorded. Chain-of-custody documentation is discussed in Section 5.00.

Sample coolers will be sealed with a security seal to identify possible tampering with the sample containers during their transport to the analytical laboratory. If this seal is intact upon receipt by the analytical laboratory, the samples will be considered suitable for testing. In the event the security seal is not intact, additional test samples will be collected.

4.62 Quality Assurance/Quality Control Procedures

To check the integrity of field sampling and equipment cleaning techniques, the following field quality assurance/quality control (QA/QC) procedures will be adhered to for this effort.

A field blank will be prepared on site utilizing pre-cleaned equipment. A trip blank will accompany sample containers through each phase of the event to assure proper bottle preparation and laboratory integrity. Trip blank and field blank samples will receive identical handling and custody procedures as on-site samples.

Field and trip blanks are used as control or external QA/QC samples to detect contamination that may be introduced in the field (either atmospheric or from sampling equipment), in transit to or from the sampling site, or in the bottle preparation, sample log-in, or sample storage stages within the laboratory. The blanks will also reflect any contamination that may occur during the analytical process.

Trip blanks are samples of organic-free water which are prepared at the same location and time as the preparation of bottles which are to be used for sampling. They remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. At no time during these procedures are they opened. Upon return to the laboratory, they are analyzed as if they were another sample, receiving the same QA/QC procedures as ordinary field samples. If these samples are accidentally opened, it will be noted on the chain-of-custody.

Field blanks are prepared in the field (at the sampling site) using empty bottles and organic-free water prepared at the same time and place as the bottles used in sampling. The preferred procedure for non-dedicated sampling equipment is to first pour the organic-free water into the clean device to be used for sampling, and then into the empty sample bottles supplied for the field blank.

Field and trip blanks are not considered part of the laboratory QA/QC procedures. The latter are used to detect contamination during analytical steps only and are included as part of the laboratory service, and assess the validity of the laboratory analytical procedures. Field and trip blanks are required as part of the QA/QC procedures for the overall sampling and analytical program.

4.70 IN-SITU PERMEABILITY TESTING

Single borehole pump tests will be conducted in the three existing bedrock wells and the two new bedrock wells installed during the field work. The pump tests will consist of the following steps.

A. A pre-cleaned suction pump with a hose placed in the monitoring well will be pumped at a constant rate.

B. The drawdown in each well will be measured during pumping using an electronic water level instrument.

C. The test will be continued until a constant head is obtained for 15 to 30 minutes.

D. The hydraulic properties of the rock will be estimated using constant head methods.

In order to evaluate the in-situ permeability and water-bearing characteristics of the saturated material (soil and rock) field permeability tests will be done on the existing monitoring wells installed during this investigation. Slug testing will be used for the in-situ estimation of permeability. The tests will be conducted as follows:

A. The static water level in the wells to be tested will be measured and recorded using an electronic water level reader. The instruments will be checked to make sure it works properly.

B. A solid slug of known volume will be placed in the well. The water level recording sequence will be started when the slug is placed into the well.

C. Upon achieving relative equilibration, the slug will be removed and the recording sequence completed.

D. The data will be plotted to illustrate a semi-logarthimic relationship between the logarthimic value of the head ratios versus time. Two representative data points will be selected to permit a calculation of the permeability of the screened interval utilizing the Hvorslev (1951) equation.

5.00 SAMPLE AND DOCUMENT CUSTODY-RECORDKEEPING

The sampler's field records will contain sufficient information such that someone can reconstruct the sampling situation without reliance on the collector's memory. A field sampling log (Figure A4) will include, at a minimum, the following:

-- Purpose of sampling,
-- Location of sampling and address,
-- Name of samplers,
-- Type of work,
-- Description of sampling point,
-- Quantity of sample collected,
-- Parameters requested for analysis,
-- Type of sample container used,
-- Preservative(s) used,
-- Filtering (if any),
-- Sample collection procedure and equipment,
-- Well evacuation procedure and equipment,
-- Well specifics such as static water level, depth, and volume purged,
-- Date and time of collection,
-- pH, temperature, specific conductance and turbidity of, sample or purge water,
-- Collector's sample identification number(s),
-- Laboratory's sample identification number(s),
-- References such as maps or photographs of the sampling site, field observations,
-- Pertinent weather factors such as temperature, wind direction, and precipitation, and
-- Any field measurements made such as pH, etc.

Chain-of-custody records for all samples, beginning with the cleaning and numbering of the sample containers at the laboratory, shall be maintained. All written records of container decontamination procedures shall be kept as well as the source of such containers. A sample shall be considered to be "in custody" of an individual if said sample is either in direct view of, or otherwise directly controlled by, the individual in custody. Storage of samples during custody shall be accomplished according to established preservation techniques in appropriately sealed and numbered storage containers. Chain-of-custody shall be accomplished by the exchange of the samples or sample sealed shuttle being transferred from one individual to the next with the transfer witnessing the signature of the recipient upon the chain-of-custody record.

The Chain-of-custody records will contain the following information:

- -- Sample number of the laboratory and GZA, if available,
- -- Signature of collector,
- -- Date and time of collection,
- -- Sample type (e.g., groundwater),
- -- Identification of well or sampling point,
- -- Number of containers,
- -- Parameters requested for analysis,
- -- Signature of person(s) involved in the chain of possession,
- -- Description of sample bottles and their condition,
- -- Problems associated with sample collection (i.e., breakage, no preservatives)

A copy of the chain-of-custody form to be used in this work is contained in Appendix A-2.

6.00 CALIBRATION PROCEDURES AND FREQUENCY

There are two areas where calibration procedures and frequency are important: 1) For field equipment and analytical devices; and 2) For laboratory analytical equipment. Each of these are discussed separately below:

6.10 FIELD

Field equipment requiring calibration will be used in the buried fuel line investigation, well sampling and air monitoring.

6.20 WELL DEVELOPMENT AND FIELD ANALYTICAL INSTRUMENTS

The following instruments will be used during the buried fuel line investigation and/or well development and sampling:

Thermometer,
Water Level Instrument,
pH meter,

Specific Conductance meter,
Turbidimeter, and
Gas Chromatograph.

Each of these units require calibration as detailed in the following discussion.

A. Thermometer

Temperature will be measured using a thermometer that is traceable to a registered NBS thermometer. Calibration is done early at GZA's office and documented according to procedures contained in the Environmental Laboratory Analytical Protocol (ELAP) manual.

B. Water Level Instrument

Water level measurements in wells will be made with an electronic tape water level indicator (Sinco Model A1453 or similar) and an engineer's rule. The instrument will be field checked to make sure it is functioning properly prior to use. The end of the probe and cable will be decontaminated between measurements by washing with phosphate free detergent, rinsing with deionized water and wiping with a clean paper towel.

C. pH Meter

This instrument is subject to fluctuation due to temperature and idleness. The following calibration steps must be performed prior to use and after every two hours of use or at a minimum of three occasions during the round (i.e., start middle and end).

These steps are in general accordance with the ELAP Method for two point calibration.

1. Activate unit to ascertain condition of power source.
2. Place probe in pH 4 standard solution (supplied by manufacturer/laboratory), take reading and adjust calibration until reading matches standard.
3. Place probe in pH 10 standard (supplied by manufacturer/laboratory), take reading and adjust slope until reading matches standard.

4. Place probe in 7 pH standard (supplied by manufacturer/laboratory), take reading.

5. If results of reading on 7 pH solution are between 6.95 and 7.05 standard units (S.U.), the unit is calibrated and ready for use.

6. If the reading is outside 6.95 - 7.05 su window, repeat calibration procedures.

D. Specific Conductance Meter

The following calibration procedure should be performed at a minimum prior to each day's use:

1. Activate unit in "battery check" mode to ascertain condition of power source.

2. Zero instrument.

3. Measure standard solution temperature.

4. Place electrode in 0.01 M KCI standard, take reading.

5. Correct reading for temperature.

6. If reading is within 20 percent either direction of standard conductance, unit is adequately calibrated.

7. If reading is outside acceptable limits, a different instrument should be used.

E. Turbidimeter

The following calibration steps must be performed prior to each sample round (note this procedure will be done at a minimum of every three months).

1. Zero Adjust - With the instrument turned off, check the meter needle position. If the needle does not read zero, adjust the mechanical zero screw.

2. Turn on the instrument and allow to warm-up for 5 minutes.

3. Insert the black body into the sample well.

4. Turn the set standard switch control fully clockwise.

5. Place the NTU range switch to the x .01 position.

6. Adjust the circuit board mounted potentiometer to read zero on the meter.

Note: An insulated, non-magnetized calibration screwdriver is required for both adjustments. Do not expect all scales to be calibrated if you only calibrate one NTU scale. You must calibrate each scale with the appropriate NTU value standard.

7. Choose one sample cuvette for reading all unknown samples. If the chosen sample cuvette is broken or replaced, the following procedure should be repeated for the new sample cuvette.

8. Set the NTU range switch to x 1 (0-100 NTU full scale).

9. Pour the 40 NTU Formazin standard into the chosen sample cuvette. Make certain that the sample cuvette is wiped clean of all dirt and fingerprints. Insert the cuvette into the sample well and align properly. Cover with the light shield.

10. Use the set standard knob to adjust the meter needle to read exactly 40 NTU.

11. Remove the sample cuvette and insert the 40 NTU standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the 40 NTU sealed standard.

12. Rinse the sample cuvette thoroughly and dry completely inside and out.

13. Fill the sample cuvette with the 5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well. Align the cuvette properly and cover with the light shield.

14. Turn NTU scale knob to x .1 (0-1- NTU full scale). Use the set standard knob to adjust the meter needle to read exactly 50 (actually 5 NTU).

15. Remove the sample cuvette and insert the 5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the 5 NTU sealed standard.

16. Rinse the sample cuvette thoroughly and dry completely inside and out.

17. Fill the sample cuvette with the .5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well, align properly and cover with light shield.

18. Turn NTU range knob to x .01 (0-1 NTU full scale). Use the set standard knob to adjust the meter needle to read exactly 50 (actually .5 NTU).

19. Remove the sample cuvette and insert the .5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the NTU sealed standard.

F. Gas Chromatograph

A Photovac Model 10S50 Gas Chromatograph will be used to screen samples. Its calibration will be checked twice a day in accordance with the manufacturer's recommendations

Calibration will consist of assessing the retention time and instrument response for standard solutions of benzene, toluene, ethylbenzene and xylene. A standard will be prepared by placing a known quantity of each compound in solution in a 40 ml vial.

A head space will then be created within the vial by withdrawing liquid and replacing it with air. The standard will then be head to 30°C and a portion of the head space gas will be injected into the GC. The length of time for each compound to elute from the GL (retention time) and GC response (peak height) will be noted. This information will be used to identify and quantify compound present in the samples.

G. Air Monitoring Equipment

The work plan contains provisions for the use of a HNu photoionization detector. Calibration of the HNu instruments will be performed according to the manufacturer's instructions (see Appendix A-1).

Calibration will be done using a factory supplied source of calibration gas. The following procedures will be used when calibrating the instrument (it should be noted that the first five steps are also necessary to the routine operation of the unit):

1. Turn function switch to "battery check" position to ascertain condition of battery;

2. Turn the function switch to the "on" position;

3. Look into the probe to ensure purple light (UV) is on;

4. Zero the instrument and wait 15-20 seconds to ensure zero is stable;

5. Set span control to desired setting (note: 9.8 is normal), lock span potentiometer into position;

6. Connect probe to calibration gas cylinder using manufacturer supplied tee and tubing;

7. Crack valve on cylinder until gas flow is available;

8. Instrument reading should equal calibration gas concentration; and

9. Comprehensive calibration and operating instruction for the HNu can be found in Appendix A to this QAPP.

6.30 ANALYTICAL LABORATORY

The specific calibration procedures and frequency of performance for laboratory analytical equipment are detailed in Appendix A-2.

7.00 ANALYTICAL PROCEDURES

7.10 FIELD

Five of the analytical procedures included in the work plan are performed in the field. These are:

- Measurement of pH;
- Measurement of Specific Conductance;
- Turbidity;
- Organic Vapor Measurement; and
- Field GC Screening

The procedures for these analyses are included in this section.

A. pH Measurement Procedure

Scope: This procedure describes ways and means of using digital pH equipment in the field. Manufacturer's recommendations accompanying the instrument should also be consulted if difficulties occur.

Purpose: The purpose of this procedure is to provide quality control in field operations, uniformity between different field personnel and a means to allow traceability of possible causes of error in analytical results. This procedure is used for analysis of the pH of water samples and to evaluate the consistency of water quality during the groundwater sampling. pH measurement must include temperature compensation during measurement.

Equipment Needed: pH meter, buffers, plastic cups, and distilled water.

Procedures:

1. Remove pH meter from the box and check that the batteries are operable.

2. Turn power on and allow meter to stabilize. (Note: Some electronic equipment is strongly affected by extremes in temperature. Avoid leaving electronic equipment in direct sunlight or on cold ground.)

3. Calibrate meter according to procedures outlined in the New York State Department of Health (NYSDOH) ELAP Manual and Section 6.00 of this QAPP.

4. Rinse pH electrode with distilled water between pH measurements of buffer solutions and prior to sample measurement. Carefully wipe probe with paper towel or tissue.

5. Samples should be measured immediately following collection. Record the temperature of the sample/buffers and adjust the probe accordingly. During measurement stir buffers and samples to provide a representative measurement.

6. Place rinsed pH electrode in the unknown groundwater sample and allow about one minute for reading to stabilize. Once meter has stabilized record the pH and temperature on the field, log book with sample location, date, time, and sampler's initials.

7. Rinse all parts of the probe that have come in contact with the sample with distilled water, discard the sample and used cups. Replace the protective cap on the pH probe and return the instrument to its case.

B. Specific Conductance Measurement Procedure

Scope: This procedure describes ways and means of obtaining conductivity measurements in aqueous media in the field using portable, hand-held equipment.

Purpose: The purpose of this procedure is to provide quality control in field operations, uniformity between field personnel, and a means to allow traceability of possible causes of error in analytical results.

Equipment Needed: Conductivity meter, plastic cup, and distilled water.

Procedures:

1. Check the battery level before using the instrument.

2. Calibrate the conductivity meter following the procedures outlined in the NYSDOH ELAP and Section 6.00 of this QAPP using a standard solution of 0.01 M KCL.

3. Rinse conductivity probe with distilled water between measurements.

4. Measure temperature immediately following sample collection, record temperature and adjust meter accordingly. Remove probe.

5. Stir sample with glass stirring rod prior to placement of rinsed conductivity cell in test sample and record specific conductance and temperature measurements obtained.

6. Record sample number, date, time, sampler's initials and results in field book.

C. Turbidity Measurement Procedure

Scope: This procedure describes methods for measuring turbidity of aqueous samples in the field.

Purpose: The purpose of this procedure is to provide quality control in field operations, uniformly between field personnel and a means to allow traceability of potential errors in the analytical results.

Equipment Needed: Turbidimeter, standards, and sample containers.

Procedure:

1. Zero the instrument. When the instrument is off, check the meter needle position. If the needle does not read Zero, adjust the mechanical zero screw.

2. Turn instrument on and allow five minutes to warm-up.

3. Choose the proper NTU range and standards for the unknowns to be read. The NTU range chosen should be the minimal range span required to read all unknowns.

	NTU RANGE SPAN (full scale)	**STANDARD**
x 1	0-100 NTU	40
x .1	0-10 NTU	5
x .01	0-1 NTU	.5

4. Calibration of NTU Scale.

Turn NTU range knob to the correct position for the chosen range span.

Insert the proper standard into the test well. Make certain the standard cuvette is clean and properly aligned. Cover with the light shield.

Use the set standard knob to adjust the meter needle to read the assigned value of the standard.

The turbidimeter is now calibrated in the chosen range and ready for use.

5. Take sample measurement. All unknowns should be measured using the same sample cuvette. Unknown samples are read by inserting the sample cuvette, properly aligned with the key, into the test well. Cover with the light shield and take the reading off the correct scale on the meter. Make certain to take the range factor (x1, x.1, or x.01) into account when calculating the actual NTU value sample.

D. Organic Vapor Measurements

Scope:

This procedure describes methods for screening atmosphere for total organic vapors.

Purpose:

To provide operating procedures for the HNu Systems Model PI-101 photoionization detector for field surveying of organic vapors.

Equipment and Materials:

HNu Systems Model PI-101 Photoionization Detector, including readout assembly, probe assembly and extension, and battery charger.

Procedures:

a. Preparation for Use

1. Assemble the photoionization probe by screwing the handle to the probe body and inserting the probe extension into the probe body.

2. Connect the probe to the meter by matching the alignment keys on the 12-pin connector, pressing down, and twisting the connector lock until a distinct snap is felt.

3. Turn the function switch to the battery check position. The needle should switch into the green arc on the scaleplate. If it does not, the unit must be recharged before use.

4. Turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. At this setting, the probe fan should turn on. (A distinct hum indicates operation of the fan.)

5. Turn the function switch to the 0-20 ppm scale setting. The UV light source should be on at this setting, indicated by a faint purple glow in the probe tip.

b. Operation - Air Quality Monitoring

1. The probe should be held in close proximity to the area being monitored to provide a representative reading. The lowest possible scale range should also be selected. In environments where levels of volatile organics are unknown, initially use the 0-20 ppm scale and then change to higher scales, if appropriate.

2. Do not allow the probe intake to directly contact soil or liquid materials. This will disrupt the air flow to the UV light source and may contaminate the probe.

3. After completion of monitoring, the meter should be turned off, cleaned, and repacked. Operating time should be recorded on the battery usage log.

E. Field GC Screening

Scope

This procedure describes methods for analyzing water samples for volatile organic compounds.

Purpose

The purpose of this procedure is to provide quality control in field procedures and means to allow traceability of results.

Field Procedures

Analysis will be completed in the field for the volatile organic compounds of concern. The organic compounds will be analyzed for a Photovac 10S50 gas chromatograph (GC) or similar equipped GC with photoionization detectors (PID).

The identification of specific compounds and their concentrations will be based on comparing standard chromatographs to sample chromatographs. Standards will be run at least once each day. The GC that will be used to analyze for organic compounds is equipped to store retention times and peak heights for standard compounds. This stored information is used when analyzing a sample to identify compounds and estimate their concentrations.

The information collected by GC (peak heights, retention times, compound identification, etc.) will be manually input onto a computer disk using a portable field computer. These data will be input on a daily basis as the job progresses.

7.20 ANALYTICAL TESTING

Quality assurance for analytical testing is described in Recra Environmental, Inc.'s QAPP in Appendix A-2.

7.30 GEOTECHNICAL TESTING

GZA's geotechnical testing laboratories, located in Buffalo, New York and Newton, Massachusetts, perform laboratory testing services for classification of soils, as well as determination of static engineering properties of soil for subsurface evaluation programs.

Testing methods conform with the latest specifications of the American Society for Testing and Materials (ASTM), and United States Army Corps of Engineers, and the United States Environmental Protection Agency (EPA). A list of tests and the method followed are shown on Table A3. GZA conducts quality control on each test by checking the data and computation. The test results are reviewed by a Professional

Engineer licensed in the State of New York. Laboratory personnel are trained and supervised by experienced technical staff. Equipment is maintained on a continuing basis and calibrated regularly, as appropriate.

8.00 DATA REDUCTION, VALIDATION AND REPORTING

This section addresses the requirements for data reduction, validation and reporting for each measurement's parameter. Brief descriptions of the following are included:

- The data reduction scheme planned for collected data; and
- The criteria that will be used to validate data integrity during collection and reporting of data.

There are two separate areas where data reduction, validation and reporting apply. These areas are in the field investigation and in the analytical laboratory. Each is discussed separately below.

8.10 FIELD PROCEDURES

All field measurements (whether analytical or other) will be recorded on standard forms. The forms will be written only in ink and will be signed at the bottom of each page. The data recorded on each form will be checked by the on-site coordinator to ensure proper procedures for sampling, analysis and measuring (detailed in other sections of the QAPP) are being followed. At that time, any data generated using "out of plan" procedures or methods can be reproduced or validated with conditions. The Project Manager will independently reduce all data which require calculation prior to reporting. This will serve as a check to ensure that math or other data reduction treatments have been properly performed. Using the described approach will serve to validate the integrity of field generated data.

The on-site coordinator will, in all reports from the field or other data reporting, include the results of the independent data review. Both the Quality Assurance Officer and the project manager will review these reports to ensure proper procedures have been followed.

8.20 ANALYTICAL LABORATORY PROCEDURES

Laboratory procedure for data reduction, validation, and reporting are detailed in Appendix A-2.

8.30 DATA VALIDATION

All analytical results generated will be reviewed by Recra Environmental, Inc. for accuracy, precision and completiveness, as well as compliance with other specific contract or method requirements. This is discussed further in Appendix A-2.

9.00 INTERNAL QUALITY CONTROL CHECKS

There are two segments to Internal Quality Control checks; those initiated in the field and those initiated in the laboratory.

Field quality control checks will consist of the collection of the following QA/QC samples (as detailed in Section 4.00 of the QAPP):

- Field blanks
- Trip blanks
- Duplicate samples

Each of these are described below:

- Field Blanks are collected to check the effectiveness of decontamination procedures for sampling equipment. Following a sampling event, sampling equipment will be decontaminated then contaminant free water provided by the laboratory will be passed through the sampler into the designated container. As with the other QA samples, sample and labeling should not indicate that it is a blank. The field blank should be transported to the laboratory and analyzed with the other samples. At a minimum, one field blank should be collected for each sampling event.

- Trip Blanks can provide an indication of positive interferences introduced in the field and in the laboratory. They will not provide information on matrix effects, accuracy, precision, or natural background. Matrices to be used for control blanks must be determined to be free of contamination prior to use.

  Trip blanks are used to check for contaminant introduction due to: (1) interaction between the sample and the container, or (2) a handling procedure which alters the sample analysis results. A trip blank is created by filling a designated sample container with distilled/deionized water in the laboratory. The trip blank should not be labeled as such, so that it remains obscure from the other samples when being analyzed.

The trip blank should be transported to the sampling location and returned to the laboratory in a manner identical to the handling procedures used for all the samples. These blanks should be subjected to the same analyses. At a minimum, one trip blank per sampling event is required.

* Duplicates can provide indications of the precision of the analytical system. They will not provide indications of matrix effects or accuracy.

A duplicate sample is a second sample collected at the exact same location and depth and time as the original sample. A duplicate sample serves to check the accuracy and reliability of laboratory instruments and procedures, and field activities.

These samples will be collected at a frequency designated in Section 4.00.

The internal quality control checks performed by the laboratory are detailed in Appendix A-2.

10.00 PERFORMANCE AND SYSTEM AUDITS

To establish an accurate profile, various agencies study the overall performance of laboratories. This includes systems audits and analysis of proficiency samples on a regular basis. A satisfactory outcome of a system audit and analyses are required for approval of the inspecting agency. The detailed laboratory approach and procedures for performing audits and for responding to audits done by outside agencies is contained in of Appendix A-2.

The Project Manager also will continually audit project specific activities by:

* Participating in planning meetings with field crews prior to initiation of field sampling activities.

* Reviewing pre-field/office punch lists, field logbook entries, and chain-of-custody and sample analyses requests immediately after the completion of field tasks.

* Debriefing field personnel following completion of field tasks.

- Maintaining good contact with the laboratory to assure that samples will be properly handled upon delivery, analyses will be completed with proper holding times, and problems (if any) are managed expeditiously.

- Completing spot checks for potential data transcriptions and calculations errors including checks of transfer of field data (such as pH, specific conductance, groundwater elevation) from logbook to final report and checks of transfer of laboratory analyses results from actual laboratory report forms to final report.

11.00 PREVENTIVE MAINTENANCE

Preventive maintenance if done on analytical equipment to help ensure accurate results and to minimize equipment breakdowns/failure. Maintenance of areas field and laboratory equipment is discussed below.

11.10 FIELD

Prior to being taken to the field, meters to be used during sampling (turbidimeters, specific conductance/thermistor meters, etc.) will be checked against laboratory meters to insure proper calibration and precision response. Thermometers will be checked against precision thermometer certified by the National Bureau of Standards. These activities will be the responsibility of the Field Team Leader. In addition, buffer solutions, standard KCl solutions to be used to field calibrate the pH and conductivity meters will be laboratory tested to insure accuracy. The preparation data of standard solutions will be clearly marked on each of the containers to be taken into the field.

PIDs, explosimeters and oxygen meters will be checked and maintained according to the manufacturers recommendation. These instruments are normally checked/overhauled once annually or whenever problems arise. Each instrument will be inspected prior to use. Batteries for the equipment will be charged to full capacity prior to use.

A log which documents problems experienced with the instruments, corrective measures taken, battery replacement dates, when used and by whom for each field instrument, will be maintained. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement, when necessary, in the field.

Equipment to be utilized during the field sampling will be examined to certify that it is in operating conditions. This includes checking the manufacturer's operating manuals and the instructions with each instrument to ensure that maintenance items are being observed. Field notes from previous equipment usage and the maintenance log will be reviewed so that any prior equipment problems are not overlooked and necessary repairs to equipment can be carried out. A spare electrode will be sent with each pH and specific conductance meter that is to be used for field measurements.

In the field, each field instrument will be visually inspected prior to field activities to detect any damages or operational problems. The instrument operation manuals will be referred to for trouble-shooting methods should equipment check-out indicate a problem.

Instrumentation problems identified in the field will be relayed to the project manager.

In addition to the preventive maintenance items detailed above, two further procedures have been found to be useful in avoiding equipment failures for all or specific instruments. These items are:

- Always keep instruments/equipment in their proper carrying case. This avoids accidental damage and accumulation of dirt.
- Whenever the equipment becomes dirty, clean as soon as possible. Electronic equipment is sensitive to dust and dirt.

11.20 ANALYTICAL LABORATORY

The analytical laboratory's approach to preventive maintenance and details of their program is contained within Appendix A-2.

12.00 DATA MEASUREMENT ASSESSMENT PROCEDURES

Data equipment assessment procedures are employed to ascertain how reliably the concentration reported reflects the actual concentration of a given analyte in the sampled media. Precision and accuracy are two characteristics of data which can be examined to determine the reliability of results.

Precision: Precision is a measure of a mutual agreement among individual measurements of the same property.

Reference control samples and analytical replicate control samples are used to determine that the results from an analytical batch of samples are within a known range of precision. The acceptance limits for the reference control samples reflect the precision under conditions with no matrix interferences. The acceptance limits for the analytical replicate control samples reflect the precision that can be obtained when there may be matrix interferences.

Accuracy: Accuracy is the degree of agreement of a measurement with an accepted reference or true value.

Reference control samples, spiked control samples, and surrogate spikes (see Section 9.00) are used to determine that the results from the analytical batch samples are within a known range of accuracy. The means of the reference control samples reflect the accuracy under the conditions with no matrix interferences. The mean recoveries for the spiked control samples and surrogate spikes reflect the accuracy that can be obtained where there may be matrix interferences.

Recra Environmental, Inc. has methods and protocols for assessing data precision and accuracy. These protocols are detailed in Appendix A-2.

13.00 CORRECTIVE ACTION

Corrective action is required when field and laboratory generated data are not within the predetermined limits for data acceptability. In most field related instances, data acceptability is determined by, and referenced to, manufacturer specifications during calibration. Once calibrated and operational, data generated by the field instrumentation is considered to be representative of the field condition measured.

If problems are noted by the regulatory agency or any field team member, they will be brought to the attention of GZA's project manager so appropriate corrective actions may be taken.

In event of erratic readings, the field instrumentation will be examined to insure that:

- The power source is adequate;
- Probe connection are secure;
- No external damage is apparent; and
- No known external source of interferences is present.

Subsequent to this, the instrumentation will be zeroed/calibrated and utilized to perform the necessary field measurements. If the instrumentation continues to respond in a questionable fashion, the unit will be returned for service, and if possible, replacement equipment secured to continue the field operations. The Field Team

Leader will ensure that records are maintained of all corrective actions undertaken and will report this information to the Quality Assurance Office and the project manager.

Recra Environmental, Inc. has protocols for corrective actions. These protocols are detailed in Appendix A-2.

Regardless of whether a problem arises in the laboratory or the field, all proposed corrective actions must be approved by the Project Manager prior to their implementation (unless the problem contains the elements of an emergency). It will be the responsibility of the Project Manager to report corrective actions and their apparent degree of success. Also, all correction actions will be followed up to ensure that the problem precipitating the correction action does not become recurrent.

14.00 QUALITY ASSURANCE REPORTS TO MANAGEMENT

14.10 ANALYTICAL LABORATORY

The Laboratory Project Manager provides periodic assessments of measurement, data accuracy and precision to the Laboratory Director, who distributes them to appropriate laboratory staff. Results of the performance audits and system audits are received by the Laboratory Director and also passed on to the lab staff. Other significant quality assurance problems which may be detected throughout the review process of the analytical data are brought to the attention of the Laboratory Director and other appropriate individuals as they arise. The Laboratory Director will immediately notify the Consultant's Project Manager of problems detected, if any, and a mutual solution to the problem will be developed. A written report detailing problems, solutions taken to resolve the problems and impacts on analytical data will be provided to the Consultant with the actual sample analyses data.

14.20 PROJECT REPORTS

Monthly project progress reports prepared by DOD will be submitted to the Project Director. These monthly reports will summarize scheduling progress compared to the approved overall project schedule, significant problems which may have arisen and corrective actions taken or proposed changes (if any) to the QAPP.

TABLES

TABLE A1

PROJECT ORGANIZATION

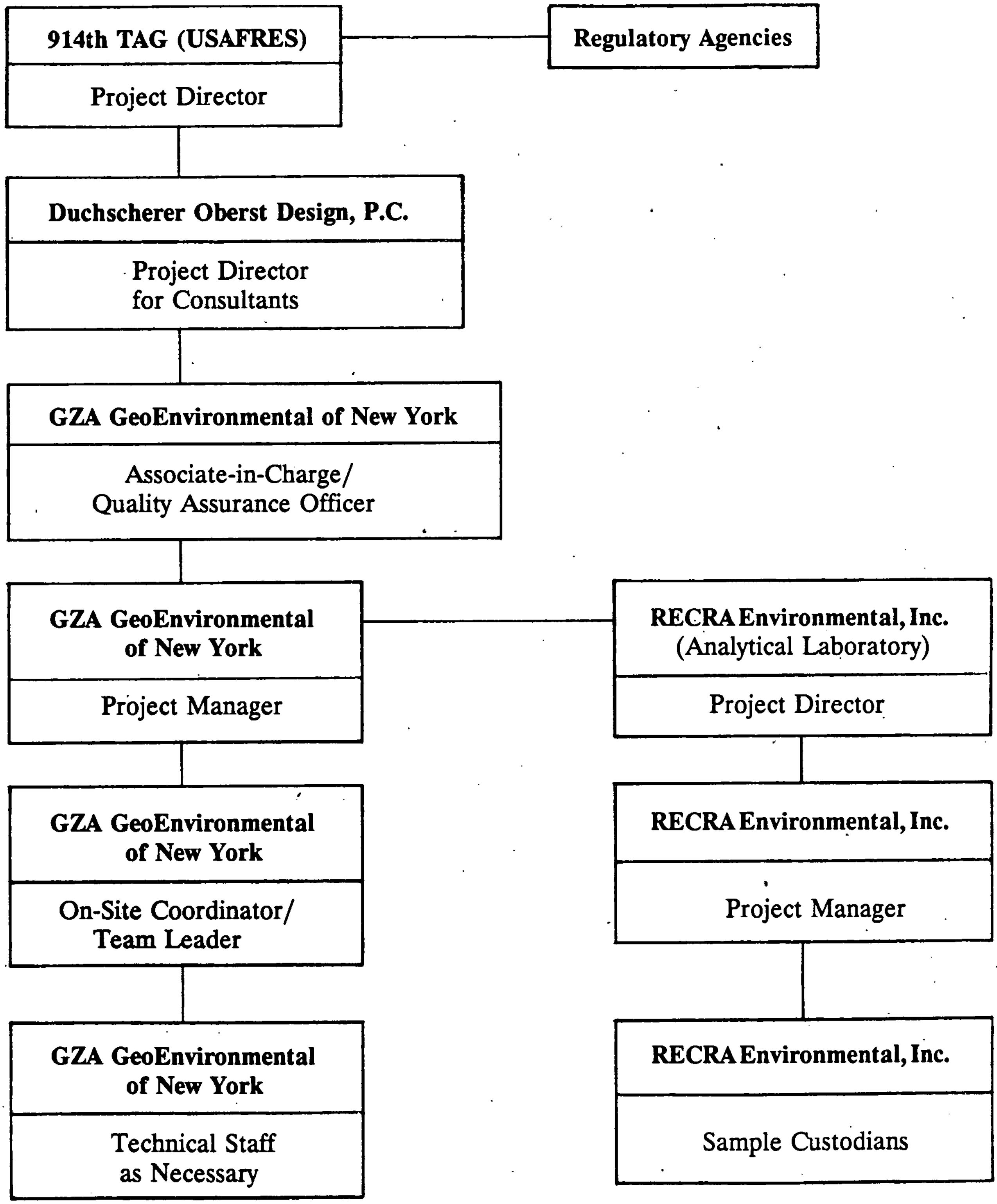


TABLE A2

MATRIX OF RESPONSIBILITIES-KEY PERSONNEL

Title	Responsibility	Assigned Personnel	Phone Number	Address
Project Director	● Overall project responsibility	W. Nivers	(716) 236-2043	914th Tactical Airlift Group (USAFRES)
Consultant's Project Director	● Overall project responsibility for consultants	J. Snyder	(716) 835-4175	Duchscherer Oberst Design, P.C.
Associate-in-Charge/Quality Assurance Officer	● Overall project QA Officer responsible for: A. Sampling QA/QC Compliance B. Data processing QC C. Data review for completeness, representativeness, comparability D. Reporting	I. Reinig	(716) 685-2300	GZA GeoEnvironmental of New York
GZA's Project Manager	● Assist Associate-in-Charge with day to day supervision, coordination, data review, reporting, etc.	T. Heins	(716) 685-2300	GZA GeoEnvironmental of New York

TABLE A2

Title	Responsibility	Assigned Personnel	Phone Number	Address
On-Site Coordinator/Team Leader	● Responsible for sampling QA/QC compliance in field (i.e., collection, storage and shipment) ● Field data collection review/reporting	G. Klawinski B. Klettke W. Lemke D. Savage	(716) 685-2300	GZA GeoEnvironmental of New York
Laboratory Director	● Responsible for: A. Overall laboratory QA/QC compliance with this QAPP B. Executing laboratory performance and system audits C. Reporting to GZA	R. Wyeth	(716) 691-2600	Recra Environmental, Inc.
Laboratory Project Manager	● Assist Laboratory Director with day to day project coordination ● Provides periodic assessments of measurement, data, accuracy, and precision to laboratory director	L. Clarke	(716) 691-2600	Recra Environmental, Inc.
Sample Custodian(s)	● Responsible for sample sign-in, out (to analysis) and custody	A. Preville	(716) 691-2600	Recra Environmental, Inc.

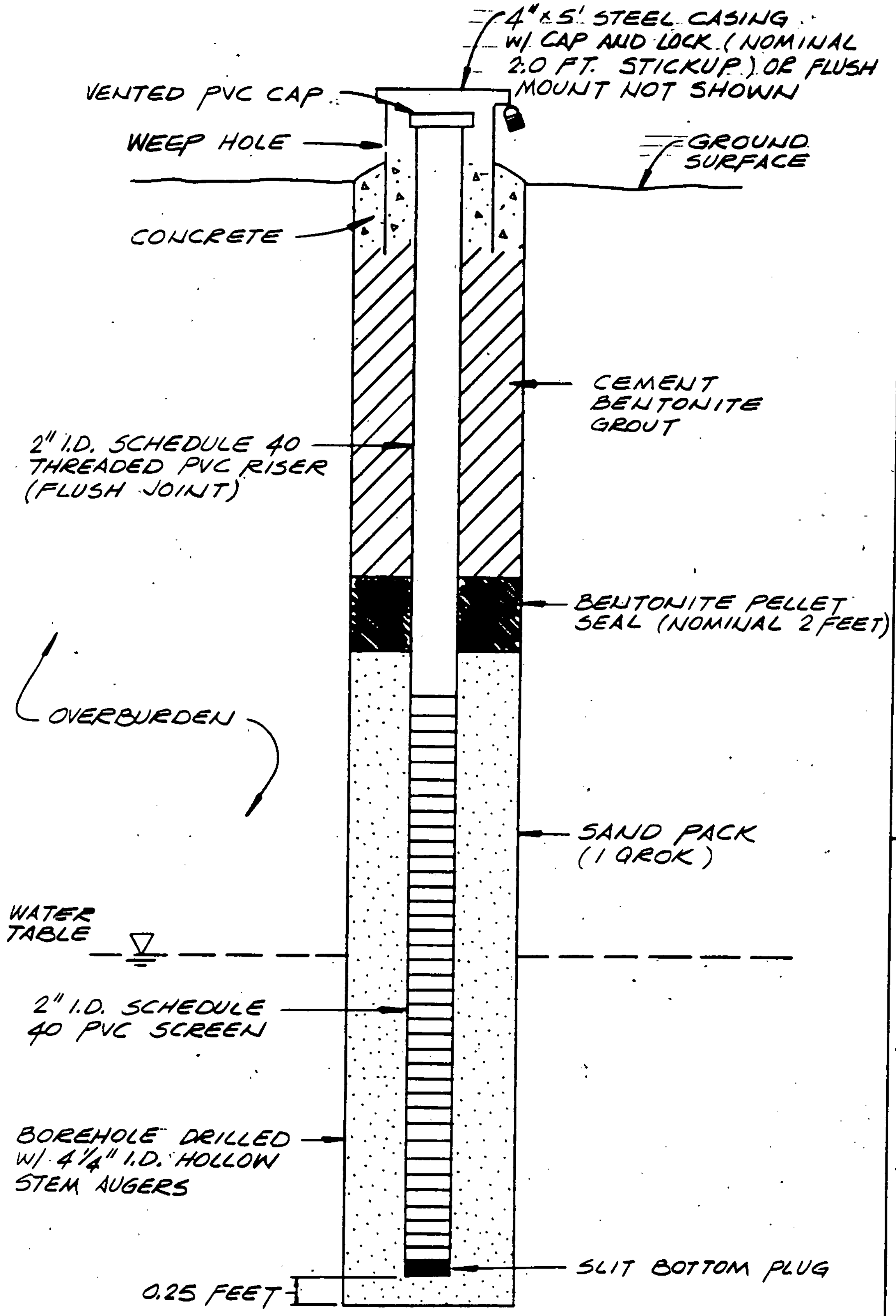
TABLE A3

Geotechnical Laboratory Test Procedures

1. The following tests are performed by GZA GeoEnvironmental's laboratory with the noted ASTM or US Army Corps of Engineers test designation:

TEST	DESIGNATION
Consolidation Properties	ASTM D2435-80
Grain Size (sieve and hydrometer)	ASTM D422-63
Moisture Content	ASTM D2216-80
Moisture Density Relationships	D698-78 or D1557-78
Falling Head Permeability Test	EM 1110-2-1906 "Falling Head Permeability Test with Back Pressure"
Constant Head Permeability Test	ASTM D2434-68
Specific Gravity	ASTM D854-83
Unconfined Compressive Strength	ASTM D2166-85
Liquid and Plastic Limits	ASTM D4318-84
Organic Content	ASTM D2974-87 (Method B & C)

FIGURES



DRAWN BY: ARH

DATE: JULY 1991

GZA

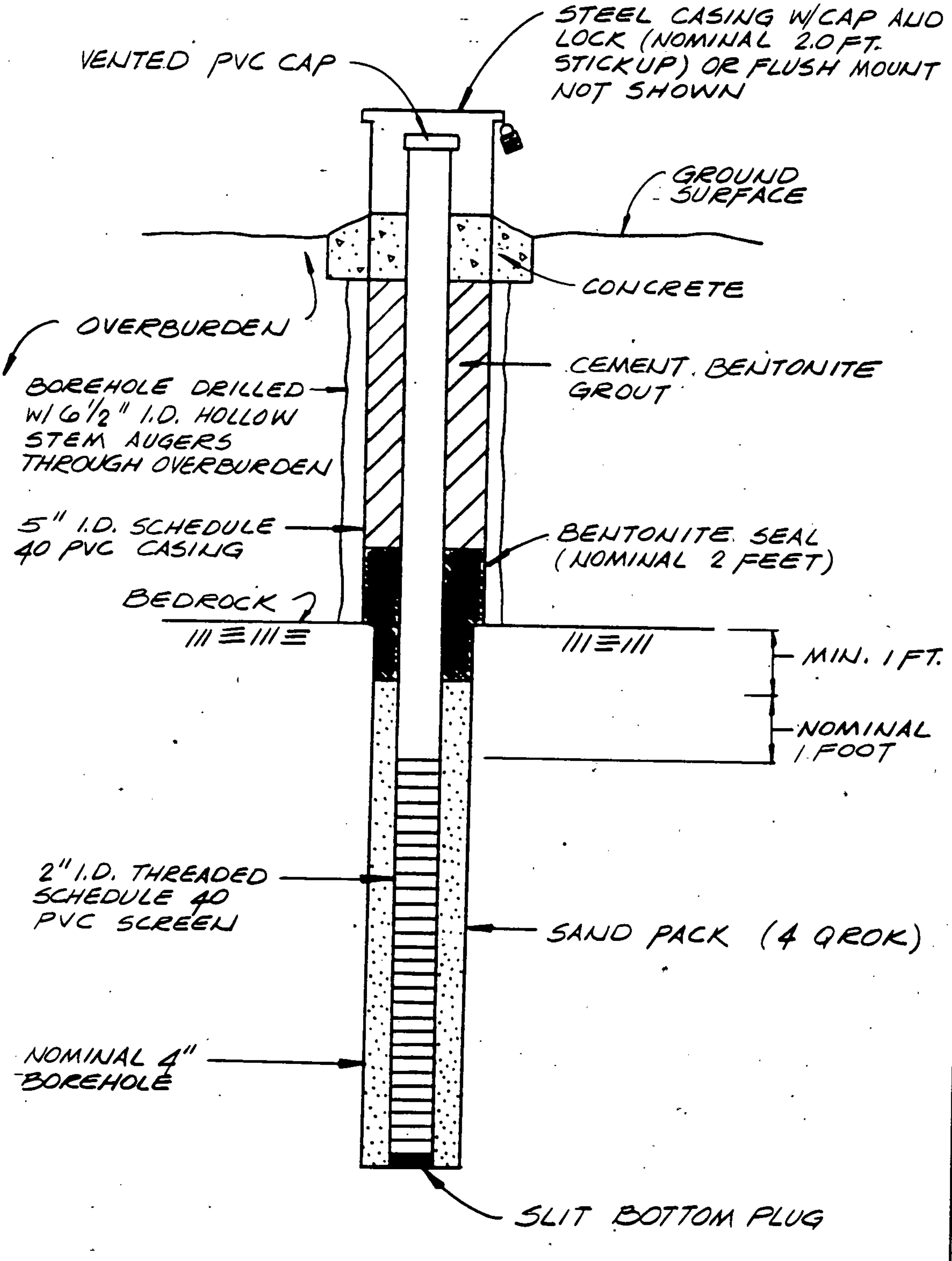
SCALE IN FEET
NOT TO SCALE

NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK
IRP SITE 8 & 13

TYPICAL OVERBURDEN WELL

PROJECT No.
R5957

FIGURE No.
A1



DRAWN BY: ARH

DATE: JULY 1991

SCALE IN FEET

NOT TO SCALE

NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK
IRP SITE 8 # 13

TYPICAL BEDROCK WELL

PROJECT No.
R5957

FIGURE No.
A2.

Figure A3

GZA GEOENVIRONMENTAL OF NEW YORK
364 NAGEL DRIVE, BUFFALO, NEW YORK

ENGINEERS AND SCIENTISTS

PROJECT ____________

BORING No. ______
SHEET 1 OF ____
FILE No. ______
CHKD. BY ______

CONTRACTOR ______
DRILLER ______
GZA GEOENVIRONMENTAL REPRESENTATIVE ______

BORING LOCATION ______
GROUND SURFACE ELEVATION ______ DATUM ______
START DATE ______ END DATE ______

TYPE OF DRILL RIG ______
CASING SIZE AND TYPE ______
OVERBURDEN SAMPLING METHOD ______
ROCK DRILLING METHOD ______

WATER LEVEL DATA				
DATE	TIME	WATER	CASING	REMARKS

DEPTH	SAMPLE					SAMPLE DESCRIPTION	EQUIPMENT INSTALLATION LOG		NOTES
	BLOWS / 6"	NO.	DEPTH (FT.)	N-VALUE /RQD(%)	RECOVERY (%)				
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

LEGEND
S - Split Spoon Soil Sample
U - Undisturbed Soil Sample
C - Rock Core Sample

NOTES:

GENERAL NOTES:
1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GZA

BORING No. ______

Figure A4

GZA SAMPLING LOG

PAGE ____ of ____

PROJECT: ____________________ FILE: ________

SAMPLE LOCATION: ____________________

DATE: ____________________ TIME: ____________________

GENERAL

SAMPLING EQUIPMENT USED: ____________________

DECONTAMINATION PROCEDURE (indicate if equipment was precleaned): ____________________

SAMPLE COLLECTION PROCEDURES (include purging, if appropriate): ____________________

IN SITU MONITORING EQUIPMENT USED AND CALIBRATED: ____________________

SAMPLE IDENTIFICATION

SAMPLE TYPE: ____________________

SAMPLE CODE: ____________________

CONTAINER	SEQUENCE NUMBER *	TEST PARAMETER	CONTAINER VOLUME	PRESERVATION
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

IN SITU MEASUREMENTS

INITIAL WATER LEVEL (MEASURED FROM MONITORING POINT): ____________________

WATER VOLUME REMOVED (IF APPLICABLE): ____________________

pH (STANDARD UNITS): ____________________

CONDUCTANCE (μ ohms/cm): ____________________

TEMPERATURE (☐ °C , ☐ °F): ____________________

TOTAL ORGANIC VAPOR (VIA PID): ____________________

LOCATION OF PID MEASUREMENT: ____________________

OTHER MEASUREMENTS:

1. ____________________
2. ____________________
3. ____________________
4. ____________________

MISCELLANEOUS INFORMATION:

CHAIN-OF-CUSTODY COMPLETED (☐ YES, ☐ NO)

SAMPLE CONTAINERS LABELED (☐ YES, ☐ NO)

SHIPPING CONTAINERS SEALED (☐ YES, ☐ NO)

TRIP BLANK (☐ YES, ☐ NO)

FIELD BLANK (☐ YES, ☐ NO)

WELL VOLUME DETERMINATION

Volume (gal.) = (πr^2)(length of water column - inches) / 231

WELL DIAMETER	LENGTH OF WATER COLUMN	VOLUME OF WATER
1-INCH	1-FOOT	0.04 GALLON
1.5-INCH	1 FOOT	0.09 GALLON
2-INCH	1 FOOT	0.16 GALLON
4-INCH	1-FOOT	0.65 GALLON
6-INCH	1-FOOT	1.46 GALLON

REMARKS: ____________________

* SEQUENCE NUMBER CORRESPONDS TO IDENTIFICATION USED ON CHAIN-OF-CUSTODY

GZA

SAMPLER ____________________

SAMPLER ____________________

SAMPLER ____________________

FIGURE A-5

SUMMARY OF FIELD WATER QUALITY TESTS

PROJECT: ______________________________

SAMPLE LOCATION: ______________________________

______________________________ GZA FILE No. __________

DATE	TIME	TEMP. (°C)	pH (STD. UNITS)	CONDUCT. (µMHOS/CM)	TURBIDITY	WATER LEVEL DEPTH(FT)		WELL VOLUME REMOVED
						INITIAL	AFTER PURGING	

GZA

Sheet ____ of ____

APPENDIX A-1

EQUIPMENT OPERATIONAL CHECK-OUT AND CALIBRATION DIRECTORY

hnu

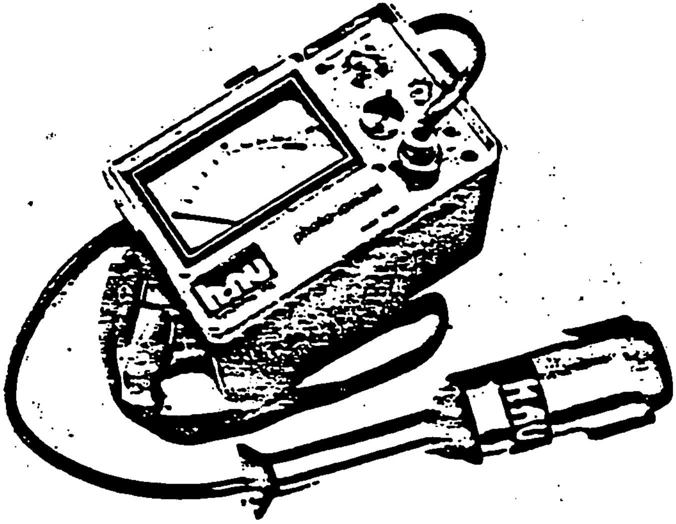
systems inc.

INSTRUCTION MANUAL

FOR

MODEL PI 101

PHOTOIONIZATION ANALYZER



SECTION 1

INTRODUCTION

The model PI 101 has been designed to measure the concentration of trace gases in many industrial or plant atmospheres. The analyzer employs the principle of photoionization for detection. This process is termed photoionization since the absorption of ultraviolet light (a photon) by a molecule leads to ionization via:

$$RH + h\nu \rightarrow RH^+ + e^-$$

where RH = trace gas

$h\nu$ = a photon with an energy $\geq$ Ionization Potential of RH

The sensor consists of a sealed ultraviolet light source that emits photons which are energetic enough to ionize many trace species (particularly organics) but do not ionize the major components of air such as O_2, N_2, CO, CO_2, or H_2O. A chamber adjacent to the ultraviolet source contains a pair of electrodes. When a positive potential is applied to one electrode, the field created drives any ions, formed by absorption of UV light, to the collector electrode where the current (proportional to concentration) is measured.

To minimize adsorption of various sample gases, the ion chamber is made of an inert fluorocarbon material, is located at the sampling point, and a rapid flow of sample gas is maintained through the small ion chamber volume.

The analyzer will operate either from a rechargeable battery for more than 10 hours or continuously from the AC battery charger. A solid state amplifier board in the probe and a removable power supply board in the readout module enable rapid servicing of the unit in the field.

The useful range of the instrument is from a fraction of a ppm to about 2,000 ppm. For measurement at levels above 2,000 ppm, dilution of the sample stream with clean air is recommended. Some typical specifications for the model PI 101 Photoionization Analyzer are given in Table 1.

TABLE 1

SPECIFICATIONS FOR MODEL PI 101
PHOTOIONIZATION ANALYZER

performance (benzene referred)

range 0.1 to 2000 ppm
detection limit 0.1 ppm
sensitivity (max) 0-2 ppm FSD over 100 division meter scale
repeatability ± 1% of FSD
linear range 0.1 to 600 ppm
useful range 0.1 to 2000 ppm
response time < 3 sec to 90% of full scale
ambient humidity to 95% RH
operating temperature ambient to 40°C*

physical

size:	probe 6.3 DIA x 28.5L (cm)	(2-1/2 x 11-1/4")
	readout 21W x 13D x 16.5H (cm)	(8-1/4 x 5-3/16 x 6-1/2")
	stowed 21W x 13D x 24H (cm)	(8-1/4 x 5-3/16 x 9-1/2")
	cable 80 cm long (32")	

weight: probe .55 kg (20 ounces)
readout 3.2 kg (7 pounds)
total (shipping) 5.4 kg (12 pounds)

controls and functions

mode switch Off, Battery Check, Standby (zero), 0-2000, 0-200, 0-20 ppm
low battery indicator light
zero (10 turn ± 300% FSD max)
span (10 turn counting dial 1.0 to 10 times nominal sensitivity)
readout 4-1/2" (11.3 cm) meter Taut Band movement graduated 0-5-10-15-20, divisions
signal output for recorder 0-(-5V) FSD
power output for recorder 12 VDC - jack on side of instrument

power requirements of operating times

continuous use, battery > 10 hours
continuous use with HNU recorder reduces instrument battery operating time to 1/2 normal time
recharge time, max < 14 hours, 3 hours to 90% of full charge
recharge current, max .4 Amps @ 15 VDC

TABLE 1 (Continued)

construction

Designed to withstand the shock and abuse to which portable instruments are often subjected. The readout is housed in a two piece aluminum case, and finished with a solvent resistant baked acrylic textured paint.

The probe is fabricated from extruded aluminum sections and machined plastic.

serviceability

The probe and readout are of a modular design allowing rapid servicing and/or replacement of mechanical and electrical components. All module interwiring includes quick disconnects.

maintenance

The instrument contains only one moving part, and consumes no gases or reagents. The only routine maintenance procedure is cleaning the light source window every several weeks.

calibration check

Check instrument calibration at least once per week with HNU calibration standard to ensure that the high sensitivity of the instrument is maintained.

* Instrument is temperature compensated so that a 20°C change in temperature corresponds to a change in reading of < ± 2% full scale at maximum sensitivity.

SECTION 2

OPERATION

2.1 Unpacking

Unpack the instrument carefully and remove the housing, the probe and any spare parts from the shipping carton. Place the instrument on a table or bench with the label upright. Remove the top section of the instrument by opening the two fasteners on the cover (see figure 1). The inner panel of the top section can be removed by pulling up on the fasteners. The top section of the instrument contains the battery charger and a waist strap. The waist strap clips on to the strap brackets of the instrument when needed.

Before attaching the probe, check the function switch on the control panel to make sure it is in the off position. The 12 pin interface connector for the probe is located just below the span adjustment on the face of the instrument (see figure 2). Carefully match the Alignment Key in the probe connector to the 12 pin connector on the control panel, and then twist the probe connector until a distinct snap and lock is felt.

Attached to the instrument is a warranty card which should be filled out completely and returned to HNU Systems.

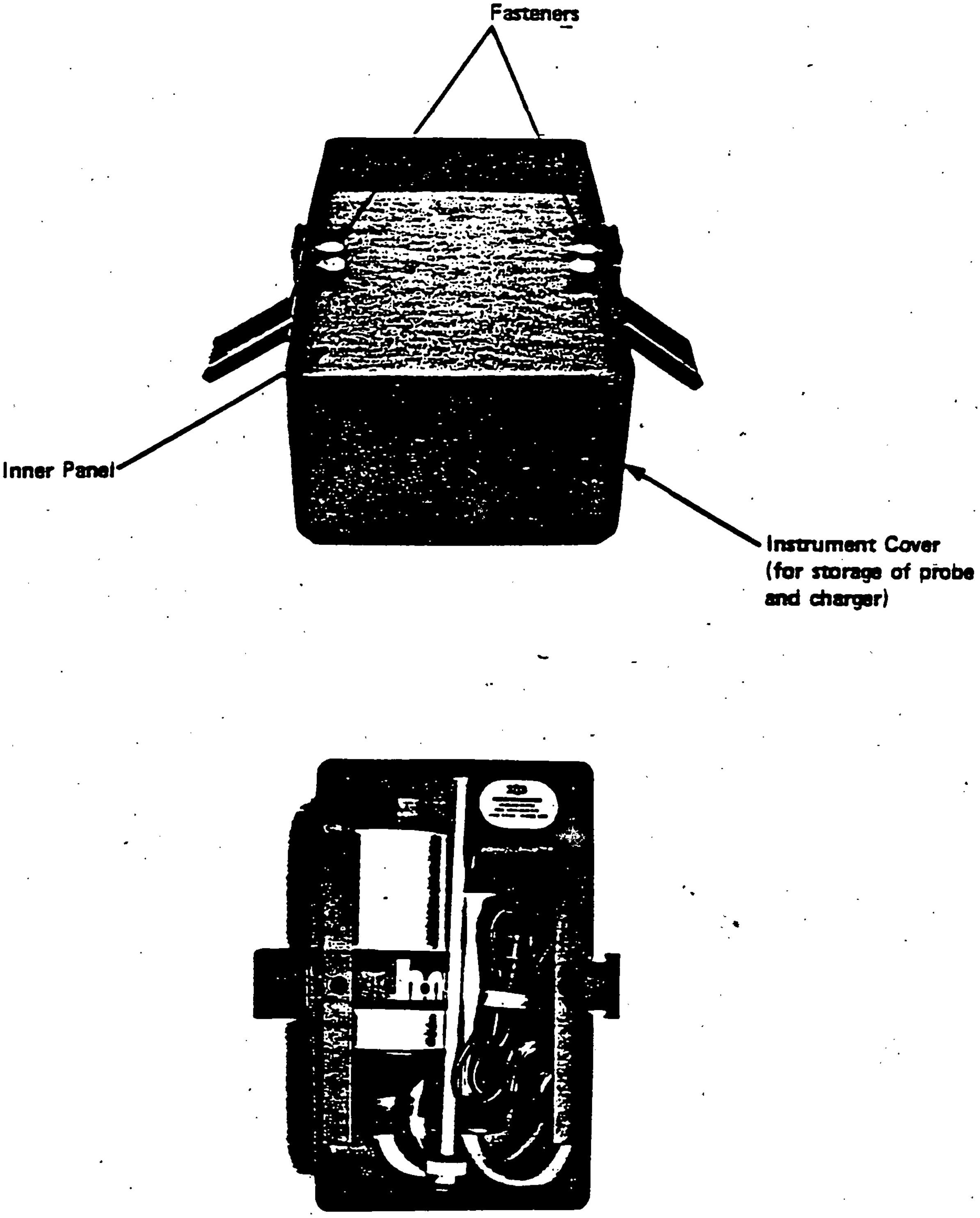
2.2 Operation

Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery arc on the scaleplate. If the needle is in the lower portion of the battery arc, the instrument should be recharged prior to making any measurements. If red LED comes on, the battery should be recharged.

Next, turn the function switch to the on position. In this position the UV light source should be on. Look into the end of the probe to see the purple glow of the lamp.

A brief description of the instrument controls and functions is shown in Figure 2.

Figure 1 (Continued)



Top View

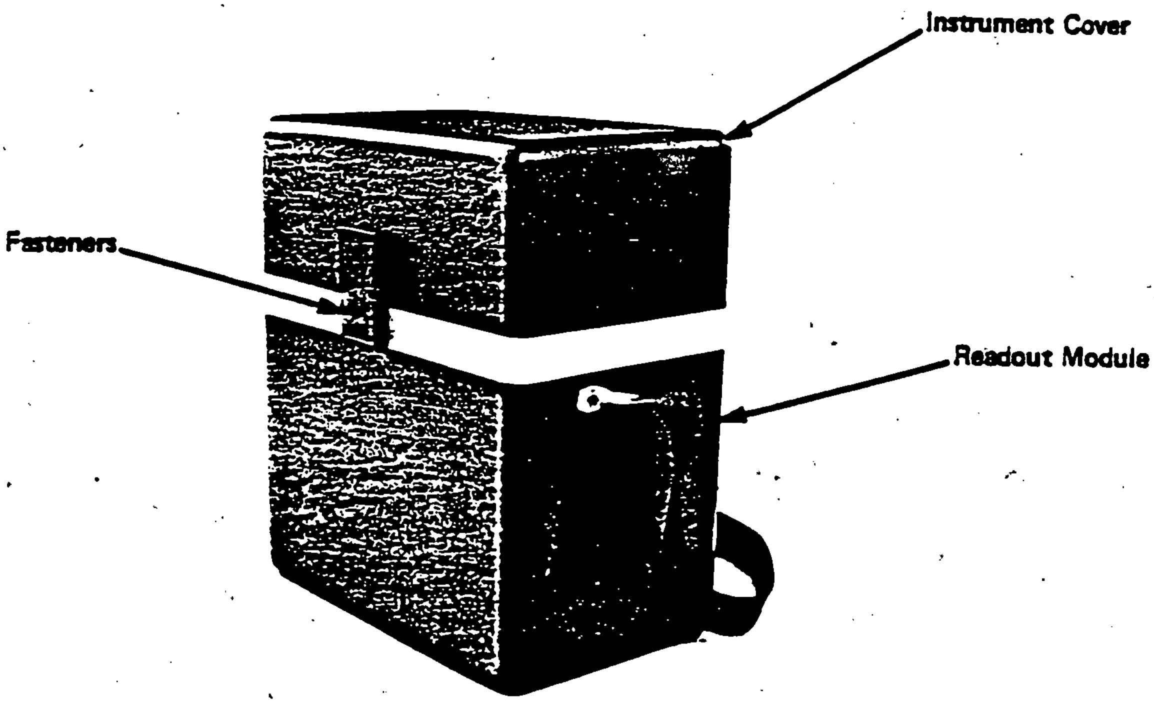


Figure 1. Unpacking the Photoionizer.

TABLE II

BRIEF DESCRIPTION OF INSTRUMENT CONTROLS AND FUNCTIONS*

Control	Function
Six Position Switch	OFF - Shuts off all power and removes DC voltages.
	ON - In any other function position or measuring mode, the electronics are on.
	BATTERY CHECK - Indicates the condition of the battery. If needle position is in lower portion of green battery arc, the instrument should be recharged.
	STANDBY - UV lamp is off but electronics are on. This position will conserve power and extend the useful operating time between recharges of the battery. This position is also utilized to adjust the electronic zero.
	RANGES - 0-20, 0-200, 0-2000 direct reading ranges available at minimum gain for benzene. More sensitivity is available by adjusting the span potentiometer.
Zero Potentiometer	A ten turn potentiometer is employed to adjust the zero electronically when the instrument is placed in the standby position with the probe attached. This eliminates the need for a hydrocarbon free gas.
Span Potentiometer	A ten turn counting potentiometer is utilized for upscale setting of the meter on calibration gas. Counter-clockwise rotation increases the sensitivity ($\sim$10 times). This pot can increase the sensitivity to make the instrument direct reading for nearly any gas which the instrument responds to.

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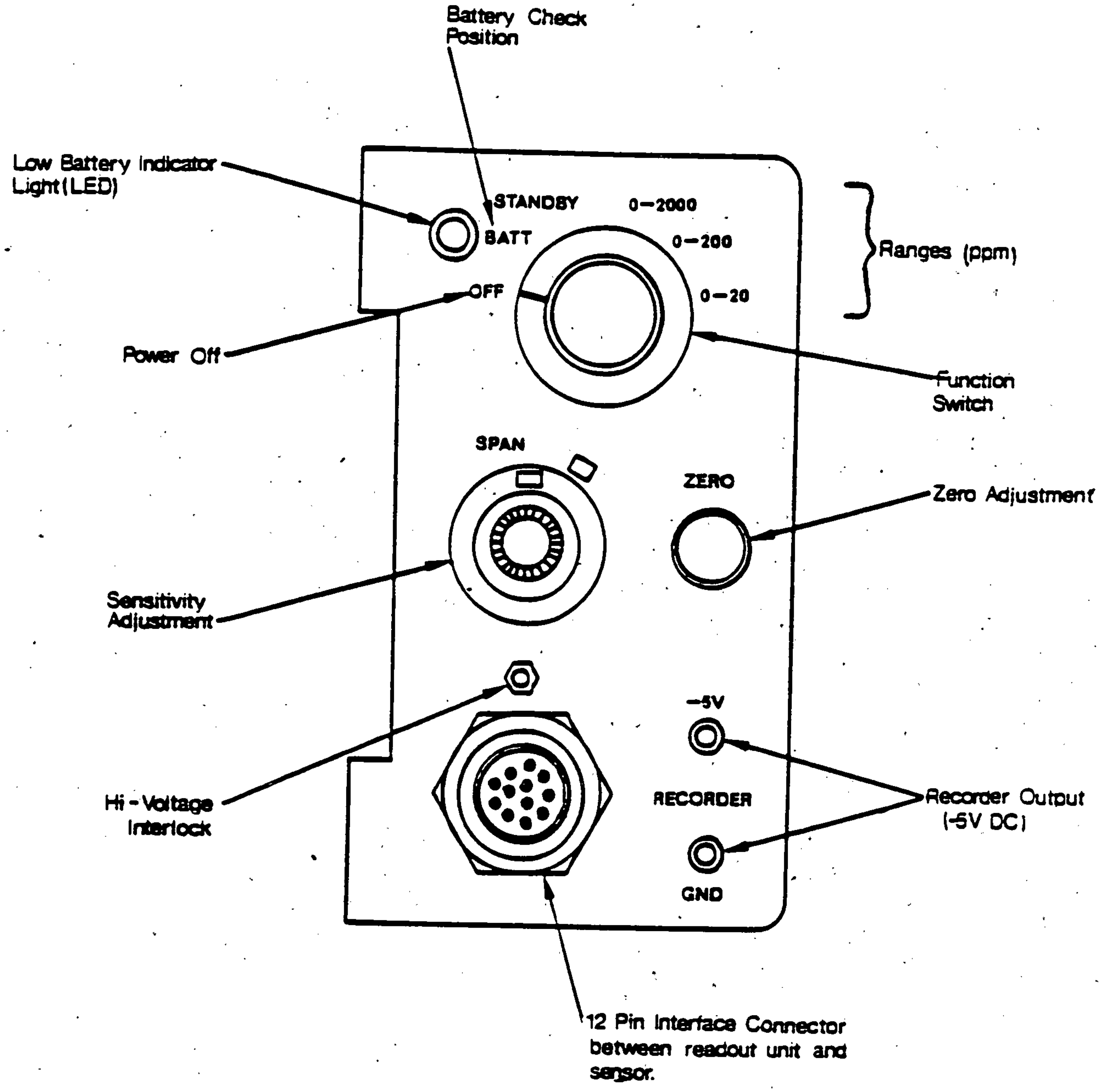
*For position of layout controls see Figure 2.

Figure 2 Control Panel Functions



To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counterclockwise rotation yields a downscale deflection. Note: no zero gas is needed, since this is an electronic zero adjustment (see below). If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 or 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero.

The instrument is now ready for calibration or measurement by switching the function switch to the proper measurement range. The instrument is supplied calibrated to read directly in ppm (v/v) 0-20, 0-200, 0-2000 of benzene with the span position set at 9.8. For additional sensitivity, the span potentiometer is turned counterclockwise (smaller numbers) to increase the gain. By changing the span setting from 10.0 to 1.0 the sensitivity is increased approximately ten fold. Then, the 0-20, 0-200, and 0-2000 ppm scales become 0-2, 0-20, and 0-200 ppm full scale, respectively. This span control is also utilized to make the instrument scale read directly in ppm of the compound being measured. E.g., it is adjusted to match the value of a calibration gas to that same reading on the instrument scale. The span control can be utilized to calibrate nearly any compound, measured by photoionization, to be direct reading on the 0-20 ppm range. For example, gain settings of 4.5 or 8.9, respectively, will provide direct reading capability (0-20, 0-200 ppm) for vinyl chloride and trichloroethylene, respectively. For a listing of approximate gain setting values see Table IV.

A small DC operated fan is used to pull air through the photoionization sensor at a flow rate of three to seven hundred centimeters per minute (ca. 0.5 lpm).. The fan provides nearly instantaneous response times (Figure 3) while consuming little power. The characteristics of a fan are such that it cannot tolerate a significant pressure drop without affecting the flow rate and therefore either the instrument reading or response time. Since photoionization is essentially a nondestructive technique, changes in flow rate do not affect the signal but if a large pressure drop is imposed at the inlet of the probe, the sample may not reach the sensor.

TABLE III

VERIFICATION OF ELECTRONIC ZERO FOR PHOTOIONIZATION ANALYZER*

Sample	Instrument Reading (ppm)	% of F.S.
Room Air	0.7	35
Room Air Passed Through 6" x 3/4" OD Charcoal Scrubber	0.1	5
Zero Air	0.25	12.5
Zero Air Passed Through 6" x 3/4" OD Charcoal Scrubber	0.04	2

---

*Maximum Gain = 2 ppm full scale.

TABLE IV

RELATIVE PHOTOIONIZATION SENSITIVITIES* FOR VARIOUS GASES

Chemical Grouping	Relative Sensitivity	Examples
Aromatic	10.0	Benzene, Toluene, Styrene
Aliphatic Amine	10.0	Diethylamine
Chlorinated Unsaturated	5-9	Vinyl Chloride, Vinylidene Chloride, Trichloroethylene
Carbonyl	5-7	MEK, MIBK, Acetone, Cyclohexene
Unsaturated	3-5	Acrolein, Propylene, Cyclohexene, Allyl Alcohol
Sulfide	3-5	Hydrogen Sulfide, Methyl Mercaptan
Paraffin (C_5-C_7)	1-3	Pentane, Hexane, Heptane
Ammonia	0.3	—
Paraffin (C_1-C_4)	0	Methane, Ethane . . .

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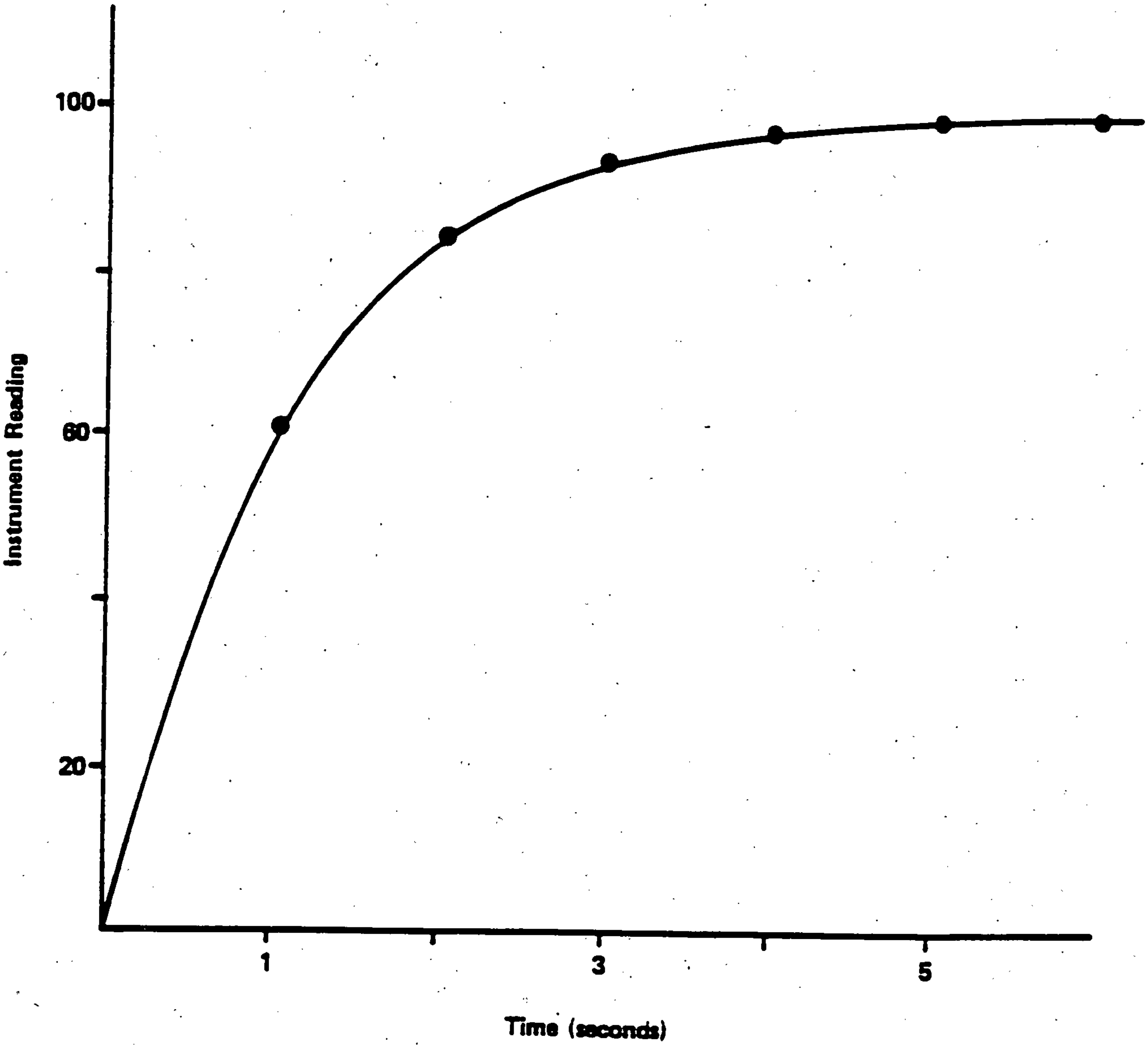
*Sensitivities in ppm (v/v).

Figure 3. Time Response for the Photoionization Analyzer.



The instrument was designed to measure trace gases over a concentration range from less than 1 ppm to 2000 ppm. Higher levels of various gases (to percentage range) can be measured but the recommended procedure is to dilute the sample with clean air to a concentration of less than 500 ppm. This is generally within the linear range of the instrument and if the measured concentration is multiplied by the dilution ratio the correct concentration in the stream can be determined. A typical calibration curve is shown in Figure 4. Note that the calibration curve for benzene (the photoionization standard) is linear (over more than three decades) up to about 600 ppm (v/v).

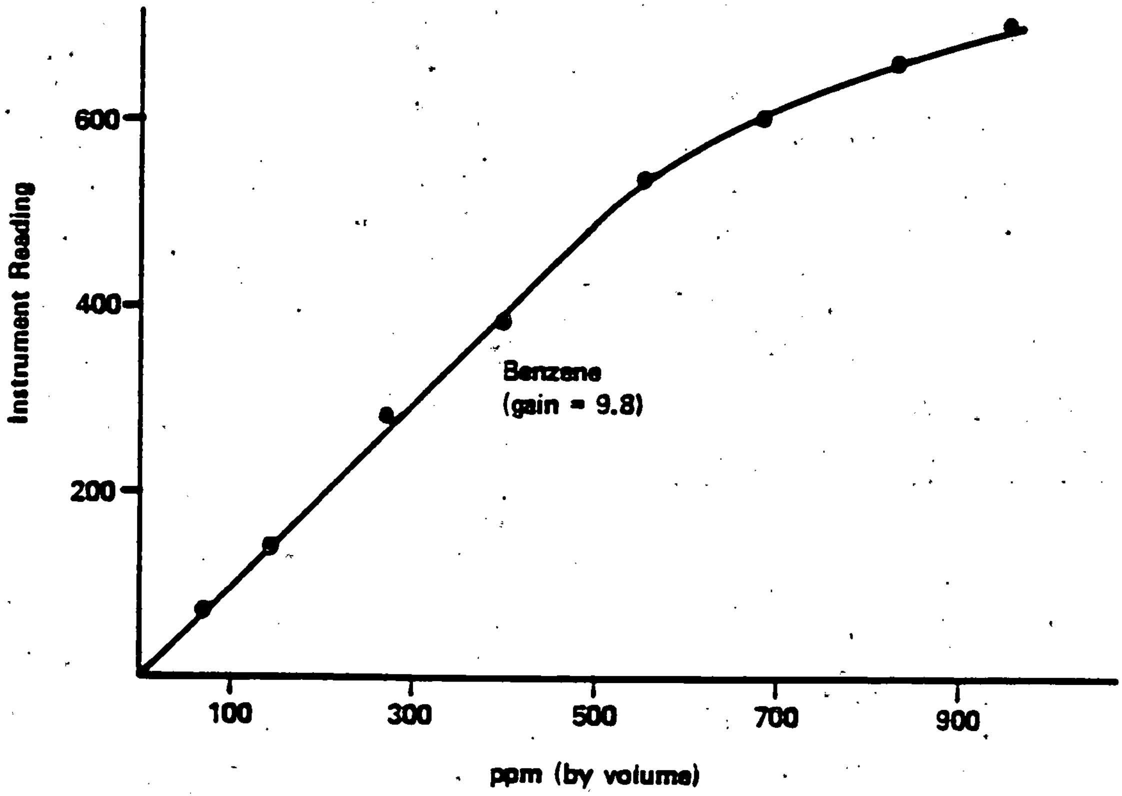
If the probe is held close to AC power lines or power transformers, an error may be observed. For measurements made in close proximity to such items, their effect on measurements can be determined by the following procedure. Zero the instrument in an electrically quiet area, in the standby position, then move the instrument to the questionable area involved. If AC pickup is going to be a problem, the meter (in the standby position) will indicate the magnitude of the error.

The instrument is equipped with an automatic solid state battery protection circuit. When the battery voltage drops below ∿ 11 volts, this circuit will automatically turn off the power to the instrument. This prevents deep discharging of the battery and considerably extends the battery life. If the instrument is unintentionally left on overnight, the battery will be unharmed because of the battery protection circuit. If the instrument battery check reads low and the lamp doesn't fire, plug the charger into the instrument. The power to the analyzer should then be returned.

To charge the battery, place the mini phone plug into the jack on left side of the bezel prior to plugging charger into 120 VAC. When disconnecting charger, remove from 120 VAC before removing mini phone plug. The battery is completely recharged overnight (ca. 14 hours). To ensure that the charger is functioning, turn the function switch to the battery check position, place phone plug into jack and plug charger into AC outlet. The meter should go upscale if charger is working and is correctly inserted into the jack.

The instrument can be operated during the recharge cycle. This will lengthen the time required to completely recharge the instrument battery.

Figure 4. Typical Calibration Curve for Photoionization Analyzer.



SECTION 3

CALIBRATION

Static or dynamic gas generation systems can be utilized for calibration of the instrument. A number of such systems for generating test atmospheres for various gases have been described by G. O. Nelson in "Controlled Test Atmospheres," Ann Arbor Science Publishers, Ann Arbor, Michigan (1971).

The most convenient packages for calibration are the non-toxic analyzed gas mixtures available from HNU Systems in pressurized containers (Catalogue #101-350).

A rapid procedure for calibration involves bringing the probe and readout in close proximity to the calibration gas, cracking the valve on the tank and checking the instrument reading. This provides a useful spot check for the instrument.

The recommended and most accurate procedure for calibration of the instrument from a pressurized container is to connect one side of a 'T' to the pressurized container of calibration gas, another side of the 'T' to a rotameter and the third side of the 'T' directly to the 8" extension to the photoionization probe (see Figure 5). Crack the valve of the pressurized container until a slight flow is indicated on the rotameter. The instrument draws in the volume of sample required for detection, and the flow in the rotameter indicates an excess of sample. Now adjust the span pot so that the instrument is reading the exact value of the calibration gas. (If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted, if necessary.)

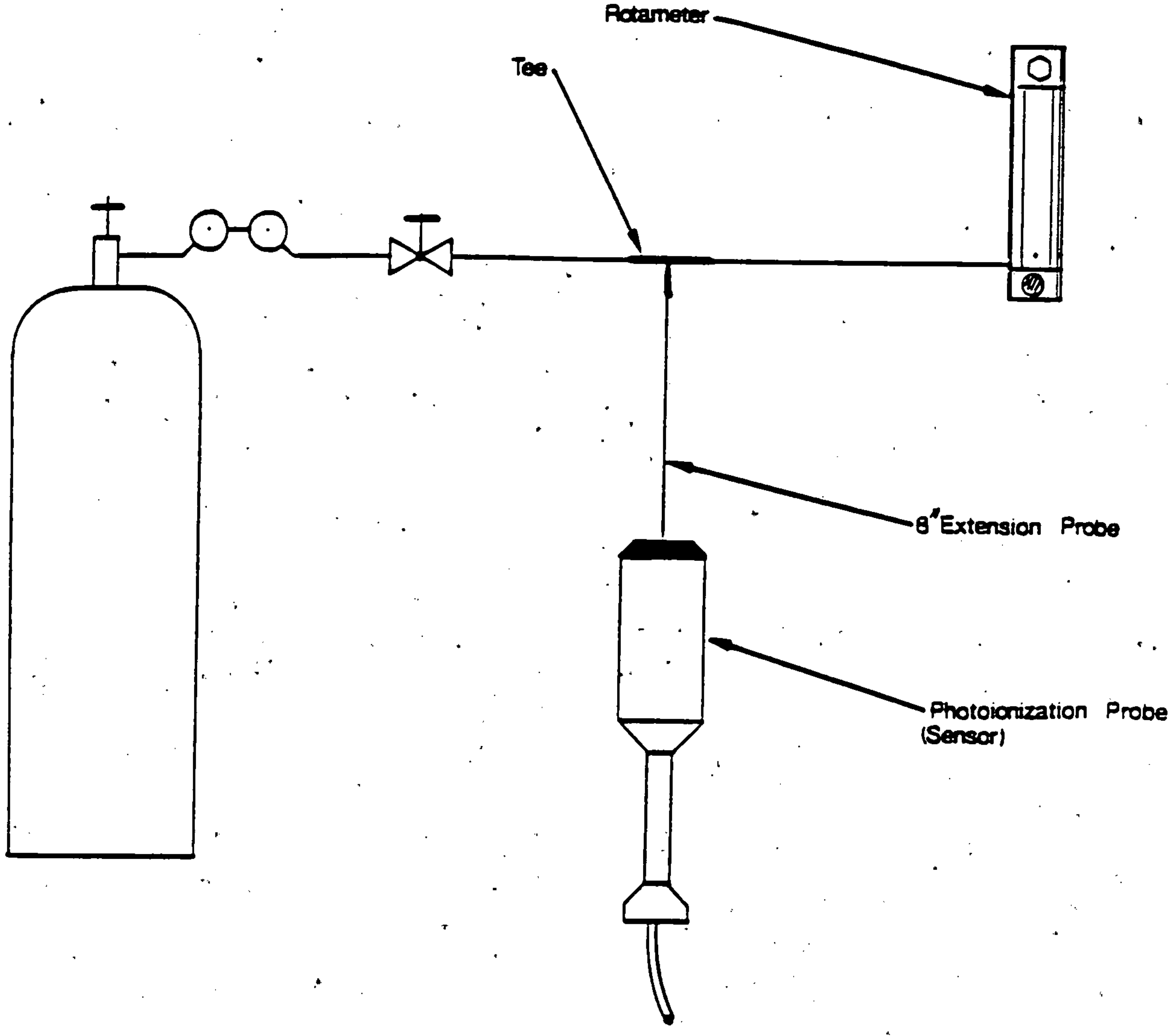


Figure 5. Recommended Calibration Procedure for Photoionization Analyzer

The calibration gas* should be prepared in the same matrix (air, nitrogen, hydrogen, etc.) in which it is to be measured, otherwise an inaccurate reading may be obtained. The increased response which is seen in oxygen free gases can be attributed to a reduction in the quenching of ions by oxygen (actually 0_2^-) and is typical of any ionization detector. The quenching effect of oxygen is constant from about ten percent 0_2 to very high levels.

If a gas standard prepared in nitrogen is to be used for measurements in air, fill a 0.5 or 1 liter bag with the standard then add 50 or 100 cc of pure oxygen to bring the level to 10-12%.

Any error between this value and 20% oxygen is quite small.

If the sample to be measured is in nitrogen, standards should be prepared in nitrogen. This will result in an increase in sensitivity of approximately 4.

---

* Calibration with toxic gases should be performed in a hood since the 101 is a non-destructive analyzer.

SECTION 4

DETECTION PRINCIPLE AND THEORY

The detection principle of this portable instrument is photoionization. A wide variety of organic compounds and some inorganic compounds can be measured with this technique. Photoionization (with ∿ 10 eV photons) applied to the analysis of trace gases in air can eliminate fragment ion formation (signals) from the major components of air yet still allow the ionization of many impurities of interest in industrial atmospheres. This is demonstrated by the listing of ionization potentials* in Tables V-XVII. Note the high (12 eV) ionization potentials for the major components of air. In addition, the choice of a sufficiently low ionization energy often permits the selective ionization of one or two components in a complex gas mixture.

While the ionization potential serves as a rough guide to whether or not a response is obtained, it does not predict what the quantitive response actually is. In some cases, a species with an ionization potential 10.3 or 10.4 eV will give a response. In these cases, however, the response is usually low because of its low ionization efficiency at 10 eV. A partial list of actual relative sensitivities obtained with a photoionization analyzer is given in Table XVIII. The use of the tables should allow a determination of the specificity of the instrument in a given application on many industrial processes; this instrument may not respond to the starting materials or by-products but will respond to a product. An example of this is seen in the vinyl chloride monomer plants where neither ethylene or dichloroethane is detected but vinyl chloride is detected.

---

* Ionization potential is defined as the energy required to move an electron an infinite distance from the nucleus or more simply, the energy required to produce a positive ion and an electron.

SECTION 5

TROUBLESHOOTING

If problems occur while using the photoionization analyzer, it is recommended that the following troubleshooting guide be followed before consulting the factory.

5.1 General Aid to Fault Determination

Check battery condition. Recharge if necessary (Section 2). Turn the instrument on. Look into the Sample Inlet of the probe unit. A violet colored glow from the UV light source should be observed in all positions of the mode switch except the standby position. If unstable readings are obtained a faulty probe cable or electrical connection could be the problem. To check, hold the probe normally and flex the cable firmly. Watch the meter for fluctuations as the cable is stressed. Individual wires in the readout can be checked in a similar way. Check the coaxial connector on the amplifier board in the probe.

In the more sensitive ranges, a fluctuation in the reading may be noted if a hand or other large object is placed in very close proximity to the probe. This is normal for the instrument and will not result in an error in the measurement as long as the probe is held stationary while the measurement is being taken.

If the probe is held close to AC power lines or power transformers an error may be observed. If measurements are to be made in close proximity to such items, their effect on measurements can be determined by the following procedure. Zero the instrument in an electrically quiet area in the standby position, then move the instrument to the questionable area involved. If AC pickup is going to be a problem, the meter (in the standby position) will indicate the magnitude of the error.

5.2 Disassembly of Instrument

PROBE - Turn the function switch to the OFF position and disconnect the probe connector from the readout unit. Remove the exhaust screw found near the base of the probe (see Figure 8.) Grasp the end cap in one hand and the probe shell in the other, and gently pull to separate the end cap and lamp housing from the shell. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing. Care must be taken so that the ion chamber doesn't fall out of the end cap and the lamp doesn't slide out of the lamp housing. Turn the end cap over in your hand and tap on the top of it; the ion chamber should fall out in your hand. Place one hand over the top of the lamp housing and tilt slightly; the light source will slide out of the housing. The amplifier board can be removed from the lamp housing assembly by unsnapping the coaxial connection and then removing the retaining screw.

To reassemble this unit, first slide the lamp back into the lamp housing. Place the ion chamber on top of the lamp housing, checking to make sure that the contacts are properly aligned. Place the end cap on top of the ion chamber and replace the two screws. The screws should be tightened only enough to seal the "O" ring. DO NOT OVERTIGHTEN. Line up the pins on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell. DO NOT FORCE the assembly into the shell as it only fits one way.

READOUT UNIT - Turn the function switch to the OFF position and disconnect the probe from the readout unit before disassembly is conducted (see Figure 10). Remove the accessory power jack plug. Loosen the screw on the bottom of the case and, holding the instrument by the bezel, remove the case. The power supply board and control panel can be removed by unscrewing two screws and two nuts. The entire panel, including the function switch, zero and span pots is removed in this operation. Electrically disconnecting this module is simple, since all connections are made with Molex connectors.

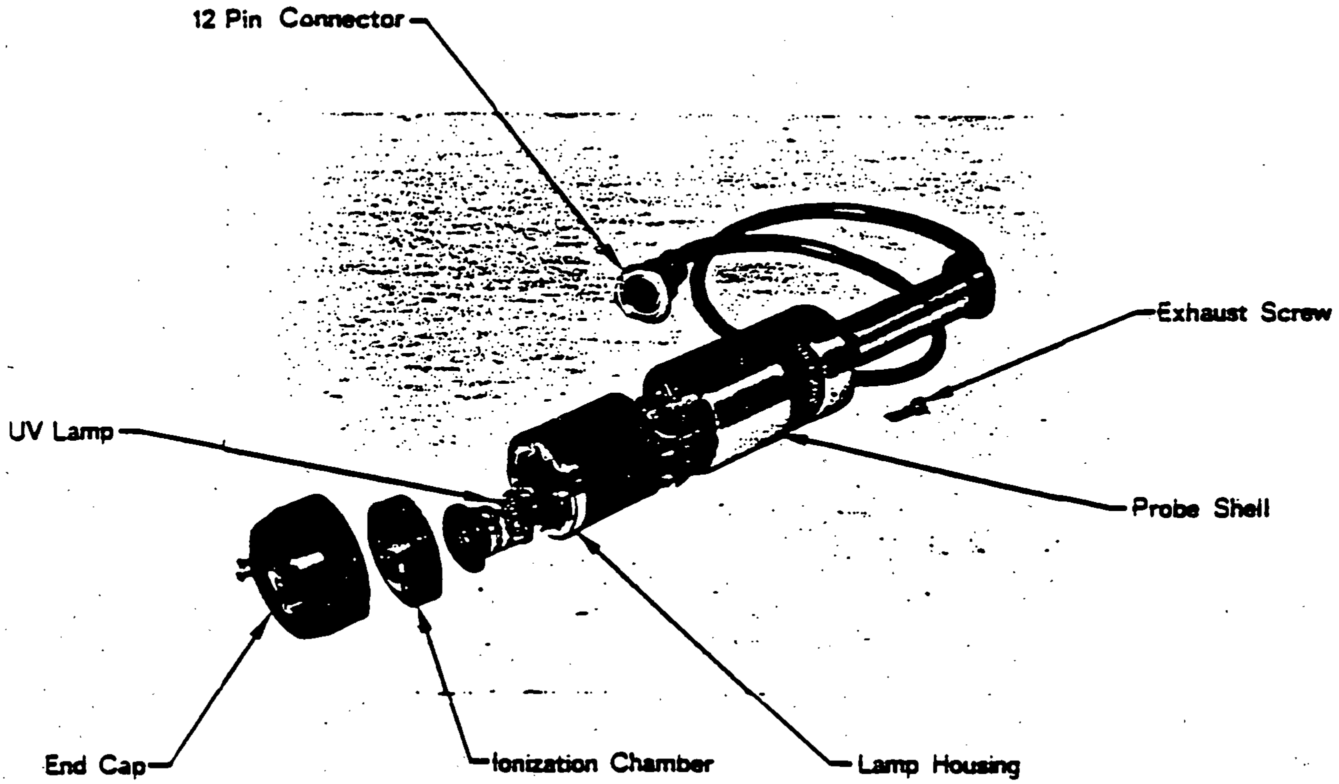


Figure 8. Component Parts of Probe

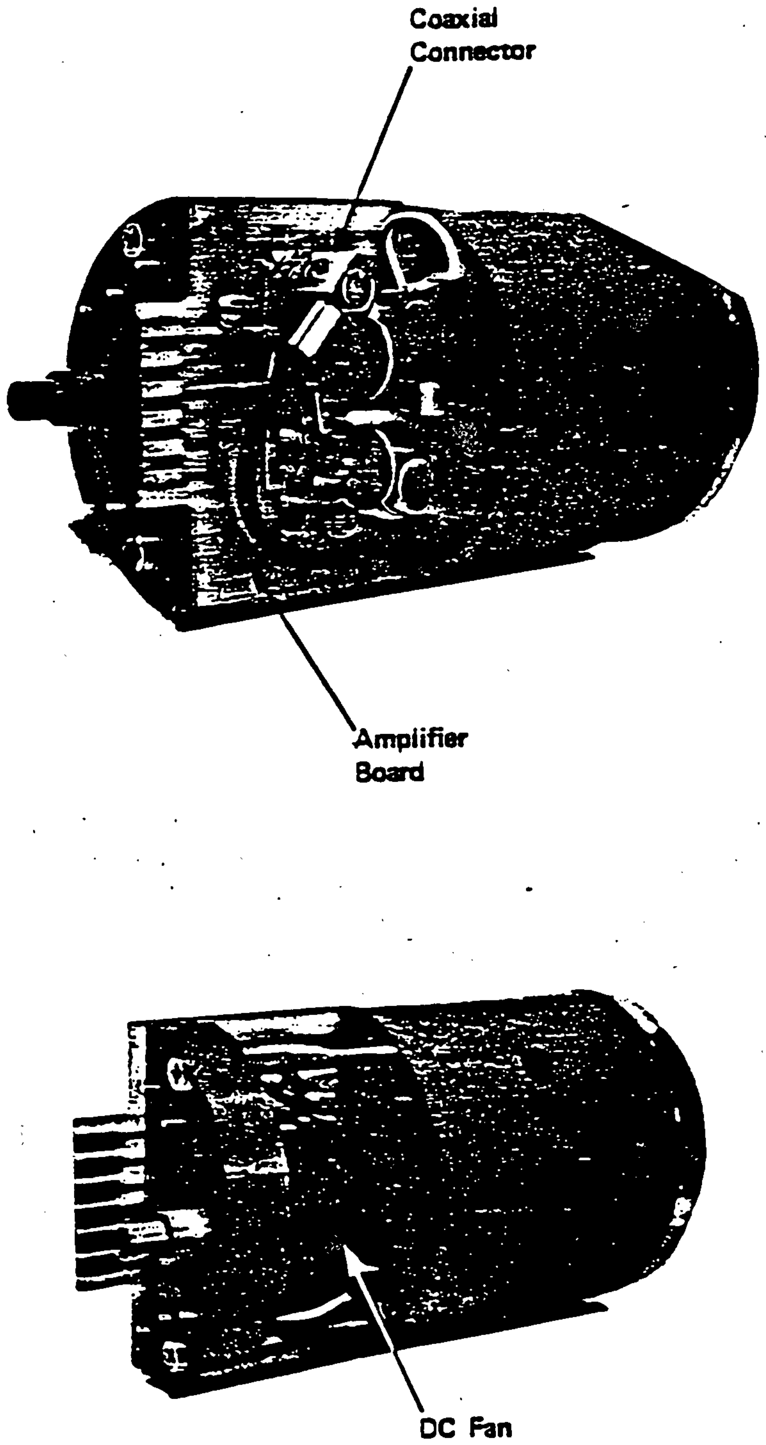


Figure 9. Component Parts of Lamp Housing.

5.3 Specific Faults

1. No meter response in any switch position (including BATT CHK)

   A. Broken meter movement

      (1) Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero.

   B. Electrical connection to meter is broken

      (1) Check all wires leading to meter and clean the contacts of quick-disconnects.

   C. Battery is completely dead

      (1) Disconnect battery and check voltage with a volt-ohm meter.

   D. Check 2 amp fuse

   E. If none of the above solves the problem, consult the factory.

2. Meter responds in BATT CHK position, but reads zero or near zero for all others

   A. Power supply defective

      (1) Check power supply voltages per Figure 11. If any voltage is out of specification, consult the factory.

   B. Input transistor or amplifier has failed

      (1) Rotate zero control; meter should deflect up/down as control is turned.

      (2) Open probe. Both transistors should be fully seated in sockets

   C. Input signal connection broken in probe or readout

      (1) Check input connector on printed circuit board. Should be firmly pressed down.

      (2) Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object.

      (3) Check all wires in readout for solid connections.

3. Instrument responds correctly in BATT CHK, AND STBY, but not in measuring mode.

   A. Check to see that light source is on (See General Faults section.)

      (1) Check high voltage power supply (see Figure 11).

      (2) Open end of probe, remove lamp and check high voltage on lamp contact ring.

      (3) If high voltage is present at all above points, light source has most likely failed. Consult the factory.

4. Instrument responds correctly in all positions, but signal is lower than expected.
    - A. Check span setting for correct value.
    - B. Clean window of light source
    - C. Double check preparation of standards. See Section 3.
    - D. Check power supply 180 V output. See Figure 11.
    - E. Check for proper fan operation. Check fan voltage. See Figure 11.
    - F. Rotate span setting. Response should change if span pot is working properly.
5. Instrument responds in all switch positions, but is noisy (erratic meter movement).
    - A. Open circuit in feedback circuit. Consult the factory.
    - B. Open circuit in cable shield or probe shield. Consult the factory.
6. Instrument response is slow and/or irreproducible.
    - A. Fan operating improperly. Check fan voltage. See Figure 11.
    - B. Check calibration and operation. See Sections 2 and 3.
7. Low battery indicator.
    - A. Indicator comes on if battery charge is low.
    - B. Indicator also comes on if ionization voltage is too high.

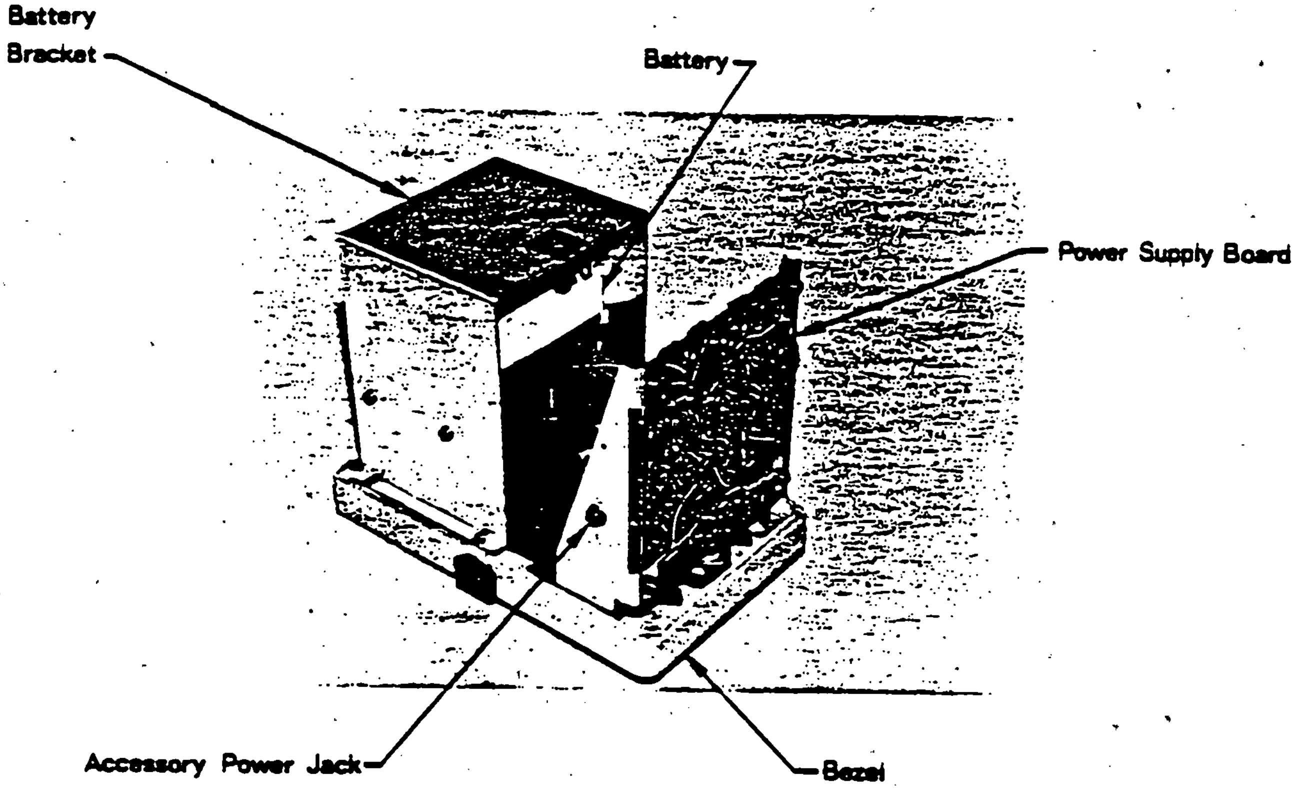
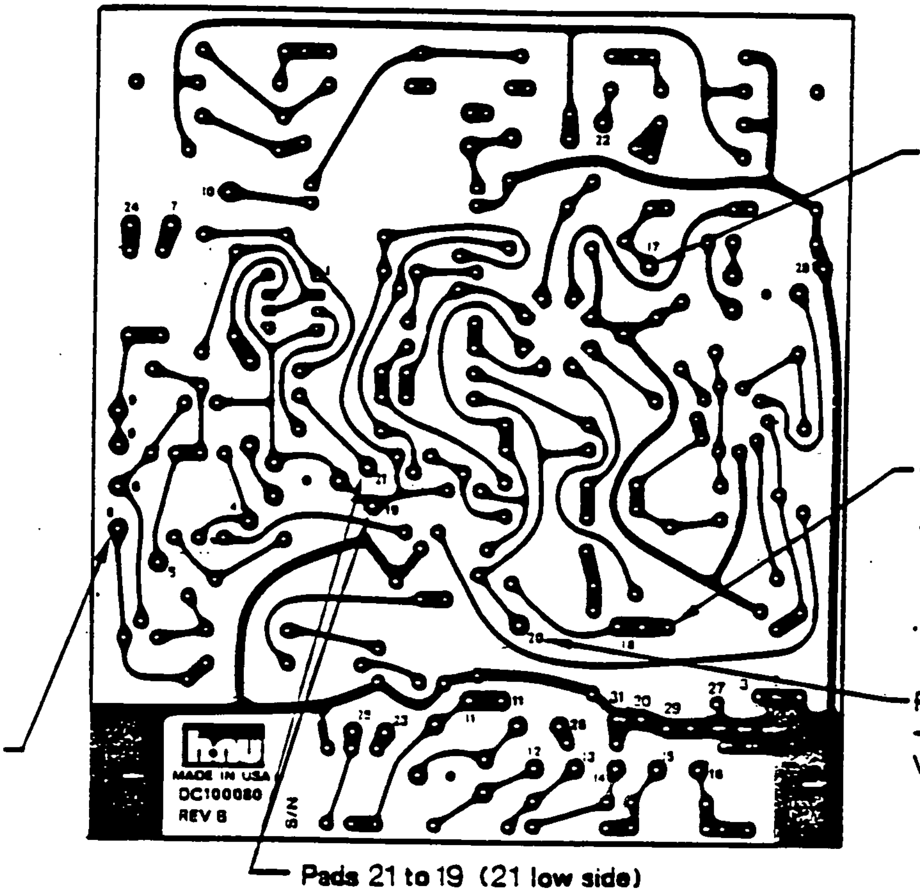


Figure 10. Component Parts Of Readout Unit.

1. All voltages measured with probe connected and instrument mode switch in BATT CHK position.
2. All measurements referred to ground (pads 2,3 and 27) except pad 21 measured to pad 19 and pad 8 to pad 11.



Pad 17
+180 to +181
Volts

Pad 18
+18 to +21
Volts

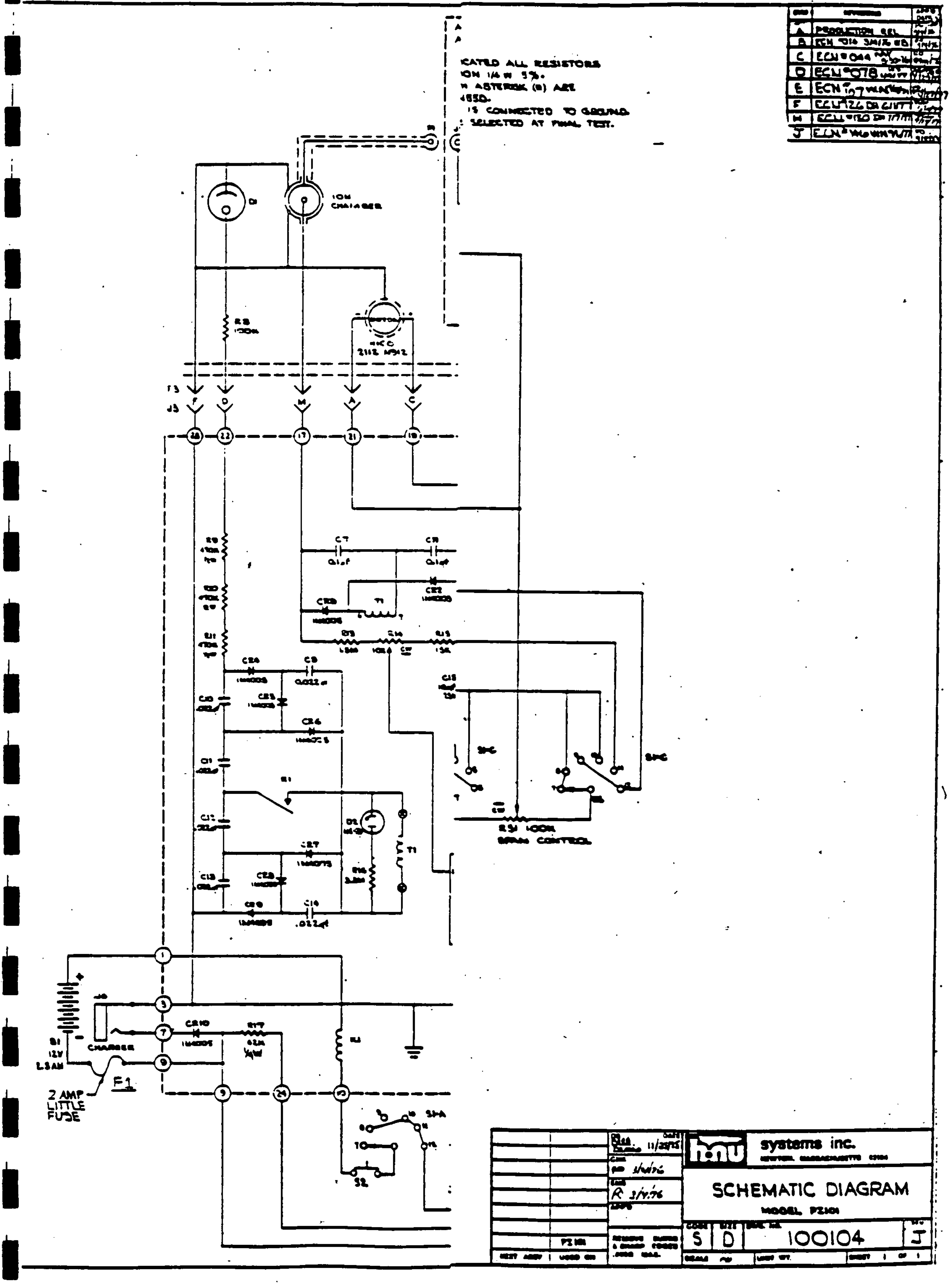
Pad 20
-9.5 to -10.5
Volts

Pad 8 -11 to
-14 Volts
Battery Voltage

Pads 21 to 19 (21 low side)
(4.5 to 5.5 Volts)

All Voltages Respect to Ground							
pads	voltage	pads	voltage	pads	voltage	pads	voltage
1	− 5.7V	9	− 12.2V	17	180V	25	0
2	GRD	10	− 12.1V	18	− 19.4V	26	0
3	GRD	11	0	19	− 10.6V	27	GRD
4	−10 7V	12	0	20	− 9.7V	28	0
5	− 11.3V	13	0	21	−14.5V	29	GRD
6	− 12.1V	14	0	22	−400V	30	GRD
7	0	15	0	23	0	31	GRD
8	− 12.2V	16	0	24	0		

Figure 11 Power Supply PC Board



...CATED ALL RESISTORS
...ION 1/4 W 5%.
...H ASTERISK (*) ARE
...ISSD.
...IS CONNECTED TO GROUND.
...SELECTED AT FINAL TEST.

[illegible]	[illegible]	[illegible]
A	PRODUCTION REL	[illegible]
B	ECN 014 3/1/76 [illegible]	[illegible]
C	ECN #044 [illegible]	[illegible]
D	ECN #078 [illegible]	[illegible]
E	ECN #127 [illegible]	[illegible]
F	ECN #126 [illegible]	[illegible]
H	ECN #150 [illegible]	[illegible]
J	ECN #160 [illegible]	[illegible]

HNU systems inc.
NEWTON, MASSACHUSETTS [illegible]

SCHEMATIC DIAGRAM

MODEL PI101

DR [illegible] 11/25/75
CHK [illegible] 3/4/76
[illegible] R 3/4/76

CODE S | SIZE D | DWG. NO. 100104 | REV J
SCALE [illegible] | UNIT WT. | SHEET 1 OF 1
PI101
NEXT ASSY | USED ON

MSA

Oxygen Indicator

part no.
468838

permissible type

model 245

instructions

MSHA approval [illegible]

[illegible]

[illegible]

PERMISSIBLE OXYGEN INDICATOR

Part No. 468838, Model 245

WARNING: IF A GAS-TIGHT SEAL OF ANY TYPE IS USED TO PROTECT THE SENSOR FACE DURING STORAGE, IT MUST BE REMOVED BEFORE CALIBRATION OR USE OF THE OXYGEN INDICATOR.

CAUTION: The Oxygen Indicator and its accessory parts must be operated only by experienced technicians who have read this instruction booklet carefully, and are specifically trained in oxygen detection techniques and safety procedures.

The oxygen indicator is easily portable and simple to operate. The unit provides a direct reading of the percentage of oxygen concentration. The sensor is temperature compensated over its normal operating range of 32°F to 104°F and is unaffected by 10% to 90% relative humidity.

Placing in Operation

The oxygen indicator is sealed in a nitrogen-purged bag to prolong sensor shelf life and should not be opened until ready to place indicator in service.

When ready to place indicator in service, open sealed bag. After removing indicator from nitrogen-purged bag, allow indicator to reach a stable indication on the meter with sensor exposed to fresh air (approximately 15 minutes) before adjusting the calibration screw to get 20.8 percent on the meter (see Calibration).

Calibration—

The sensor is temperature compensated from 32°F to 104°F and need not be calibrated at the temperature of use in this range. For general use, it is recommended that the indicator be calibrated when it is at a temperature near the middle of this range (approx. 70°F). For the highest degree of accuracy in ambient temperatures near the extremes of this range or operation in ambients beyond the compensated range, the indicator should be calibrated at the temperature of use. The minimum and maximum calibrating and operating temperatures are 0°F and 125°F. The indicator response time is increased in temperatures beyond the compensated range, particularly below 32°F, therefore extra time must be allowed to obtain accurate calibrations and measurements.

To calibrate the indicator, press button on right side of case and expose the sensor to fresh air, allow the sensor to be exposed to fresh air until the meter reading stabilizes, then set meter at the 20.8%* mark by rotating calibration screw (at top of indicator case). Note, if the calibration is done at temperatures outside of the 32°F to 104°F range, it will be necessary to store the oxygen indicator at that temperature for approximately one hour before calibrating.

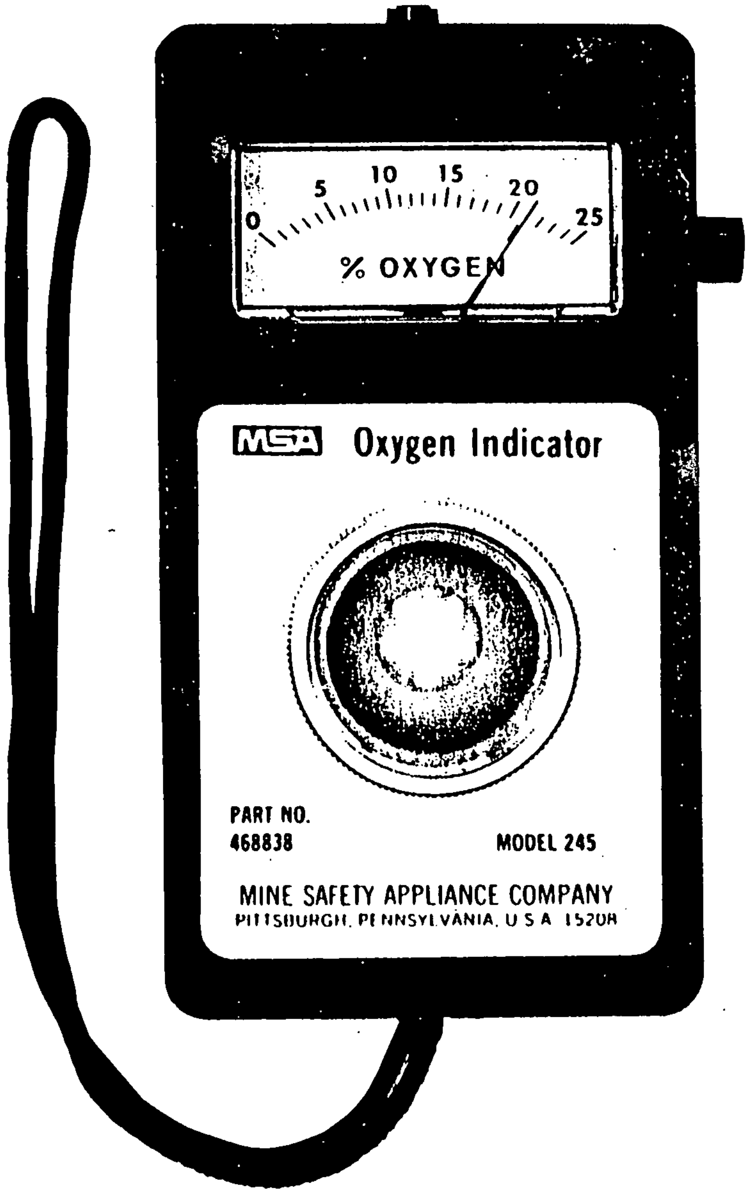


Figure 1. Oxygen Indicator, Model 245

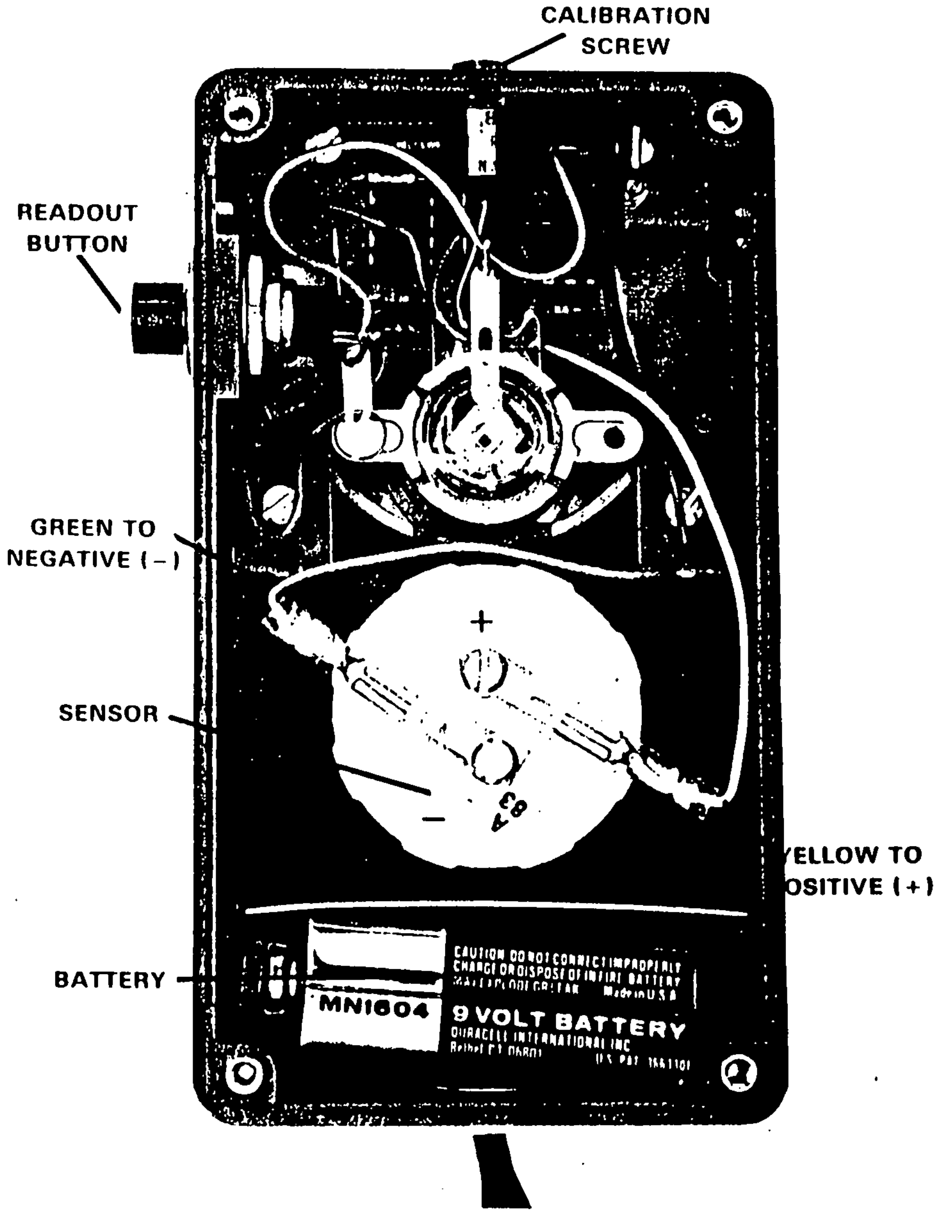


Figure 2. Oxygen Indicator, Rear Interior View

If it is desired to check zero for the indicator, disconnect the wires from the cell and connect them together, press button on right side of case. The meter should read zero. If other than a zero reading is obtained, the indicator should be returned for service. The internal potentiometer on the PC board is factory set, and should not be changed.

The sensor zero may be checked by blanketing it with nitrogen using Remote Sampling Adaptor, PN458144. Remove the aspirator bulb, insert the remote sampling adaptor in the face of the sensor, as shown, and supply 300 cc/min of oxygen-free nitrogen through a supply line. If other than a zero reading is obtained on the meter, the sensor should be replaced.

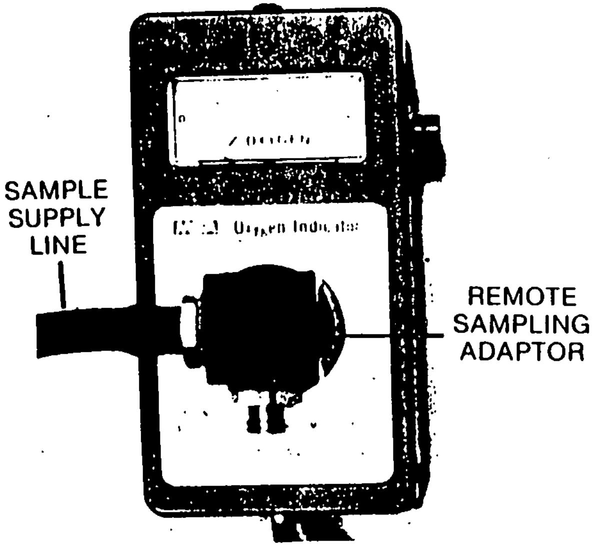


Figure 3. Blanketing Sensor

If other than ambient conditions are of interest, a two-point calibration check is recommended to verify linearity:

1. Calibrate the indicator in fresh air as previously described.
2. Expose the sensor to calibration gas with a concentration near the intended operating range using a Remote Sampling Adaptor, PN458144 to blanket the sensor.

If the reading is more than 2% off, the sensor should be replaced or the indicator should be returned for service.

The Oxygen Indicator calibration is quite stable over long periods of time and will not require large corrections of the calibration control during the life of the sensor. Near the end of the useful life of the sensor (approx. one year), the calibration control will require more frequent and larger corrections to obtain the 20.8% fresh air reading. If the Indicator cannot be adjusted to 20.8% in fresh air, the sensor will probably need replacement (see Maintenance).

Operation—

After calibrating or checking the reading of the Indicator with fresh air, move the Indicator to the atmosphere to be tested, press button on right hand side of case and meter will show the percent oxygen concentration.*

In sample areas where the temperature is not constant (changes by more than 30°F), or in sampling atmospheres that differ in temperature from that of the calibration air (by more than 30°F), the fresh air reading should be rechecked approximately every hour to obtain the greatest accuracy capable of the Indicator.

Sampling conditions that lead to condensation of moisture on the sensor face will cause erroneously low oxygen readings. These conditions, such as taking a cool sensor into a warm, moist atmosphere, produce a film of water on the sensor face which reduces the transport of oxygen from the atmosphere to the inside of the sensor. To prevent this difficulty, the sensor should be kept as warm or warmer than the sample area before and in the intervals between sampling.

---

*The Model 245 indicates the partial pressure of oxygen in the atmosphere or calibration gas tested. Therefore, if the instrument is calibrated at one barometric pressure and subsequently used to test atmospheres at another, for example at a different altitude, the change in oxygen partial pressure will be indicated as an equivalent change in volume per cent. Adequate oxygen to sustain life is dependent upon the partial pressure rather than the per cent of oxygen by volume. To use the Model 245 for oxygen deficiency measurements, it should therefore be calibrated to read 20.8% O_2 when sampling fresh air at approximately sea level barometric pressure. The equivalent oxygen volume percents are shown in the following chart:

ALTITUDE	OXYGEN INDICATION	ALTITUDE	OXYGEN INDICATION
– 1000 (Feet)	21.6 (%)	5500 (Feet)	17.0 (%)
– 500	21.2	6000	16.7
sea level	20.8	6500	16.4
500	20.4	7000	16.1
1000	20.1	7500	15.7
1500	19.7	8000	15.4
2000	19.3	8500	15.2
2500	19.0	9000	14.9
3000	18.6	9500	14.6
3500	18.3	10000	14.3
4000	18.0		
4500	17.6		
5000	17.3		

NOTE: Pressure changes of greater than ± 1/3 atmosphere may result in sensor damage.

For remote sampling, insert the Remote Sampling Adaptor, PN458144, in the face of the sensor as shown in Figure 4. Attach the appropriate sampling line. (See list of Replacement and Accessory Parts.) Locate other end of sampling line in area of interest. Use the following table to determine the required number of aspirations in accordance with sample line length.

SAMPLE LINE LENGTH (IN FEET)	ASPIRATIONS REQUIRED
5	2
10	3
15	3
25	4
35	5
50	7

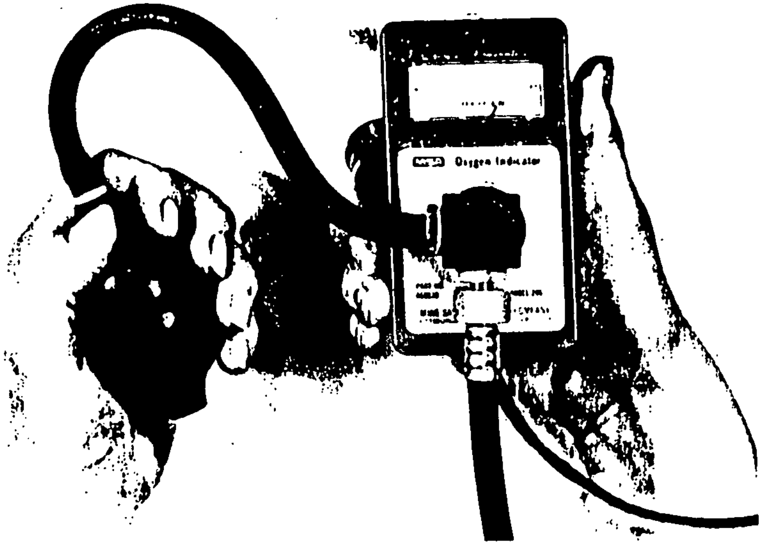


Figure 4. Remote Sampling

The sensor is free from interference from other chemical substances when these are present in less than TLV concentrations. Strong oxidants such as fluorine, chlorine and ozone will lead to erroneously high oxygen readings when these are present in concentrations exceeding 5,000 ppm or 0.5%. The predicated life is reduced to approximately 6 months by operation in 10% CO_2 and 3 months by operation in 20% CO_2. As the sensor approaches the end of operating life, it will require frequent recalibration. Shortly thereafter, sensor output will decline rapidly to zero output. Normally sensor output remains fairly stable over most of its useful life and should require little recalibration.

Maintenance—

The oxygen sensing portion of the sensor is covered with a very thin film of Teflon which is easily damaged if touched with hard or sharp objects. If the sensor face requires cleaning, rinse with water and blot dry with tissue paper or cotton.

When reading can no longer be correctly adjusted during calibration, it can be assumed that the functional life of either the sensor or the battery has terminated. The 9 volt alkaline battery is expected to last for the life of the sensor. It is suggested that the battery be replaced as a first step and the calibration adjustment again tried. With a new battery, if the instrument can still not be correctly calibrated, the sensor must be replaced. Always replace the battery when replacing the sensor.

To replace the battery, remove the back cover plate of the Indicator which is held by four screws. Lift the battery out of its recess and replace it.

To replace the sensor, remove the four screws on the back cover plate of the Indicator and unscrew the face ring of sensor at front of instrument. The sensor can then be removed by detaching the two sensor wires. Attach new sensor wires, yellow to positive (+), green to negative (–), tighten the face ring and replace the back plate. After calibration, the unit is ready to operate.

WARNING: Use genuine MSA replacement parts when performing any maintenance procedures provided in this manual. Repair or alteration of the Model 245 Oxygen Indicator beyond the scope of these maintenance instructions by anyone other than a certified MSA serviceman, may void all warranties and approvals.

Replacement and Accessory Parts

457621 Oxygen Sensor
628817 Battery (9V alkaline,
NEMA Type 1604)
458144 Adapter for Remote Sampling
011354 Sampling Line, 5 ft.
011955 Sampling Line, 10 ft.
011912 Sampling Line, 15 ft.
011913 Sampling Line, 25 ft.
011957 Sampling Line, 35 ft.
011958 Sampling Line, 50 ft.

If additional service is required send the complete instrument to:

Local MSA Repair Center
or
Mine Safety Appliances Company
3706 Crondall Lane
Owings Mills, Maryland 21117
(301) 356-2400

MFD. BY

MSA MINE SAFETY APPLIANCES COMPANY
PITTSBURGH, PENNSYLVANIA, U.S.A. 15208

L 775 (L) Rev. [illegible] MANUAL NO. [illegible]

Explosimeter®

part no.
89220

combustible gas indicator model 2A

instruction manual

IMPORTANT WARNING

Like any piece of complex equipment, the MSA Explosimeter will perform as designed only if it is used and serviced in accordance with the manufacturer's instructions. This manual must be carefully read by all individuals who have or will have responsibility for using or servicing the Explosimeter combustible gas indicator. The warranties made by Mine Safety Appliances Company with respect to this product are voided if the equipment is not used and serviced in accordance with the instructions in this manual. Please protect yourself by following them. We encourage our customers to write or call for a demonstration of this equipment prior to use or for any additional information relative to use or repairs.

MFD. BY

MSA MINE SAFETY APPLIANCES COMPANY
PITTSBURGH, PENNSYLVANIA, U.S.A. 15208

FACTORY MUTUAL
FM
APPROVED

Intrinsically Safe for use in Class I, Division 1, Group D and Non-Incendive for use in Class I, Division 2, Groups A, B, C and D hazardous locations, as defined by the National Electrical Code when used with Eveready #950 or Burgess #800 batteries.

INDEX

Explosimeter® model 2A combustible gas indicator
Instruction Manual

GENERAL DESCRIPTION

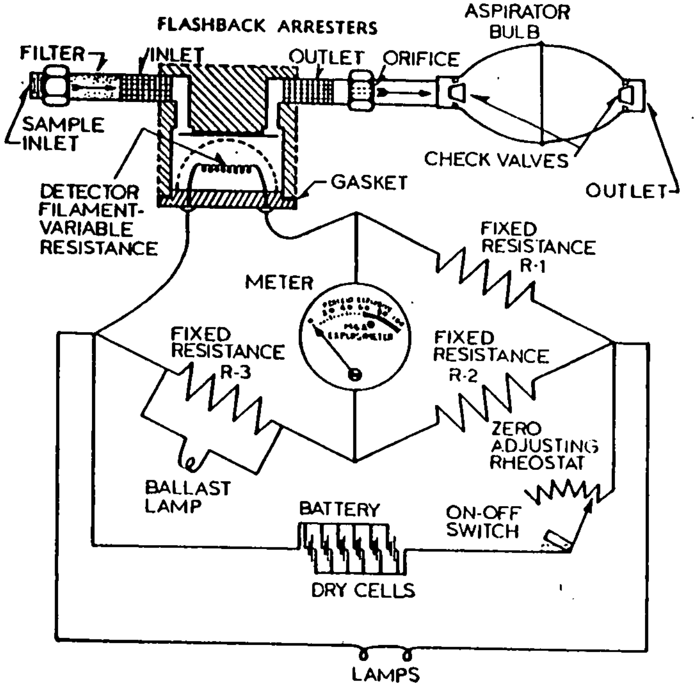


Figure 1—Schematic Flow System and Wiring Diagram.

The Model 2A explosimeter is an instrument by means of which an atmosphere may be quickly and conveniently tested for concentrations of flammable gases and vapors which it may contain. It depends for its operation upon the heat developed by the actual combustion of the flammable portion of the sampled atmosphere. Tests are made with the instrument by drawing a sample of the atmosphere to be tested over a heated catalytic filament which forms part of a balanced electrical circuit. The current for this circuit is provided by six flashlight dry cells. Combustibles in the sample are burned on the filament which raises its temperature and increases its resistance in proportion to the concentration of combustibles in the sample. The resulting unbalance of the electrical circuit causes a deflection of the meter pointer which indicates on the scale the concentration of combustible gases or vapors in the sample. This scale is graduated in percent of the lower explosive limit.

The electrical bridge circuit of the instrument is designed so that its balance is established at the proper operating temperature of the detector filament. The circuit balance and detector current are adjusted simultaneously by the adjustment of a single rheostat. The proper relation between these two factors is maintained by a special ballast lamp in the circuit.

A schematic diagram of the electrical circuit and flow system of the instrument is shown in Figure 1. The sample is drawn through the filter chamber into the combustion chamber of the instrument by an aspirator bulb. Entering through the inlet flashback arrester, the sample strikes a baffle plate, diffuses through the combustion chamber, contacts the detector filament, and leaves through the outlet flashback arrester.

Two pea size lamps, built into the meter case, illuminate the meter dial. The effect of the illumination is dependent on the darkness of the area in which the instrument is used. These lamps are illuminated as long as the instrument is turned "ON."

The Model 2A is listed by UL and approved by FM as follows:

> Intrinsically Safe for use in Class I, Division 1, Group D and Non-Incendive for use in Class I, Division 2, Groups A, B, C and D hazardous locations, as defined by the National Electrical Code when used with Eveready #950 or #800 batteries.

The MSA Explosimeter should be used strictly in accordance with labels, warnings and limitations instructions and within the limitations stated.

The MSA Explosimeter will give efficient and economical service if Instructions for Operation and Maintenance are carefully followed.

WARNINGS AND LIMITATIONS

The Model 2 Explosimeter is not designed for testing mixtures of hydrogen, acetylene or other combustibles in which the oxygen content exceeds that of normal air (oxygen enriched atmospheres).

The instrument has been designed as a general purpose combustible gas indicator, intended to detect the presence of flammable gases and vapors, and the instrument will indicate in a general way whether or not the atmosphere is dangerous from a flammability standpoint. It is important that such information obtained with the instrument be appraised by someone skilled or experienced in interpreting the instrument reading intelligently, in the light of environment, industrial practice, and exposure. For example, an atmosphere that is indicated as non-hazardous from the standpoint of fire and explosion, may, if inhaled, be toxic to workmen who are exposed for some time. Similarly a vessel which is safe before work is started may be rendered *explosive* by future operations as, for example, stirring or handling bottom sludge in a petroleum storage tank. The latter example indicates the need for frequent repeated tests of questionable spaces while work is in progress.

The instrument will respond to those concentrations of gases or vapors which are drawn through the sampling system. If the combustible is a high boiling point solvent and is tested at normal ambient temperature a relatively low vapor concentration will be shown by the instrument. If the container holding such solvents is subsequently heated as by welding and soldering, it is to be expected that the vapor concentration will increase, and thus the atmosphere of a vessel which was originally shown to contain only a low concentration of vapors may be rendered *explosive*.

If an attempt is made to use such instruments for testing atmospheres contaminated with high boiling point solvents where the questionable space is at a higher temperature than the instrument, it can be anticipated that there may be some condensation of the combustible vapors in the sampling line and in the flow system of the instrument; as a consequence the instrument may indicate less than the true concentration of vapors. For some such instances, condensation can be prevented by heating the sampling line and instrument to a temperature equivalent to or above that of the space to be tested; however, in no instance should these items be heated above 150° F.

The instrument will not indicate the potential explosive hazard of combustible gases and vapors when they are present in concentrations above their

upper explosive limits (see Operating Instructions, Page 6).

Furthermore, the instrument has been designed to measure combustible vapors IN AIR. It is not capable of measuring the percentage of vapors in steam or inert atmospheres, due to the absence of oxygen necessary for combustion on the instrument detector unit. For a test of combustibility the steam or inert gas must be displaced with air.

The instrument will not indicate the presence of explosive or combustible mists or sprays such as lubrication oil, or explosive dusts such as grain or coal dust.

When sampling over liquids, care should be taken that the end of the sampling line does not touch the surface of the liquid. It is recommended that a probe tube be used in tests of this character to prevent the liquid from being drawn into the sampling tube.

OXY-HYDROGEN AND OXY-ACETYLENE MIXTURES

The Model 2A Explosimeter is not designed for testing mixtures of hydrogen, acetylene, or other combustibles, in which the oxygen content exceeds that or normal air (oxygen enriched atmospheres). For that specific usage, the Model 3 Explosimeter and the Model 4 Explosimeter have been designed.

The Model 3 Explosimeter is similar in all respects to the Model 2A, except that it is equipped with heavy duty flashback arresters which are capable of confining within the combustion chamber explosions of mixtures of hydrogen and oxygen in excess of its normal content in air.

The Model 4 Explosimeter is designed for testing Oxygen-Acetylene mixtures and is calibrated for Acetylene.

The use of these special model instruments are not required for testing hydrogen or acetylene in air.

TESTING ATMOSPHERES CONTAMINATED WITH LEADED GASOLINE

When an atmosphere contaminated with leaded gasoline is tested with a Model 2A Explosimeter, the lead produces a solid product of combustion which, upon repeated exposure, may develop a coating upon the detector filament resulting in a loss of sensitivity. To reduce this possibility, an inhibitor-filter is available for insertion in place of the normal cotton filter in the instrument. This device chemically reacts with the tetra-ethyl lead vapors to produce a more volatile lead compound.

Such inhibitor-filters are available in packages of six each and identified by Part No. 47740. Each consists of a glass ampoule wrapped with cotton and filled with chemical. To prepare the item for use, the ampoule should be crushed between the fingers then inserted into the filter chamber of the Model 2A Explosimeter in place of the normal filter.

One inhibitor-filter will provide protection for an instrument of eight hours of continuous testing.

WARNING

Silanes, silicones, silicates and other compounds containing silicon in the tested atmosphere may seriously impair the response of the instrument. Some of these materials rapidly "poison" the detector filament so that it will not function properly. When such materials are even suspected to be in atmosphere being tested, the instrument must be checked frequently (at least after 5 tests). A Calibration Test System (see parts list for accessories required) is available to conduct this test.

The Calibration Test System can also be used to periodically check the instrument calibration. If the instrument reads low on the test gas, immediately

replace the filament and the inlet filter and re-test. See also pages 2, 5 and 11 for additional limitations and cautions.

OPERATING INSTRUCTIONS

The MSA Explosimeter is set in its proper operating condition by the adjustment of a single control. This control is a rheostat regulating the current to the Explosimeter measuring circuit. The rheostat knob is held in the "OFF" position by a locking bar. This bar must be lifted before the knob can be turned from "OFF " position.

In an area known to be free of combustible gas or vapors prepare the 2A Explosimeter for operation as follows:

1. Lift the end of the rheostat knob "ON-OFF" bar and turn the rheostat knob one quarter turn clockwise.

This operation closes the battery circuit. Because of unequal heating of circuit elements there will be an initial deflection of the meter pointer. The meter pointer may move rapidly upscale and then return to a point below ZERO, or drop directly below ZERO.

2. Flush fresh air through the instrument.

The circuit of the instrument must be balanced with air free of combustible gases or vapors surrounding the detector filament. Five squeezes of the aspirator bulb are sufficient to flush the combustion chamber. If a sampling line is used, an additional two squeezes will be required for each 10 feet of line.

3. Adjust rheostat knob until meter pointer rests at Zero.

Clockwise rotation of the rheostat knob causes the meter pointer to move up scale. A clockwise rotation sufficient to move the meter pointer considerably above zero should be avoided as this subjects the detector filament to an excessive current and may shorten its life.

The Explosimeter is now ready for operation. Place end of sampling line at the point where the sample is to be taken.

1. Readjust meter pointer to zero if necessary by turning rheostat knob.
2. Aspirate sample through instrument until highest reading is obtained.

Approximately five (5) squeezes of the bulb are sufficient to give maximum deflection. If a sampling line is used add two (2) squeezes for each ten (10) feet of line.

This reading indicates the concentration of combustible gases or vapors in the sample.

The graduation on the scale of the indicating meter are in percent of the lower explosive limit. Thus, a deflection of the meter pointer between zero and 100%, shows how closely the atmosphere being tested approaches the minimum concentration required for the explosion. When a test is made with the instrument and the meter pointer is deflected to the extreme right side of the scale and remains there, then the atmosphere under test is *explosive*.

If the meter pointer moves rapidly across the scale and on continued aspiration quickly returns to a position within the scale range or below zero, it is an indication that the concentration of flammable gases or vapors may be above the upper explosive limit. To verify this, immediately aspirate fresh air (air free of combustible gases or vapors) through the sampling line or directly into the instrument. Then, if the meter pointer moves first to the right and then to the left of the scale, it is an indication that the concentration of flammable gas or vapor in the sample is above the upper explosive limit.

When it is necessary to estimate or compare concentrations of combustible gases above the lower explosive limit a Dilution Tube may be employed. The use of the Dilution Tube is described in the section entitled "Dilution Tube."

The meter scale is red above 60 to indicate that gas concentrations within that range are nearly explosive. Such gas-air mixtures are considered unsafe where men must work.

3. To turn instrument off: Rotate rheostat knob counterclockwise until arrow on knob points to "OFF." The locking bar will drop into position in its slot indicating that the rheostat is in the "OFF" position.

The terminal voltage of dry cells gradually decreases as the cells are used. This drop in voltage takes place most rapidly in the first few minutes after the current is turned on. The balance of the Model 2A Explosimeter circuit is dependent upon the applied voltage and therefore gradually changes as the instrument is in operation. With freshly installed batteries the balance may be expected to change approximately 5% (1 scale division) in 5 minutes. After 10 to 20 minutes of use, the shift of the balance setting should not exceed 1% (1/5 scale division) in 5 minutes.

When it is possible to do so, the bridge circuit balance should be checked before each test. If this is not practical, the balance adjustment should be made at three-minute intervals during the first ten minutes of testing and every ten minutes thereafter.

MAINTENANCE

REPLACEMENT OF DRY CELLS

The Model 2A Explosimeter is adapted to use six Eveready #950 or Burgess #800 Flashlight Dry Cells operating in parallel. They will give 8 to 12 hours of continuous service. Considerably longer life may be expected in intermittent service.

The Pointer on the rheostat knob indicates approximately the condition of the dry cells. When the circuit is properly balanced with fresh cells, the pointer on the rheostat knob should be directed toward the left edge of the instrument.

When the meter pointer remains below ZERO and cannot be brought up to ZERO even when the control rheostat is turned to its extreme clockwise position (knob pointer directed at right edge of case) the cells are exhausted and must be replaced.

The dry cells are replaced by removing the bottom of the instrument case which is held in place by two slotted screws. The cells operate in parallel and must be installed with the tops (positive terminal) toward the top of the battery compartment.

The cells should be replaced in groups. Do not use partially discharged cells with new cells.

DETECTOR UNIT

The detector filament of the Model 2A EXPLOSIMETER is made of platinum. The life of the detector unit depends greatly upon the concentrations of gases tested. When the majority of samples tested contain not more than 50% of the lower explosive limit a detector filament will serve for several thousand tests. When higher concentrations, especially above the lower explosive limit (above 100% on the EXPLOSIMETER scale) are frequently encountered, the life of the detector unit will be shortened. It is advisable, when gaseous concentrations above the scale range of the instrument are indicated, to stop sampling and flush the Model 2A Explosimeter with fresh air.

If the pointer of the indicating meter moves to the extreme right side of its scale when the instrument is turned on and cannot be adjusted to ZERO, the detector filament may be burned out and should be replaced.

A spare Detector Unit is located inside the case of the instrument below the panel and may be obtained by removing the three screws that hold the panel in place.

REPLACEMENT OF DETECTOR UNIT

Remove the top of the Model 2A Explosimeter case. Remove the screws holding the two green wires to the terminals in the top of the bakelite head of the detector unit. Unscrew the unit from the combustion chamber. Screw the replacement detector unit tightly into the combustion chamber. The gasket should be clean and properly seated.

When the green wires leading to the terminals on the top of the detector head are replaced, care should be taken that the screws holding them are firmly set and that the two terminal lugs at the ends of the wires do not touch each other.

Provisions should be made to replace the spare filament in the receptacle inside the case, so that in the event another filament burns out while the instrument is being used in the field, a spare will be available.

BALLAST LAMP

The MSA Explosimeter uses a special electrical bridge circuit of "controlled stability." It is this feature that makes it practical to adjust the circuit balance and detector operating temperature with a single operating control. The function of the ballast lamp is to regulate the circuit stability.

This lamp is especially manufactured for the MINE SAFETY APPLIANCES COMPANY. It is selected according to rigid standards and is not replaceable by any commercially made lamp.

The filament of the ballast lamp of a properly operating instrument may glow dimly, but is never

brightly illuminated. The lamp should always be kept firmly screwed into its socket and never removed from it. It may be expected to last throughout the life of the instrument.

Replacement is required only in the case of breakage or after it has been subjected to severe mechanical shock.

FLASHBACK ARRESTERS

The flashback arresters are located in the inlet and outlet of the detector filament chamber. The inlet arrester is reached by removing the detector filament and the baffle plate at the bottom of the detector chamber. The outlet flashback arrester is reached by removing the aspirator bulb coupling.

The arresters are made of cadmium plated copper screen tightly wrapped upon a rod. They may be removed by pulling this rod with a pair of long-nosed pliers. If they are clogged they should be replaced with new ones. The flashback arresters are inexpensive and their function is so important that any attempt to clean them is not recommended.

WARNING: ALWAYS BE SURE THAT BOTH ARRESTERS ARE IN THEIR PLACES AND FIT SNUGLY BEFORE THE INSTRUMENT IS REASSEMBLED. THE FLASHBACK ARRESTERS ARE IMPORTANT SINCE THEY PREVENT THE POSSIBILITY OF FLAME PROPAGATION FROM THE COMBUSTION CHAMBERS.

CALIBRATION

A Calibration Test Assembly Model R is available to periodically check the Explosimeter with a known concentration of methane-in-air. The Explosimeter calibration should be checked after replacement of filament, ballast lamp, flashback arresters, after prolonged periods of non-use, or if catalytic "poisons" may be present in the sample. (see page 5).

THE FLOW SYSTEM

The normal rate of sample flow through the instrument is 0.030 to 0.050 cubic feet per minute. The indication of the instrument is practically independent of the rate of sample flow within wide limits. To check for leaks in the flow system, close inlet of the instrument with one finger of the left hand; then depress the aspirator bulb. Immediately seal the aspirator bulb outlet with one finger of the right hand. As long as both fingers are held in place the bulb should remain deflated. If the bulb fills, then there is a leak in the flow system, which includes: the filament, aspirator bulb, or inlet and outlet fitting gaskets. To check the aspirator exhaust valve for leakage, close inlet of the instrument with one finger of the left hand; then depress the aspirator bulb. The bulb should not completely inflate in less than 6 seconds.

To check for flow (after checking for leaks), depress the aspirator bulb without blocking either intake or exhaust The bulb should fill completely in 1 to 2 seconds, if not, see maintenance sections: Filter Chamber, Flow Regulating Orifice, and Flashback Arrestors and/or replece the aspirator bulb assembly.

THE FLOW REGULATING ORIFICE

An orifice controlling the rate of flow through the Model 2A Explosimeter is located in the aspirator bulb coupling. It may be screwed out after the rubber tubing connection to the bulb is removed. It is made of a special non-corrosive material. If it is clogged, it may be cleaned by pushing a fine wire through its opening.

FILTER CHAMBER

The Model 2A Explosimeter has a filter chamber integrally cast in the case. It is reached by unscrewing the sampling line coupling. A cotton Filter (Part No. 16499) should be inserted to remove dust or liquid from incoming sample. An activated charcoal filter (Part No. 14318) should be used when it is desired to differentiate between illuminating gas and petroleum vapors. The petroleum vapors are absorbed by the activated charcoal.

An Inhibitor Filter (Part No. 47740) must be used when the atmosphere contains or is suspected of containing vapors of leaded gasoline.

METER

If the mechanical ZERO setting of the meter has been disturbed in transport or by accident and the meter pointer is not on the ZERO line when the current in instrument is "OFF", set pointer to ZERO by slowly turning screw on meter face with a small screw driver.

It is recommended that at the end of a series of tests the instrument be flushed by aspirating in fresh air to eliminate traces of combustible vapors that may have been absorbed.

After periods of idleness or considerable operation in severly corrosive atmospheres, the contacts of the rheostat may become tarnished causing erratic response to the operating control. This may be corrected by removing the batteries and turning the operating control back and forth a number of times.

SPECIAL SAMPLING APPLICATIONS

DILUTION TUBE

For those tests where concentrations of combustible gases in excess of lower explosive limit concentrations (100% on instrument meter) are to be compared, such as in testing bar holes in the ground adjacent to a leak in a buried gas pipe, or in following the purging of a closed vessel that has contained flammable gases or vapors, a special air-dilution tube is available. Such dilution tubes are available in 1:1, 10:1 and 20:1 ratios of air to sample. Thus rich concentrations of gas can be compared.

The dilution tube is connected by screw threads between the intake of the instrument and the end of the sampling line which is normally attached directly to the instrument. It is therefore necessary in all tests made with the dilution tube attached to the instrument that the instrument be operated in fresh air and the gaseous sample delivered to the instrument through the sampling line. This permits a comparison of a series of samples beyond the normal range of the instrument, to determine which sample contains the highest concentration of combustible gases. This tube also makes it possible to follow the progress of purging operation where an atmosphere of combustibles is being replaced with inert gases.

PRESSURE TESTING BAR HOLES

In some instances where bar holes are drilled to locate pipe line leaks, a group of holes, all containing pure gas may be found. This condition usually occurs near a large leak. It is expected that the gas pressure will be greatest in the bar hole nearest the leak. The instrument may be used to locate the position of the leak by utilizing this bar hole pressure. This is done by observing the time required for this pressure to force gas through the instrument sampling line. A proble tube equipped with a plug for sealing off the bar hole into which it is inserted is required. The following test procedure should be followed.

Aspirate fresh air through the Model 2A Explosimeter then unscrew the aspirator bulb coupling. This removes the flow regulating orifice from the instrument. Adjust the rheostat until the meter pointer rests on "ZERO."

The probe tube is now inserted in the bar hole and sealed off with the plug. Observe the time at which this is done. Pressure developed in the bar hole will force gas through the sampling line to the instrument. This will be indicated by an upward deflection of the meter pointer as the gas reaches the detector chamber.

Determine the time required for the gas to pass through the proble line. The bar hole showing the shortest time will have the greatest pressure.

When the upward deflection of the meter pointer starts, turn off the instrument, replace the aspirator bulb and flush out the probe line for the next test.

QUESTIONS AND ANSWERS

1. Should the meter pointer go to the upper end of the scale as the Model 2A Explosimeter is turned on and cannot be returned to ZERO by counterclockwise rotation of the rheostat:

(a) The combustion chamber may be filled with an explosive mixture. Flush with air free of combustible gases.

(b) The connection to the detector unit may be loose. (Page 10.)

(c) The detector unit may be burned out. (Page 10.)

2. Should the meter pointer start up the scale when the instrument is turned on and then return to a point below ZERO and cannot be adjusted to ZERO by extreme clockwise rotation of the rheostat:

(a) The dry cells may require replacement. (Page 8.)

(b) There may be a very high concentration of combustible gases in the combustion chamber. Flush with air free of combustible gases.

3. Should the meter pointer go directly to some point below ZERO and cannot be adjusted to ZERO with the Rheostat:

(a) The detector unit terminals may be touching each other. (Page 10.)

(b) The ballast lamp may be loose in its socket or may be damaged and require replacement. (Page 10.)

4. Should the meter pointer move up scale more than one division when the instrument is operated in fresh air, the flashback arresters are clogged. (Page 11.)

5. Should the operation of the instrument be sluggish and require more than the specified number of aspirations for maximum deflection of the meter pointer:

(a) The flashback arresters may be clogged. (Page 11.)

(b) The flow orifice in the aspirator coupling may be plugged. Clean with fine wire.

(c) Cotton filter may be plugged. (Page 13.)

(d) The aspirator bulb may be damaged. Replace with new aspirator bulb.

6. Should the motion of the meter pointer be erratic as the rheostat knob is adjusted, the rheostat contact requires cleaning. (Page 13.)

7. Should service other than that outlined be necessary, instrument should be returned to Mine Safety Appliances Company, Repair Dept., 7522 Meade Street, Pittsburgh, Pennsylvania 15208.

REPLACEMENT PARTS AND ACCESSORIES

FOR EXPLOSIMETER® MODEL 2A combustible gas indicator

Combustible Gas Indicator

When ordering replacement parts specify Part Number and give Description.

Pt. No.	Description
89220	MSA EXPLOSIMETER Combustible Gas Indicator Type Model 2A complete with carrying straps, less sampling lines
11354	5 ft. Sampling Line complete with couplings
11955	10 ft. Sampling Line complete with couplings
11912	15 ft. Sampling Line complete with couplings
11913	25 ft. Sampling Line complete with couplings
11957	35 ft. Sampling Line complete with couplings
11958	50 ft. Sampling Line complete with couplings
85374	Dilution Tube, 1:1 ratio
11377	Dilution Tube, 20:1 ratio
45174	Dilution Tube, 10:1 ratio
11960	4 ft. Solid Probe Rod
11961	3 ft. Hollow Brass Probe Tube
11355	Replacement Filament Unit
30052	Dry Cell (6 required)

52148	Ballast Lamp
14318	Cartridges, Charcoal, pkg. of 6
16499	Cotton Filters, pkg. of 6
15264	Flashback Arrester (2 required)
47740	Inhibitor Filters, pkg. of 6
74814	Line Trap Assembly
994198	Instruction Manual
16839	Aspirator Bulb Assembly

CALIBRATION TEST SYSTEM

459948	Flow Control
449401	Adapter-Hose
459945	Calibration Gas Methane 2.0%
459942	Calibration Gas Methane 2.5%

TURBIDIMETER

MODEL 8391-35

MODEL 8391-37

Instruction Manual

Cole
Parmer

Cole-Parmer Instrument Company
7425 North Oak Park Avenue, Chicago, Illinois 60648

WARRANTY

All instruments are fully guaranteed against defective materials and workmanship for one year. Any attempted repair voids the warranty on this instrument.

Turbidimeter

Table of Contents

1.0 INTRODUCTION

The turbidimeter is a nephelometric instrument that quantitates light reflecting particles in solution. The instrument measures the scattered light captured by a photosensor that is located at a 90° angle to the incident light.

The turbidimeter is designed to conform to EPA requirements as described in the "EPA Manual of Methods for Chemical Analysis of Water and Wastes."

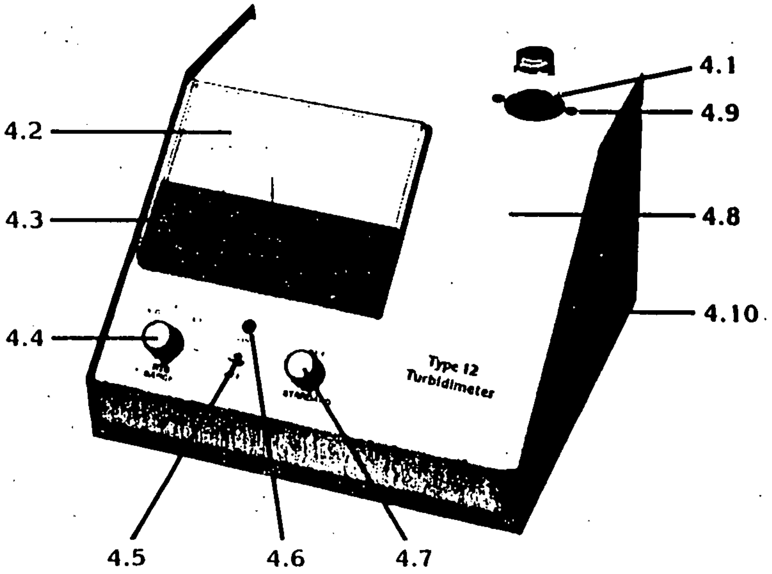
2.0 THEORY

When a liquid contains particulate matter, a beam of light passed through the sample will be scattered in all directions. The amount of light that is scattered can then be directly related to the concentration of the particulate matter. Nephelometry is based upon the measurement of the amount of scattered light detected by a photo cell located at a 90° angle to the incident beam of light. A common application of nephelometric measurement is in the area of drinking water monitoring. The US Congress established drinking water regulations in 1975. One of the key parameters in these regulations is the measurement of turbidity. Because turbidity in water can be be caused by clay, silt, organic matter, bacterial colonies, and plankton, turbid water can pose a significant health hazard. Therefore acceptable drinking water must fall below an established NTU value and water must be monitored daily.

3.0 SPECIFICATIONS

Range:	0-1, 0-10, 0-100 NTU
Accuracy:	±2% Full Scale
Recorder Output:	0-1 Volt Analog
Readout:	6-Inch Analog Meter
Light:	Tungsten
Power:	115 VAC (60 Hz) or 230 VAC (50 Hz/60 Hz)
Size:	10" W × 8.75" D × 6.5" H
Weight:	5 lbs.

4.0 FRONT PANEL



4.1 TEST WELL — one inch diameter test well for sample cuvette or sealed standard.

4.2 ANALOG METER FACE — Sample read-out of turbidity in Nephelometric Turbidity Units (NTU).

4.3 MECHANICAL ZERO — Screw used to adjust the meter needle to zero when the instrument is turned off.

4.4 NTU RANGE — Three position knob used to select proper turbidity range.

Position	**Full Scale Range**
× 1	0-100 NTU
× .1	0-10 NTU
× .01	0-1 NTU

4.5 ON-OFF — Main instrument power switch.
ON — Full power available to the instrument.
OFF — No power available to the instrument.

4.6 INDICATOR LIGHT — Red LED indicates power is available to the instrument.

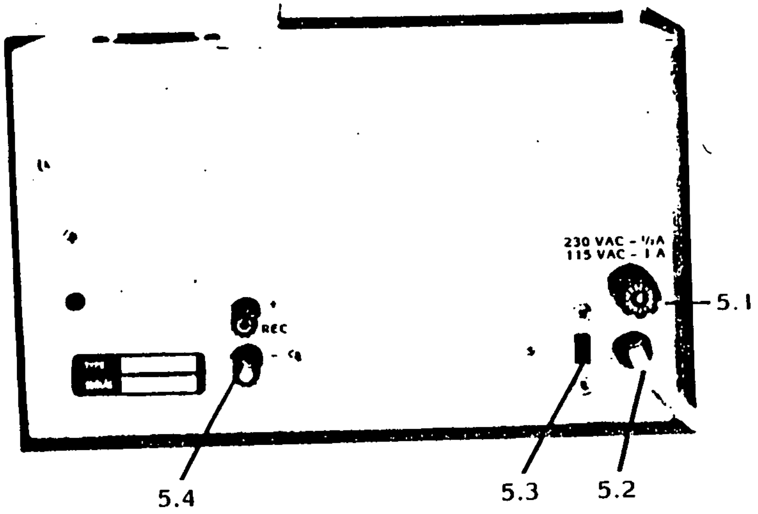
4.7 STANDARD-SET — Adjustment knob used for instrument calibration.

4.8 INSTRUCTION PANEL — Brief calibration and operating instructions.

4.9 ALIGNMENT KEY — Key on test well used for sample tube alignment.

4.10 CALIBRATION ADJUSTMENT — Hole in shroud to access internal calibration.

5.0 BACK PANEL



5.1 FUSE — Holder for a replaceable fuse, ½ amp 230 VAC or 1 amp 115 VAC.

5.2 ATTACHED LINE CORD — Three prong plug with attached line cord for use with 115 VAC or 230 VAC outlet.

5.3 SELECTOR SWITCH — For 115 VAC or 230 VAC operation.

5.4 RECORDER OUTPUT + AND − : 0-1 Volt analog output for interface to a chart recorder.

6.0 PRELIMINARY SET-UP

6.1 Remove and inspect carton for the following items:

- a. Turbidimeter
- b. Light Shield
- c. Black Body
- d. Spare Lamp Assembly
- e. Four Sample Cuvettes
- f. Three Standards: .5, 5, 40 NTU
- g. Instruction Manual
- h. Registration and Warranty Card

6.2 Place meter on a flat, stable surface away from vibrations and direct sunlight.

6.3 Make certain the power is off by depressing toggle switch on the front panel toward OFF.

6.4 Select the appropriate line voltage with the switch on the back panel and correct fuse value.

6.5 Plug the line cord into the proper recepticle.

6.6 Turn power on by pushing toggle switch to ON. Red LED will illuminate.

7.0 CUVETTE ALIGNMENT

To eliminate reading errors due to irregularities in the sample cuvette and standard cuvette glass, it is important to establish the correct alignment of each cuvette in the test well. After the cuvettes have been aligned they should be marked with a waterproof pen to insure consistent and reproduceable readings. The procedure for correct alignment follows:

7.1 All cuvette alignment procedures should be performed with light shield to minimize the effect of stray light.

7.2 Determine proper alignment.

- a. Turn instrument on and warm-up for at least 5 minutes.
- b. Fill each clean sample cuvette with tap water.
- c. Clean the cuvettes with a soft, absorbant tissue to remove water drops and finger prints.

d. Place sample cuvette in test well.

e. Turn NTU scale selector switch to the X1 position.

f. Set pot should be turned fully counter-clockwise.

g. Slowly rotate cuvette 360° in test well and observe meter response. Proper alignment is achieved when the cuvette position produces the lowest meter reading.

h. Mark cuvette with water proof marking pen to correspond to the key on the test well.

8.0 CALIBRATION

8.1 Zero Adjust

a. With the instrument turned off, check the meter needle position. If the needle does not read zero, adjust the mechanical zero screw.

b. Turn on the instrument and allow to warm-up for 5 minutes.

c. Insert the black body into the sample well.

d. Turn the set standard control fully clockwise.

e. Place the NTU range switch to the × .01 position.

f. Adjust the circuit board mounted potentiometer to read zero on the meter (an access hole is marked on the right hand side of the instrument).

Note: An insulated, non magnetized calibration screwdriver is required for both adjustments.

8.2 Do not expect all scales to be calibrated if you only calibrate one NTU scale. You must calibrate each scale with the appropriate NTU value standard. For example, if you calibrate the 0-100 NTU scale with the 40 NTU API Standard, do NOT expect the 0.5 NTU API Standard to register 0.5 NTU on the 0-1 NTU scale. That is why API provides standards for these different scales (0.5, 5, and 40).

Remember sealed standards are NOT primary standards. SEALED STANDARDS ARE REFERENCE STANDARDS AND MUST BE USED IN CONJUNCTION WITH OUR PRIMARY STANDARD TO MEET EPA REQUIREMENTS.

8.3 Calibrations of Secondary Standards

Note: Due to irregularities in glass cuvettes the EPA requires the use of primary standards for calibration. The EPA defines primary standards as an EPA approved standard (Formazin or the commercially available standard from Advanced Polymer Systems) that is read in the same glass cuvette as the sample. This can be very time consuming and expensive. The standards included with the instrument can be used if the following procedure is performed. The EPA defines sealed standards as secondary standards.

a. Choose one sample cuvette for reading all unknown samples. If the chosen sample cuvette is broken or replaced, the following procedure should be repeated for the new sample cuvette.

b. Make the Formazin standard or obtain the standard commercially available from Advanced Polymer Systems. These are the only two standards currently acceptable by the EPA.

c. Set the NTU Range switch to × 1 (0-100 NTU full scale).

d. Pour the 40 NTU Formazin or commercial standard into the chosen sample cuvette. Make certain that the sample cuvette is wiped clean of all dirt and fingerprints. Insert the cuvette into the sample well and align properly. Cover with the light shield.

e. Use the SET STANDARD knob to adjust the meter needle to read exactly 40 NTU.

f. Remove the sample cuvette and insert the 40 NTU standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the 40 NTU sealed standard.

g. Rinse the sample cuvette thoroughly and dry completely inside and out.

h. Fill the sample cuvette with the 5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well. Align the cuvette properly and cover with the light shield.

i. Turn NTU RANGE knob to × .1 (0-10 NTU full scale). Use the SET STANDARD knob to adjust the meter needle to read exactly 50 (actually 5 NTU).

j. Remove the sample cuvette and insert the 5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the 5 NTU sealed standard.

k. Rinse the sample cuvette thoroughly and dry completely inside and out.

l. Fill the sample cuvette with the .5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well, align properly and cover with light shield.

m. Turn NTU RANGE knob to × .01 (0-1 NTU full scale). Use the SET STANDARD knob to adjust the meter needle to read exactly 50 (actually .5 NTU).

n. Remove the sample cuvette and insert the .5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value. This is the value that should now be used for the NTU sealed standard.

IMPORTANT NOTE: The above procedure should be performed every three months or every time a new sample cuvette is used. Repeated use of both the sample cuvette and sealed standard cuvettes will cause wear and scratches on the glass. This wear will result in a change in the assigned value of the standard. It is important to realize that a change in the assigned value does not necessarily indicate degradation or deterioration of the standard material itself.

9.0 STANDARD OPERATION

9.1 Zero the instrument. When the instrument is off, check the meter needle position. If the needle does not read zero, adjust the mechanical zero screw.

9.2 Turn instrument on and allow 5 minutes to warm-up.

9.3 Choose the proper NTU range and standards for the unknowns to be read. The NTU range chosen should be the minimal range span required to read all unknowns.

NTU RANGE	SPAN (full scale)	STANDARD
× 1	0-100 NTU	40
× .1	0-10 NTU	5
× .01	0-1 NTU	.5

9.4 Calibration of NTU Scale.

a. Turn NTU RANGE knob to the correct position for the chosen range span.

b. Insert the proper standard into the test well. Make certain the standard cuvette is clean and properly aligned. Cover with the light shield.

c. Use the SET STANDARD knob to adjust the meter needle to read the assigned value of the standard.

d. The turbidimeter is now calibrated in the chosen range and ready for use.

9.5 Taking a measurement. All unknowns should be measured using the same sample cuvette. Unknown samples are read by inserting the sample cuvette, properly aligned with the key, into the test well. Cover with the light shield and take the reading off of the correct scale on the meter. Make certain to take the range factor (× 1, × .1, or × .01) into account when calculating the actual NTU value of the sample.

9.6 Possible sources of error. To insure accurate readings it is important to eliminate all possible sources of reading errors:

a. Always make certain that the cuvette being read is properly aligned.

b. Never take a reading without the light shield in place.

c. Dirt and fingerprints on the cuvette can cause significant errors in turbidity readings. Make certain that the sample or standard cuvette is clean both inside and out before using. If possible always handle the cuvette by the top portion to avoid fingerprints.

d. Make certain that the sample being measured is free of bubbles and floating debris.

9.7 Highly concentrated samples. Samples with turbidity measurements above 40 NTU should only be used as a gauge of approximate concentration to indicate the amount of dilution required.

10.0 LAMP ADJUSTMENT

The position of the lamp with respect to the lens is very critical. A plastic tube is included with the turbidimeter to allow you to check the relative position of the lamp. Proceed as follows:

10.1 Turn the instrument on.

10.2 Position the plastic viewing tube in the test well with the blue lens on top.

10.3 The lamp filament coil should be seen centered in the viewing tube.

10.4 If the filament is not near center, or not visible at all, it is necessary to readjust the lamp.

10.5 Turn the instrument off.

Note: 115/230 AC voltage near lamp adjustment. Use caution.

10.6 Remove the outer shroud by unscrewing the four rubber feet on the bottom of the instrument.

Note: Two adjustments are used to align the lamp. Horizontal — adjust to center the filament. Vertical — adjust to focus the filament.

10.7 Loosen the thumb screws holding the lamp plate to the vertical support bracket.

10.8 Turn the instrument on.

10.9 Adjust the lamp plate to center the filament in the viewing tube.

10.10 Turn the instrument off.

10.11 Tighten thumb screws to secure lamp plate.

10.12 Loosen screws securing vertical support brackets.

10.13 Turn the instrument on.

10.14 Hold a paper or cardboard horizontally approximately one foot over the test well. When in focus, the filament coil will be visible on the paper.

10.15 Adjust the lamp bracket as necessary.

10.16 Turn the instrument off.

10.17 Tighten the vertical support bracket screws.

10.18 Replace the outside shroud and secure with rubber feet.

11.0 TROUBLESHOOTING

11.1 Symptom — Meter exhibits no response
ACTION

a. Check power to meter: Meter not plugged in, power not turned on, fuse burned out.
CONCLUSION — If meter power seems to be present, continue.

b. Check tungsten lamp.

   CAUTION — Do not look directly at the lamp. To check the lamp, look for the presence of the light beam on the side of the test well.

   CONCLUSION — If the bulb is not on when the meter is on, the bulb needs to be replaced.

   If the bulb appears to be working properly, the meter needs to be serviced to determine the source of the problem.

11.2 **Symptom** — Unable to calibrate or obtain full meter deflection

ACTION

a. Check the standard tube for damage. Scratches or wear on the standard tube can cause significant errors. Replace standard if necessary.

b. Check the standard for deterioration, mold growth, or other signs of obvious contamination. If any contamination is suspected, replace the standard.

c. Clean the focusing lens. Dirt or debris on the focusing lens can interfere with the light source. Clean the focusing lens with lens paper or a lens cloth.

d. Check for low supply voltage. Have an electrician or other qualified person check the line voltage. The line voltage should be between 105 VAC and 125 VAC for 115 VAC operation, and between 215 VAC and 250 VAC for 230 VAC operation. Insufficient power to the instrument can cause faulty meter function.

   CONCLUSION — If none of the above procedures can solve the problem, the meter needs to be serviced.

11.3 **Symptom** — Meter exhibits no response when the NTU RANGE switch is changed.

ACTION

a. Meter needs to be serviced.

APPENDIX A-2

RECRA ENVIRONMENTAL, INC.

Quality Assurance/Quality Control Plan

RECRA ENVIRONMENTAL, INC.

Chemical and Environmental Analysis Services

World University Games Buffalo '93
GRAND PATRON
HELPING TO BRING THE
WORLD TO BUFFALO

RECRA ENVIRONMENTAL, INC.

QUALITY ASSURANCE/ QUALITY CONTROL PLAN

BUILDING 202 DRUM STORAGE YARD (SITE 8)
UNDERGROUND TANK PIT (SITE 13)
NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK

JUNE 25, 1991

PREPARED BY:

RECRA ENVIRONMENTAL, INC.
CORPORATE OFFICE
10 HAZELWOOD DRIVE
AMHERST, NEW YORK 14228

NOTE: THIS DOCUMENT WAS ORIGINALLY PREPARED IN APRIL 1991 AND HAS BEEN RECENTLY ADAPTED FOR THE ABOVE REFERENCED PROJECT.

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1. INTRODUCTION

Recra Environmental, Inc. (Recra) is in the business of providing chemical and environmental analysis services. These services are provided to industrial and commercial concerns, governmental agencies, public utilities, engineering firms, law firms and waste services companies. Recra's laboratories participate in the U.S. Environmental Protection Agency Contract Laboratory Program (CLP) and are certified or approved by various federal and state agencies across the country.

Recra Environmental, Inc.'s corporate mission, simply stated, is:

> "To deliver high quality chemical and environmental analysis services on a timely basis to our customers in a manner that achieves nationally recognized professional and business excellence".

2.0 QUALITY ASSURANCE/QUALITY CONTROL POLICY

2.1 Project Description

In order to achieve our corporate mission, Recra is committed to following the guidelines established in this manual. Compliance with this manual provides for technically sound and legally defensible analytical results of known and documentable quality. The program presented herein defines Recra's QA/QC objectives, operating and support procedures, and specific criteria which provide the focus for an effective on-going program. Recra's philosophy is to build quality into our products and services at every step of their production. Every employee at Recra has a role in quality control and every employee is responsible and accountable for the quality of their work.

Sample Analysis
Building 202 Drum Storage Yard
(Site 8)

Analytical Laboratory Subcontractor

Parameter Description	Method Number	Estimated Quality*
Chloride	9250	11
Fluoride	340.2	11
Nitrate	9200	11
Sulfate	9035-38	11
Filterable Residue (TDS)	160.1	11
Total Metals: Calcium, Magnesium, Sodium, Zinc, Chromium, Aluminum, Copper, Nickel, Silica, Boron, Lead	6010/7000	11
Total Petroleum Hydrocarbons	418.1	11
Purgeable Halocarbons	8010	12
Purgeable Aromatic Hydrocarbons	8020	12

SEE ATTACHMENT 1

Sample Analysis
Building 202
Underground Tank Pit
(Site 13)

Parameter Description	Method Number	Estimated Quality*
Chloride	9250	10
Fluoride	340.2	10
Nitrate	9200	10
Sulfate	9035-38	10
Filterable Residue (TDS)	160.1	10
Total Metals: Calcium, Magnesium, Sodium, Zinc, Chromium, Aluminum, Copper, Nickel, Silica, Boron, Lead	6010/7000	10
Total Petroleum Hydrocarbons	418.1	10
Purgeable Halocarbons	8010	11
Purgeable Aromatic Hydrocarbons	8020	11

*Samples include eight well samples, one field blank, one rinsate blank, one duplicate and one trip blank (trip blank analyzed for volatile only).

Standard Quality Assurance Procedures are documented and available upon request of the Corporate or Facility Quality Assurance Officer.

SEE ATTACHMENT 1

3. PURPOSE, SCOPE AND FORMAT OF THE QUALITY ASSURANCE PLAN

This Quality Assurance (QA) plan presents the essential elements of Recra's QA/QC program. This plan is modeled after numerous documents including, most notably, the following two U.S. Environmental Protection Agency guidance documents:

1) "Interim Guidelines and Specifications for Preparing Quality Assurance Program Plans", QAMS-004/80, December 29, 1980 and

2) "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans", QAMS-005/80, February, 1989.

Both of these documents were published by the U.S. Environmental Protection Agency's Office of Monitoring Systems and Quality Assurance. All of the elements of these reference documents, as well as items and issues specific to the operation of Recra's laboratories, are described in this plan.

The purpose of Recra's QA plan is to control and monitor the quality and acceptability of laboratory data relative to standard laboratory practices, standard methods employed, and contractual obligations between Recra and our clients.

The QA/QC policies defined herein are designed to eliminate, to the extent possible, systematic and random errors, which affect data quality.

Analytical data is rarely "perfect", but a good QA/QC program, coupled with sound professional judgement, will result in analytical data of acceptable, known, and documentable quality. Attainment of this type of data is the ultimate goal of any QA/QC program.

At Recra, the overall quality program is divided into two parts;

Quality Assurance, and
Quality Control

The simplest means of differentiating between control and assurance is to define the type of activities which occur in each function. Quality Assurance activities are generally more system related and include the following:

- Organization
- Facility(s)
- Equipment
- Preventive Maintenance
- Staff
- Laboratory Certifications
- Chain-of-Custody Procedures
- Report Preparation Procedures
- Audits

Quality Assurance generally relates to laboratory qualifications and capabilities.

Quality Control on the other hand, is performance related and is generally based on established acceptance criteria as defined by methodology or past results. Quality Control activities include:

- Adherence to Methodology
- Calibration Procedures and Frequency
- Analytical Precision
- Analytical Accuracy
- Standard Reference Materials
- Use of Laboratory and Field Blanks
- Detection and Quantification Limits
- Data Reduction and Validation
- Data Completeness
- Corrective Action(s)

The quality control program in effect at Recra Environmental Laboratories is based upon recommendations contained in the EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories (March 1979), 600/4-79-019 and U.S. EPA Good Laboratory Practice Standards (August 17, 1989), 40 CFR Parts 160 and 792.

4. CORPORATE AND DIVISIONAL ORGANIZATION

Recra Environmental, Inc. operates four facilities located in, Amherst, New York; Columbia, Maryland; Cleveland, Ohio; and Farmington Hills, Michigan. Table 4-1 illustrates the different facilities operated by Recra.

Implementation of the QA Program is the principal responsibility of the Corporate QA Officer. Assisting the Corporate QA Officer with this responsibility are facility QA Officers (QAO). The responsibilities of the facility QAO is to implement and audit the compliance with QA policy and monitor adherence to QC procedures at all levels of the laboratory operation. Facility QAOs report to the Corporate QAO who in turn reports to the president and CEO.

The corporate organizational structure is presented in Figure 4-1. Figure 4-2 presents a representative organizational structure for Recra's testing operations.

Both management and staff understand their responsibility and authority in achieving the stated quality objectives. Personnel work together to monitor all QA/QC activities and to assure that these activities are performed according to authorized policies and procedures. Standard operating procedures practiced by Recra's laboratory staff to achieve this goal include but are not necessarily limited to the following:

- Extensive sample security, tracking and documentation.
- Certified and documented traceability of standards, reagents, and gases
- Strict calibration procedures, criteria and frequency
- Analysis of spikes, surrogates, internal standards, and control samples
- Duplicates and various blanks
- Statistical assessment of internal Quality Control
- Documented preventive maintenance of equipment
- Thorough review, validation and data quality assessment
- Corrective action reports
- Internal record keeping and document control
- Performance and systems audits
- Comprehensive Standard Operating Procedures (SOPs)

It is the responsibility of each individual analyst to perform the specified number of quality control analyses on a given set of samples. The proper number of duplicates, spikes, and blanks, however, has been mandated by laboratory management and is not left to the analyst's discretion. In addition to performing the proper amount of quality control, the analyst is responsible for the initial review and assessment of the data generated. If data is outside of warning limits or out of control, the source of the problem will be identified with the aid of the appropriate supervisor or manager. Supervisors are ultimately responsible for all data generated from their section, and all data in an analytical report must first be approved by the appropriate supervisor. Following the supervisors review and acceptance of the data, the results are submitted through the department manager to the data processing and/or report writing group. Upon preparation of the report, the review process continues through the QA department and ultimately the Laboratory Director.

All analytical reports (including all quality control data) are reviewed for purposes of maintaining the highest standards of QA/QC. More specific details on how data quality is reviewed, assessed, and either approved or rejected is presented in latter sections of this document.

In the overall operation of Recra's laboratories, the Chief Executive Officer is ultimately responsible for the performance of all staff personnel and for the overall quality of the data. Administrative functions including financial control, contractual issues, and various other business concerns are directly under the control of the Chief Executive Officer. Day to day operational management resides with the Laboratory Director at each location. Data assessment relative to completeness, comparability and quality as well as final data/report review are completed under the direction and control of the individual facility QA Officer.

Individual analysts, under the direction of the supervisors, are responsible for the performance of instrument calibration and sample analysis, along with the performance of associated quality control analyses; i.e., blanks, spikes, duplicates, etc. All data are entered into individually bound laboratory notebooks specific to each instrument and analysis. These are reviewed by supervisors and managers and are signed or witnessed periodically.

Supervisors are charged with maintaining instrumentation in proper operating order according to manufacturers' specifications. Scheduling of routine servicing as well as reacting to instrument problems are also the duty of the supervisor. All major instrumentation is maintained under service agreement with the manufacturer. Logs and files of service requirements and visits are also maintained.

TABLE 4-1

RECRA ENVIRONMENTAL, INC.
FACILITIES

CORPORATE HEADQUARTERS

Audubon Business Centre
10 Hazelwood Drive
Amherst, NY 14228-2298
(716) 691-2600

New York Testing Laboratories

111 Wales Avenue
Tonawanda, NY 14150
(716) 692-2801

505 Fillmore Avenue
Tonawanda, NY 14150
(716) 692-2833

10 Hazelwood Drive
Amherst, NY 14228-2298
(716) 691-2600

Maryland Testing Laboratory

8320 Guilford Road
Columbia, MD 21046
(301) 381-2288

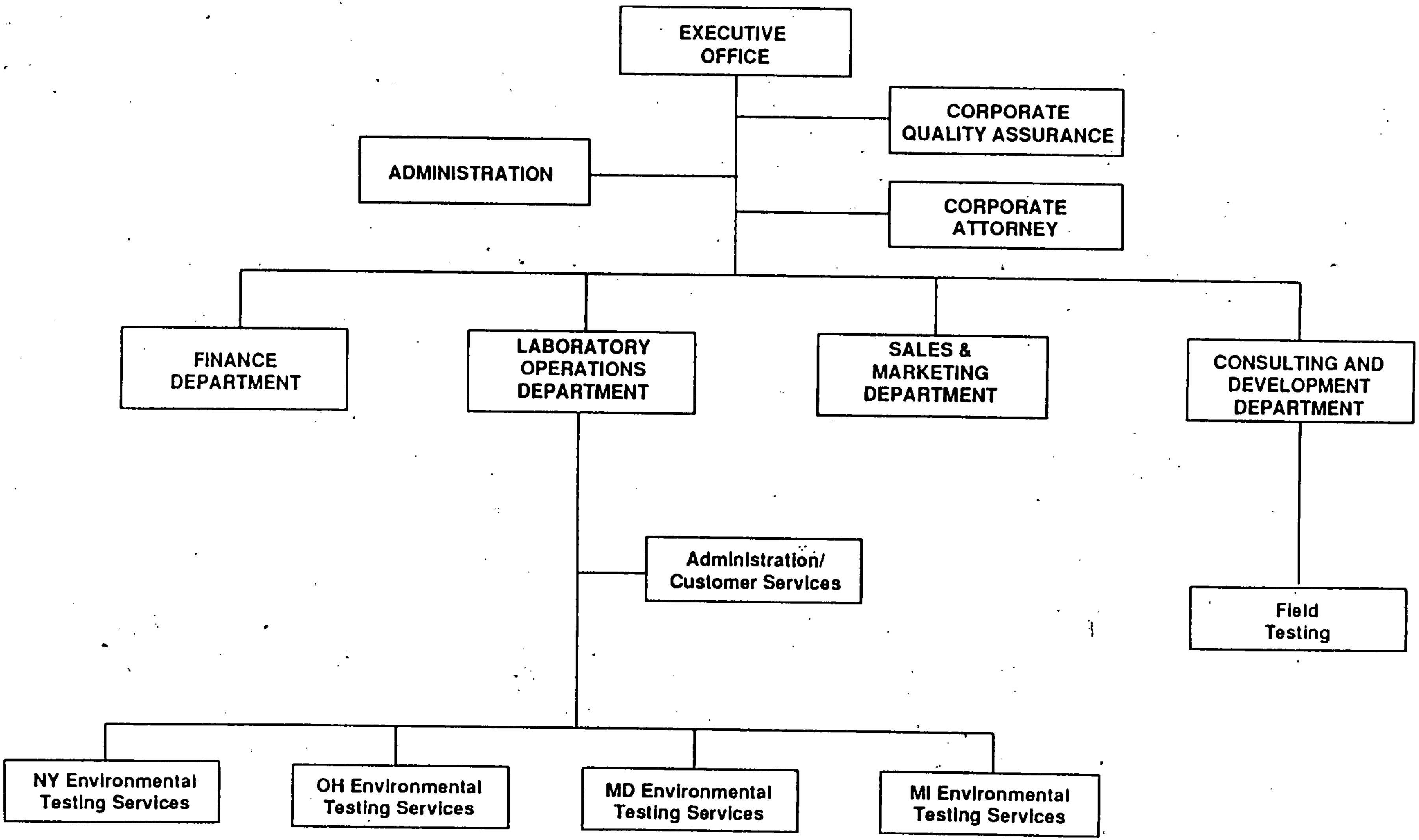
Ohio Testing Laboratory

8001 Sweet Valley Drive
Cleveland, OH 44125
(216) 328-9510

Michigan Testing Laboratory

23963 Research Drive
Farmington Hills, MI 48024
(313) 442-0450

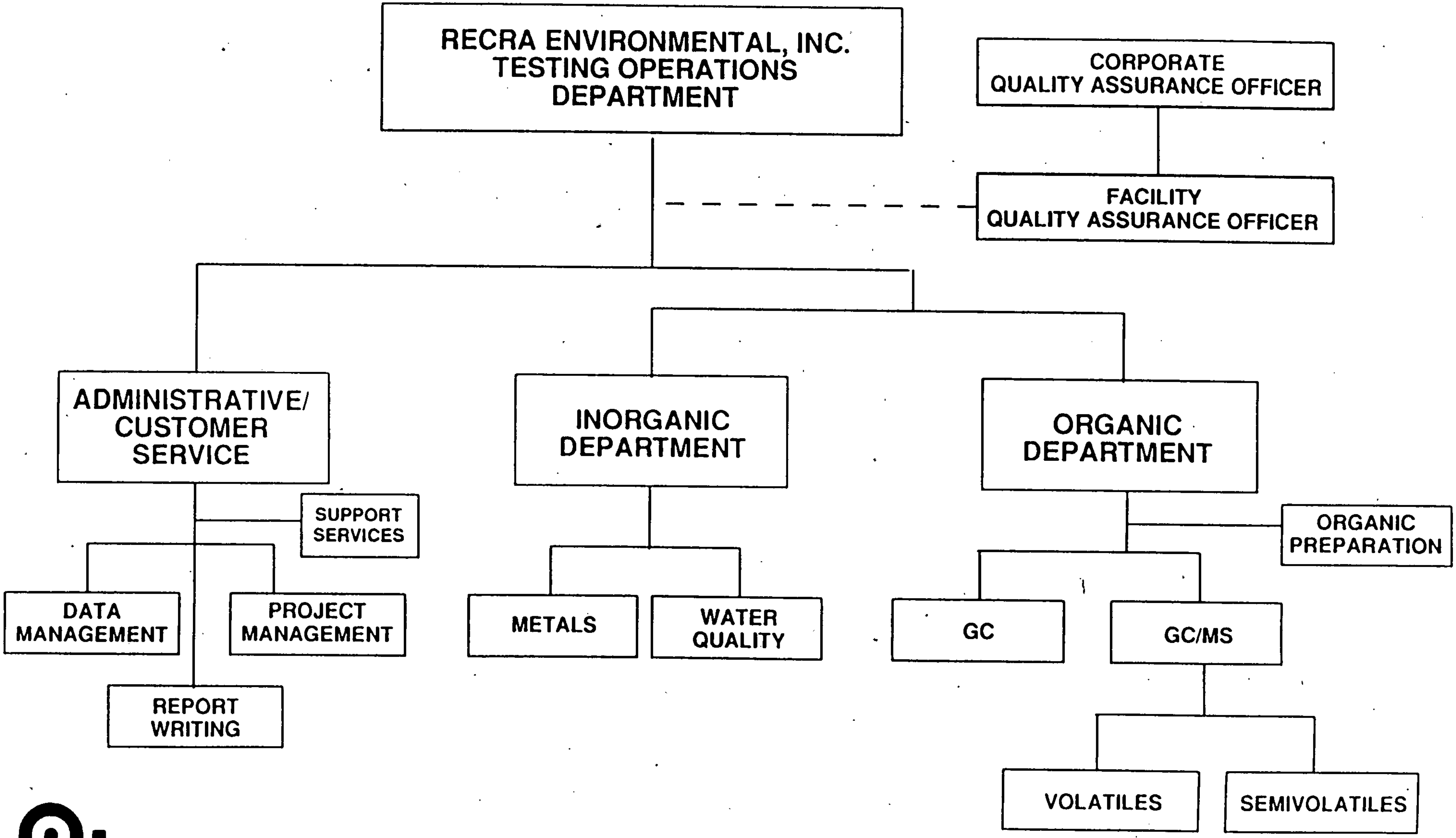
Figure 4-1
RECRA ENVIRONMENTAL, INC.
ORGANIZATIONAL CHART



SEE ATTACHMENT 2

Figure 4-2

Recra Environmental, Inc.
Generalized Laboratory Organization



5. DATA QUALITY OBJECTIVES

Data quality objectives with regard to Recra's environmental testing services are described in terms of accuracy, precision, completeness, representativeness, and comparability. General definitions of these terms follow:

- **Accuracy** - the degree of agreement of a measurement (or an average of measurements of the same thing), X, with an accepted reference or true value, T, usually expressed as the absolute value of the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100 (1X-T1)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system.

  For purposes of the Recra QA Plan, the determination will be made as percent (%) recovery of known constituent additions (spikes).

- **Precision** - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is expressed in terms of standard deviation. Various measures of precision exist, depending upon the "prescribed similar conditions".

For purposes of the Recra QA Plan, the coefficient of variation (a measure of standard deviation) can also be used as a measure of precision. Relative percent difference is also used for compliance with certain methodologies. Experience has shown that, based upon the wide range of concentrations found in laboratory samples, the "normalization" of precision data by use of the coefficient of variation can accommodate data review activities.

- **Completeness** - a measure of the amount of valid data obtained from a measurement system, compared to the amount that was expected to be obtained under correct normal conditions.

  Generally, the established criteria at Recra for completeness is minimally 90%. In specific cases or investigations however, where matrices include soils and leachates, completeness criteria on a project specific basis as presented in project specific quality assurance plan or quality assurance project plan (QAPjP) of less than 90% are being utilized.

  Representativeness - expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

  Comparability - expresses the confidence with which one data set can be compared to another.

Comparability of data sets is a function of numerous variables. These variables include laboratory errors and biases, and the representativeness of the samples, and the inherent "population variance" within the data set of which the samples are a part. Comparability, in a general sense, is valuable but is difficult to apply with any certainty, confidence or specificity. Representativeness of data is a function of both field and laboratory variance. The field variance is often greater than 80% of the overall variance between results. The remaining 20% or less of the variance in the data is attributable to both systematic and random laboratory error which, to the extent possible, is controlled by the QA/QC activities illustrated within (and measured by) the precision and the accuracy of the analysis.

6. SAMPLING PROCEDURES

The quality of data can be greatly effected by sample collection activities. If the integrity of collected samples is for some reason in question, the data will also be in question regardless of its analytical quality. Recra operates a separate field testing department, which under its own standard operating procedures, is responsible for the collection of samples representative of the matrix being investigated. If the reader is interested in these standard operating procedures and what measures Recra takes to insure sample integrity, a copy of those procedures is available upon request.

From an analytical perspective, the following procedures are followed to insure the integrity of the samples:

- Upon collection, samples are placed in the proper containers. In general, samples collected for organic analysis are placed in pre-cleaned, glass containers, and samples collected for inorganic analysis are placed in precleaned plastic (polyethylene) bottles.
- Samples are properly and appropriately preserved in order to minimize loss of the constituent(s) of interest due to physical, chemical or biological mechanisms.

- Appropriate volumes must be collected to insure that method or contract required detection limits (or quantification limits) can be successfully obtained and that the required level of quality control relative to both precision and accuracy can be completed.
- Samples must be shipped in a timely fashion so that holding-times and/or analysis times as prescribed by the methodology can be met. Samples must also be shipped in containers which will preserve the refrigeration temperature for those parameters for which such refrigeration is required in the defined preservation protocols.

Table 6-1 lists the volume requirements, preservation protocols, container types and holding-times applicable to common analyses. It must be pointed out that the information presented in this table may vary dependent upon the requirements of given programs, matrices, special methods, clients, or governmental agency protocols. Recra personnel can provide consultation and assistance in this regard, should such assistance be required.

Table 6.1 (page 1 of 4)
Recra Environmental, Inc.
Recommended Sample Preservation/Storage and Holding Times

PARAMETER DESCRIPTION	MINIMUM SAMPLE VOLUME SOLID/LIQUID		CONTAINER TYPE SOLID/LIQUID		PRESERVATIVE LIQUID SAMPLES	HOLDING TIME
Acidity		100 mls		250 ml HDPE	Cool 4°C	14 days
Alkalinity		100 mls		250 ml HDPE	Cool 4°C	14 days
Ammonia		500 mls		1 L HDPE	Cool 4°C, $H_2SO_4 < 2$	28 days
Biochemical Oxygen Demand		1 L		2 L HDPE	Cool 4°C	48 hours
Bromide		100 mls		250 ml HDPE	None Required	28 days
Chemical Oxygen Demand		50 mls		125 ml HDPE	Cool 4°C, $H_2SO_4 < 2$	28 days
Chloride		50 mls		125 ml HDPE	None Required	28 days
Chlorine, Total Residual		200 mls		500 ml HDPE	None Required	Analyze Immediately
Color		50 mls		125 ml HDPE	Cool 4°C	48 hours
Cyanide, Total and Amenable	10 gms	500 mls	1 L BR	1 L HDPE	0.6 gms ascorbic acid NaOH to pH 12	14 days
Fluoride		300 mls		500 ml HDPE	None Required	28 days
Hardness		100 mls		250 ml HDPE	HNO_3 or $H_2SO_4 < 2$	6 months
Hydrogen Ion (pH)	100 gms	25 mls	4 oz CWM	60 ml HDPE	None Required	Analyze Immediately
Kjeldahl and Organic Nitrogen		500 mls		1 L HDPE	Cool 4°C, $H_2SO_4 < 2$	28 days
Chromium VI	10 gms	100 mls	8 oz CWM	250 ml HDPE	Cool 4°C	24 hours
Mercury	10 gms	100 mls	8 oz CWM	250 ml HDPE	$HNO_3 < 2$	28 days
Metals (except Mercury and Chrome VI)	10 gms	200 mls	16 oz BR	500 ml HDPE	$HNO_3 < 2$	6 months
Nitrate		100 mls		250 ml HDPE	Cool 4°C	48 hours
Nitrate + Nitrite		100 mls		250 ml HDPE	Cool 4°C, $H_2SO_4 < 2$	28 days
Nitrite		50 mls		125 ml HDPE	Cool 4°C	48 hours
Oil and Grease	10 gms	1 L	8 oz CWM	2 L CWM	Cool 4°C, $H_2SO_4 < 2$	28 days
Organic Carbon	10 gms	25 mls	8 oz CWM	125 ml HDPE	Cool 4°C, $H_2SO_4 < 2$	28 days
Orthophosphate		50 mls		125 ml HDPE	Cool 4°C, Filter immed.	48 hours
Oxygen, Dissolved		300 mls		500 ml glass	Store in dark	8 hours

Table 6.1 (page 2 of 4)
Recra Environmental, Inc.
Recommended Sample Preservation/Storage and Holding Times

PARAMETER DESCRIPTION	MINIMUM SAMPLE VOLUME SOLID/LIQUID	CONTAINER TYPE SOLID/LIQUID	PRESERVATIVE LIQUID SAMPLES	HOLDING TIME
Phenols, Total	500 mls	1 L BR	Cool 4°C, H2SO4 <2	28 days
Phosphorus, Total	50 mls	125 ml HDPE	Cool 4°C, H2SO4 <2	28 days
Residue, Total	100 mls	250 ml HDPE	Cool 4°C	7 days
Residue, Filterable	100 mls	250 ml HDPE	Cool 4°C	7 days
Residue, Non-filterable	100 mls	250 ml HDPE	Cool 4°C	7 days
Residue, Settleable	1 L	2 L glass	Cool 4°C	48 hours
Residue, Volatile	100 mls	250 ml HDPE	Cool 4°C	7 days
Silica	50 mls	125 ml HDPE	Cool 4°C	28 days
Specific Conductance	100 gms 100 mls	8 oz GWM 250 ml HDPE	Cool 4°C	28 days
Sulfate	50 mls	125 ml HDPE	Cool 4°C	28 days
Sulfide	100 gms 500 mls	8 oz GWM 1 L HDPE	NaOH to pH 9, Zn Acetate	7 days
Sulfite	50 mls	125 ml HDPE	None Required	Analyze Immediately
Surfactants	250 mls	500 ml HDPE	Cool 4°C	48 hours
Temperature	1 L	2 L HDPE	None Required	Analyze Immediately
Turbidity	100 mls	250 ml HDPE	Cool 4°C	48 hours
Purgeable Halocarbons	5 gms 40 mls	4 oz GWM 40 ml GV	Cool 4°C, .008% Na2S2O3	14 days
Purgeable Aromatic Hydrocarbons	5 gms 40 mls	4 oz GWM 40 ml GV	HCl 2 Cool 4°C, .008% Na2S2O3	14 days
Acrolein and Acrylonitrile	5 gms 40 mls	4 oz GWM 40 ml GV	pH 4.5 Cool 4°C, .008% Na2S2O3	14 days
Phenols	10 gms 1 L	8 oz GWM 2.5 L AGJ	Cool 4°C. .008% Na2S2O3	7 days until extraction 40 days until analysis
Benzidines	10 gms 1 L	8 oz GWM 2.5 L AGJ	Cool 4°C, .008% Na2S2O3	7 days until extraction 40 days until analysis
Phthalate Esters	10 gms 1 L	8 oz GWM 2.5 L AGJ	Cool 4°C	7 days until extraction 40 days until analysis
Nitrosamines	10 gms 1 L	8 oz GWM 2.5 L AGJ	Cool 4°C, .008% Na2 S2O3	7 days until extraction 40 days until analysis
PCBs	10 gms 1 L	8 oz GWM 2.5 L AGJ	Cool 4°C	7 days until extraction 40 days until analysis
Nitroaromatics and Isophorone	10 gms 1 L	8 oz GWM 2.5 L AGJ	.008% Na2 S2O3 Store in dark, Cool 4°C	7 days until extraction 40 days until analysis

Table 6.1 (page 3 of 4)

Recra Environmental, Inc.

Recommended Sample Preservation/Storage and Holding Times

PARAMETER DESCRIPTION	MINIMUM SAMPLE VOLUME SOLID/LIQUID		CONTAINER TYPE SOLID/LIQUID		PRESERVATIVE LIQUID SAMPLES	HOLDING TIME
Polynuclear Aromatic Hydrocarbons	10 gms	1 L	8 oz CWM	2.5 L AGJ	.008% $Na_2S_2O_3$ Store in dark 4°C	7 days until extraction 40 days until analysis
Haloethers	10 gms	1 L	8 oz CWM	2.5 L AGJ	Cool 4°C, .008% $Na_2S_2O_3$	7 days until extraction 40 days until analysis
Chlorinated Hydrocarbons	10 gms	1 L	8 oz CWM	2.5 L AGJ	Cool 4°C	7 days until extraction 40 days until analysis
Chlorinated Herbicides	10 gms	1 L	8 oz CWM	2.5 L AGJ	Cool 4°C	7 days until extraction 40 days until analysis
Dioxins and Furans	10 gms	1 L	8 oz CWM	2.5 L AGJ	Cool 4°C, .008% $Na_2S_2O_3$	7 days until extraction 40 days until analysis
TOX	10 gms	250 mls	4 oz CWM	1 L BR	Cool 4°C, H_2SO_4 <2	7 days until extraction 40 days until analysis
Pesticides, Chlorinated	10 gms	1 L	8 oz CWM	2.5 L AGJ	Cool 4°C, pH 5.9	7 days until extraction 40 days until analysis
Nonhalogenated Volatiles	5 gms	40 mls	4 oz CWM	40 ml GV	Cool 4°C	14 days
Volatile Organics	5 gms	40 mls	4 oz CWM	40 ml GV	Cool 4°C	14 days
Semi-volatile Organics	10 gms	1 L	8 oz CWM	2.5 L AGJ	Cool 4°C	7 days until extraction 40 days until analysis
EP TOX Extraction	100 gms		32 oz AWM		None	7 days until extraction 40 days until analysis
TCLP Extraction	100 gms		32 oz AWM		None	14 days

Table 6.1 (continued)
page 4 of 4

Storage Containers:

AGJ	Amber Glass Jug
AWM	Amber Wide Mouth
BR	Boston Round
CWM	Clear Glass Wide Mouth
GV	Glass Vial
HDPE	High Density Polyethylene

It should be noted that this table is to be used only as a guideline, and that the requirements for preservation, storage and holding times may vary per protocol, individual method and/or regulatory requirements.

7. SAMPLE CUSTODY PROCEDURES

Recra's chain-of-custody procedures are based upon the National Environmental Information Center (NEIC) policies and procedures (EPA-330/9-78-001-R). A full-time sample custodian is assigned the responsibility of sample control for the laboratory. It is the responsibility of the sample custodian to receive all incoming samples at the laboratory. Once received, the custodian insures that all samples are received in good condition (i.e., unbroken, cooled, etc.), that the associated paperwork, such as chain-of-custody sheets are completed and signs the chain-of-custody forms (Figure 7-1). The custodian will also insure that the samples are appropriately subsampled and preserved properly for the specific parameters of interest, consistent with the applicable program or protocols if such splitting and preservation procedures were not previously accomplished. Documentation is maintained for all inter- and intra-laboratory sample tracking by the laboratory sample custodian. If samples are received after the custodian has finished his work shift, designated second or third shift personnel will inspect and take possession of samples, and sign the chain-of-custody forms.

The sample custodian will then place the samples into secure, limited access storage (refrigerated storage if required).

Consistent with the analyses requested on the chain-of-custody form or other documentation, analyses by laboratory analysts will begin in accordance with the appropriate methodologies. Samples are removed from storage only after internal chain-of-custody sign-out procedures are followed.

All remaining sample (and empty sample bottles when the available volume is consumed by the analysis) are returned to secure and limited access storage. Upon completion of the entire analytical work effort, samples are ultimately disposed of by the sample custodian. The length of time that samples are held is thirty (30) days after reports are submitted to the client, or a period of time consistent with specific contract terms and conditions. Whenever possible, samples of a hazardous nature or the remaining sample(s) are returned to the client or the clients designee.

Sample or sample bottle disposal only occurs upon approval of the Laboratory Director. All empty sample bottles are disposed of as non-hazardous solid waste consistent with sample exclusion and empty container provisions of RCRA. All liquid and solid samples requiring disposal are reviewed prior to authorization for disposal. If the samples are hazardous by characteristic (reactive, corrosive, ignitable or toxic) or are a TSCA/PCB waste, appropriate controlled disposal is accomplished. Recra is a permitted generator of hazardous wastes and has disposal contracts with all necessary types of subtitle-C TSDF facilities. Full documentation of each step of the disposal process, consistent with the requirements of RCRA, are monitored by Recra's Environmental Health and Safety Officer.

For other non-characteristically hazardous or non-TSCA materials, Recra will review the available analytical results for the samples in question and dependent on the presence of and concentration of hazardous constituents will either dispose of materials as hazardous wastes, or exercise its options to dispose of the materials as non-hazardous waste based upon the laboratory sample exclusion provisions of RCRA.

igu 7-1

RECRA ENVIRONMENTAL, INC.

CHAIN OF CUSTODY RECORD

PROJECT NO	**SITE NAME**
SAMPLERS (SIGNATURE)	

STATION NO	DATE	TIME	COMP	GRAB	STATION LOCATION	NO OF CONTAINERS							REMARKS

RELINQUISHED BY (SIGNATURE)	DATE TIME	RECEIVED BY (SIGNATURE)	RELINQUISHED BY (SIGNATURE)	DATE TIME	RECEIVED BY (SIGNATURE)	
RELINQUISHED BY (SIGNATURE)	DATE TIME	RECEIVED BY (SIGNATURE)	RELINQUISHED BY (SIGNATURE)	DATE TIME	RECEIVED BY (SIGNATURE)	
RELINQUISHED BY (SIGNATURE)	DATE TIME	RECEIVED FOR LABORATORY BY (SIGNATURE)	DATE TIME	REMARKS		

Distribution: Original accompanies shipment; copy to coordinator field files.

8. CALIBRATION PROCEDURES AND FREQUENCY

Paramount to successful analysis of environmental samples is standardization, in one form or another, of all of the materials and equipment used in completion of the analysis.

Critical to the standardization process is the use of materials of known purity and quality, and the traceability of standard solutions and reagents used in the testing procedures and protocols. Recra carefully monitors the use of all laboratory materials including solutions, standards and reagents through well-documented procedures.

All solid chemicals and acids/bases used by Recra are reagent grade or better. All gases are high purity or better. All standards or standard solutions are obtained from the U.S. Environmental Protection Agency or from reliable commercial sources. All Standard Reference Materials or Performance Evaluation Materials are obtained from the National Institution of Standards and Technology (formerly National Bureau of Standards) or reliable commercial sources.

All materials including standards or standard solutions are logged upon receipt, and are identified by material name, lot number, purity and/or concentration, supplier, receipt/preparation date, recipient/preparers name, expiration date and all other pertinent information. All primary standards are traceable to their source of generation and to certification of purity and solution concentrations provided by the manufacturer.

Standards or standard solutions are validated prior to use. This validation may take the form of supplier certifications. This validation may also be restandardization for acids or bases, response factor comparison, standard curve response, or comparison to other standards made at a different time or by a different analyst. All standards and standard materials are routinely checked for signs of deterioration including unusual volume changes (solvent loss), discoloration, formation of precipitates, changes in analyte response or simply age. All standards and standard solutions are properly stored and handled, and are labelled with all appropriate information including compound/solution name, concentration, solvent, expiration date, preparation date and initials of preparer.

All solvent materials or materials used as a part of a given procedure are also checked. Each new lot of solvent is analyzed to insure the absence of interfering constituents. Reagent and method blanks are routinely analyzed to protect against laboratory based contamination of the samples.

Analytical instrumentation available at Recra's facilities includes a wide variety of equipment. Table 8-1 illustrates some of the primary instrumentation and equipment at the Recra facilities.

Each laboratory employs computer software for the generation of analytical data. Our GC/MS systems use Finnigan Formaster to reduce the data and for the generation of report forms. The GC instrumentation also utilizes the Formaster software plus Nelson Turbochrome. Ward software has been installed for the metals department, and water quality data requires manual entry into a data base system.

Instruments are calibrated in order to assure that they are operating correctly and that method required criteria can be met. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the method being performed. System responses for midpoint standards are recorded in a standards response log. To a large extent, calibration considerations such as frequency of calibration or re-calibration, linear ranges, minimum concentrations, and use of specific selected constituents are determined by the manufacturer, the analytical method, or by contractual requirements.

Since calibration procedures and frequencies vary by type of instrumentation system, (GC/MS, GC, atomic absorption spectrophotometer, and inductively coupled plasma spectrometer), each are addressed individually in the following paragraphs.

Gas Chromatograph/Mass Spectrometer/Data System (GC/MS/DS)

The mass spectrometer (MS) is tuned prior to each analytical event and verified after twelve hours of continuous operation, or consistent with the method being performed. The tuning is accomplished using DFTPP or BFB (as appropriate) according to EPA procedures. The tuning and mass calibration/ion abundance criteria are maintained on file.

Initial standard curves consist of at least five levels within the dynamic range of the analytical system. Recalibration of initial standard curves are completed when method criteria is not compliant or at a minimum, monthly. All compounds of interest will have ≤25% Relative Standard Deviation (RSD) of the response factors of the initial standard curve or a Pearson (R) correlation coefficient of ≤0.995 or criteria consistent with the method being performed, before analysis can begin. After initial calibration and ten sample analyses or after twelve hours, a mid-point standard must be analyzed to verify continued calibration. For analysis to continue, the response for every analyte of interest must not vary by more than the method defined criteria or ±20%. In the event calibration criteria are not met, a new calibration curve must be prepared for that compound(s).

For volatile organics, surrogates are used to verify recovery of the constituents of interest from purge and trap GC/MS systems. Quantitation is accomplished via internal standardization techniques.

For semi-volatile organics, numerous surrogates characteristic of the constituents of interest are added to the sample prior to extraction to assess the accuracy of the procedure. Internal standards are also added to all extracts and calibration solutions immediately before analysis for purposes of quantification.

Various blanks are analyzed with each group of samples to assess potential contamination or interferences.

Surrogates and internal standards are added to all samples and standards and their responses are monitored with each analysis as well as being reported, in summary form, on a daily basis. When all GC/MS analyses are completed, the extracted ion currents of the characteristic ions of the recovery and internal quantitation standards are profiled.

Gas Chromatographs

After determination of acceptable chromatograph resolution, detector sensitivity and chromatographic performance, calibration curves are generated from the analysis of pure compounds at known concentrations covering the dynamic range within each analysis group. Recalibration of initial standard curves are completed when method criteria is not compliant or monthly. All compounds of interest will have ≤20% Relative Standard Deviation (RSD) of the response factors of the initial standard curve, a Pearson (R) correlation coefficient of ≥0.995 or criteria consistent with the method being performed, before analysis can begin. At the beginning of each new run and/or ten sample analyses, a mid-point standard must be analyzed to verify continued calibration. For analysis to continue, the response for every analyte of interest must not vary by more than the method defined criteria or ±15%. In the event calibration criteria are not met, a new calibration curve must be prepared for that compound(s).

The laboratory must calculate retention time windows for each standard on each GC column and whenever a new GC column is installed as outlined below. This data is documented and retained on file at each applicable facility.

Three injections of all single component standard mixtures and multi-response components are injected throughout the course of a 72-hour period. The standard deviation of the three absolute retention times for each single component standard is calculated. After selection of one major peak for the multi-response compounds, the standard deviation of the three retention times for that peak is calculated. The acceptable retention time window is defined as plus or minus three times the standard deviation of the absolute retention times for each standard. In those cases where the standard deviation for a compound is zero, the laboratory must substitute the standard deviation of a close eluting, similar compound to develop a valid retention time window.

The establishment of daily retention time windows is accomplished by using the absolute retention time of each analyte from the daily standard as the midpoint of the window for that day. The daily retention time window equals the midpoint plus or minus three times the previously determined standard deviation.

If any of the continuing calibration standards fall outside this daily retention time window, the system is out of control. The cause of the problem must be determined and corrected.

Various blanks are analyzed with each group of samples to assess potential contamination or interferences.

Surrogates are added to all samples and standards and their responses are monitored with each analysis as well as being reported, in summary form, on a daily basis.

Atomic Absorption Spectrophotometer/Plasma Spectrometer

Prior to the determination and the concentration of a particular metal in a sample, the instrument must be calibrated. This is first accomplished by a minimum of two (furnace) or three (flame) instrument manufacturer standards. The ICP calibration consists of a standard and a blank.

The instrument calibration is then verified with an initial calibration verification (ICV) standard which cannot vary by more than ± 10% from its' true value.

A five point calibration curve is then generated to encompass the expected sample concentrations. Acceptable criteria includes a Pearson Correlation coefficient of ≥ 0.995 and the Y intercept less than the detection limit consistent with the specific method.

To ensure calibration is within acceptable criteria, a continuing calibration verification (CCV) standard must be analyzed at a frequency of 10% and after the last analytical sample. The results of the CCVs cannot vary by more than ± 10%.

If the results of the ICV or CCV deviate from the control limits, the analysis must be stopped, the problem corrected, the instrument recalibrated, the calibration verified; reanalysis of the preceding ten analytical samples or all samples analyzed since the last acceptable calibration verification must then occur.

Spectrometer/Colorimeter

Initial calibration consists of a daily five point curve that encompasses the expected range of the analytical samples or the dynamic range of the instrument. The correlation coefficient of this curve must be ≥0.995 and the Y intercept must be less than the method detection limit in order for analysis to begin. A calibration verification sample (CVS) is to be analyzed after each curve to verify calibration and must be within ±10% of its true value or within the manufacturers confidence limits. A continuing calibration verification (CCV) standard, must be analyzed after every ten sample analyses and at the end of the analytical run. The CCV must be within ± 10% of its true value or the analysis is stopped, problem investigated and resolved, and affected sample re-analyzed.

Gravimetric

Calibration of the analytical balance is annually performed by the manufacturer or his authorized representative. Continuing calibration is achieved with daily use of a minimum of three certified "S" weights in the dynamic range of the samples being analyzed or as specified by the method.

Titrimetric

Calibration is accomplished by the standardization of solutions as maintained in the solution log and/or method log books. A calibration verification sample (CVS) is then analyzed to verify calibration and must be within ±10% of its true value or within the manufacturers confidence limits. A continuing calibration verification (CCV) standard, must be analyzed after every ten analyses and at the end of the analytical run. CCV must be within 10% of its true value or the analysis is stopped, problem investigated and resolved, and affected samples re-analyzed.

pH

The pH meter is subject to daily calibration which starts with a 4 or 10 and a 7 pH standard. Next, all 3 calibration standards are read and recorded. The standards must read ± 0.05 of its true value. A calibration verification sample (CVS) is then analyzed to verify calibration and must also be within ±0.05 of the true value or within the manufacturers confidence limits. A continuing calibration verification (CCV) standard, must be analyzed after every ten sample analyses and at the end of the analytical run. CCV must be within 10% of its true value or the analysis is stopped, problem investigated and resolved, and affected samples re-analyzed.

TOC, TOX, TRPH

To insure the instrumentation is in calibration, a five point curve is generated containing concentrations that bracket expected sample values. The correlation coefficient must be ≥ 0.995 and the Y intercept less than the method detection limit before sample analysis may begin.

After the curve criteria is in compliance, a calibration verification sample (CVS) is then analyzed to verify calibration and must be within ±10% of the true value or within the manufacturers confidence limits. A continuing calibration verification (CCV) standard, must be analyzed every ten sample analyses and at the end of the analytical run. CCV must be within 10% of its true value or the analysis is stopped, problem investigated and resolved, and affected samples re-analyzed.

Calibration for other water quality analyses are performed following protocols in the "Methods for Chemical Analysis of Water and Wastes" EPA - 600/4-79-020. A calibration verification sample (CVS) is then analyzed after curve criteria is met to verify calibration and must be within ±10% of the true value or within the manufacturers confidence limits. A continuing calibration verification (CCV) standard, must be analyzed every ten sample analyses and at the end of the analytical run. CCV must be within 10% of its true value or the analysis is stopped, problem investigated and resolved, and affected samples re-analyzed.

TABLE 8-1

RECRA ENVIRONMENTAL, INC.
MAJOR LABORATORY EQUIPMENT
Page 1 of 3

Gas Chromatograph/Mass Spectrometer (GC/MS)

Finnigan Model 5100 SP	3 units
Finnigan Model 3200	1 unit
Finnigan Model INCOS 50	7 units
Hewlett Packard Model 5993B	1 unit
Hewlett Packard Model 5993C	1 unit
Hewlett Packard Model 5970B	6 units

Gas Chromatograph (GC)

Hewlett Packard Model 5840A Electron Capture/Flame Ionization Detectors	1 unit
Hewlett Packard Model 5880 Electron Capture/Flame Ionization Detectors	1 unit
Hewlett Packard Model 5880 Electron Capture Detectors	2 units
Hewlett Packard Model 5890 Electron Capture Detectors	9 units
Hewlett Packard Model 5890 Flame Ionization Detector	2 units
Hewlett Packard Model 5790 Electron Capture Detector	1 unit
Hewlett Packard Model 5890 Series II Electron Capture/Nitrogen Phosphorous Detectors	1 unit
Hewlett Packard Model 5890 Series II Dual Electron Capture Detectors	1 unit
Perkin-Elmer Model 8500 Hall/Photoionization Detectors	2 units
Perkin-Elmer Model Sigma 1 Flame Ionization/Nitrogen Phosphorous Detectors	1 unit
Perkin-Elmer Model Sigma 3 Electrolytic Conductivity Detector	1 unit
Gow-Mac Model 550 Thermal Conductivity Detector	1 unit

TABLE 8-1 (continued)

RECRA ENVIRONMENTAL, INC.
MAJOR LABORATORY EQUIPMENT
Page 2 of 3

Perkin-Elmer Sigma 2000 Hall/Photoionization Detectors	1 unit
Perkin-Elmer Sigma 2000 Electron Capture/Flame Ionization Detectors HS6 Head Space Analyzer	1 unit
Dynatech PTA-30 Auto Samplers	3 units
Tekmar LSC-2 Purge & Trap Sampler	5 units
Tekmar LCS2000 Purge and Trap Sampler	6 units
Tekmar ALS2016 Autosampler	6 units
Tekmar ALS Autosampler	4 units
ABC Industries Gel Permeation Chromotograph UV Detector	2 units
Atomic Absorption Spectrophotometer (AA) Perkin-Elmer Model 5000 - Graphite Furnace	2 units
Zeeman Furnace Atomic Absorption Spectrophotometer Perkin-Elmer Model 5100	3 units
Atomic Absorptiuon Spectophotometer (AA) Perkin-Elmer Model 3100 - Flame	2 units
Inductively Coupled Argon Plasma Spectrometer (ICP) Sequential Perkin-Elmer Plasma 40	1 unit
Inductively Coupled Argon Plasma Spectrometer (ICP) Simultaneous ARL Model 3560	1 unit
Mercury Analyzer System/Cold Vapor Coleman Model MAS-50B	2 units
Shimadzu Total Organic Carbon Analyzer Model AS1-502	1 unit
Shimadzu Total Organic Carbon Analyzer Model 500	2 units

TABLE 8-1 (continued)

RECRA ENVIRONMENTAL, INC.
MAJOR LABORATORY EQUIPMENT
Page 3 of 3

Beckman Carbon Analyzer Model 915A	1 unit
Beckman UV-VIS Spectrometer Model DU-62	1 unit
Shimadzu UV-VIS Spectrometer Model UV-120-02	2 units
Perkin-Elmer UV-VIS Spectrometer Model 200	1 unit
Milton Roy UV-VIS Spectrometer Spectronic 1201	1 unit
Bausch & Lomb Spectrometer Model 20	1 unit
Coleman Spectrometer Model 35	1 unit
Perkin-Elmer IR Spectrometer Model 567	1 unit
Dohrmann Total Organic Halides Analyzer Model DX-20A	1 unit

9. ANALYTICAL PROCEDURES

Most analytical programs performed by Recra's environmental laboratories testing services result from state or federal regulatory or enforcement requirements. Methods most frequently used by Recra therefore originate within these agencies, most notably the U.S. Environmental Protection Agency.

Recra's laboratories participate in the U.S. Environmental Protection Agency CLP Program, have been deemed technically acceptable by the U.S. Army Corps of Engineers, the New York State Department of Environmental Conservation, the New Jersey Department of Environmental Protection, the NY Department of Transportation and are certified by numerous state health or environmental departments as well as those by various industrial concerns.

Consistent with these certification or approval programs, Recra performs a wide variety of test procedures in addition to U.S. Environmental Protection Agency protocols. Some of these methods are distinctly different from EPA procedures while others are merely modifications of EPA methodologies. The following list of referenced analytical methods illustrates those procedures most commonly employed within our laboratories. Recra's capabilities are not limited to this list of methods, however.

- Current U.S. Environmental Protection Agency Contract Laboratory Program (CLP) protocols for analysis of organic (target compound list) and inorganic (target analyte list) hazardous constituents.

- "Test Methods for Evaluating Solid Waste" SW-846, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response
  - (a) 2nd Edition (revised), Update I (1984), Update II (1985)
  - (b) 3rd Edition, with appropriate updates.
- "Guidelines Establishing Test Procedures for the Analysis of Pollutants", 40 CFR 136 (Federal Water Pollution Control Act Amendments of 1972 as amended by the Clean Water Act of 1977), as most recently amended
- "Methods of Chemical Analysis of Water and Wastes", U.S. Environmental Protection Agency, Office of Environmental Monitoring and Support Laboratory, EPA-600/4-79-020, Revised, March 1983.
- "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", U.S. Environmental Protection Agency, Office of Environmental Monitoring and Support Laboratory, EPA-600/4-82-057, July 1982.
- "Methods for the Determination of Organic Compounds in Drinking Waters", U.S. Environmental Protection Agency, Office of Research and Development, Environmental Monitoring Systems Laboratory, EPA-600/4-88/039, December 1988.
- Standard Methods for the Examination of Water and Wastewater, 17th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington, DC, 1989.

- Official Methods of Analysis, 14th Edition, Association of Official Analytical Chemists (AOAC), Arlington, VA, 1984 (or most recent edition)
- Annual Book of ASTM Standards, Section 11, Volumes 11.01, 11.02, 11.03, 11.04, American Society for Testing and Materials (ASTM), Philadelphia, PA, 1988 (or most recent edition).
- "Techniques of Water Resources Investigation of the United States Geological Society", Book 5, Laboratory Analyses, USGC, Washington, DC, 1979.
- "NIOSH Manual of Analytical Methods", 3rd Edition, U.S. Department of Health and Human Services, National Institutes for Occupational Safety and Health, August, 1987.
- "Interim Methods for the Sampling and Analysis of Priority Pollutants in Sediments and Fish Tissue", U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, August 1977, revised 1980.

The selection of analytical methods or protocols is generally a programmatic decision outside of the scope of this document. In general, however, factors such as program objectives, data quality objectives, type of sample matrices, qualitative certainty, quantification sensitivity, precision and accuracy all need to be considered. Methods are routinely documented in standard operating procedures (SOP's) which are available within the laboratory.

Recra's laboratories also have the capabilities to develop new analytical procedures (or modify existing protocols) to meet specific client needs.

10. DATA REDUCTION VALIDATION AND REPORTING

All analytical results generated by Recra's laboratories are reviewed for accuracy, precision and completeness, as well as compliance with other specific contract or method requirements.

The analyst has prime responsibility and accountability for the correctness and completion of his/her data. Each laboratory analyst has responsibility for QA/QC functions at their level and within their assigned tasks. The reduction of data, its validation and the ultimate reporting of results is aided greatly by automated data management systems throughout the laboratories. Figure 10-1 illustrates schematically the organic and inorganic data routines and generalizes the report writing activities. More specifically, the QA/QC function is schematically provided in Figure 10-2. Initial review by the analyst and supervisor is completed in relation to compliance with methodology and acceptability of precision and accuracy results. Review at the supervisor/manager level includes these elements as well as a review of data acceptability based upon internal QC criteria.

Tertiary review occurs within the Analytical Program Office where pertinent information pertaining to each specific analysis (i.e., GC/MS, GC, metals, and water quality) is compiled. The data generated from the GC/MS, GC and metals department through various computer programs, is transferred to the Analytical Program Office. Analytical data forms are then processed and data validation is accomplished. Water quality data is written in log books, verified and manually entered onto data forms. This review activity is accomplished relative to quality of data from each department which is contributing to the overall efforts for the program or job.

After report preparation, the laboratory director and the facility QA officer provide the final review of the data submitted to the client.

Generally, for any and all measurement systems at Recra, the following chronological steps are adhered to at one or more levels of the review process:

- sample receipt;
- sample logging, inventory, chain-of-custody;
- sample splitting and preservation (if required);
- sample storage;
- sample preparation (extraction and/or digestion);
- sample analysis (standard, QC and samples);
- data calculation;
- re-analysis (if and when required) and assessment;
- data review/QC logging;
- report preparation;
- report review/final QC review;
- report issuance/central file maintenance;
- data storage on magnetic tape
- sample archival and/or disposal.

All chromatograms, standards information, QA/QC results, analytical results, appropriate copies of separations or digestion logbooks, injection log book pages, linear regression/graphs, and any other project specific information is maintained in the job/case file and is used for data calculation and final report preparation.

Any one or all of Recra's four specific analytical groups may be involved in the testing activities specific to a given project. The specific means by which each group processes this data is in general agreement with the above steps but is more specifically outlined below.

WATER QUALITY

This group is responsible for the analysis of samples for pH, specific conductance, chloride, total organic carbon, etc. Each of these test procedures utilizes a separate bound data notebook which contains appropriate information such as:

- instrument I.D.
- method utilized
- analysis date
- analyst
- job number
- sample I.D.
- initial volume or weight of sample
- dry weight (for solids only)
- volume distilled
- volume extracted
- sample absorbance from UV-VIS spectrophotometer at the appropriate analytical wavelength
- all appropriate blank information
- all appropriate calibration information
- results of replicate sample analyses
- spike (recovery) determinations
- SRM recovery

- final sample concentrations
- reagent/standard solution ID

With the above information and calculations performed in accordance with the published methods, results are generated and verified. Data and associated QA/QC from the logbook is reviewed by all appropriate levels of laboratory operations and upon approval is sent to the Analytical Program Office for purposes of report preparation.

METALS

In a similar fashion, the metals department enters the following information into separate bound notebooks or into computer systems:

- methodology (analysis and digestion)
- analysis date
- instrument I.D.
- analyst
- job number
- sample I.D.
- initial volume or weight of sample
- final volume after digestion (if required)
- background absorbance or emission readings from the AA or ICP respectively for each sample per metal
- absorbance or emission readings from the AA or ICP for each sample per metal
- all required blank information
- all appropriate calibration information
- absorbance/concentration readings for all replicate samples

- absorbance/concentration readings for all pre-spike/post-spike samples
- absorbance/concentration readings for all standard reference material
- solutions/reagents I.D.

With the above information and calculations performed in accordance with the published methods, results are generated and verified. Data and associated QA/QC from the logbook(s) is reviewed by all appropriate levels of laboratory operations and upon approval is sent to the Analytical Program Office for purposes of report preparation.

GAS CHROMATOGRAPHY (including separations laboratory)

The sample processing begins in the separations laboratory where a bound notebook is maintained for the purpose of recording all pertinent information regarding the extraction and clean-up (if required) for the samples. This logbook contains the following data:

- analyst
- methodology (extraction)
- extraction date
- surrogate additions
- job number
- sample blank/I.D.
- extracted volume or weight of sample
- final concentration volume
- extraction/concentration holding time compliance with protocol
- vial number (for extracts produced)
- analysis type (BN, AP, Pest.)

- glassware set where appropriate
- I.D. of QC samples with MS/MSD/SRM, etc.
- cleanup
- solvent/reagent I.D.

The above information is required for either GC or GC/MS analyses. The addition of "glassware sets", where appropriate, has proved useful. Within a laboratory such as Recra's, which is involved in the analysis of waste samples or contaminated aqueous samples, the glassware set information allows for identification of one specific area in which potential quality control problems may be found.

After samples have been prepared for analysis by the separations group, the GC department uses a series of logs, reporting forms and computer software to maintain the necessary data. The first is the bound injection log which contains the following:

- analyst
- instrument I.D.
- injection date
- job number
- sample I.D./vial number
- instrument run number
- method number (specific column and instrument conditions for the particular analyses)
- detector used

With the above information and calculations performed in accordance with the published methods, results are generated and verified. Data and associated QA/QC from the logbook(s) is reviewed by all appropriate levels of laboratory operations and upon approval is sent to the Analytical Program Office for purposes of report preparation.

GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

Regarding the analysis of base neutral, acid-phenolic, volatile priority pollutant, HSL compounds and pesticide/PCB confirmation (by CLP or non-CLP methods) separate bound injection logs are again employed.

A bound injection log is maintained for each of Recra's GC/MS units and contains the following information:

- method
- instrument I.D.
- analysis date/time
- analyst
- computer file number
- sample I.D. and extract vial number
- job number/case number
- injected volume
- appropriate separations laboratory information
- dilution factors
- column I.D.
- internal standard retention time and % recoveries
- surrogate recoveries

With the above information and calculations performed in accordance with the published methods, results are generated and verified. Data and associated QA/QC from the logbook is reviewed by all appropriate levels of laboratory operations and upon approval is sent to the Analytical Program Office for purposes of report preparation.

FIGURE 10-1

AUTOMATED ANALYTICAL REPORT WRITING

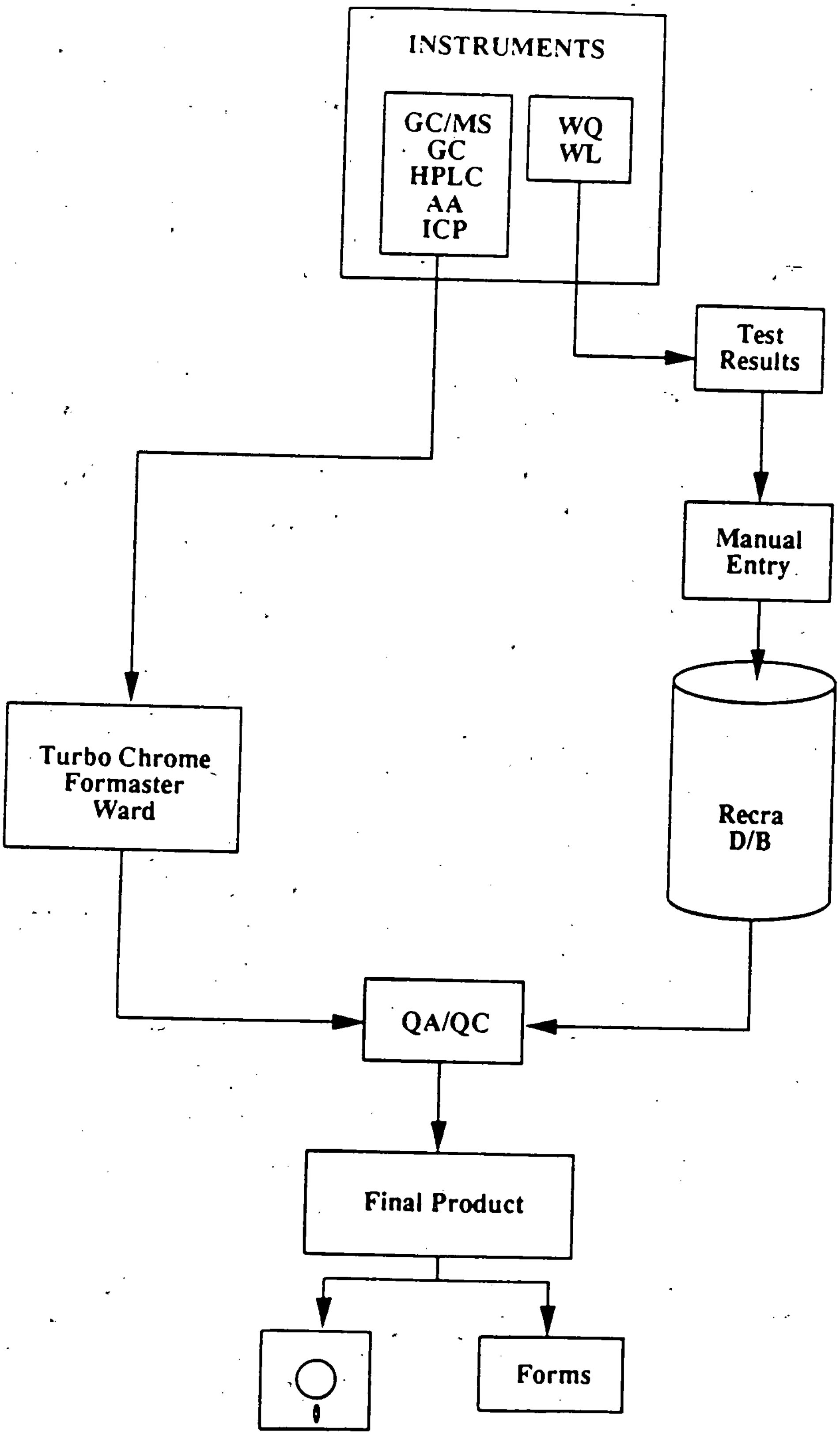
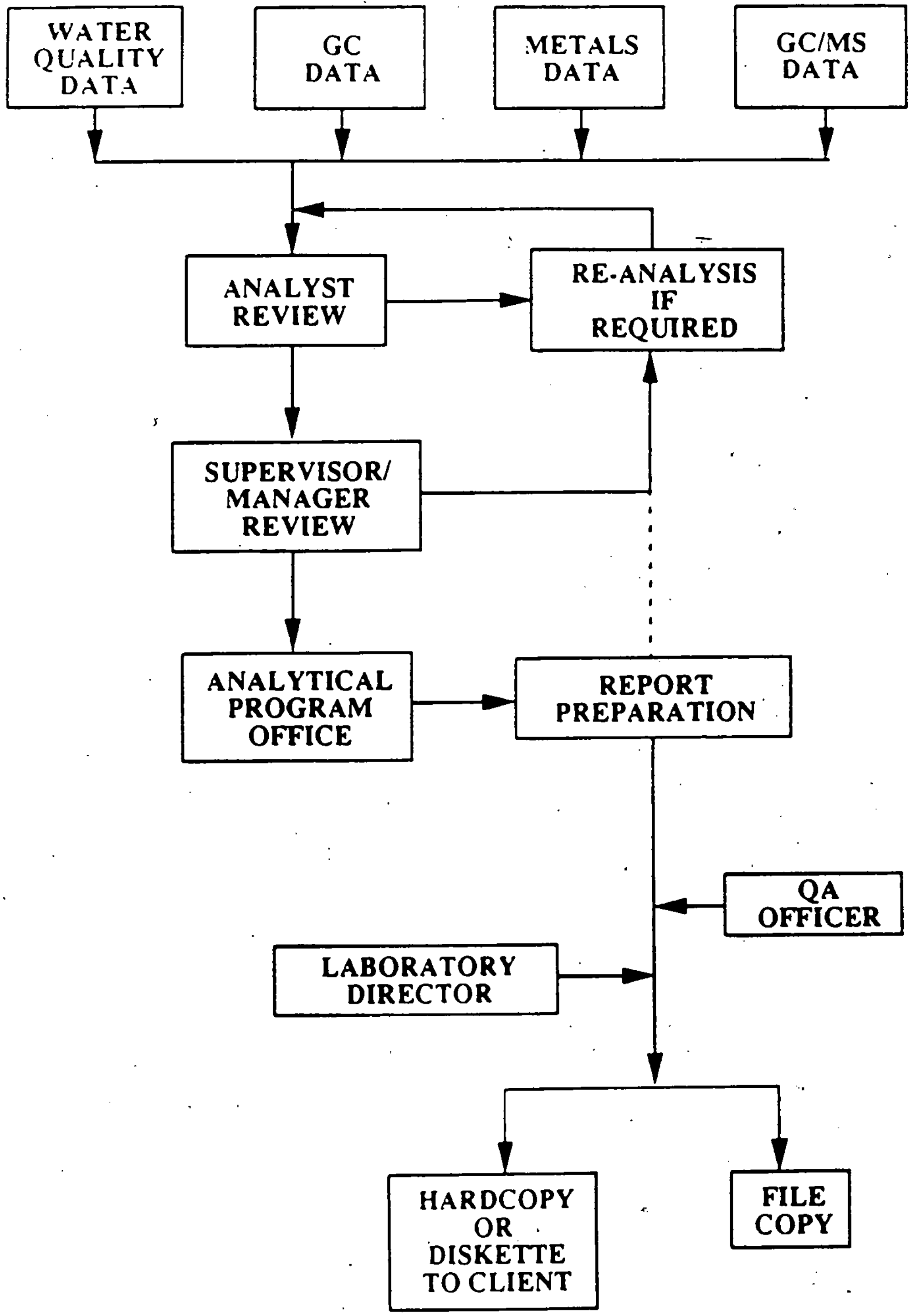


FIGURE 10-2
QA/QC PROCESS



11. INTERNAL QUALITY CONTROL CHECKS

As previously described steps are taken by Recra to insure the quality of our analytical results, including measures such as proper sampling techniques, appropriately cleaned sample and reagent bottles (either cleaned by the laboratory or purchased as "certified clean"), proper sample identification and logging, applicable sample preservation and storage. Additionally the use of controlled materials, standards reagents or solvents all contribute to maintenance of overall laboratory control.

One control issue not yet discussed is the use of laboratory glassware. Organic glassware is cleaned according to the following procedure:

1. rinsed with final solvent immediately after use,
2. hot detergent wash,
3. hot tap water rinsed (3 times),
4. DI water rinsed (3 times),
5. rinsed with reagent grade acetone, and
6. rinsed with pesticide grade hexane or methylene chloride, depending upon methodology, just prior to use

Glassware used for metals analysis is cleaned according to the following procedure:

1. hot detergent wash,
2. hot tap water rinse (3 times),
3. DI water rinse (3 times),
4. 1:1 nitric acid-water mixture rinse, and
5. final rinsing is accomplished with copious quantities of deionized water

Water Quality/Wet Chemistry Glassware is cleaned according to the following procedures:

1. hot detergent wash,
2. hot tap water rinse (3 times), and
3. DI water rinse (3 times)

Additional cleaning with appropriate agents including, but not necessarily limited to, chromic, nitric or hydrochloric acid may be necessary for extremely dirty glassware.

Internal quality control checks include analysis of method or preparation blanks to monitor the potential introduction of contaminants into the preparation or analytical process. The frequency of these blanks for both organic and inorganic analysis is one per sample set or five percent.

Additional blanks which monitor a variety of processes include trip blanks (VOA only), field blanks, holding blanks (VOA only) and solvent/reagent blanks. The field (rinse) and trip blanks are considered by the lab to be samples and will be analyzed as received. Trip blanks only pertain to volatile organics. Holding blanks also pertain to volatile organics only and will be analyzed one per SDG or five percent. Organic solvent/reagent blanks are analyzed once per lot whereas inorganic solvent/reagent blanks are run once per sample set.

As per the requirements of select methods, initial calibration blanks (ICB) and continuing calibration blanks (CCB) must be completed to insure compliance with protocols.

Organic and inorganic blanks must contain less than the MDL or CRDL of all analytes of interest unless otherwise dictated by protocol or as stated in Section 16 of this manual.

Accuracy and precision are two criteria used to evaluate the quality of generated data.

Accuracy is a measure of the ability of a laboratory to determine the true concentration of a constituent in a sample and the correctness of data. Three means used to insure accuracy are recovery surrogates, matrix spikes/matrix spike duplicates (MS/MSD), and standard reference materials (SRMs); each being measured, documented and maintained separately.

The second criterion is precision. Precision is a measure of the reproducibility of the data. MS/MSD and/or sample and sample duplicate are used to establish precision.

In order to assess the quality of the data, both criteria must be defined. Precision and accuracy charts are maintained for specific parameters as described in the EPA handbook or NYS ELAP manual. Actual criteria is defined by method protocol or method performance.

Organic analysis of drinking water require ten percent matrix spikes (MS) and ten percent matrix duplicates (MD). The ten percent spiking requirement should be met with an equivalent number of matrix spike duplicates (MSD). If there are less than ten samples analyzed, the laboratory must analyze a MS, MSD, and a MD once per set or once per month. All other protocols require one MS and MSD per analytical batch or five percent. The CLP defined spiking solution is used. Additionally, a monthly matrix spike containing all analytes of interest for the 600 and 500 series methods are analyzed.

Inorganic CLP samples require a MS and MD at a frequency of ten percent each. All other protocols (SW-846, 40 CFR 136), will incorporate a MS and MSD or MD at a frequency of one per batch or five percent each. Post spikes will be analyzed when pre spikes fail criteria, or consistent with specific protocols.

Accuracy, as measured by percent recovery for matrix spikes/matrix spike duplicates as well as surrogates, internal standards and standard reference materials, is charted. The percent recovery is the amount of the compound recovered from the sample compared to the amount added. The percent recovery of an analyte is an indication of the accuracy of an analysis and is expressed on an accuracy chart.

The accuracy chart presented in Figure 11-1 was developed by determining the mean percent recovery of Fluoride in a series of typical water samples. Percent recovery is calculated as follows:

$$\%\ \text{Recovery} = \frac{\text{Spiked Sample Concentration} - \text{Background Concentration}}{\text{Known Spike Concentration}} \times 100$$

The standard deviation of percent recoveries is calculated and the upper and lower warning limits are set at plus or minus two standard deviation units. The upper and lower control limits are set at plus or minus three standard deviation units. Alternate criteria for acceptable accuracy can be defined by specific protocols or methods.

Acceptable data is realized when results fall between the lower and upper warning limits. If the quality control value falls between the control limit and warning limit (UCL and UWL or LCL and LWL), the analysis should be scrutinized as possibly out-of-control. The sample results however, are still acceptable at this point.

Organic analyses employing the GCMS and GC requires that all samples contain method surrogates. Internal standards are required for all GCMS analyses and must be added to all standards and samples. Acceptable criteria for the recovery of surrogates and internal standards are defined by methods or past laboratory performance. Control charts for internal standards and method surrogates are illustrated in Figures 11-2 and 11-3, respectively.

Standard Recra QA/QC policy also includes the analysis of Standard Reference Materials (SRMs) or matrix spike blanks (MSB). SRMs are independently supplied samples with known concentrations of selected parameters. They are often accompanied not only with a known value, but an acceptable range for analytical results. Recra Environmental, maintains a supply of SRMs. In cases where an SRM is not available, one can be prepared by the laboratory staff with materials other than the various calibration solutions. These laboratory prepared solutions are referred to as matrix spike blanks. The frequency of SRMs or MSBs employed for organic analyses is one per method batch or five percent; CLP spiking solution compounds are utilized where applicable. Inorganic analyses also require one SRM or MSB per batch or five percent.

The precision chart presented in Figure 11-4 is typical of charts used to monitor laboratory precision and is based upon information presented in Section 6 of the EPA <u>Handbook of Analytical Quality Control in Water and Wastewater Laboratories</u> (March 1979), 600/5-79-019.

The Upper Control Limit (UCL) used in charting the precision for inorganic analyses, through duplicates, is calculated as follows:

$$\begin{aligned} UCL &= D4R \\ &= 3.27\ (0.006) \\ &= 0.0196 \end{aligned}$$

Where:

D4 = Stewart factor for ranges based upon duplicate analyses.
R = The mean range of multiple replicate determinations.

The critical R value (R_C) is the upper control limit rounded off to an operationally feasible number; i.e., the $R_C = 0.020$. This R_C or critical R value is the maximum allowable difference between replicate determinations on a single sample in the 0-0.5 mg/l concentration range. The R value is plotted every day analyses are performed and the points are reviewed for trends. If an R value exceeds the R_C value, the data are invalid and the cause for such performance is investigated and corrected before analyses are resumed.

For organic constituents, the upper control limit is based upon the standard deviation of previous MS/MSD replicate pairs. The relative percent difference (RPD) for an MS/MSD pair is calculated according to the following formula;

$$\frac{(MS - MSD)}{1/2\ (MS + MSD)} \times 100 = RPD$$

Using the last 20 MS/MSD pairs, the standard deviation of the RPDs is determined and the upper control limit is established at the mean RPD plus three times the standard deviation of the RPD. Each MS/MSD RPD is plotted against the upper control limit as illustrated in Figure 11-5. Control limits are reviewed at least semi-annually or as necessary, based upon standard principles of quality control.

FIGURE 11-1

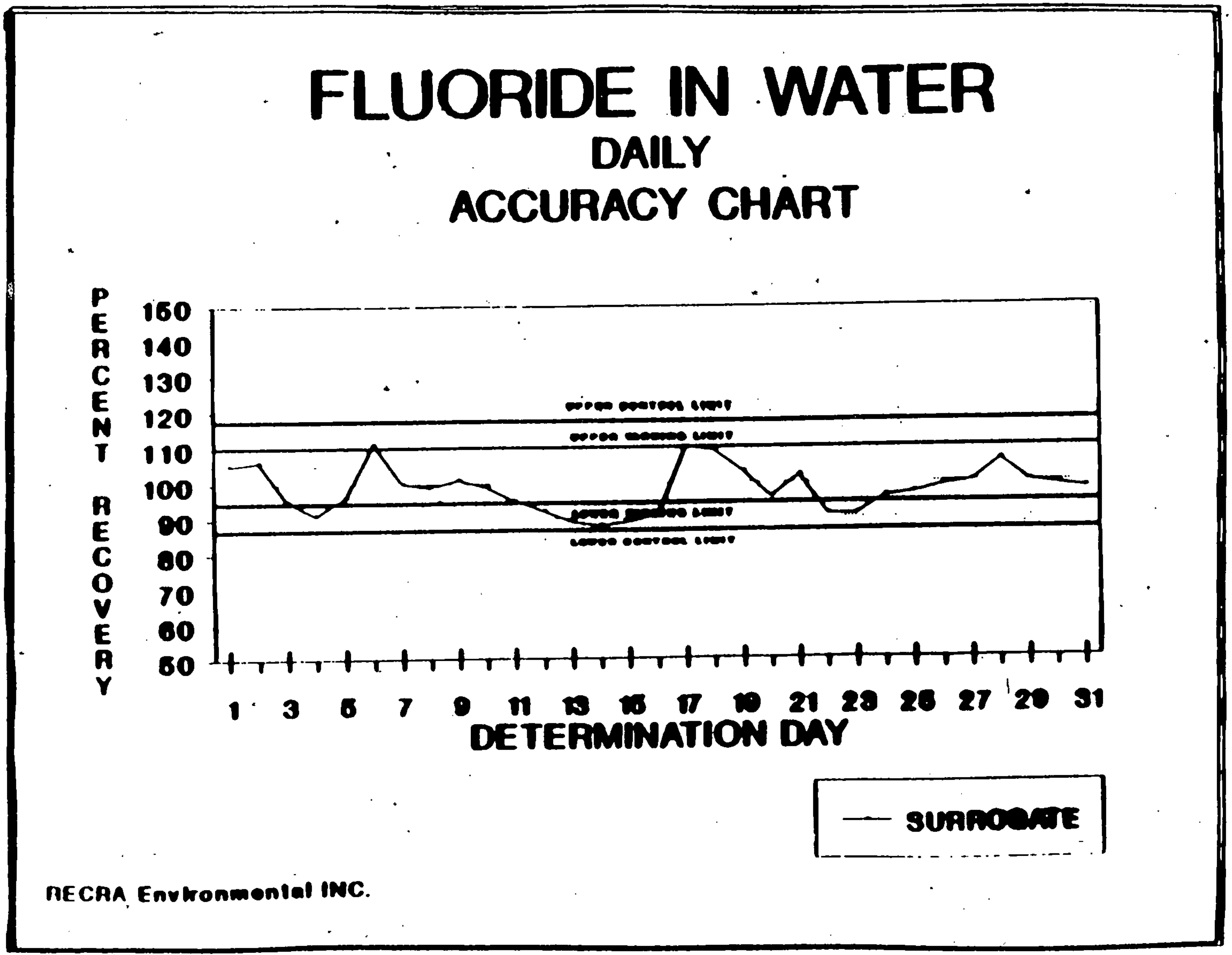
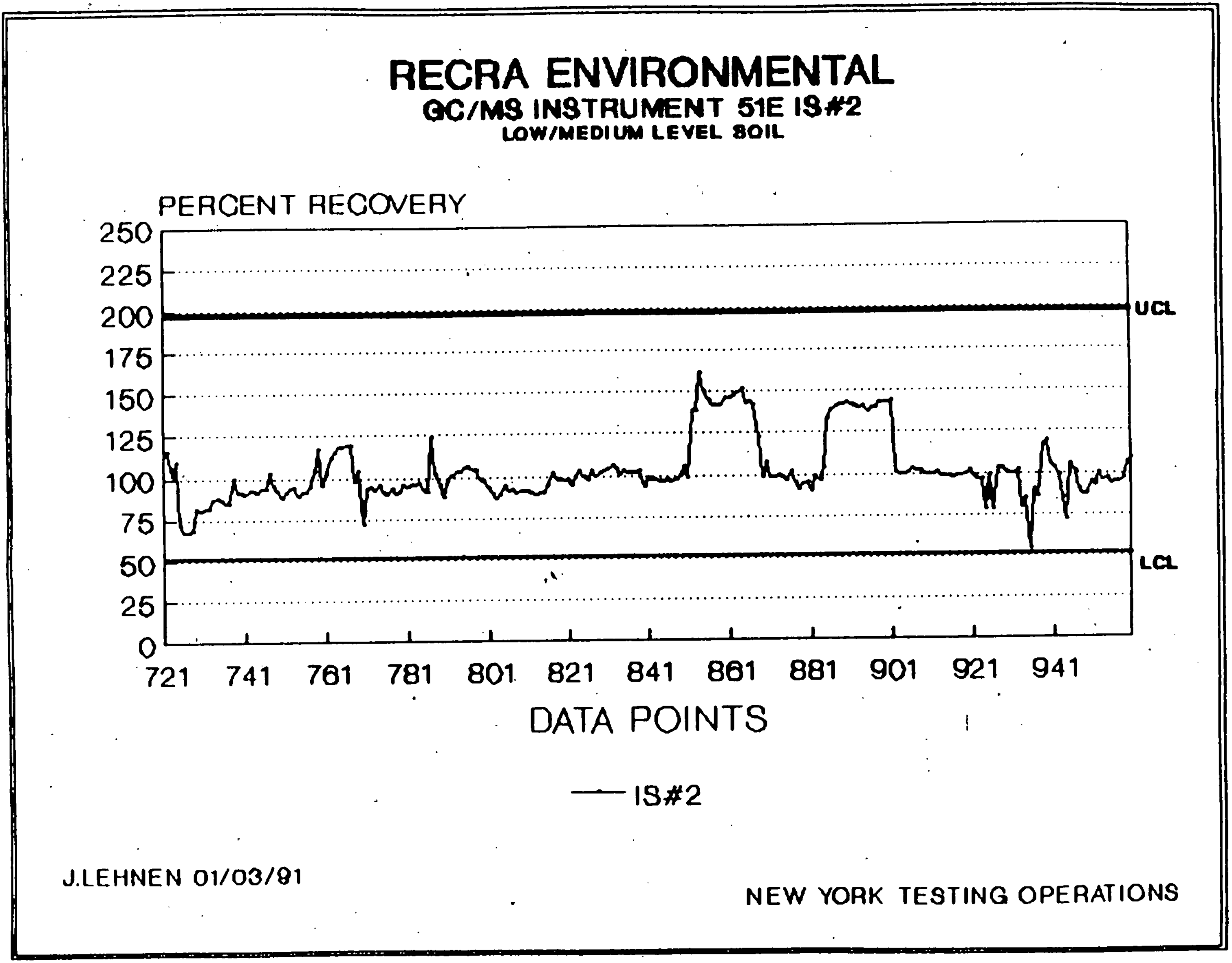

FLUORIDE IN WATER
DAILY
ACCURACY CHART
PERCENT RECOVERY
150
140
130
120
110
100
90
80
70
60
50
UPPER CONTROL LIMIT
UPPER WARNING LIMIT
LOWER WARNING LIMIT
LOWER CONTROL LIMIT
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
DETERMINATION DAY
SURROGATE
RECRA Environmental INC.

FIGURE 11-2



RECRA ENVIRONMENTAL, INC.

FIGURE 11-3

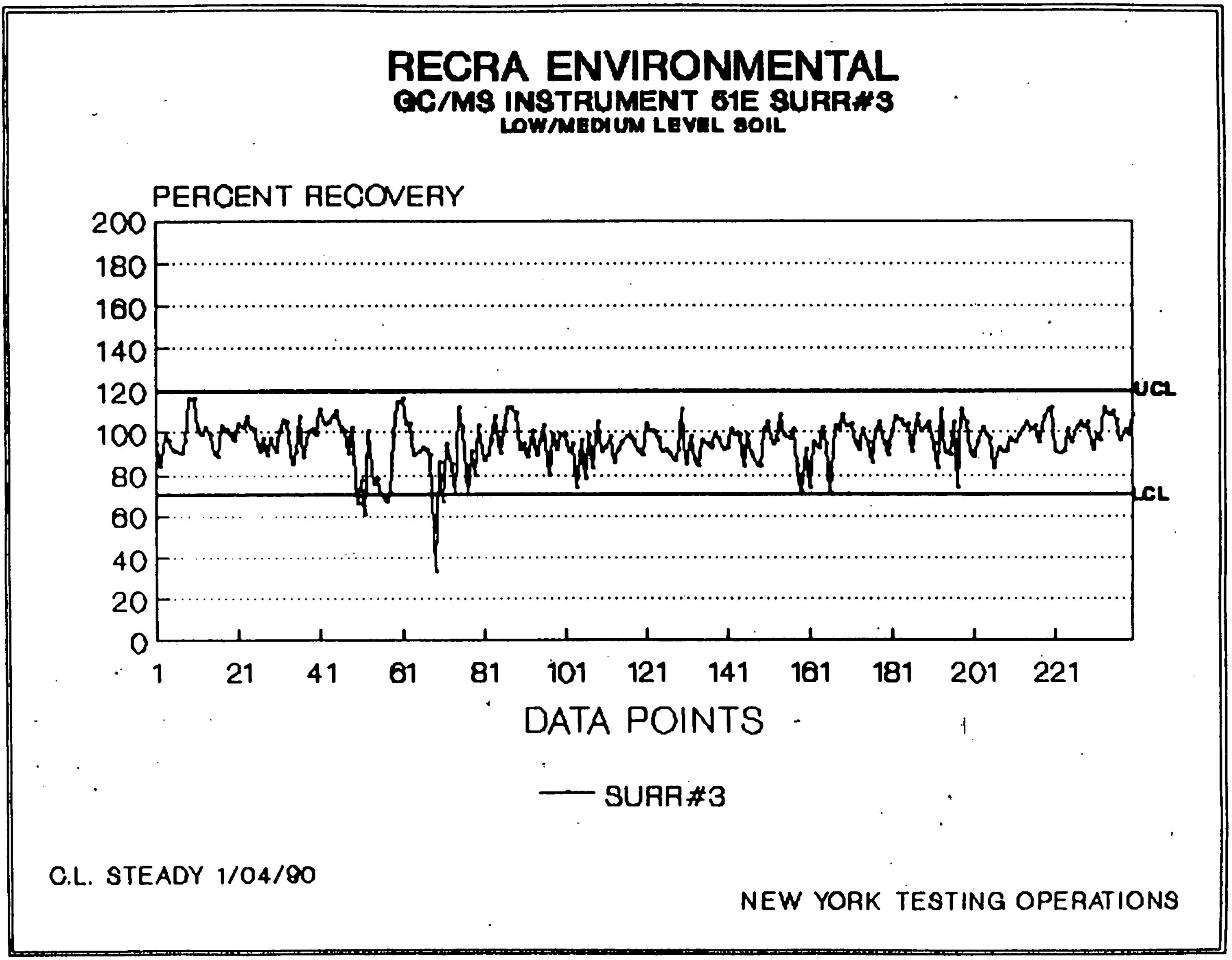
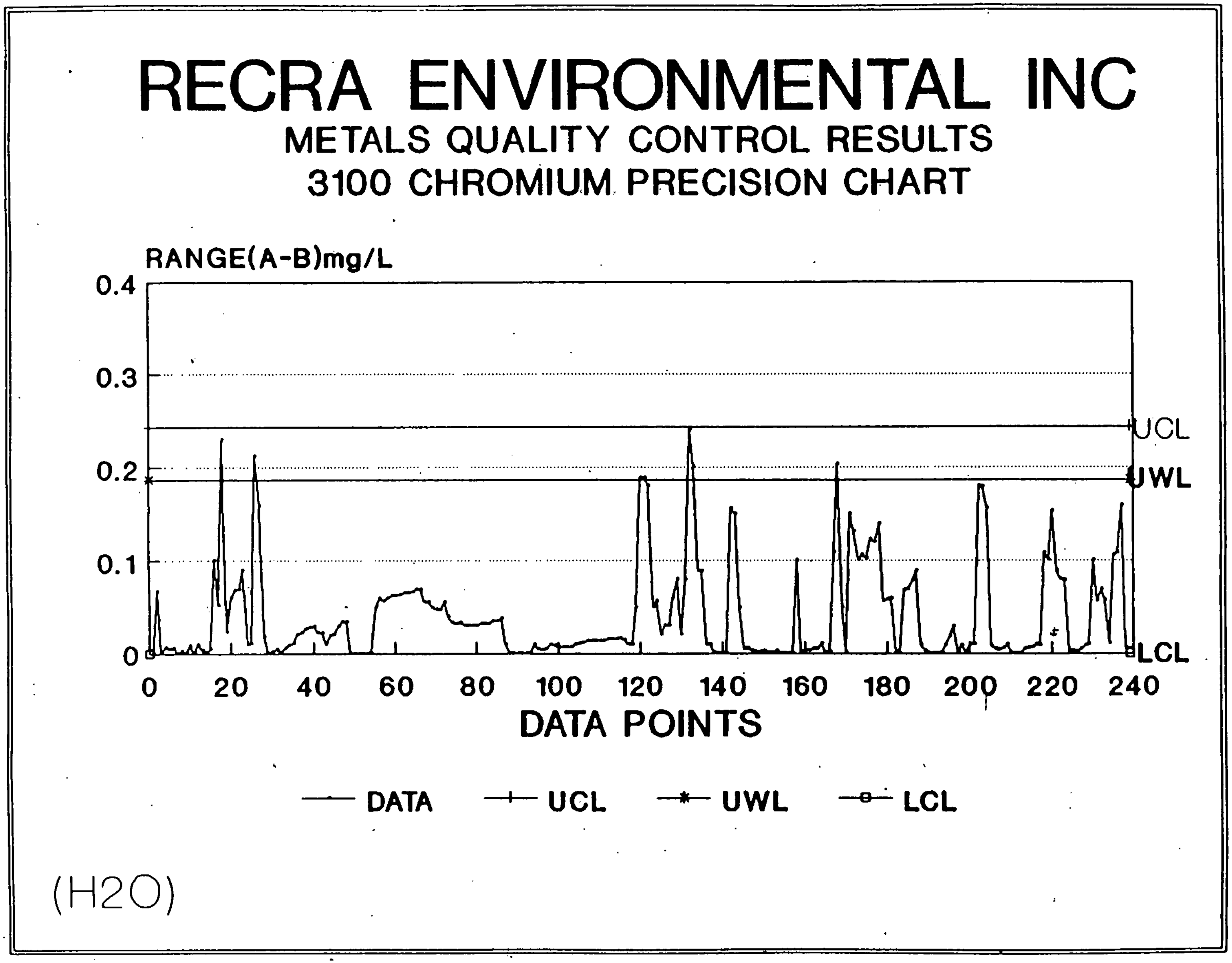
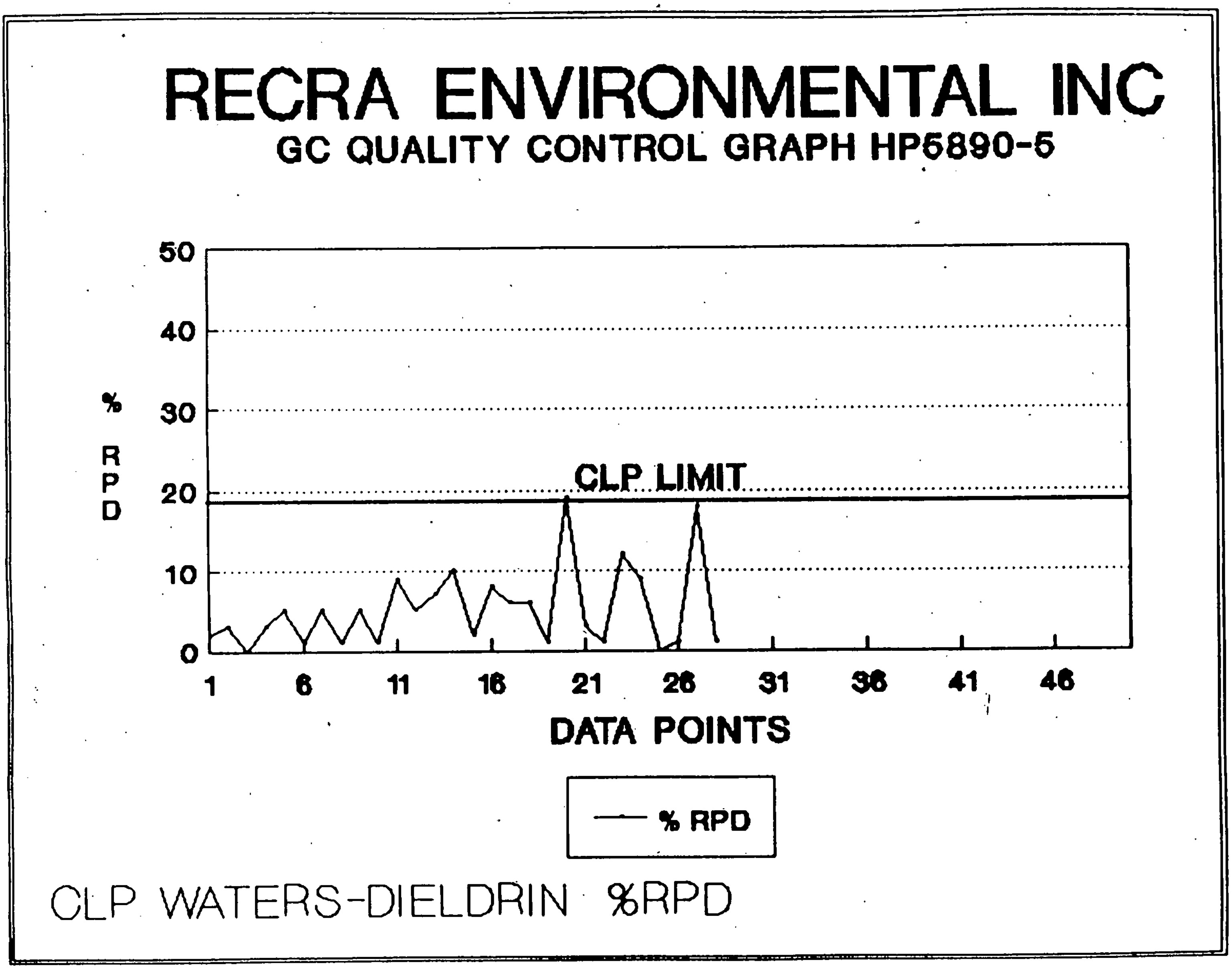

RECRA ENVIRONMENTAL
GC/MS INSTRUMENT 51E SURR#3
LOW/MEDIUM LEVEL SOIL
PERCENT RECOVERY
200
180
160
140
120
100
80
60
40
20
0
UCL
LCL
1
21
41
61
81
101
121
141
161
181
201
221
DATA POINTS
SURR#3
C.L. STEADY 1/04/90
NEW YORK TESTING OPERATIONS

FIGURE 11-4



RECRA ENVIRONMENTAL, INC.

FIGURE 11-5


RECRA ENVIRONMENTAL INC
GC QUALITY CONTROL GRAPH HP5890-5
50
40
% RPD
30
20
CLP LIMIT
10
0
1
6
11
16
21
26
31
36
41
46
DATA POINTS
% RPD
CLP WATERS-DIELDRIN %RPD

12. INTERNAL RECORD KEEPING AND DOCUMENT CONTROL

Various record keeping and document control procedures are employed by Recra Environmental. All sample and analytical activities are documented, and maintained according to specific regulatory requirements and SOP.

Corrections or additions to documents, supporting documents and raw data are made by drawing a single line through the error and entering the corrected information. Corrections and additions to supporting documents and raw data are initialed and dated. No information is written over, obliterated or rendered unreadable. Unused portions of documents are "z'd" out, and appropriately dated and initialed.

Laboratory notebooks and logbooks are issued, inventoried and archived by the Facility Quality Assurance Officer. Each notebook and logbook is reviewed for completeness, legibility and compliance on at least a bi-weekly basis by the appropriate area supervisor. When completed or closed out, notebooks and logbooks are archived for an indefinite period of time.

Sample Tracking and Custody is maintained with both inter- and intra-company chain-of-custody and transfer procedures.

File organization, preparation, review and archival exists for each and every individual job. Job files begin at the time of sample receipt and contain all information specific to that particular job. Each job file is reviewed for QC requirements stipulated in other sections of this manual. Job files are maintained for a minimum of five (5) years.

SOPs may be generated, or revisions suggested, by any Recra employee. The proposed SOP is then reviewed and approved by the Facility Laboratory Director or Chief Laboratory Operations Officer, the Facility or Corporate Quality Assurance Officer and the Corporate Health and Safety Officer (when applicable). An approved SOP is issued, with old revisions retrieved and archived, to the appropriate personnel. SOPs are available to all laboratory personnel for their reference. SOPs are also available, upon request from the Facility Quality Assurance Officer, to clients for their review.

The revision process for technical or documentation procedures is accomplished as needed or according to updates and changes in regulatory requirements. A review committee including the Laboratory Director, The Chief Laboratory Officer and the Quality Assurance Officer exists for necessary approval of SOP modifications.

13. PERFORMANCE AND SYSTEM AUDITS

By NEIC definition, an audit is a systematic check to determine the quality of operation of some function or activity. Audits are further defined as being of two basic types; performance and system audits.

A performance audit is one in which quantitative or qualitative data are independently obtained for comparison with routinely obtained data from a measurement system. Performance audits are completed at Recra Environmental via a number of mechanisms, including the analyses of evaluation samples from various states, U.S. Environmental Protection Agency and industrial clients, as well as the analysis of commercially available check samples. Additionally, Recra's Corporate QA Officer submits blind or double blind performance evaluation samples to the laboratory on a semi-annual basis. The routine use of available and applicable SRMs or MSBs, although not blind samples, provides for continuous performance auditing.

System audits, as opposed to performance audits, are strictly qualitative and consist of an on-site review of a laboratory's quality assurance system and physical facilities for calibration and measurement. System audits are routinely performed by many of Recra's clients as an element of Recra's participation in their certification or contract programs. New York State, New Jersey, U.S. Corps of Engineers, and the U.S. Environmental Protection Agency all routinely audit Recra's facilities relative to analytical services contracts. Additionally, detailed internal audits are performed on a semi-annual basis by the Corporate and Facility Quality Assurance Officers.

At the conclusion of internal or external system audits, reports are made to Recra's operating divisions for appropriate comment and corrective actions where necessary. Written response to internal as well as external audits are required. Records of audits and corrective actions are maintained by the Corporate QA Officer.

Analytical services that Recra may choose to subcontract require a system audit by Recra's QA department of those subcontractors. During the audit, the subcontracted laboratory will supply to Recra amongst other information their past proficiency evaluation studies/results. At the conclusion of the system audit, a written report is issued to the subcontracted laboratory. A written response is required from the subcontractor and is kept on file at Recra Environmental, Inc.

14. PREVENTATIVE MAINTENANCE

All major analytical equipment at Recra is covered by some type of maintenance contract generally with the manufacturer of said equipment. The degree and extent of contracted routine or preventative maintenance assistance is a function of the complexity of the equipment, amount of equipment redundancy at Recra, and our in-house expertise relative to repair and maintenance of the particular piece of equipment. All maintenance activities are documented and maintained in permanent files and logbooks.

All analytical balances are under a service agreement with the manufacturer or their authorized representative to provide emergency service, preventative maintenance and calibration on an annual basis.

With regard to Recra's Atomic Absorption/Emission Spectrophotometers, a manufacturers maintenance plan covers all systems. The plans include replacement parts required during preventive maintenance and all emergency maintenance visits. Routine operator maintenance and cleaning is performed by an experienced analyst or chemist according to manufacturer's specifications.

Hewlett Packard GC/MS and Finnigan GC/MS systems are under service agreements covering all repair parts, extended parts, labor and travel. Our internal preventative maintenance service involves cleaning, adjusting, inspecting and performing testing procedures designed to reduce product failure and/or extend useful product life.

Gas chromatographic systems are under service agreements with Hewlett Packard and Perkin Elmer which cover all repair parts, extended parts, labor and travel. Our experienced analysts clean, adjust, inspect and perform test procedures designed to reduce product failure and/or extend useful product life according to manufacturer's specifications.

15. DATA QUALITY ASSESSMENT

The procedures employed by Recra Environmental, Inc. to assess the quality of data originated in our facilities includes, but is not limited to, the following:

- Identification of the sample matrices requiring analysis
- Identification of the analytical method used to acquire the data
- Determination of analytical precision - per method
- Determination of analytical accuracy - per method
- Determination of analytical completeness
- Determination of method detection limits

These procedures, for the most part, have been previously discussed in other sections of this manual. With regard to method detection limits (MDL), method specific requirements are verified during initial performance of the method and verified quarterly for all parameters. EPA procedures are used for determination of MDL's.

Data quality reviews by analysts, supervisors, managers, laboratory directors and QA personnel all contribute to the total process. Analytical project managers within the analytical program office interface with clients in order to insure that their needs are met and that information provided fulfills their requirements. Recra's staff also provide compliance screening activities on all CLP analysis prior to its delivery to any client requesting such testing services.

Data validation, data quality assessments or data usability determinations are also services available from Recra for our clients. These services are provided consistent with applicable state and or federal guidelines and applicable method based QA requirements. These services are provided for Recra generated data and data produced by other laboratories.

16. CORRECTIVE ACTION

Recra's evaluation of data quality and acceptability for methodologies such as CLP (where criteria are defined by the protocol), results of internal standard and surrogate recovery and MS and MSD analysis are evaluated consistent with the protocol or method. The following paragraphs define criteria which must be met to maintain Recra's high standards of data quality. Corrective action procedures and evaluation criteria, which are an integral part of the entire QA processes, are also presented.

GCMS

Internal Standards

Every standard, blank, analytical and QC sample contains internal standards (IS). These standards are used as the basis for the quantitation of the various compounds being analyzed. The extracted ion current profile (EICP) is monitored through the internal standards, and cannot vary by more than a factor of two (-50 to +100%) from the most recent calibration standard. If this occurs, the mass spectrometric system must be inspected for malfunction and the problem corrected. All samples must be re-analyzed. In the event that re-analysis continues to illustrate failure of IS recovery, matrix effects may be responsible for said non-compliance.

Method Blank

The method blank analysis must be performed with each sample batch or at a minimum every 20 samples and monitors contamination throughout the analytical process. For a volatile method blank to be acceptable it must not contain:

1. Concentrations greater than five times the detection limit of methylene chloride, acetone, toluene, or 2-butanone.

2. Concentrations greater than the detection limit of any analyte other than the above mentioned.

3. Any TICs (Tentatively Identified Compounds) greater than 10% of the nearest internal standard.

For a semi-volatile method blank to be acceptable, it must not contain:

1. Concentrations greater than five times the detection limit of phthalate esters.

2. Concentrations greater than the detection limit of any analyte other than the above mentioned.

3. Any TICs greater than 10% of the nearest internal standard.

If these criteria are not met, the problem is investigated with the guidance of the facility QAO and the situation is corrected. If necessary, all samples associated with the contaminated blank are re-analyzed or re-extracted and re-analyzed. This re-analysis should occur within defined holding times

Surrogates

Surrogates are added to every standard, blank, analytical and QC sample to monitor the preparation and analysis of these materials. If any one surrogate deviates from the volatile method specified criteria, the following actions must be taken:

1. Check for calculation errors, degradation or contamination of internal standards and surrogates and review instrument performance.

2. Re-analyze or re-extract and re-analyze the sample unless surrogate recovery can be resolved with consideration of MS/MSD.

3. If the sample is a method blank it must be re-analyzed.

The above actions also apply for semi-volatiles if any one surrogate compound in either fraction (base neutral or acid) is below 10% or the recoveries of 2 or more surrogate compounds in either or both fractions are outside method specified criteria. If method blanks for semi-volatile analysis are non-compliant, corrective actions should be taken under the direction of the facility QAO.

Matrix Spikes/Matrix Spike Duplicates/Matrix Spike Blanks

MS/MSD/MSB

These spikes and duplicates are used to evaluate matrix effects of the sample upon the analytical methodology being used. The recovery criteria for the MS/MSD are for advisory purposes only, however, results must be reported on a job/case basis. MS/MSD recoveries which suggest serious matrix affects must be brought to the immediate attention of the facility QAO, investigated, documented, and corrective action applied.

The MSB (SRM) recoveries are not for advisory purposes, they monitor the extraction and analytical processes. These recoveries must measure between 75 and 125% or method or manufacturer specified limits.

GC/VOA, PESTICIDES/PCB AND HERBICIDES

Method Blank

The method blank analysis must be performed with each sample batch or every 20 samples and contain less than the detection limit of any analyte. If this criterion is not met, the problem is investigated with the guidance of the facility QAO and the situation is corrected. If necessary, all samples associated with the contaminated blank must be re-analyzed or re-extracted and re-analyzed. This re-analysis should occur, when necessary, before defined holding times are expired.

Surrogates

All standards, blanks and samples must contain surrogate spiking compound(s). Recoveries should be within acceptable criteria, if not, results are checked for calculation errors, degradation or contamination of surrogates and instrument performance. Unless surrogate recovery can be resolved with consideration of the MS/MSD failure to produce acceptable surrogate recoveries generally require re-analysis or re-extraction and re-analysis of the affected sample(s). If a method blank is non-compliant, corrective actions should be taken under the directive of the facility QAO.

Matrix Spikes/Matrix Spike Duplicates/Matrix Spike Blanks

MS/MSD/MSB

These spikes and duplicates are used to evaluate matrix effect of the sample upon the analytical methodology being used. The recovery criteria for the MS/MSD are for advisory purposes only, however results must be reported on a job/case basis. MS/MSD recoveries which suggest serious matrix affects must be brought to the immediate attention of the facility QAO, investigated, documented, and corrective action applied.

The MSB (SRM) recoveries are not for advisory purposes, they monitor the extraction and analytical processes. These recoveries must measure between 75 and 125% or method or manufacturer specified limits.

PESTICIDES/PCB ONLY

Dibutylchlorendate (DBC) Retention Time Shift

The retention time shift for DBC should be less than 2.0 percent difference for packed columns, 1.5 percent for wide bore capillary columns, and 0.3 percent for narrow bore capillary columns. If this criteria is not met for a pesticide/PCB standard, the non-compliance is investigated, documented and necessary corrective action is taken. If a sample or a blank does not comply, attempts are made to identify the problem and correct and/or document this non-compliance.

Endrin/4,4'DDT Breakdown

At the beginning of each analytical sequence and after column resolution has been verified, evaluation standards containing Aldrin, Endrin, 4,4'-DDT and DBC must be analyzed. The percent breakdown for Endrin and/or 4,4'-DDT must not exceed 20% or corrective action(s) must be taken before further analysis.

METALS AA/ICP

Initial Calibration Blank (ICB)/Continuing Calibration Blank (CCB)

The ICB is analyzed immediately after the initial calibration verification standard, the CCB is analyzed after the continuing calibration standard at a frequency of 10% and at the end of the analytical sequence. The ICB and CCB monitor only the analytical system. All element concentrations must be below the detection limit or analysis must be terminated, the problem corrected and the instrument recalibrated. In the event a CCB is non-compliant, all analytical samples must be re-analyzed since the analysis of the last compliant blank.

Method Blank

The method or preparation blank monitors the digestion process and should not exhibit results above the detection limits. If this situation does occur, the analyst investigates the problem, and subsequently corrects and documents action(s) necessary for resolution. The requirement of re-analyses of any affected sample(s) will be based upon the degree of corrective action (if required) and/or as directed by the facility QAO.

Matrix Spikes/Matrix Spike Duplicates/Matrix Duplicate/Matrix Spike Blanks (MS/MSD/MD/MSB)

These spikes and duplicates are used to evaluate matrix effect of the sample upon the analytical methodology being used. The criteria for the MS/MSD/MD are for advisory purposes only, however, results must be reported on a job/case basis. MS/MSD/MD results which suggest serious matrix affects must be brought to the immediate attention of the facility QAO, investigated, documented, and corrective action applied.

The MSB (LCS) recoveries are not for advisory purposes, they monitor the extraction and analytical processes. These recoveries must measure between 75 and 125% or method or manufacturer specified limits.

ICP ONLY

Interference Check Sample (ICS)

At the beginning of each analytical sequence, an ICS is to be performed to verify the interelement and background correction factors. The criteria of ± 20% of the true value has been established. If the ICS is not compliant, analysis is terminated, corrective action is taken and the instrument is recalibrated.

LIMITED CHEMISTRY

Method Blank

This method blank which monitors contamination throughout the analytical processes must contain less than the detection limit for any analyte being tested.

If this criteria is not met, the problem is investigated with the guidance of the facility QAO and appropriate corrective action is taken. If necessary, re-analysis of samples associated with the contaminated blank is completed. This re-analysis must occur before holding times have expired.

Matrix Spikes/Matrix Spike Duplicates/Matrix Duplicate/Matrix Spike Blanks (MS/MSD/MD/MSB)

These spikes and duplicates are used to evaluate matrix effect of the samples upon the analytical methodology being used. The criteria for the MS/MSD/MD is method specified or analytically derived and must be monitored daily or on a job/case basis. Any analyte outliers must be brought to the immediate attention of the facility QAO, investigated, documented, and corrective action applied.

The MSB (SRM) recoveries monitor the preparation and analytical processes. These recoveries must measure between 75 and 125% or method or manufacturer specified limits.

17. QUALITY ASSURANCE REPORTS TO MANAGEMENT

Critically important to the successful implementation of the QA Plan is the reporting system which provides the means by which the program can be reviewed, problems identified, and programmatic changes made to remediate or improve the plan.

Quality Assurance reports to management take a number of forms as follows:

- QA job/case summary
- Audit reports, internal and external audits with responses
- Performance evaluation sample results; internal and external sources
- Daily QA/QC summary reports
- QA charts (trend analyses)
- Corrective Action Notices

QA/QC summary reports are presented to laboratory management personnel so that performance criteria can be monitored on a daily basis for all analysis from each analytical department.

Additionally, monthly, quarterly and annual QA reports which include measures of productivity, compliance, data usability and instrument performance are produced to management. These reports also summarize both internal and external audit findings, contract performance issues and corrective action for the specified period of record.

APPENDIX

RECRA ENVIRONMENTAL, INC.

CORPORATE QUALITY ASSURANCE PLAN

GLOSSARY OF TERMS

GLOSSARY OF TERMS

The following is a list of terms and definitions used throughout the Quality Assurance Manual:

- AA Spectroscopy - Atomic absorption spectrometers which measure explicit wavelengths of metals by absorption.
- Absorbance - a measure of the decrease in incident light passing through a sample into the detector.
- Accuracy - The degree of agreement between the true or accepted reference value and the measured value.
- Analysis - The separation, identification and quantification of a compound into its constituent parts, the breaking down of a complex substance into simpler substances.
- Analyte - the element or ion an analysis seeks to determine; the element or compound of interest.
- Analytical Balance - A mechanical or electrical balance with a sensitivity of 0.1 milligram or less.
- Analytical Batch - Samples which are analyzed together with the same method sequence, the same lots of reagents and with the same manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch should be of similar composition (i.e., groundwater, sludge, etc.)

- Analytical Sample - Any solution or media introduced into an instrument or apparatus on which an analysis is performed excluding instrument calibration, initial calibration verification, initial calibration blank, continuing calibration verification and continuing calibration blank. Note the following are all defined as analytical samples: undiluted and diluted samples, predigestion spike samples, duplicate samples, serial dilution samples, analytical spike samples, post-digestion spike samples, interference check samples (ICS), CRDL standard for AA (CRA), CRDL standard for ICP (CRI), laboratory control sample (LCS), and method/preparation blank (MB/PB).

- BFB (4-Bromofluorobenzene) - The compound chosen to establish mass spectral instrument performance for volatile analyses.

- Blank - An artificial sample designed to monitor the introduction of artifacts into the analysis process. For aqueous samples, reagent water is used as a blank matrix. A common matrix does not exist for solid samples, therefore, reagent water, sodium sulfate, or reagent grade kaolin is used. There are several types of blanks which monitor a variety of processes: laboratory (method) blank, trip blank, holding blank and field blank.

- Calibration Verification - The periodic analysis of one or more standards independent of the calibration standards to verify the accuracy of the calibration standards as well as the calibration ratio.

- CVS - Calibration Verification Sample is a standard solution derived from a source different from your calibration standards. This standard is a check only on your calibration since it is not prepared or extracted similar to the analytical samples.

- Chain-of-Custody - A document designed to trace the custody of a sample(s) from the point of origin to final destination with the intent of legally proving that custody remained intact and that tampering or substitutions were precluded.

- Coefficient of Variation (CV) - the standard deviation as a percent of the arithmetic mean.

- Colorimetric - Analyses based on the measurement of color that develops during the test-specific reaction. This determination is made at a specific wavelength on a spectrometer.

- Completeness - A measure of the amount of valid data obtained from a measurement system relative to the amount of data that was expected to be obtained under correct, normal conditions.

- Concentration - The relative fraction of one substance in another, normally expressed in weight percent, volume percent or as a weight per volume ratio.

- Correlation Coefficient - a number (r) which indicates the degree of dependence between two variables (concentration - absorbance). The more dependent they are the closer the value (r) to unity (1.000); normally determined on the basis of the least squares analysis.

- Custody - Immediate charge, control or possession exercised by a person or competent authority.

- DFTPP (Decaflurortriphenylphosphine) - The compound chosen to establish mass spectral instrument performance for semi-volatile analysis.

- Duplicate - A second aliquot of a sample that is treated the same as the original sample in order to determine the precision of the method.

- Field Blank - An organic or aqueous solution that should be free of analytes. This solution is transferred from one vessel to another at the sampling site and preserved with the appropriate reagents. This blank served as a check on reagent and environmental contamination. Rinse or rinsate blank are often also considered to be field blanks.

- Gravimetric - Analyses based on the direct or indirect weighing of an analyte. This weighing usually requires at least a four decimal place analytical balance.

- Holding Time - The storage time allowed between sample collection, preparation and sample analysis when the proper preservation and storage techniques are used.

- Inductively Coupled Plasma (ICP) - A technique for the simultaneous or sequential multi-element determination of elements in solution. The basis of the method is the measurement of atomic emission by an optical spectroscopic technique.

- Initial Calibration - The analysis of standards containing various amounts of analyte to establish the ratio of the measurement system response to analyte mass or concentration across the working range of the analytical technique.

- Instrument Detection Limit (IDL) - The smallest signal above background noise that an instrument can detect reliably.

- Internal Standards - Compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for VOAs), and sample extract (for semi-volatiles) at a known concentration, prior to analysis. Internal standards are used as the basis for quantitation of the target compounds.

- Laboratory Control Sample (LCS) - a control sample of known composition. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for any samples received.

- Matrix - The physical characteristics or state of a sample, i.e., water, soil, sludge, etc..

- Matrix Spike - Aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring spiked analyte recovery.

- Matrix Spike Duplicate - A second aliquot of the same matrix as the matrix spike (above) that is measured to determine the precision of the method.

- Method or Reagent Blank - An organic or aqueous solution(s) that should be free of analytes. The method (or preparation) blank must be carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. This blank is used to correct for possible contamination resulting from the preparation or processing of the sample.

- Method Detection Limit (MDL) - The minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.

- Percent Error - A measure of accuracy that is calculated as the absolute error relative to the true value, expressed as a percent.

- Performance Evaluation (PE) Sample - A sample of known composition provided by commercial source, state or federal agency for analysis; used to evaluate laboratory performance/capabilities.

- PQL - The practical quantitation limit is the lowest level that can be reliably achieved for actual specific samples within specified limits of precision and accuracy during routine laboratory operating conditions.

- Precision - The agreement of repeatability of a set of replicate results among themselves, usually expressed in terms of the deviation of a set of results from the arithmetic mean. Precision may be qualified in terms of possible sources of variability, replicatability, repeatability and reproducibility.

- Qualitative Analysis - A procedure which determines the presence or absence of a specific analyte.

- Quality Assurance - All those planned and systematic actions necessary to provide adequate confidence in a laboratory result(s).

- Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of measurement equipment and processes to meet established requirements.

- Quantitative Analysis - A procedure which measures or determines the amount of a specific analyte with precision and accuracy.

- Recovery - A determination of the accuracy of the analytical procedure made by comparing measured values for a fortified (spiked) sample against the known spike values. Recovery is determined by the following equation:

$$\% \text{ Recovery} = \frac{\text{measured value}}{\text{spiked value}} \times 100\%$$

- Relative Percent Difference (RPD) - A measure of precision that is calculated as the difference between two results, relative to their arithmetic mean, expressed as a percent.

- Relative Standard Deviation (RSD) - A measure of precision that is calculated as the standard deviation(s) of a set of values relative to their arithmetic mean, expressed as a percent.

- Reproducibility - The precision of repeated but independent measurements made on the same sample by the same analyst at essentially the same time under the same conditions; the precision of measurements of the same sample at different locations.

- Resolution - Also termed separation, the separation between peaks on a chromatogram.

- Rinsate Blank - The DI water used to rinse the sample collection equipment. This monitors the possible contaminants from the collection devices. Often times referred to as a field blank.

- Run - A continuous analytical sequence consisting of prepared samples and all associated quality assurance measurements.

- Sample Delivery Group (SDG) - a unit within a sample Case that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer samples within a Case, received over a period of up to 14 calendar days. Data from all samples in an SDG are due concurrently. A Sample Delivery Group is defined by one of the following, whichever occurs first:

    - Case; or
    - Each 20 samples within a Case; or
    - Each 14-day calendar period during which samples in a Case are received, beginning with receipt of the first sample in the Case or SDG.

Samples may be assigned to Sample Delivery Groups by matrix (i.e., all soils in one SDG, all waters in another), at the discretion of the laboratory.

- Sample Matrix - All of the chemical components and physical characteristics of a sample other than the parameter of interest.
- Semivolatile Compounds - Compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with Base/Neutral/Acid (BNA) compounds.
- Sensitivity - The ability of a measurement system to detect and accurately quantitate a parameter at a critical level within a specific sample matrix.
- Solution - The liquid mixture of two or more substances where one is dissolved in the other.
- Solvent - Liquid that is capable of dissolving another substance.
- Standard Deviation - The square root of the variance of a set of values.
- Surrogates (Surrogate Standard) - Compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard; used to evaluate analytical efficiency by measuring recovery. Surrogates are brominated, deuterated, fluorinated, or isotopically labelled compounds not expected to be detected in environmental media.
- Test Method - A defined technical procedure to determine one or more specific characteristics of a material or product.

- Trip Blank - An organic or aqueous solution that is free of analytes and is transported to the sampling site and returned to the laboratory without being opened. This serves as a check on sample contamination originating from sample transport, shipping and from the site conditions.

- Volatile Compounds - Compounds amenable to analysis such as purge and trap techniques. Used synonymously with purgeable compounds. Usually reflect solvent type materials and constituents with relatively low boiling points.

ATTACHMENT 1

EXHIBIT C

TARGET COMPOUND LISTS (TCLs)

AND

CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Exhibit A

Table of Contents

SECTION I
SUPERFUND-CLP ORGANICS
Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Volatiles	CAS Number	Quantitation Limits** Low Water µg/L	Quantitation Limits** Low Soil/Sediment[a] µg/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethylene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. 1,2-Dichloroethylene(total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon tetrachloride	56-23-5	5	5
16. Vinyl acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,2-Dichloropropane	78-87-5	5	5
19. cis-1,3-Dichloropropene	10061-01-5	5	5
20. Trichloroethene	79-01-6	5	5
21. Dibromochloromethane	124-48-1	5	5
22. 1,1,2-Trichloroethane	79-00-5	5	5
23. Benzene	71-43-2	5	5
24. trans-1,3-Dichloropropene	10061-02-6	5	5
25. Bromoform	75-25-2	5	5
26. 4-Methyl-2-pentanone	108-10-1	10	10
27. 2-Hexanone	591-78-6	10	10
28. Tetrachloroethene	127-18-4	5	5
29. Toluene	108-88-3	5	5
30. 1,1,2,2-Tetrachloroethane	79-34-5	5	5

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Volatiles (continued)	CAS Number	Quantitation Limits** Low Water μg/L	 Low Soil/Sediment[a] μg/Kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Total Xylenes	1330-20-7	5	5

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[a] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation Limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the protocol, will be higher.

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

		Quantitation Limits**	
Semivolatiles	CAS Number	Low Water µg/L	Low Soil/Sediment[b] µg/Kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. 2,2'-oxybis(1-Chloropriopane	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n-propylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	50	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (p-chloro-m-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

Semivolatiles (continued)	CAS Number	Quantitation Limits** Low Water µg/L	Quantitation Limits** Low Soil/Sediment[b] µg/Kg
64. 2-Nitroaniline	88-74-4	50	1600
65. Dimethyl phthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl phenyl ether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butyl phthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butyl benzyl phthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benz(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octyl phthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

		Quantitation Limits**	
		Low Water	Low Soil/Sediment[b]
Semivolatiles (continued)	CAS Number	µg/L	µg/Kg
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

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[b] Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRDL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Superfund Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)*

		Quantitation Limits**	
Pesticides/PCBs	CAS Number	Low Water µg/L	Low Soil/Sediment[c] µg/Kg
100. alpha-BHC	319-84-6	0.05	8.0
101. beta-BHC	319-85-7	0.05	8.0
102. delta-BHC	319-86-8	0.05	8.0
103. gamma-BHC (Lindane)	58-89-9	0.05	8.0
104. Heptachlor	76-44-8	0.05	8.0
105. Aldrin	309-00-2	0.05	8.0
106. Heptachlor epoxide	1024-57-3	0.05	8.0
107. Endosulfan I	959-98-8	0.05	8.0
108. Dieldrin	60-57-1	0.10	16.
109. 4,4'-DDE	72-55-9	0.10	16.
110. Endrin	72-20-8	0.10	16.
111. Endosulfan II	33213-65-9	0.10	16.
112. 4,4'-DDD	72-54-8	0.10	16.
113. Endosulfan sulfate	1031-07-8	0.10	16.
114. 4,4'-DDT	50-29-3	0.10	16.
115. Endrin ketone	53494-70-5	0.10	16.
116. Methoxychlor	72-43-5	0.5	80.
117. alpha-Chlordane	5103-71-9	0.5	80.
118. gamma-Chlordane	5103-74-2	0.5	80.
119. Toxaphene	8001-35-2	1.0	160.
120. AROCLOR-1016	12674-11-2	0.5	80.
121. AROCLOR-1221	11104-28-2	0.5	80.
122. AROCLOR-1232	11141-16-5	0.5	80.
123. AROCLOR-1242	53469-21-9	0.5	80.
124. AROCLOR-1248	12672-29-6	0.5	80.
125. AROCLOR-1254	11097-69-1	1.0	160.
126. AROCLOR-1260	11096-82-5	1.0	160.

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[c] Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Pesticide TCL compounds are 15 times the individual Low Soil/Sediment CRDL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation Limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculate on dry weight basis, as required by the protocol, will be higher.

SECTION II

SUPERFUND-CLP INORGANICS

Superfund Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	Contract Required Quantitation Level (μg/L)
1. Aluminum	200
2. Antimony	60
3. Arsenic	10
4. Barium	200
5. Beryllium	5
6. Cadmium	5
7. Calcium	5000
8. Chromium	10
9. Cobalt	50
10. Copper	25
11. Iron	100
12. Lead	5
13. Magnesium	5000
14. Manganese	15
15. Mercury	0.2
16. Nickel	40
17. Potassium	5000
18. Selenium	5
19. Silver	10
20. Sodium	5000
21. Thallium	10
22. Vanadium	50
23. Zinc	20
24. Cyanide	10

1: Any analytical method specified in Exhibit D, CLP-Inorganics may be utilized as long as the documented instrument or method detection limits meet the Contract Required Quantitation Level (CRQL) requirements. Higher quantitation levels may <u>only</u> be used in the following circumstance:

If the sample concentration exceeds two times the quantitation limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the contract required quantitation level. This is illustrated in the example below:

For lead:
Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 85
Contract Required Quantitation Level (CRQL) = 5

The value of 85 may be reported even though instrument detection limit is greater than Contract Required Quantitation Limit. The instrument or method detection limit must be documented as described in Exhibit E.

2: These CRQL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The quantitation limits for samples may be considerably higher depending on the sample matrix.

Regulatory Promulgated Parameters

In addition to the preceding lists, the Laboratory may be asked to analyze for any or all of the conventional water quality parameters as listed in 40CFR Part 136 or for the hazardous waste parameters listed in 40CFR Part 260 through 270.

Quantitation limits to be achieved for these analyses are specified.

SECTION III
40CFR Part 136 Parameters
Target Compound List (TCL) and
Contract Required Quantitation Limit

Parameter	Contract Required Quantitation Level ($\mu g/L$)
<u>Conventionals</u>	
1. Biochemical Oxygen Demand (BOD_5)	2,000
2. Chemical Oxygen Demand (COD)	1,000
3. Total Dissolved Solids (TDS)	10,000
4. Total Suspended Solids (TSS)	10,000
5. Ammonia, as N	50
6. Total Kjeldahl Nitrogen, as N	100
7. Nitrate-Nitrite	100
8. Total Phosphorus	50
9. Reactive Phosphorus	10
10. Sulfate	5,000
11. Oil and Grease	5,000
12. Total Organic Carbon	2,000
13. Total Phenols	10
14. Chloride	5,000
15. Fluoride	500
16. Cyanide	10
<u>Metals</u>	
17. Aluminum	200
18. Antimony	60
19. Arsenic	10
20. Barium	200
21. Beryllium	5
22. Cadmium	5
23. Calcium	5,000
24. Chromium	10
25. Cobalt	50
26. Copper	25
27. Gold	10
28. Iridium	200
29. Iron	100
30. Lead	5
31. Magnesium	5,000
32. Manganese	15

40CFR Part 136 Parameters (continued) Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level ($\mu g/L$)
<u>Metals (cont.)</u>		
33. Mercury		0.2
34. Molybdenum		10
35. Nickel		40
36. Osmium		100
37. Palladium		100
38. Platinum		200
39. Potassium		5,000
40. Rhenium		5,000
41. Rhodium		100
42. Ruthenium		500
43. Selenium		5
44. Silver		10
45. Sodium		5,000
46. Thallium		10
47. Tin		40
48. Titanium		100
49. Vanadium		50
50. Zinc		20
<u>Volatile Organics (Method 624)</u>		
1. Chloromethane	74-87-3	10
2. Bromomethane	74-83-9	10
3. Vinyl chloride	75-01-4	10
4. Chloroethane	75-00-3	10
5. Methylene chloride	75-09-2	5
6. 1,1-Dichloroethene	75-35-4	5
7. 1,1-Dichloroethane	75-35-3	5
8. trans-1,2-Dichloroethene	156-60-5	5
9. Chloroform	67-66-3	5
10. 1,2-Dichloroethane	107-06-2	5
11. 1,1,1-Trichloroethane	71-55-6	5
12. Carbon tetrachloride	56-23-5	5
13. Bromodichloromethane	75-27-4	5

40CFR Part 136 Parameters (continued)
Target Compound List (TCL) and
Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level ($\mu g/L$)
Volatile Organics (Method 624 cont.)		
14. 1,1,2,2-Tetrachloroethane	79-34-5	5
15. 1,2-Dichloropropane	78-87-5	5
16. trans-1,3-Dichloropropene	10061-02-6	5
17. Trichloroethene	79-01-6	5
18. Dibromochloromethane	124-48-1	5
19. 1,1,2-Trichloroethane	79-00-5	5
20. Benzene	71-43-2	5
21. cis-1,3-Dichloropropene	10061-01-5	5
22. 2-Chloroethyl vinyl ether	110-75-8	10
23. Bromoform	75-25-2	5
24. Tetrachloroethene	127-18-4	5
25. Toluene	108-88-3	5
26. Chlorobenzene	108-90-7	5
27. Ethyl Benzene	100-41-4	5
28. 1,3-Dichlorobenzene	541-73-1	10
29. 1,4-Dichlorobenzene	106-46-7	10
30. 1,2-Dichlorobenzene	95-50-1	10
31. Trichlorofluoromethane	75-69-4	10
Volatile Organics (Method 601)		
1. Chloromethane	74-87-3	0.5
2. Bromomethane	74-83-9	5
3. Vinyl chloride	75-01-4	1.0
4. Chloroethane	75-00-3	5
5. Methylene chloride	75-09-2	1.0
6. 1,1-Dichloroethene	75-35-4	0.1
7. 1,1-Dichloroethane	75-35-3	0.5
8. trans-1,2-Dichloroethene	156-60-5	0.5
9. Chloroform	67-66-3	0.5
10. 1,2-Dichloroethane	107-06-2	0.1
11. 1,1,1-Trichloroethane	71-55-6	0.1
12. Carbon tetrachloride	56-23-5	0.5
13. Bromodichloromethane	75-27-4	0.5

40CFR Part 136 Parameters (continued)
Target Compound List (TCL) and
Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
Volatile Organics (Method 601 cont.)		
14. 1,1,2,2-Tetrachloroethane	79-34-5	0.1
15. 1,2-Dichloropropane	78-87-5.	0.5
16. trans-1,3-Dichloropropene	10061-02-6	1.0
17. Trichloroethene	79-01-6	0.5
18. Dibromochloromethane	124-48-1	0.5
19. 1,1,2-Trichloroethane	79-00-5	0.1
21. cis-1,3-Dichloropropene	10061-01-5	0.5
22. 2-Chloroethyl vinyl ether	110-75-8	0.5
23. Bromoform	75-25-2	1.0
24. Tetrachloroethene	127-18-4	0.1
25. Chlorobenzene	108-90-7	1.0
26. 1,2-Dichlorobenzene	95-50-1	1.0
27. 1,3-Dichlorobenzene	541-73-1	1.0
28. 1,4-Dichlorobenzene	106-46-7	1.0
29. Trichlorofluoromethane	106-46-7	2.0
Volatile Organics (Method 602)		
1. Benzene	71-43-2	1.0
2. Toluene	108-88-3	1.0
3. Chlorobenzene	108-90-7	1.0
4. Ethyl Benzene	100-41-4	1.0
5. 1,3-Dichlorobenzene	541-73-1	1.0
6. 1,4-Dichlorobenzene	106-46-7	1.0
7. 1,2-Dichlorobenzene	95-50-1	1.0
Semivolatile Organics (Method 625)		
1. N-Nitrosodimethylamine	62-75-9	10
2. Phenol	108-95-2	10
3. bis(2-Chloroethyl) ether	111-44-4	10
4. 2-Chlorophenol	95-57-8	10
5. 1,3-Dichlorobenzene	541-73-1	10

40CFR Part 136 Parameters (continued)
Target Compound List (TCL) and
Contract Required Quantitation Limit

Semivolatile Organics (Method 625 cont.)

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
6. 1,4-Dichlorobenzene	106-46-7	10
7. 1,2-Dichlorobenzene	95-50-1	10
8. 2,2'-oxybis(1-Chloropropane)	108-60-1	10
9. N-Nitrosodi-n-propylamine	621-64-7	10
10. Hexachloroethane	67-72-1	10
11. Nitrobenzene	98-95-3	10
12. Isophorone	78-59-1	10
13. 2-Nitrophenol	88-75-5	10
14. 2,4-Dimethylphenol	105-67-9	10
15. bis(2-Chloroethoxy) methane	111-91-1	10
16. 2,4-Dichlorophenol	120-83-2	10
17. 1,2,4-Trichlorobenzene	120-82-1	10
18. Naphthalene	91-20-3	10
19. Hexachlorobutadiene	87-68-3	10
20. 4-Chloro-3-methylphenol (p-chloro-m-cresol)	59-50-7	10
21. Hexachlorocyclopentadiene	77-47-4	10
22. 2,4,6-Trichlorophenol	88-06-2	10
23. 2-Chloronaphthalene	91-58-7	10
24. Dimethyl phthalate	131-11-3	10
25. Acenaphthylene	208-96-8	10
26. Acenaphthene	83-32-9	10
27. 2,4-Dinitrophenol	51-28-5	50
28. 4-Nitrophenol	100-02-7	50
29. 2,4-Dinitrotoluene	121-14-2	10
30. 2,6-Dinitrotoluene	606-20-2	10
31. Diethylphthalate	84-66-2	10
32. 4-Chlorophenyl phenyl ether	7005-72-3	10
33. Fluorene	86-73-7	10
34. 4,6-Dinitro-2-methylphenol	534-52-1	50
35. N-nitroso diphenylamine	86-30-6	10
36. 4-Bromophenyl phenyl ether	101-55-3	10
37. Hexachlorobenzene	118-74-1	10
38. Pentachlorophenol	87-86-5	50

40CFR Part 136 Parameters (continued)
Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
<u>Semivolatile Organics (Method 625 cont.)</u>		
39. Phenanthrene	85-01-8	10
40. Anthracene	120-12-7	10
41. Di-n-butyl phthalate	84-74-2	10
42. Fluoranthene	206-44-0	10
43. Benzidine	92-87-5	80
44. Pyrene	129-00-0	10
45. Butyl benzyl phthalate	85-68-7	10
46. 3,3'-Dichlorobenzidine	91-94-1	20
47. Benz(a)anthracene	56-55-3	10
48. bis(2-ethylhexyl)phthalate	117-81-7	10
49. Chrysene	218-01-9	10
50. Di-n-octyl phthalate	117-84-0	10
51. Benzo(b)fluoranthene	205-99-2	10
52. Benzo(k)fluoranthene	207-08-9	10
53. Benzo(a)pyrene	50-32-8	10
54. Indeno(1,2,3-cd)pyrene	193-39-5	10
55. Dibenz(a,h)anthracene	53-70-3	10
56. Benzo(g,h,i)perylene	191-24-2	10
<u>Pesticides/PCBs (Method 608)</u>		
1. alpha-BHC	319-84-6	0.05
2. beta-BHC	319-85-7	0.05
3. delta-BHC	319-86-8	0.05
4. gamma-BHC (Lindane)	58-89-9	0.05
5. Heptachlor	76-44-8	0.05
6. Aldrin	309-00-2	0.05
7. Heptachlor epoxide	1024-57-3	0.05
8. Endosulfan I	959-98-8	0.05
9. Dieldrin	60-57-1	0.10
10. 4,4'-DDE	72-55-9	0.10
11. Endrin	72-20-8	0.10
12. Endosulfan II	33213-65-9	0.10
13. 4,4'-DDD	72-54-8	0.10

40CFR Part 136 Parameters (continued)
Target Compound List (TCL) and
Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
Pesticides/PCBs (Method 608 cont.)		
14. Endrin aldehyde	7421-93-4	0.10
15. Endosulfan sulfate	1031-07-8	0.10
16. 4,4'-DDT	50-29-3	0.10
17. Chlordane	57-74-9	0.5
18. Toxaphene	8001-35-2	1.0
19. AROCLOR-1016	12674-11-2	0.5
20. AROCLOR-1221	11104-28-2	0.5
21. AROCLOR-1232	11141-16-5	0.5
22. AROCLOR-1242	53469-21-9	0.5
23. AROCLOR-1248	12672-29-6	0.5
24. AROCLOR-1254	11097-69-1	1.0
25. AROCLOR-1260	11096-82-5	1.0
Other Pesticides/Herbicides		
1. Ametryn	834-12-8	2.0
2. Aminocarb	2032-59-9	1.0
3. Atraton	1610-17-9	2.0
4. Atrazine	1912-24-9	2.0
5. Azinphos methyl	86-50-0	1.0
6. Barban	101-27-9	0.5
7. Captan	133-06-2	1.0
8. Carbaryl	63-25-2	1.0
9. Chlorpropham	101-21-3	1.0
10. 2,4-Dichlorophenoxy acetic acid; (2,4-D)	94-75-2	2.0
11. Demeton-O	298-03-3	1.0
12. Demeton-S	126-75-0	1.0
13. Diazinon	333-41-5	1.0
14. Dicamba	1918-00-9	2.0
15. Dichloran	-	1.0
16. Disulfoton	298-04-4	2.0
17. Diuron	330-54-1	1.0
18. Fenuron	101-42-8	0.5

40CFR Part 136 Parameters (continued)
Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level ($\mu g/L$)
<u>Other Pesticides and Herbicides</u>		
19. Fenuron-TCA	4482-55-7	1.0
20. Linuron	330-55-2	1.0
21. Malathion	121-75-5	1.0
22. Methiocarb	2032-65-7	2.0
23. Methoxychlor	72-43-5	0.5
24. Mexacarbate	315-18-4	1.0
25. Mirex	2385-85-5	1.0
26. Monuron	150-68-5	0.5
27. Monuron-TCA	140-41-0	1.0
28. Neburon	555-37-3	1.0
29. Parathion ethyl	56-38-2	1.0
30. Parathion methyl	298-00-0	1.0
31. Pentachloronitrobenzene; (PCNB)	82-68-8	1.0
32. Prometon	1610-18-0	2.0
33. Prometryn	7287-19-6	2.0
34. Propazine	139-40-2	2.0
35. Propham	-	2.0
36. Propoxur	114-26-1	1.0
37. Secbumeton	26259-45-0	2.0
38. Siduron	1982-49-6	0.5
39. Simazine	122-34-9	2.0
40. Strobane	-	1.0
41. Swep	1918-18-9	2.0
42. 2,4,5-Trichlorophenoxyacetic acid; (2,4,5-T)	93-76-5	2.0
43. (2,4,5-Trichlorophenoxy)-propionic acid; (2,4,5-TP; Silvex)	93-72-1	2.0
44. Terbuthylazine	5915-41-3	2.0
45. Trifluraline	1582-09-8	1.0

40CFR Part 136 Parameters (continued)
Target Compound List (TCL) and
Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
<u>Dioxin</u>		
1. 2,3,7,8-Tetrachlorodibenzo-p-dioxin; (2,3,7,8-TCDD)	1746-01-6	0.005

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter		CAS Number	Contract Required Quantitation Level (µg/L)
A.	Ignitability (° C or ° F)	NA	NA
B.	Corrosivity (pH units)	NA	NA
C.	Reactivity		
	1. Total Releasable Cyanide as HCN		100,000
	2. Total Releasable Sufide as H_2S		100,000
D.	Extraction Procedure Toxicity; (EP Tox) (concentrations in extract)		
	1. Arsenic		1,000
	2. Barium		10,000
	3. Cadmium		100
	4. Total Chromium		1,000
	5. Lead		1,000
	6. Mercury		50
	7. Selenium		100
	8. Silver		1,000
	9. gamma-BHC (Lindane)	58-89-9	100
	10. 2,4-Dichlorophenoxyacetic acid; (2,4-D)	94-75-2	1,000
	11. Endrin	72-20-8	5
	12. Methoxychlor	72-43-5	1,000
	13. 2,4,5-Trichlorophenoxy-propionic acid; (2,4,5-TP; Silvex)	93-72-1	100
	14. Toxaphene	8001-35-2	100

RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
E. Toxcity Charactaristic Leaching Procedure (TCLP) (concentrations in extract)		
Metals		
1. Arsenic		1,000
2. Barium		10,000
3. Cadmium		100
4. Total Chromium		1,000
5. Lead		1,000
6. Mercury		50
7. Selenium		100
8. Silver		1,000
Volatiles		
1. Acetone	67-64-1	10
2. Acrylonitrile	107-13-1	1,000
3. Benzene	71-43-2	10
4. 2-Butanone (Methylethylketone)	78-93-3	10
5. n-Butyl alcohol	71-36-6	1,000
6. Carbon disulfide	75-15-0	100
7. Carbon tetrachloride	56-23-5	10
8. Chlorobenzene	108-90-7	10
9. Chloroform	67-66-3	10
10. 1,2-Dichloroethane	107-06-2	10
11. 1,1-Dichloroethylene	75-35-4	10
12. Ethyl acetate	141-78-6	10
13. Ethyl benzene	100-41-4	10
14. Ethyl ether	60-29-7	10
15. Methanol	67-56-1	10
16. Methylene chloride	75-09-2	10
17. 4-Methyl-2-pentanone (Methyl iso-butyl ketone)	108-10-1	10

RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level ($\mu g/L$)
E. TCLP (cont.)		
Volatiles (cont.)		
18. 2-Methyl-l-propanol (iso-Butyl alcohol)	78-83-1	1,000
19. 1,1,1,2-Tetrachloroethane	630-20-6	1,000
20. 1,1,2,2-Tetrachloroethane	79-34-5	100
21. Tetrachloroethylene	127-18-4	10
22. Toluene	108-88-3	100
23. 1,1,1-Trichloroethane	71-55-6	100
24. 1,1,2-Trichloroethane	79-00-5	100
25. Trichloroethylene	79-01-6	10
26. Trichlorofluoromethane	75-69-4	10
27. 1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	100
28. Vinyl chloride	75-01-4	10
29. Xylene (Total)	1330-20-7	10
Semivolatiles		
1. bis(2-Chloroethyl) ether	111-44-4	10
2. Cyclohexanone	108-94-1	10
3. 1,2-Dichlorobenzene	95-50-1	10
4. 1,4-Dichlorobenzene	106-46-7	10
5. 2,4-Dinitrotoluene	121-14-2	10
6. Hexachlorobenzene	118-74-1	10
7. Hexachlorobutadiene	87-68-3	10
8. Hexachlorodibenzo-p-dioxins (all isomers)		0.5
9. Hexachlorodibenzofurans (all isomers)		0.5
10. Hexachloroethane	67-72-1	100
11. 2-Methylphenol (o-Cresol)	95-48-7	10

RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limit (μg/L)
E. TCLP (cont.)		
Semivolatiles (cont.)		
12. 3-Methylphenol (m-Cresol)	108-39-4	10
13. 4-Methylphenol (p-Cresol)	106-44-5	10
14. Nitrobenzene	98-95-3	10
15. Pentachlorodibenzo-p-dioxins (all isomers)		0.5
16. Pentachlorodibenzofurans (all isomers)		0.5
17. Pentachlorophenol	87-86-5	5
18. Phenol	108-95-2	1,000
19. Pyridine	110-86-1	100
20. Tetrachlorodibenzo-p-dioxins (all isomers)		0.5
21. Tetrachlorodibenzofurans (all isomers)		0.5
22. 2,3,4,6-Tetrachlorophenol	58-90-2	50
23. 2,4,5-Trichlorophenol	95-95-4	10
24. 2,4,6-Trichlorophenol	88-06-2	10
Pesticides		
1. gamma-BHC (Lindane)	58-89-9	10
2. Chlordane	57-74-9	10
3. 2,4-Dichlorophenoxyacetic acid; (2,4-D)	94-75-7	100
4. Endrin	72-20-8	0.5
5. Heptachlor	76-44-8	0.5
6. Heptachlor epoxide	1024-57-3	0.5
7. Methoxychlor	72-43-5	100
8. 2,4,5-Trichlorophenoxy-propionic acid; (2,4,5-TP; Silvex)	93-76-5	10
9. Toxaphene	8001-35-2	10

RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

F. Appendix IX Substances

Volatiles

All by 8240 except where noted

Parameter	CAS Number	Contract Required Quantitation Limits	
		Low Water (µg/L)	Low Soil/Sediment (µg/Kg)
1. Acetone	67-64-1	10	10
2. Acetonitrile	75-05-8	100	100
3. Acrolein	107-02-8	5	5
4. Acrylonitrile	107-13-1	5	5
5. Benzene	71-43-2	5	5
6. Bromodichloromethane	75-27-4	5	5
7. Bromoform	75-25-2	5	5
8. Bromomethane	74-83-9	10	10
9. 2-Butanone (Methyl ethyl ketone)	78-93-3	10	10
10. Carbon disulfide	75-15-0	5	5
11. Carbon tetrachloride	56-23-5	5	5
12. Chlorobenzene	108-90-7	5	5
13. 2-Chloro-1,3-butadiene	126-99-8	5	5
14. Chloroethane	75-00-3	10	10
15. Chloroform	67-66-3	5	5
16. Chloromethane	74-87-3	10	10
17. 3-Chloropropene	107-05-1	100	100
18. Dibromochloromethane	124-48-1	5	5
19. 1,2-Dibromo-3-chloropropane	96-12-8	5	5
20. 1,2-Dibromoethane	106-93-4	5	5
21. Dibromomethane	74-95-3	5	5
22. trans-1,4-Dichloro-2-butene	110-57-6	5	5
8010 23. Dichlorodifluoromethane	75-71-8	5	5
24. 1,1-Dichloroethane	75-34-3	5	5
25. 1,2-Dichloroethane	107-06-2	5	5
26. 1,1-Dichloroethylene	75-35-4	5	5
27. trans-1,2-Dichloroethylene	156-60-5	5	5

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µg/Kg)
F. Appendix IX (cont.)			
Volatiles (cont.)			
28. Dichloromethane	75-09-2	5	5
29. 1,2-Dichloropropane	78-87-5	5	5
30. cis-1,3-Dichloropropane	10061-01-5	5	5
31. trans-1,3-Dichloropropane	10061-02-6	5	5
32. 1,4-Dioxane-	123-91-1	150	150
33. Ethylbenzene	100-41-4	5	5
34. Ethylmethacrylate	97-63-2	5	5
35. 2-Hexanone	591-78-6	10	10
36. Iodomethane	74-88-4	5	5
8015 37. Methacrylonitrile	126-98-7	5	5
8015 38. Methylmethacrylate	80-62-6	5	5
39. 4-Methyl-2-pentanone (Methyl iso-butyl ketone)	108-10-1	10	10
8015 40. 2-Methyl-1-propanol (iso-Butyl alcohol)	78-83-1	50	50
41. Pentachloroethane	76-01-7	5	5
42. 2-Picoline	109-06-8	5	5
43. Propionitrile-	107-12-0	5	5
8270 44. Pyridine-	110-86-1	5	5
45. Styrene	100-42-5	5	5
46. 1,1,1,2-Tetrachloroethane	630-20-6	5	5
47. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
48. Tetrachloroethylene	127-18-4	5	5
49. Toluene	108-88-3	5	5
50. 1,1,1-Trichloroethane	71-55-6	5	5
51. 1,1,2-Trichloroethane	79-00-5	5	5

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

F. Appendix IX (cont.)

All but 8270 except where noted.

		Contract Required Quantitation Limits	
Parameter	CAS Number	Low Water (µg/L)	Low Soil/Sediment (µg/Kg)
Volatiles (cont.)			
52. Trichloroethylene	79-01-6	5	5
53. Trichlorofluoromethane	75-69-4	5	5
54. 1,2,3-Trichloropropane	96-18-4	5	5
55. Vinyl acetate	108-05-4	5	5
56. Vinyl chloride	75-01-4	10	10
57. Xylene (Total)	1330-20-7	5	5
Semivolatiles			
58. Acenaphthene	83-32-9	10	330
59. Acenaphthylene	208-96-8	10	330
60. Acetophenone	98-86-2	10	330
61. 2-Acetylaminofluorene	53-96-3	10	330
62. 4-Aminobiphenyl	92-67-1	10	330
63. Aniline	62-53-3	10	330
64. Anthracene	120-12-7	10	330
65. Aramite	140-57-8	10	330
66. Benz[a]anthracene	56-55-3	10	330
67. Benzo[b]fluoranthene	205-99-2	10	330
68. Benzo[k]fluoranthene	207-08-9	10	330
69. Benzo[g.h,i]perylene	191-24-2	10	330
70. Benzo[a]pyrene	50-32-8	10	330
71. Benzyl alcohol	100-51-6	10	330
72. Bis(2-chloroethoxy)-methane	111-91-1	10	330
73. Bis(2-chloroethyl)ether	111-44-4	10	330
74. 2,2'-oxybis(1-Chloro-propane	108-60-1	10	330
75. Bis(2-ethylhexyl)-phthalate	117-81-7	10	330

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µg/Kg)
F. Appendix IX (cont.)			
Semivolatiles (cont.)			
76. 4-Bromophenyl phenyl ether	101-55-3	10	330
77. Butyl benzyl phthalate	85-68-7	10	330
78. p-Chloroaniline	106-47-8	10	330
79. Chlorobenzilate	510-15-6	10	330
80. 4-chloro-3-methylphenol (p-chloro-m-cresol)	59-50-7	10	330
81. 2-Chloronaphthalene	91-58-7	10	330
82. 2-Chlorophenol	95-57-8	10	330
83. 4-Chlorophenyl phenyl ether	7005-72-3	10	330
84. Chrysene	218-01-9	10	330
85. Diallate	2303-16-4	10	330
86. Dibenz[a,h]anthracene	53-70-3	10	330
87. Dibenzofuran	132-64-9	10	330
88. Di-n-butylphthalate	84-74-2	10	330
89. 1,2-Dichlorobenzene	95-50-1	10	330
90. 1,3-Dichlorobenzene	541-73-1	10	330
91. 1,4-Dichlorobenzene	106-46-7	10	330
92. 3,3'Dichlorobenzidine	91-94-1	20	660
93. 2,4-Dichlorophenol	120-83-2	10	330
94. 2,6-Dichlorophenol	87-65-0	10	330
95. Diethylphthlate	84-66-2	10	330
96. O,O-Diethyl-O-2-pyrazinyl-phosphorothioate	297-97-2	10	330
97. Dimethoate	60-51-5	10	330
98. p-(Dimethylamino)azobenzene	60-11-7	10	330
99. 7,12-Dimethylbenz[a]-anthracene	57-97-6	10	330

RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

F. Appendix IX (cont.)

Semivolatiles (cont.)

		Contract Required Quantitation Limits	
		Low Water	Low Soil/Sediment
Parameter	CAS Number	(µg/L)	(µ/Kg)
100. 3,3'-Dimethylbenzidine	119-93-7	10	330
101. α,α-Dimethylphenethylamine	122-09-8	10	330
102. 2,4-Dimethylphenol	105-67-9	10	330
103. Dimethylphthlate	131-11-3	10	330
104. 1,3-Dinitrobenzene	99-65-0	10	330
105. 4,6-Dinitro-2-methylphenol	534-52-1	50	1,600
106. 2,4-Dinitrophenol	51-28-5	50	1,600
107. 2,4-Dinitrotoluene	121-14-2	10	330
108. 2,6-Dinitrotoluene	606-20-2	10	330
109. Di-n-octylphthalate	117-84-0	10	330
110. Diphenylamine	122-39-4	10	330
111. Ethyl methanesulfonate	62-50-0	10	330
NOT CHROM. 112. Famphur	52-85-7	10	330
113. Fluoranthene	206-44-0	10	330
114. Fluorene	86-73-7	10	330
115. Hexachlorobenzene	118-74-1	10	330
116. Hexachlorobutadiene	87-68-3	10	330
117. Hexachlorocyclopentadiene	77-47-4	10	330
S/C 8280 118. Hexachlorodibenzo-p-dioxins (all isomers)		0.01	1.0
119. Hexachlorodibenzofurans (all isomers)		0.01	1.0
120. Hexachloroethane	67-72-1	10	330
121. Hexachlorophene	70-30-4	10	330
122. Hexachloropropene	1888-71-7	10	330
123. Indeno(1,2,3-c,d)-pyrene	193-39-5	10	330
124. Isodrin	465-73-6	10	330
~~125. Isophorone~~	~~78-59-1~~	~~10~~	~~330~~

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (μg/L)	 Low Soil/Sediment (μ/Kg)
F. Appendix IX (cont.)			
Semivolatiles (cont.)			
125. Isophorone	78-59-1	10	330
126. Isosafrole	120-58-1	10	330
127. Kepone	143-50-0	10	330
128. Methapyrilene	91-80-5	10	330
129. 3-Methylcholanthrene	56-49-5	10	330
130. Methyl methane sulfonate	66-27-3	10	330
131. 2-Methylnaphthalene	91-57-6	10	330
132. 2-Methylphenol (o-Cresol)	95-48-7	10	330
133. 3-Methylphenol (m-Cresol)	108-39-4	10	330
134. 4-Methylphenol (p-Cresol)	106-44-5	10	330
135. Naphthalene	91-20-3	10	330
136. 1,4-Naphthoquinone	130-15-4	10	330
137. 1-Naphthylamine	134-32-7	10	330
138. 2-Naphthylamine	91-59-8	10	330
139. 2-Nitroaniline	88-74-4	50	1,600
140. 3-Nitroaniline	99-09-2	50	1,600
141. 4-Nitroaniline	100-01-6	50	1,600
142. Nitrobenzene	98-95-3	10	330
143. 2-Nitrophenol	88-75-5	10	330
144. 4-Nitrophenol	100-02-7	50	1,600
145. 4-Nitroquinoline-1-oxide	56-57-5	10	330
146. N-Nitrosodi-n-butylamine	924-16-3	10	330
147. N-Nitrosodiethylamine	55-18-5	10	330
148. N-Nitrosodimethylamine	62-75-9	10	330
149. N-Nitrosodiphenylamine	86-30-6	10	330

			Contract Required Quantitation Limits	
	Parameter	CAS Number	Low Water (µg/L)	Low Soil/Sediment (µ/Kg)
	F. Appendix IX (cont.)			
	<u>Semivolatiles (cont.)</u>			
	150. N-Nitrosodi-n-propylamine	621-24-7	10	330
	151. N-Nitrosomethylethylamine	10595-95-6	10	330
	152. N-Nitrosomorpholine	59-89-2	10	330
	153. N-Nitrosopiperidine	100-75-4	10	330
	154. N-Nitrosopyrrolidine	930-55-2	10	330
	155. 5-Nitro-o-toluidine	99-55-8	10	330
	156. Parathion	56-38-2	10	330
	157. Pentachlorobenzene	608-93-5	10	330
s|c 8280	158. Pentachlorodibenzo-p-dioxins (all isomers)		0.01	1.0
	159. Pentachlorodibenzofurans (all isomers)		0.01	1.0
	160. Pentachloronitrobenzene	82-68-8	10	330
	161. Pentachlorophenol	87-86-5	50	1,600
	162. Phenacetin	62-44-2	10	330
	163. Phenanthrene	85-01-8	10	330
	164. Phenol	108-95-2	10	330
	165. p-Phenylenediamine	106-50-3	10	330
	166. Pronamide	23950-58-5	10	330
	167. Pyrene	129-00-0	10	330
	168. Safrole	94-59-7	10	330
	169. 1,2,4,5-Tetrachlorobenzene	95-94-3	10	330
s|c 8280	170. 2,3,7,8-Tetrachlorodibenzo-p-dioxin; (2,3,7,8-TCDD)	1746-01-6	0.005	0.5
	171, Tetrachlorodibenzo-p-dioxins (all isomers)		0.01	1.0

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µ/Kg)
F. Appendix IX (cont.)			
<u>Semivolatiles (cont.)</u>			
S/C 8280 { 172. Tetrachlorodibenzofurans (all isomers)		0.01	1.0
173. 2,3,4,6-Tetrachlorophenol	58-90-2	10	330
8140 174. Tetraethyldithiopyrophosphate (Sulfotepp)	3689-24-5	10	330
175. o-Toluidine	95-53-4	10	330
176. 1,2,4-Trichlorobenzene	120-82-1	10	330
177. 2,4,5-Trichlorophenol	95-95-4	10	330
178. 2,4,6-Trichlorophenol	88-06-2	10	330
179. O,O,O-Triethylphosphorothioate	126-68-1	10	330
180. 1,2,3-Trinitrobenzene	99-35-4	10	330
<u>Pesticides/Herbicides/PCBs</u>			
181. Aldrin	309-00-2	0.05	8.0
182. AROCLOR-1016	12674-11-2	0.5	80
183. AROCLOR-1221	11104-28-2	0.5	80
184. AROCLOR-1232	11141-16-5	0.5	80
185. AROCLOR-1242	53469-21-9	0.5	80
186. AROCLOR-1248	12672-29-6	0.5	80
187. AROCLOR-1254	11097-69-1	1.0	160
188. AROCLOR-1260	11096-82-5	1.0	160
189. alpha-BHC	319-84-6	0.05	8.0
190. beta-BHC	319-85-7	0.05	8.0
191. delta-BHC	319-86-8	0.05	8.0
192. gamma-BHC (Lindane)	58-89-9	0.05	8.0
Kepone			

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

F. Appendix IX (cont.)

Pesticides/Herbicides/PCBs (cont.)

	Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µg/Kg)
Cannot Chrom	193. 2-sec-Butyl-4,6-dinitrophenol; (Dinoseb; DNBP)	88-85-7	1.0	160
8080	194. Chlordane (Total)	57-74-9	0.5	80
8150	195. 2,4-Dichlorophenoxy-acetic acid; (2,4-D)	94-75-7	10.	800
8080	196. 4,4'-DDD	72-54-8	0.10	16
	197. 4,4'-DDE	72-55-9	0.10	16
	198. 4,4'-DDT	50-29-3	0.10	16
↓	199. Dieldrin	60-57-1	0.10	16
8270	200. Disulfoton	298-04-4	2.0	320
8080	201. Endosulfan I	959-98-8	0.10	16
	202. Endosulfan II	33213-65-9	0.10	16
	203. Endosulfan sulfate	1031-07-8	0.10	16
	204. Endrin	72-20-8	0.10	16
	205. Endrin aldehyde	7421-93-4	0.20	32
	206. Heptachlor	76-44-8	0.05	8.0
	207. Heptachlor epoxide	1024-57-3	0.05	8.0
↓	208. Methoxychlor	72-43-5	0.05	80
8270	209. Methyl parathion	298-00-0	0.5	80
8140	210. Phorate	298-02-2	2.0	320
8150	211. (2,4,5-Trichloro-phenoxy)propanoic acid; (2,4,5-TP; Silvex)	93-72-1	2.0	320
8150	212. 2,4,5-Trichloro-phenoxyacetic acid (2,4,5-T)	93-76-5	2.0	320
8080	213. Toxaphene	8001-35-2	1.0	160

RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µg/Kg)
F. Appendix IX (cont.)			
<u>Inorganics</u>			
214. Antimony		60	6,000
215. Arsenic		10	1,000
216. Barium		200	20,000
217. Beryllium		5.0	500
218. Cadmium		5.0	500
219. Chromium		10	1,000
220. Cobalt		50	5,000
221. Cooper		25	2,500
222. Cyanide	57-12-5	40	4,000
223. Lead		5.0	500
224. Mercury		0.2	20
225. Nickel		40	4,000
226. Selenium		5.0	500
227. Silver		10	1,000
228. Sulfide	18496-25-8	10,000	-
229. Thallium		10	1,000
230. Tin		40	4,000
231. Vanadium		50	5,000
232. Zinc		20	2,000
G. <u>Volatiles (Method 8240)</u>			
1. Acetone	67-64-1	10	10
2. Benzene	71-43-2	5	5
3. Bromodichloromethane	75-27-4	5	5
4. Bromoform	75-25-2	5	5
5. Bromomethane	74-83-9	10	10
6. 2-Butanone (Methyl ethyl ketone)	78-93-3	10	10
7. Carbon disulfide	75-15-0	5	5
8. Carbon tetrachloride	56-23-5	5	5
9. Chlorobenzene	108-90-7	5	5

		Contract Required Quantitation Limits	
Parameter	CAS Number	Low Water (µg/L)	Low Soil/Sediment (µg/Kg)
G. Volatiles (Method 8240 cont.)			
10. Chloroethane	75-00-3	10	10
11. Chloroform	67-66-3	5	5
12. Chloromethane	74-87-3	10	10
13. Dibromochloromethane	124-48-1	5	5
14. 1,1-Dichloroethane	75-34-3	5	5
15. 1,2-Dichloroethane	107-06-2	5	5
16. 1,1-Dichloroethylene	75-35-4	5	5
17. 1,2-Dichloroethylene (Total)	156-60-5	5	5
18. Dichloromethane	75-09-2	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. cis-1,3-Dichloropropene	10061-01-5	5	5
21. trans-1,3-Dichloropropene	10061-02-6	5	5
22. Ethylbenzene	100-41-4	5	5
23. 2-Hexanone	591-78-6	10	10
24. 4-Methyl-2-pentanone (Methyl iso-butyl ketone)	108-10-1	10	10
25. Styrene	100-42-5	5	5
26. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
27. Tetrachloroethylene	127-18-4	5	5
28. Toluene	108-88-3	5	5
29. 1,1,1-Trichloroethane	71-55-6	5	5
30. 1,1,2-Trichloroethane	79-00-5	5	5
31. Trichloroethylene	79-01-6	5	5
32. Vinyl acetate	108-05-4	5	5
33. Vinyl chloride	75-01-4	10	10
34. Xylene (Total)	1330-20-7	5	5
35. 2-Chloroethylvinyl ether	110-75-8	10	10

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µg/Kg)
H. Semivolatiles (Method 8270)			
1. Acenaphthene	83-32-9	10	330
2. Acenaphthylene	208-96-8	10	330
3. Anthracene	120-12-7	10	330
4. Benz[a]anthracene	56-55-3	10	330
5. Benzo[b]fluoranthene	205-99-2	10	330
6. Benzo[k]fluoranthene	207-08-9	10	330
7. Benzo[g.h,i]perylene	191-24-2	10	330
8. Benzo[a]pyrene	50-32-8	10	330
9. Benzoic acid	65-85-0	50	1,600
10. Benzyl alcohol	100-51-6	10	330
11. bis(2-Chloroethoxy)-methane	111-91-1	10	330
12. bis(2-Chloroethyl)ether	111-44-4	10	330
13. 2,2′-oxybis(1-Chloro-propane)	108-60-1	10	330
14. bis(2-Ethylhexyl)-phthalate	117-81-7	10	330
15. 4-Bromophenyl phenyl ether	101-55-3	10	330
16. Butyl benzyl phthalate	85-68-7	10	330
17. 4-Chloroaniline	106-47-8	10	330
18. 4-chloro-3-methylphenol (p-chloro-m-cresol)	59-50-7	10	330
19. 2-Chloronaphthalene	91-58-7	10	330
20. 2-Chlorophenol	95-57-8	10	330
21. 4-Chlorophenyl phenyl ether	7005-72-3	10	330
22. Chrysene	218-01-9	10	330
23. Dibenz[a,h]anthracene	53-70-3	10	330
24. Dibenzofuran	132-64-9	10	330
25. Di-n-butylphthalate	84-74-2	10	330
26. 1,2-Dichlorobenzene	95-50-1	10	330
27. 1,3-Dichlorobenzene	541-73-1	10	330

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µg/Kg)
H. Semivolatiles (Method 8270 cont.)			
28. 1,4-Dichlorobenzene	106-46-7	10	330
29. 3,3'Dichlorobenzidine	91-94-1	20	660
30. 2,4-Dichlorophenol	120-83-2	10	330
31. Diethylphthlate	84-66-2	10	330
32. 2,4-Dimethylphenol	105-67-9	10	330
33. Dimethylphthlate	131-11-3	10	330
34. 2,4-Dinitro-2-methylphenol	534-52-1	50	1,600
35. 2,4-Dinitrophenol	51-28-5	50	1,600
36. 2,4-Dinitrotoluene	121-14-2	10	330
37. 2,6-Dinitrotoluene	606-20-2	10	330
38. Di-n-octylphthalate	117-84-0	10	330
39. Fluoranthene	206-44-0	10	330
40. Fluorene	86-73-7	10	330
41. Hexachlorobenzene	118-74-1	10	330
42. Hexachlorobutadiene	87-68-3	10	330
43. Hexachlorocyclopentadiene	77-47-4	10	330
44. Hexachloroethane	67-72-1	10	330
45. Indeno(1,2,3-c,d)-pyrene	193-39-5	10	330
46. Isophorone	78-59-1	10	330
47. 2-Methylnaphthalene	91-57-6	10	330
48. 2-Methylphenol (o-Cresol)	95-48-7	10	330
49. 4-Methylphenol (p-Cresol)	106-44-5	10	330
50. Naphthalene	91-20-3	10	330
51. 2-Nitroaniline	88-74-4	50	1,600
52. 3-Nitroaniline	99-09-2	50	1,600
53. 4-Nitroaniline	100-01-6	50	1,600
54. Nitrobenzene	98-95-3	10	330
55. 2-Nitrophenol	88-75-5	10	330

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

		Contract Required Quantitation Limits	
Parameter	CAS Number	Low Water (µg/L)	Low Soil/Sediment (µg/Kg)
H. Semivolatiles (Method 8270 cont.)			
56. 4-Nitrophenol	100-02-7	50	1,600
57. N-Nitrosodiphenylamine	86-30-6	10	330
58. N-Nitrosodi-n-propylamine	621-24-7	10	330
59. Pentachlorophenol	87-86-5	50	1,600
60. Phenanthrene	85-01-8	10	330
61. Phenol	108-95-2	10	330
62. Pyrene	129-00-0	10	330
63. 1,2,4-Trichlorobenzene	120-82-1	10	330
64. 2,4,5-Trichlorophenol	95-95-4	10	330
65. 2,4,6-Trichlorophenol	88-06-2	10	330
I. Pesticides/PCBs (Method 8080)			
1. Aldrin	309-00-2	0.05	8.0
2. AROCLOR-1016	12674-11-2	0.5	80
3. AROCLOR-1221	11104-28-2	0.5	80
4. AROCLOR-1232	11141-16-5	0.5	80
5. AROCLOR-1242	53469-21-9	0.5	80
6. AROCLOR-1248	12672-29-6	0.5	80
7. AROCLOR-1254	11097-69-1	1.0	160
8. AROCLOR-1260	11096-82-5	1.0	160
9. alpha-BHC	319-84-6	0.05	8.0
10. beta-BHC	319-85-7	0.05	8.0
11. delta-BHC	319-86-8	0.05	8.0
12. gamma-BHC (Lindane)	58-89-9	0.05	8.0
13. Chlordane (Total)	57-74-9	0.5	80
14. 4,4'-DDD	72-54-8	0.10	16
15. 4,4'-DDE	72-55-9	0.10	16
16. 4,4'-DDT	50-29-3	0.10	16
17. Dieldrin	60-57-1	0.10	16
18. Endosulfan I	959-98-8	0.10	16

SECTION IV
RCRA Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Limits Low Water (µg/L)	 Low Soil/Sediment (µg/Kg)
I. Pesticides/PCBs (Method 8080 cont.)			
19. Endosulfan II	33213-65-9	0.10	16
20. Endosulfan sulfate	1031-07-8	0.10	16
21. Endrin	72-20-8	0.10	16
22. Endrin ketone	53494-70-5	0.10	16
23. Heptachlor	76-44-8	0.05	8.0
24. Heptachlor epoxide	1024-57-3	0.05	8.0
25. Methoxychlor	72-43-5	0.05	80
26. Toxaphene	8001-35-2	1.0	160

SECTION V
Non-Conventional Pesticides Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level ($\mu g/L$)
1. Alachlor	15972-60-8	1.0
2. AOP	(NA)	100
3. Benfluralin	1861-40-1	1.0
4. Benomyl	17804-35-2	50
5. Bentazon	25057-89-0	50
6. Bolstar	35400-43-2	1.0
7. Bromacil	314-40-9	10
8. Busan 40	51026-26-9	100
9. Busan 85	128-03-0	100
10. Butachlor	23184-66-9	1.0
11. Carban-S	128-04-1	100
12. Carbendazim	10605-21-7	50
13. Carbofuran	1583-66-2	20
14. Chlorobenzilate	510-15-6	1.0
15. Chloropyrifos	2921-88-2	2.0
16. Chloropyrifos Methyl	5598-13-0	2.0
17. Coumaphos	56-72-4	10
18. Cyanazine	21725-46-2	30
19. 2,4-DB	94-82-6	5.0
20. 2,4-DB isobutyl ester	533-74-4	5.0
21. 2,4-DB isooctyl ester	1320-15-6	5.0
22. Dibromochloropropane (DBCP)	96-12-8	0.2
23. DEET	134-62-3	20
24. Dichlorvos	62-73-7	0.5
25. Dinoseb	88-85-7	0.5
26. Ethalfluralin	55283-68-6	1.0
27. Etridiazole	2593-15-9	0.2
28. Fensulfolthion	115-90-2	10
29. Fenthion	55-38-9	0.5
30. Ferbam	14484-64-1	100
31. Fluometuron	2164-17-2	50
32. Glyphosate	1071-83-6	25
33. Hexazinone	51235-04-2	5.0
34. Isopropalin	33820-53-0	0.1
35. KN Methyl	(NA)	100

SECTION V
Non-Conventional Pesticides Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter		CAS Number	Contract Required Quantitation Level (µg/L)
36.	Mancozeb	8018-01-7	100
37.	Maneb	12427-38-2	100
38.	Mephosfolan	950-10-7	100
39.	Metham	137-42-8	20
40.	Methomyl	16752-77-5	100
41.	Metribuzin	21087-64-9	2.0
42.	Mevinphos	7786-34-7	2.0
43.	Nabam	142-59-6	100
44.	Naled	300-76-5	0.5
45.	Niacide	15339-36-3	100
46.	Oxamyl	23135-22-0	50
47.	Phorate	298-02-2	1.0
48.	Profluralin	26399-36-0	1.0
49.	Propachlor	1918-16-7	1.0
50.	Ronnel	299-84-3	2.0
51.	Simetryne	1014-70-6	0.4
52.	Stirofos	961-11-5	25
53.	Terbacil	5902-51-2	20
54.	Terbufos	13071-79-9	100
55.	Terbutryn	886-50-0	0.3
56.	Triadimefon	43121-43-3	5.0
57.	Trichloronate	327-96-0	1.0
58.	Tricyclazole	41814-78-2	20
59.	ZAC	(NA)	100
60.	Zineb	12122-67-7	100
61.	Ziram	137-30-4	10

SECTION VI
40CFR Part 141 Parameters
Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
Volatile Organics (Method 524.2)		
1. Acetone	67-64-1	1.0
2. Benzene	71-43-2	0.5
3. Bromobenzene	108-86-1	1.0
4. Bromochloromethane	74-97-5	1.0
5. Bromodichloromethane	75-27-4	0.5
6. Bromoform	75-25-2	0.5
7. Bromomethane	74-83-9	1.0
8. n-Butylbenzene	104-51-8	1.0
9. 2-Butanone (Methyl ethyl ketone)	78-93-3	1.0
10. sec-Butylbenzene	135-98-8	1.0
11. tert-Butylbenzene	98-06-6	1.0
12. Carbon disulfide	75-15-0	0.5
13. Carbon tetrachloride	56-23-5	0.5
14. Chlorobenzene	108-90-7	0.5
15. Chloroethane	75-00-3	1.0
16. Chloroform	67-66-3	0.5
17. Chloromethane	74-87-3	1.0
18. 2-Chlorotoluene	95-49-8	1.0
19. 4-Chlorotoluene	106-43-4	1.0
20. Dibromochloromethane	124-48-1	0.5
21. 1,2-Dibromo-3-chloropropane	96-12-8	1.0
22. 1,2-Dibromoethane	106-93-4	1.0
23. Dibromomethane	74-95-3	1.0
24. 1,2-Dichlorobenzene	95-50-1	1.0
25. 1,3-Dichlorobenzene	541-73-1	1.0
26. 1,4-Dichlorobenzene	106-46-7	1.0
27. Dichlorodifluoromethane	75-71-8	1.0
28. 1,1-Dichloroethane	75-34-3	0.5
29. 1,2-Dichloroethane	107-06-2	0.5
30. 1,1-Dichloroethylene	75-35-4	0.5

40CFR Part 141 Parameters (continued)
Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (µg/L)
Volatile Organics (Method 524.2)		
31. cis-1,2-Dichloroethylene	156-59-4	0.5
32. trans-1,2-Dichloroethylene	156-60-5	0.5
33. Dichloromethane	75-09-2	0.5
34. 1,2-Dichloropropane	78-87-5	0.5
35. 1,3-Dichloropropane	142-28-9	1.0
36. 2,2-Dichloropropane	590-20-7	1.0
37. 1,1-Dichloropropene	563-58-6	1.0
38. cis-1,3-Dichloropropene	10061-01-5	0.5
39. trans-1,3-Dichloropropene	10061-02-6	0.5
40. Ethylbenzene	100-41-4	0.5
41. 2-Hexanone	591-78-6	1.0
42. Hexachlorobutadiene	87-68-3	1.0
43. Isopropylbenzene	98-82-8	1.0
44. 4-Isopropyltoluene	99-87-6	1.0
45. 4-Methyl-2-pentanone (Methyl iso-butyl ketone)	108-10-1	1.0
46. Naphthalene	91-20-3	1.0
47. n-Propylbenzene	103-65-1	1.0
48. Styrene	100-42-5	0.5
49. 1,1,1,2-Tetrachloroethane	630-20-6	0.5
50. 1,1,2,2-Tetrachloroethane	79-34-5	0.5
51. Tetrachloroethylene	127-18-4	0.5
52. Toluene	108-88-3	0.5
53. 1,2,3-Trichlorobenzene	87-61-6	1.0
54. 1,2,4-Trichlorobenzene	120-82-1	1.0
55. 1,1,1-Trichloroethane	71-55-6	0.5
56. 1,1,2-Trichloroethane	79-00-5	0.5

Target Compound List (TCL) and Contract Required Quantitation Limit

Parameter	CAS Number	Contract Required Quantitation Level (μg/L)
Volatile Organics (Method 524.2)		
57. Trichloroethylene	79-01-6	0.5
58. Trichlorofluoromethane	75-69-4	1.0
59. 1,2,3-Trichloropropane	96-18-4	1.0
60. 1,2,4-Trimethylbenzene	95-63-6	1.0
61. 1,3,5-Trimethylbenzene	108-67-8	1.0
62. Vinyl acetate	108-05-4	0.5
63. Vinyl chloride	75-01-4	1.0
64. o-Xylene	95-47-6	0.5
65. m-Xylene	108-38-3	0.5
66. p-Xylene	106-42-3	0.5
67. 2-Chloroethylvinyl ether	110-75-8	1.0

ATTACHMENT 2

Deborah J. Kinecki manages the company's New York testing operations, and has been with the Recra laboratory organization for over 10 years. She has extensive experience in both the organic and inorganic analytical laboratories of the company. She has held various laboratory management and technical positions in the company. She holds a Bachelor of Science Degree in Biology from Niagara University.

Dr. Kenneth C. Malinowski is in charge of all laboratory operations of the company. He was previously Vice President of Research and Development for CECOS International. Prior to that, Dr. Malinowski was President of Recra Research (the predecessor company) and worked for other hazardous waste management companies. Dr. Malinowski has published extensively in the area of hazardous waste management technology; he holds a Bachelor of Arts Degree in Biology from SUNY College at Buffalo, and Masters and Ph.D. Degrees in the Ecological Sciences from Yale University.

R. Steven Maxwell directs the sales, marketing and corporate development activities of the company. Previously he was Vice President of Business Development for USPCI, Inc., a hazardous waste disposal company and a subsidiary of Union Pacific Corporation, and was Manager of Strategic and Market Planning for Union Pacific. Prior to that he worked in financial and strategic planning capacities for Marathon Oil and Getty Oil Company. Mr. Maxwell holds a Bachelor of Arts Degree in Geology from Earlham College, and Masters Degrees in Geological Sciences and in Public Administration from Harvard University.

Frank K. Milano directs the company's data management services. Mr. Milano is responsible for development of internal data management systems as well as for customized electronic data deliverables for external clients. He has broad management information systems experience in the environmental arena as well as other industries. He was previously MIS Director for Comptek Research, and held similar positions for American Precision Industries and Digital Equipment Corporation. He holds a Bachelor of Science Degree in Mathematics and Physics from the State University of New York at Brockport, and a Masters Degree in Business Administration from Canisius College.

James H. Miller is in charge of environmental testing sales for the company. He was previously an Assistant Area Superintendent and Process Engineer at Occidental Chemical, and worked in television journalism. Mr. Miller holds a Bachelor of Arts Degree in Journalism from the State University of New York at Buffalo and a Bachelor of Science Degree in Chemical Engineering from Clarkson University.

Thomas G. Robertson manages the customer service operations of the company. Mr. Robertson has broad business management experience, having previously managed and founded various commodity trading companies. He was a division manager for the consulting firm of Booz, Allen and Hamilton, and prior to that was the Assistant Director of the Children's Hospital of Buffalo, New York. He holds a Bachelor of Arts Degree from Colgate and an MBA Degree from the University of Chicago.

Brian C. Senefelder manages the company's technology incubator facility and real property testing services. Previously he was Environmental Health and Safety Manager at Chemical Waste Management's Model City, New York facilities, and he held other various positions for Chemical Waste Management. Mr. Senefelder holds a Bachelor of Science Degree in Environmental Chemistry from SUNY College at Buffalo.

Robert A. Stadelmaier is Chairman of the Board of Directors and President of the company. After working for other hazardous waste management concerns, Mr. Stadelmaier founded the predecessor company, Recra Research, in 1977. He later became President and Chief Operating Officer of CECOS International, but rejoined Recra Environmental in 1986. At the appointment of the EPA Administrator, Mr. Stadelmaier has served on advisory committees to EPA and on the New York State Hazardous Waste Advisory Committee. Mr. Stadelmaier holds a Bachelor of Arts Degree in Chemistry from the SUNY College at Buffalo.

Thomas F. Stanczyk coordinates the company's waste minimization and regulatory analysis activities and has been with the organization for 11 years. Previously he managed the waste characterization and treatability lab of the company and served in various management roles at Recra Research. Prior to that he worked for Chemtrol Pollution Services and other waste management concerns. Mr. Stanczyk has taught and published extensively on the subject of waste minimization and prevention; he holds a Bachelor of Arts Degree in Chemistry from Niagara University.

C. James **Stellrecht** manages the sales of environmental testing to government agencies; he has been with the organization for over 13 years. Mr. Stellrecht previously held various positions in Recra Research, including Vice President of Sales and Director of Program Development. Mr. Stellrecht holds a Bachelor of Arts Degree in Biology from SUNY at Potsdam.

Robert K. Wyeth is the Quality Assurance Officer for all of Recra's laboratories and is in charge of maintaining all Federal, State and corporate certifications; previously he was responsible for overall operations at the predecessor company, Recra Research. He has been with the organization since its founding in various environmental liability consulting and management roles, and prior to that he was the Assistant Director of the Great Lakes Laboratory. Mr. Wyeth has a Bachelor of Science Degree in Chemistry from Illinois State University, and a Masters Degree in Chemistry from the SUNY College at Buffalo.

APPENDIX B

APPENDIX B

HEALTH AND SAFETY PLAN

Remedial Design for
IRP Site 3 - Building 202 Drum Storage Yard
and IRP Site 13 - Underground Tank Pit
Niagara Falls Air Force Base
Niagara Falls, New York

APPROVALS

Project Manager

Thomas R. Heins

Date

Associate-in-Charge

Irvine G. Reinig II

Date

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1.00 INTRODUCTION

The following Health and Safety Plan (HASP) was prepared for use by GZA GeoEnvironmental of New York (GZA) personnel for the proposed field work in conjunction with the Remedial Design for Installation Restoration Program (IRP) Site 8 - Building 202 Drum Storage Yard and IRP Site 13 - Underground Tank Pit at the Niagara Falls Air Force Base, Niagara Falls, New York. GZA personnel engaged in the above-referenced field work are required to become familiar and comply with the requirements cited herein.

GZA does not guarantee the health and safety of any person entering this site. Due to the activities proposed, it is not possible to discover, evaluate, and provide protection for all possible hazard which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at these sites. The Health and Safety Guidelines in this plan were prepared specifically for these sites and should not be used on any other site without prior research and evaluation by trained health and safety specialists.

1.10 SITE LOCATION

IRP Site 8 and IRP Site 13 is located on the Niagara Falls Air Force Base at Niagara Falls Airport, Niagara Falls, New York. Figure B1 shows the location of the sites.

1.20 SITE HISTORY AND DESCRIPTION

IRP Site 8 was previously a gravel pad located north of Building 202 at the Niagara Falls IAP. The location of IRP Site 8 on the Niagara Falls Air Force Base is shown on Figure B1. It is understood that the gravel pad was used between 1978 and 1982 for short-term storage of hazardous waste drums prior to disposal off site. The gravel pad was subsequently paved over with asphalt concrete. A new asphalt concrete overlay was placed in 1988. The drums were reported to have been stored on the asphalt pavement also. Minor spills from drums were reported in this area and evidence of the spills were observed during a Phase I site investigation.

IRP Site 13 is the location of a former underground motor fuel storage tank, which was converted to a general slop waste tank. The tank has since been removed and the pit backfilled. The location of IRP Site 13 is shown on Figure B1.

Conditions at Site 8 and Site 13 are further described in reports of previous investigations made at the Niagara Falls IAP. They include:

-- Phase I records search made by Engineering Science in 1983.

-- Phase II, Stage 1 Confirmation/Quantification Report made by Science Applicants International Corporation (SAIC) in April 1986.

-- Installation Restoration Report (IRP) Remedial Investigation/Feasibility Study (RI/FS) made by SAIC in October 1990.

Subsurface samples from test borings and groundwater samples from monitoring wells installed during the above previous studies have been analyzed by others.

Groundwater analysis, as part of the October 1990 RI/FS, reported elevated levels (in excess of New York State Drinking Water Standards) of organics, including toluene, tricholoethene (TCE) and 1,1-dichloroethane in downgradient wells at IRP Site 8. Groundwater analysis at IRP Site 13, as part of the October 1990 RI/FS, reported elevated levels of organics, including vinyl chloride, TCE, toluene and ethylbenzene in wells directly adjacent to the site. At both sites, the elevated levels of organics were reported to be in the overburden groundwater. See Section 2.30 of the Work Plan for additional details. Reportedly, underground utilities are present in the areas adjacent to each site. The possibility of contaminant migration along such utilities has not been investigated to date.

A baseline risk assessment made at both sites by SAIC, as part of the RI/FS, concluded that the elevated organics present in the groundwater are a potential health hazard and therefore, it was recommended that the groundwater be remediated. The baseline risk assessment also concluded that the soil material itself did not pose a potential health hazard at either site and therefore, it does not require remedial action.

1.30 PURPOSE

The purpose of this HASP is to inform GZA personnel of the currently known and suspected hazards associated with work as part of the investigation for remedial design. All GZA personnel are required to become familiar with and follow the provisions of this plan as well as applicable Federal, state and local laws, including those set forth by the Occupational Safety and Health Administration (OSHA), particularly 29 CFR 1910 and 29 CFR 1926.

GZA personnel will be informed of the anticipated on-site hazards, oriented with the health and safety procedures to be followed during implementation of this plan, and provided a copy of this document. GZA will inform its subcontractors of the hazards known and suspected at the site. Each subcontractor will be responsible for their own health and safety. GZA is not responsible for the health and safety of site workers other than their own employees. On-site personnel will be required to sign a form verifying their understanding of the hazards at the site prior to commencing field work as described in Section 3.10.

2.00 HAZARD EVALUATION

General categories of hazards associated with the activities cited herein are physical and chemical. These are described separately below.

2.10 PHYSICAL

The type of physical hazards expected during the activities described herein are slips and falls, falling objects, electrical, explosive, noise, heat stress, and cold exposure. The health and safety procedures to reduce the potential for injury associated with these hazards are presented in Section 3.00.

2.20 CHEMICAL

Based on the site's history, GZA personnel may be exposed to various organic and inorganic compounds. The major contaminants of concern are shown on Table B1 for IRP Site 8 and IRP Site 13.

The compounds noted on Table B1 present health related concerns as a result of inhalation and/or dermal contact at appropriate concentrations (Dangerous Properties of Industrial Materials, Sax, 1984). Appendix B-1 contains excerpts from the cited reference for these compounds. Table B1 summarizes the symptoms of exposure and potential health effects, (NIOSH Pocket Guide to Chemical Hazards, USDOH, 1990).

Threshold limit values (TLVs) for these compounds are shown on Table B2. This information was also obtained from the NIOSH Pocket Guide for Chemical Hazards, USDOH, 1990.

3.00 SITE SAFETY PROCEDURES

3.10 SAFETY AND ORIENTATION MEETINGS

GZA will name the Site Safety Officer (SSO) and the alternative prior to start of the field work. The GZA SSO or alternate will conduct a safety orientation meeting prior to initiation of the field activities as described in Section 3.30. Additional safety meetings will be held during each activity as deemed appropriate by the SSO or alternate. These meetings will be used to inform GZA personnel of individual responsibilities, potential hazards, changes in the level of protection, and emergency response procedures. All attendees must complete the master copy of the Health and Safety Orientation Verification Form, Figure B2, held by the SSO.

3.20 WORK ZONE

The following areas will be delineated by the SSO or alternate prior to commencement of each work activity as necessary to reduce the potential for transfer of contamination off site: exclusion area, containment reduction zone (CRZ), and support area. These areas shall conform to guidelines as published by the United States Environmental Protection Agency (USEPA) in "Standard Operating Safety Guides", 1984.

Generally, the exclusion area will be the site of activity. Only personnel qualified to work in potentially hazardous areas, as determined by the SSO or alternate and listed in Section 8.00, will enter the exclusion area or CRZ. All individuals present at the site must report to the SSO or alternate using the Sign-In Sheet (Figure B3) at the beginning and end of each work day. The CRZ will provide an area away from the exclusion area for decontamination. The support area will be designated for staff not expected to enter the exclusion area and for equipment storage.

In selecting locations for drilling activities, all utility companies shall be requested to map-out buried pipelines and wires prior to operation of equipment. Under no circumstances shall site activities be conducted where there is a question as to the location of underground natural gas or electrical lines. In positioning equipment, vertical or overhead booms must be oriented such that contact with overhead wires is not possible.

3.30 FIELD WORK

Field activities during this investigation shall be comprised of both disruptive and non-disruptive activities. Non-disruptive activities are survey activities. Disruptive activities are those activities which may result in the handling, excavation, or boring of potentially contaminated materials. The field activities planned are briefly described below, additional details are in the work plan.

3.31 Non-Disruptive Activities

A. Survey

Sampling points and monitoring wells will be located by optical survey methods and plotted on the base map. The elevations of these points will also be determined by optical survey methods.

3.32 Disruptive Activities

A. Test Borings

A series of test borings will be advanced utilizing a drill rig to permit sampling of the soil materials. Borings will be advanced using hollow stem augers. Soil samples will be collected every 2 feet and retained in glass jars.

B. Monitoring Well Installation

Monitoring wells will be installed within boreholes to permit the collection of groundwater samples for analysis.

C. Sampling and Analysis

1. Soils: Soil samples from boreholes will be selected for geotechnical laboratory analysis. Sample selection will be based upon soil type and depth.

2. Groundwater: Groundwater samples will be collected from the monitoring wells and probe holes in a utility trench and will be analyzed by a subcontracted analytical laboratory for the compounds listed below:

   - Common Anions (Chloride, Fluoride, Nitrate, Sulfate, Alkalinity)
   - Common Cations (Calcium Magnesium, Sodium)
   - Total Dissolved Solids
   - Total (unfiltered) metals (Zinc, Chromium, Iron Manganese, Barium, Aluminum, Copper, Nickel, Silicon, Potassium, Lead and Boron)
   - Total Petroleum Hydrocarbons
   - Purgable Hydrocarbons
   - Purgable Aromatics

Since the level of contaminants previously detected at IRP Site 8 and IRP Site 13 are parts-per-million range in the soils, protective equipment described is commensurate with the characteristics of the contaminants and the concentrations previously reported.

3.40 LEVELS OF PROTECTION

3.41 Non-Disruptive Activities

Non-Disruptive Activities will be done in accordance with USEPA Level D protection. USEPA Level D Protection for non-disruptive activities shall consist of:

- Coveralls
- Steel-toed safety shoes (ANSI 2.41.1)
- Protective goggles (ANSI Z87.1)
- Hard hat (ANSI Z89.1)

3.42 Disruptive Activities

Disruptive activities will be done in accordance with USEPA Level D, if monitoring levels are exceeded (see Section 3.50 Air Monitoring and Action Levels), work will stop and the situation will be re-evaluated with a possible upgrade to Level C. Monitoring will be maintained throughout disruptive activities. Level D Protection for disruptive activities shall consist of:

- Neoprene boots
- Protective goggles (ANSI Z87.1)
- Hard hat (ANSI Z89.1)
- Hearing Protection (ANSI 234.22) (as needed)
- Latex gloves with Neoprene or Nitrile overgloves
- Tyvek or coated tyvek, such as Saranex coverall (at the discretion of the SSO)
- Escape respirator

Level C Protection shall consist of:

All equipment listed above for USEPA Level D protection for disruptive activities plus a full-face air purifying respirator equipped with a combination organic vapor/acid gas/high efficiency particulate filter in place of an escape respirator.

3.50 AIR MONITORING AND ACTION LEVELS

Monitoring of GZA workers' breathing zone will be done during disruptive activities throughout the day. The frequency of measurements will depend on anticipated conditions and visual observations. The minimum measurement frequency will be hourly.

The breathing zone will be monitored using a photoionization detector (PID), equipped with a 10.2 eV ultraviolet lamp (HNu or equivalent), oxygen meter and explosimeter [lower explosive limit (LEL) detector]. The action levels for the air monitoring is shown below.

INSTRUMENT	READING (over background, if applicable)	ACTION
PID	0 ppm	Continue monitoring (level D)
	0-5 ppm	Go to level C at discretion of SSO
	greater than 5 ppm	Stop work, leave area contact
Explosimeter	0-25% LEL	Continue monitoring (Level D)
	greater than 25% LEL	Stop work, leave area, contact SSO
0_2 Meter	less than 19.5% or greater than 22%	Stop work, leave area, contact SSO

3.60 DISPOSAL AND DECONTAMINATION

All disposable protective clothing is to be removed in the CRZ and disposed of properly. Reusable protective clothing (e.g. rain suits, boots, etc.) may be cleaned daily following work and stored on site for re-use. Contaminated clothing which can not/is not cleaned will be bagged, kept separate from soil and water, and removed from the site for subsequent disposal by the 914th Tactical Airlift Group, U.S. Air Force Reserve.

Decontamination procedures must provide an organized process by which levels of contamination are reduced. The decontamination process will consist of a series of procedures performed in a specific sequence. For example, outer, more heavily contaminated items (e.g. outer boots and gloves) shall be decontaminated (washed with soapy water and rinsed) and removed. Personnel should wash their face and hands in the last station of the CRZ. Each procedure shall be performed at a separate station in order to prevent cross contamination (see Figure B4). Entry and exit points to the work area shall be marked.

If it is necessary to upgrade the level of protection, decontamination procedures will upgraded, accordingly.

Sampling equipment and heavy drilling equipment is to be cleaned or steam-cleaned before leaving the project site. See the work plan for additional information on decontaminating field equipment and machinery.

4.00 MEDICAL MONITORING

All GZA personnel and on-site subcontractors are required to comply with the medical surveillance and examination requirements outlined in 29 CFR 1910.

All personnel involved in site activities at the facility are required to have completed and satisfactorily passed a baseline medical examination. Baseline examinations shall include, as a minimum, the following: medical history, general physical examination, electrocardiogram, CBC and blood chemistry profiles (clinical laboratory R/814 and heavy metals) urinalysis, EKG, chest x-ray, visual examination, pulmonary function testing, audiometric testing, and other tests as determined necessary by the physician. Re-examination of affected personnel shall be performed annually for the above criteria.

5.00 EDUCATION AND TRAINING

All personnel will receive safety training in accordance with 29 CFR 1910.120 prior to performing any work at the site. The goal of this safety training will be the development of safety awareness as a part of the thought process of all personnel. To accomplish this, safety training will be provided to all personnel commensurate with the activities they will perform at the site.

Additional safety training and education at the site shall provide basic on-the-job instruction in the following areas:

-- An introduction to the Facility.
-- An overview of the existing contamination profile and safety concerns associated with working at the site.
-- Instruction on organizational and reporting procedures.

- Instruction on the use of personal protection, safety, and monitoring equipment.
- Instruction on decontamination and disposal measures.
- An overview of accident and emergency response procedures.

With regard to respirator usage, training and education activities will follow the procedures set forth by 29 CFR 1910.134. "Respiratory Protection," of the U.S. Department of Labor, OSHA, General Industry Standards.

As a minimum, training and education in respiratory protection will focus on the following items:

- Proper use of respirators and their limitations in both routine and emergency situations
- Cleaning, decontamination, and disinfection procedures
- Storage requirements
- Inspection, maintenance, and repair requirements

Personnel will be instructed in how to properly fit a respirator to achieve the required face-piece-to-face seal for respiratory protection purposes. Conditions which could affect this face seal will be highlighted, including the presence of beards, sideburns, eyeglasses, and the absence of one or both dentures. Employees will be subjected to an initial semi-quantitative respirator fit test with annual semi-quantitative fit tests thereafter.

6.00 PERSONAL HYGIENE

6.10 GENERAL

To prevent injuries and to minimize potential exposure, the following general safe work practices will be adhered to at the facility. These procedures are particularly important when dealing with situations of known or unknown toxic hazards, and/or when relying on portable field monitoring equipment. These practices serve as a guideline of general precautionary measures for reducing the risks associated with on-site work activities/operations at potentially hazardous locations.

6.20 PERSONAL HYGIENE

Eating, drinking, chewing gum or tobacco, taking medication, smoking, and the application of makeup is prohibited in a contaminated or potentially contaminated area or where the possibility for the transfer of contamination exists.

All contact with potentially contaminated substances will be avoided. Do not walk through puddles, pools, mud, etc. Avoid kneeling on the ground, leaning or sitting on drums, equipment, or ground. Do not place monitoring equipment on potentially contaminated surfaces (i.e., drum, ground, etc.). Whenever possible, limit the number of individuals entering a known contaminated or restricted work zone.

No beard may be worn by individuals working in areas that require respiratory protection.

6.30 PERSONAL PROTECTION

Be familiar with and knowledgeable about standard operating safety procedures. **USE YOUR COMMON SENSE.**

Be familiar, knowledgeable, and adhere to all instructions in the HASP. Any individual that continually fails to adhere to this plan will not be permitted to return to work at the site.

7.00 EMERGENCY RESPONSE

7.10 EMERGENCY HELP

In the event of personnel exposure, accident, injury, or fire at the facility, the following general accident and emergency response procedures are to be followed by all personnel.

The following is a list of emergency phone numbers and Figure B5 provides directions to Niagara Falls Memorial Hospital. This information and a copy of the HASP will be on site whenever work is being conducted at the facility.

EMERGENCY HELP

Fire Department:	(on base) Building 700 Corner of Stephenson Road and Flint Road (716) 236-2117 or 2118
Security Police:	(on base) Building 310 Corner of Utzig Drive and Kirkbridge Road (716) 236-2280 or 2281

EMERGENCY HELP (Cont'd)

Ambulance: (off base) Contact base Fire Department
(They have a contract with an off base ambulance service)
(716) 236-2117 or 2118

Hospital: (off base) Memorial Hospital
621 10th Street in Niagara Falls
(716) 278-4394

Command Post: (on base) Building 800
Kirkbridge Road
(716) 236-2150

Ground Safety: (on base) Building 800
Kirkbridge Road
(716) 236-2140 or 2142

The SSO or alternate shall be responsible for instituting appropriate procedures in response to an emergency.

7.20 EVACUATION PROCEDURES

In an emergency situation, and when time permits, the individuals responsible for determining when evacuation of the work area is required, includes either the SSO or alternate, depending on availability and ongoing work activities, the site should be evacuated by turning off equipment and leaving the area.

Imminent or actual dangers that constitute an evacuation scenario include:

- Unexpected release of toxic substances.
- A generalized fire or threat of generalized fire that cannot be avoided.
- An explosion or the threat of explosion that cannot be averted.
- The escape of toxic vapors when personal respiratory equipment is not available or inaccessible.
- When the oxygen concentration falls below 19.5 percent or exceeds 22 percent as indicated by an oxygen meter.
- When the lower explosive limit (LEL) of flammable gases exceeds 25 percent LEL as indicated by the EGI.

7.30 EMERGENCY DECONTAMINATION PROCEDURES

In the event of an accident or emergency incident, the decontamination and disposal procedures outlined in Section 3.50 will be followed to the greatest extent possible, as time and circumstances permit. Care will be taken to avoid cross-contaminating inner layer garments as much as possible while hastily removing safety equipment.

7.40 INCIDENT REPORTING

Following an accident or emergency episode, an incident report will be completed by the responsible individual in charge at the scene of the incident. Personnel that witnessed the episode will be questioned as necessary. Information to be included in the incident report will include, as a minimum, the following items:

- Name of person or persons involved.
- Date and time.
- Exact location.
- Description.
- Type of exposure suspected or nature of injury.
- Nature of emergency response or medical attention received.
- Witnesses/other personnel involved.
- Corrective measures performed or recommended to mitigate or prevent the repeat of the incident.

All incident reports will be filed with the SSO, and the Regional and Corporate Health and Safety Personnel.

7.50 EMERGENCY PROCEDURES

The following are basic emergency response actions in the event that an individual is injured or contaminated. In no event should these field procedures replace medical attention by qualified medical/emergency personnel.

Inhalation Exposure:

A) If symptoms are present (dizziness, nausea, headache, shortness of breath, burning sensation in mouth, throat, or lungs), the victim should be escorted from the work zone air space immediately.

B) If unconscious, the victim should be removed from the work zone immediately. Rescuers should, if practical, be wearing proper respiratory and protective equipment before attempting the rescue.

C) If the victim is no longer breathing, mouth-to-mouth resuscitation (CPR) or some other form of artificial respiration should begin immediately and medical support personnel notified.

Skin Exposure:

A) The skin should be washed with copious amounts of soap and water. If clothing is contaminated, it should be removed immediately and the skin washed thoroughly with running water. All contaminated parts of the body, including the hair, should be thoroughly decontaminated. It may be necessary to wash repeatedly.

Ingestion:

A) Medical support should be obtained immediately. Information on the ingested material will be provided (e.g. amount and type of material).

Eyes:

A) If a toxicant should get into the eyes, flush with generous amounts of water. Washing should be continued for at least 15 minutes and medical attention obtained, if deemed necessary be the GZA SSO or alternate.

Personal Injury:

A) The injured person should be moved (if appropriate) outside the work zone. The SSO or alternate must be notified immediately to evaluate the nature of the injury, and the affected person should be decontaminated to the extent practical.

First aid should be administered and arrangements made to transport the injured person, if necessary, to the designated medical facility (Mercy Hospital, Figure 1). GZA personnel shall not re-enter the work zone until the cause of the injury or symptoms is determined, and it is designated safe to re-enter by the GZA SSO or alternate.

8.00 AUTHORIZED PERSONNEL

The following GZA personnel are authorized to enter the work zones. This list may be amended as per the SSO.

Name	Social Security #
Irvine Reinig II	126-36-8131
Thomas Heins	075-60-2381
Raymond Kampff	130-38-2484
Robert Szustakowski	083-54-9540
Gary Klawinski	097-50-4253
John Danzer	101-52-1497
Ernie Hanna	085-52-8883
Bart Klettke	072-50-1022
Ken May	051-44-5835
Robert Redenbach	121-52-1698
William Lemke	078-42-1911
Dave Savage	104-54-9565

9.00 HASP MODIFICATIONS

All changes in the HASP must be approved by the SSO. In order to document and enact modifications recommended by the alternate for which verbal approval has been granted, the written change must be dated and initialed by both the alternate and the SSO. In cases when this procedure for change is employed, subsequent formal HASP revisions reflecting the change will be forwarded by the SSO.

TABLES

TABLE B1

NIOSH POCKET GUIDE
TO CHEMICAL HAZARDS 1990
EXPOSURE ROUTES AND SYMPTOMS

Niagara Falls IRP

IRP Site 8

Compound	Exposure Routes	Symptoms	Target Organs
1,4 Dichlorobenzene	Inhalation Ingestion Contact	Headache Eye Irritation, Swelling Periorbital, Profuse Rhinitis, Anorexia, Nausea, Vomit, Low-weight, Jaundice, Cirrhosis In animals: Liver, Kidney Damage	Liver, Respiratory Eyes Kidneys Skin
Dichlorodiflouro - methane	Inhalation Contact	Dizziness, Tremors, Unconsciousness Cardiac Arrhythmias Cardiac Arrest	Cardiovascular System, Peripheral Nervous System
1,1 Dichloroethane	Inhalation Ingestion Contact	Central Nervous System Depression Skin Irritation Liver, Kidney Damage	Skin Liver Kidneys
Trans - 1,2 - Dichloro-ethane	Inhalation Ingestion Contact	Eyes and Respiratory System Irritation Central Nervous System Depression	Respiratory System Eyes Central Nervous System
Methylene Chloride	Inhalation Ingestion Contact	Fatique, Weakness Sleepiness, Light-headedness Limbs numb, tingle Nausea Irritated eyes and skin	Skin Cardio Vasular System Eyes Central Nervous System
Toluene**	Inhalation Skin Absorption Ingestion Contact	Fatigue, Weakness Confusion, Euphoria, Dizziness, Headache, Dilated Pupils, Lacrimation, Nervousness, Muscle Fatigue, Insomnia, Dermatitus, Paresthesia	Central Nervous System Liver Kidneys Skin

TABLE B1

NIOSH POCKET GUIDE
TO CHEMICAL HAZARDS 1990
EXPOSURE ROUTES AND SYMPTOMS

Niagara Falls IRP

IRP Site 8

Compound	Exposure Routes	Symptoms	Target Organs
1,1,1 Trichloroethane	Inhalation Ingestion Contact	Headache, Lassitude, Central Nervous System Depression, Poor Equilibrium, Irritated Eyes, Dermatitus, Cardiac Arrhythmias	Skin Central Nervous System Cardiovascular
Trichloroethene	Inhalation Ingestion Contact	Headache, Vertigo, Visual Disturbance, Tremors, Somnolence, Nausea, Vomiting Irritated Eyes, Dermatitus Cardiac Arrhythmias Paresthesia	Respiratory System Heart Liver Kidneys Central Nervous System Skin

Note:

**Detected above ARAR in two wells.

TABLE B1

NIOSH POCKET GUIDE
TO CHEMICAL HAZARDS 1990
EXPOSURE ROUTES AND SYMPTOMS

Niagara Falls IRP

IRP Site 13

Compound	Exposure Routes	Symptoms	Target Organs
Benzene*	Inhalation Skin Absorption Ingestion Contact	Irritated Eyes, Nose and Respiratory System, Giddiness, Headache, Nausea Staggered Gait, Fatique, Anorexia, Lassitude Dermatitus, Bone Marrow Depression	Blood Central Nervous System Skin Bone Marrow Eyes Respiratory System
Chlorobenzene	Inhalation Ingestion Contact	Irritated Eyes, Nose and Skin Drowziness, Incoordination In Animals: Liver, Lung and Kidney Damage	Respiratory System Skin Central Nervous System Liver
1,2 Dichlorobenzene	Inhalation Skin Absorption Ingestion Contact	Irritated Nose and Eyes Liver and Kidney Damage Skin Blister	Liver Kidneys Skin Eyes
1,4 Dichlorobenzene	Inhalation Ingestion Contact	Headache Eye Irritation, Swelling Periorbital, Profuse Rhinitis, Anorexia, Nausea, Vomit Low-Weight, Jaundice, Cirrhosis In Animals: Liver and Kidney Damager	Liver Respiratory System Kidneys Skin
1,3 Dichlorobenzene	NA	NA	NA
1,2 Dichloroethane	Inhalation Ingestion Skin Absorption Contact	Central Nervous System Depression, Nausea, Vomit, Dermatitus, Irritated Eyes, Cornea Opacity	Skin Liver Kidneys Eyes Central Nervous System

TABLE B1

NIOSH POCKET GUIDE
TO CHEMICAL HAZARDS 1990
EXPOSURE ROUTES AND SYMPTOMS

Niagara Falls IRP

IRP Site 13

Compound	Exposure Routes	Symptoms	Target Organs
Trans - 1,2 - Dichloroethene	Inhalation Ingestion	Eyes and Respiratory System Irritation, Central Nervous System Depression	Respiratory Eyes Central Nervous System
Ethylbenzene	Inhalation Ingestion Contact	Irritated Eyes, Mucus Membrane Headache, Dermatitus, Narcosis Coma	Skin Central Nervous System
Methylene Chloride	Inhalation Ingestion Contact	Fatigue, Weakness, Sleepiness, Light-headedness, Limbs numb, tingle, Nausea, Irritated Eyes and Skin	Skin Cardiovascular System Eyes Central Nervous System
Toluene	Inhalation Skin Absorption Ingestion Contact	Fatigue, Weakness, Confusion, Euphoria, Dizziness, Headache, Dilated Pupils, Lacrimation, Nervousness, Muscle Fatigue, Insomnia, Dermatitus, Paresthesia	Central Nervous System Liver Kidneys Skin
Trichloroethene*	Inhalation Ingestion Contact	Headache, Vertigo, Visual Disturbance Visual Disturbance, Tremors, Somnolence, Nausea, Vomiting, Irritated Eyes, Dermatitus, Cardiac Arrhythmias, Paresthesia	Respiratory System Liver Kidneys Central Nervous System Skin
Vinyl Chloride**	Inhalation	Weakness, Abdominal Pain, Gastrointestinal Bleeding, Hepatomegaly, Pallor or Cyanosis of Extremities	Liver, Central Nervous System Blood, Respiratory System, Lymphatic System

TABLE B1

NIOSH POCKET GUIDE
TO CHEMICAL HAZARDS 1990
EXPOSURE ROUTES AND SYMPTOMS

Niagara Falls IRP

IRP Site 13

Compound	Exposure Routes	Symptoms	Target Organs
Xylenes	Inhalation Skin Absorption Ingestion Contact	Dizziness, Excitement, Drowsiness, Incoordination, Staggering Gait, Irritated Eyes, Nose and Throat Corneal Vacuolization Anorexia, Nausea, Vomiting, Abdominal Pain, Dermatitus	Central Nervous System Eyes Gastrointestinal Tract Blood, Liver, Kidneys Skin

Notes:

* Detected above ARAR in one well.
** Detected above ARAR in two wells.

TABLE B2

TWA AND IDLH VALUE FOR COMPOUNDS REPORTED AT NIAGARA FALLS IRP

IRP Site No. 8

	(from ACGIH) TWA (ppm unless otherwise noted)	(from NIOSH) IDLH (ppm unless otherwise noted)
1,4 Dichlorobenzene (carc)	75	1,000
Dichlorodiflouromethane	1,000	50,000
1,1 Dichloroethane	200	4,000
Trans - 1,2 - dichloroethene	200	4,000
Methylene Chloride	50	5,000
Toluene	100	2,000
1,1,1 Trichloroethane	350	1,000
Trichloroethene	50	1,000

IRP Site No. 13

	(from ACGIH) TWA (ppm unless otherwise noted)	(from NIOSH) IDLH (ppm unless otherwise noted)
Benzene	10	3,000
Chlorobenzene	75	2,400
1,2 Dichlorobenzene	50	1,000
1,4 Dichlorobenzene	75	1,000
1,3 Dichlorobenzene	NA	NA
1,2 Dichloroethane	10	1,000
Trans - 1,2 - Dichloroethene	200	4,000
Ethylbenzene	100	2,000
Methylene Chloride	50	5,000
Toluene	100	2,000
Trichloroethene	50	1,000
Vinyl Chloride	5	---
Xylenes	100	1,000

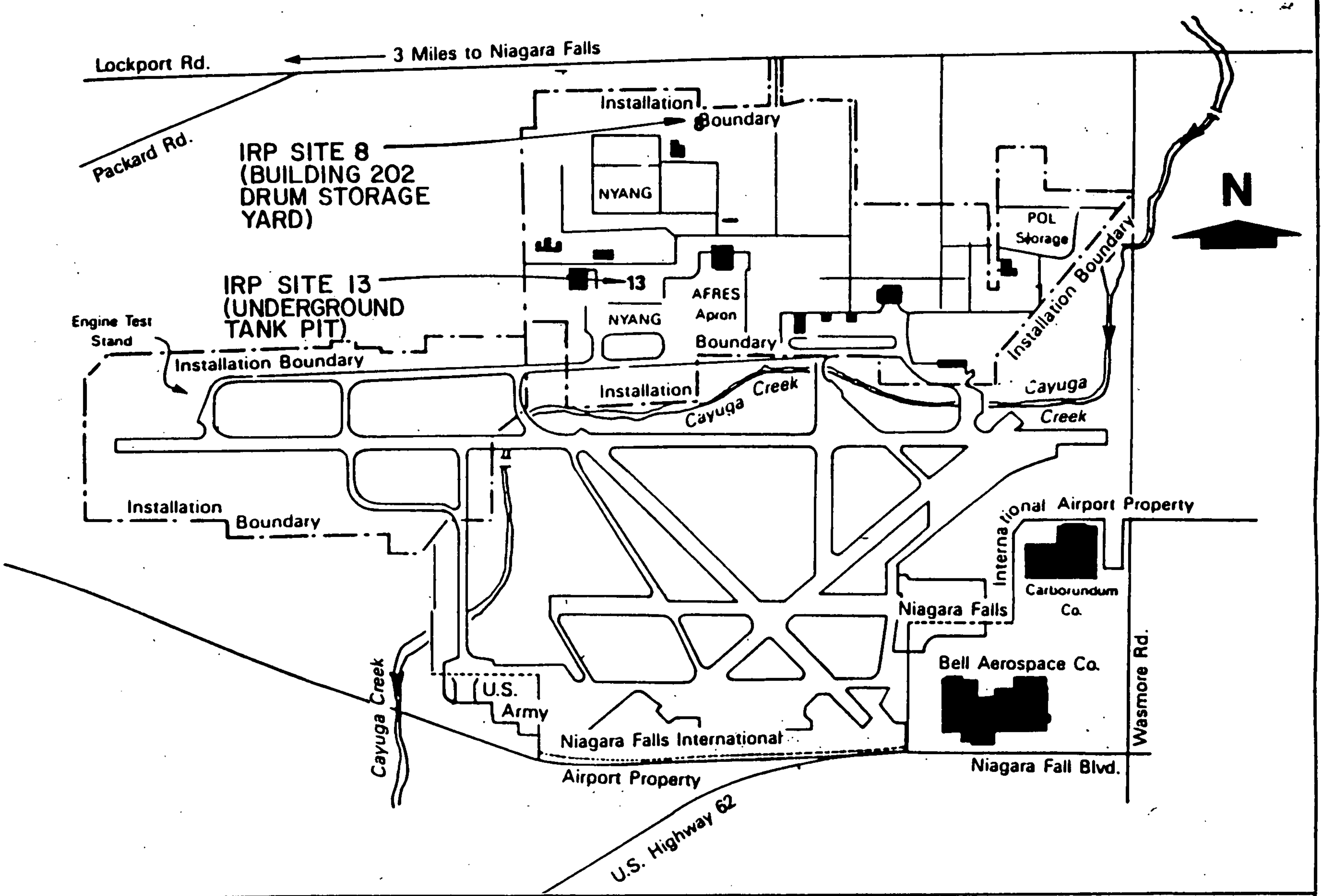
Note:

TWA = Time Weighted Average
IDIH = Immediately Dangerous to Life and Health

FIGURES

NOTE:

THIS FIGURE WAS ADAPTED FROM A PLAN PRESENTED IN THE FINAL WORK PLAN FOR THE IRP RI/FS PREPARED BY SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC) JUNE 1990.



NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK
WORK PLAN REMEDIAL DESIGN FOR IRP SITE 8 - BUILDING 202 DRUM STORAGE YARD AND IRP SITE 13 - UNDERGROUND TANK PIT

SITE LOCATION PLAN

PROJECT No. R5957

FIGURE No. B1

SCALE IN FEET

NOT TO SCALE

DRAWN BY: ARH

DATE: JULY 1991

GZA GeoEnvironmental of New York

FIGURE B2

HEALTH AND SAFETY ORIENTATION VERIFICATION FORM
IRP Site 8 and IRP Site 13 at the
Niagara Falls Air Force Base

The undersigned do hereby attest that they have read and understand this Health and Safety Plan have received an initial on-site health and safety orientation on

____________________.

Date

Name (Print)	Signature	Social Security #	Company

FIGURE B3

IRP SITE 8 AND IRP SITE 13

SIGN-IN SHEET

Remedial Design for IRP Site 8 and IRP Site 13

Date: ____________

GZA File No: R5957

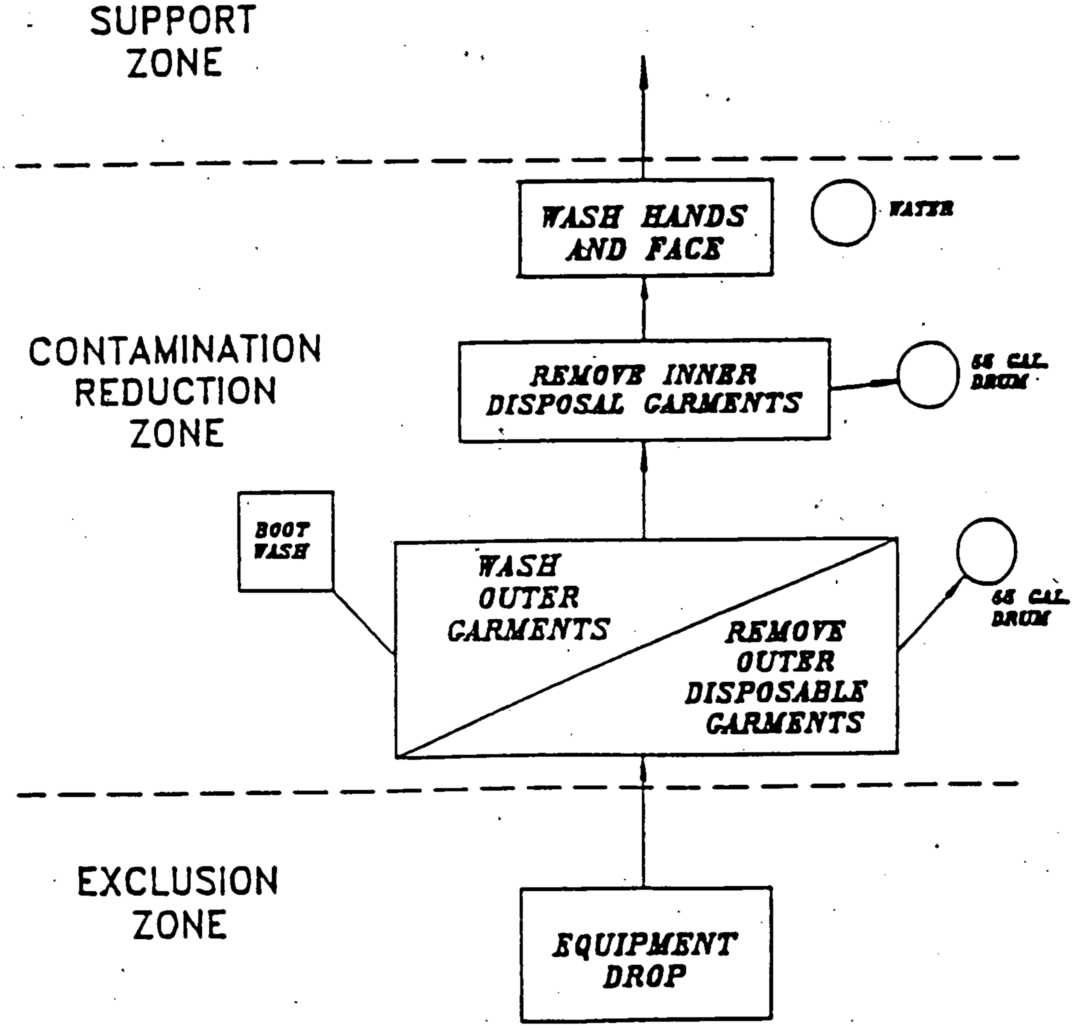
Niagara Falls Air Force Base
Niagara Falls, New York

Printed Name	Signature	Affiliation	S. S. #	Time In	Time Out

FIGURE B4

DECONTAMINATION AREA

(BASED ON "OCCUPATIONAL SAFETY AND HEALTH GUIDANCE MANUAL FOR HAZARDOUS WASTE SITE ACTIVITIES", NIOSH/OSHA/USCG/EPA, 1985)



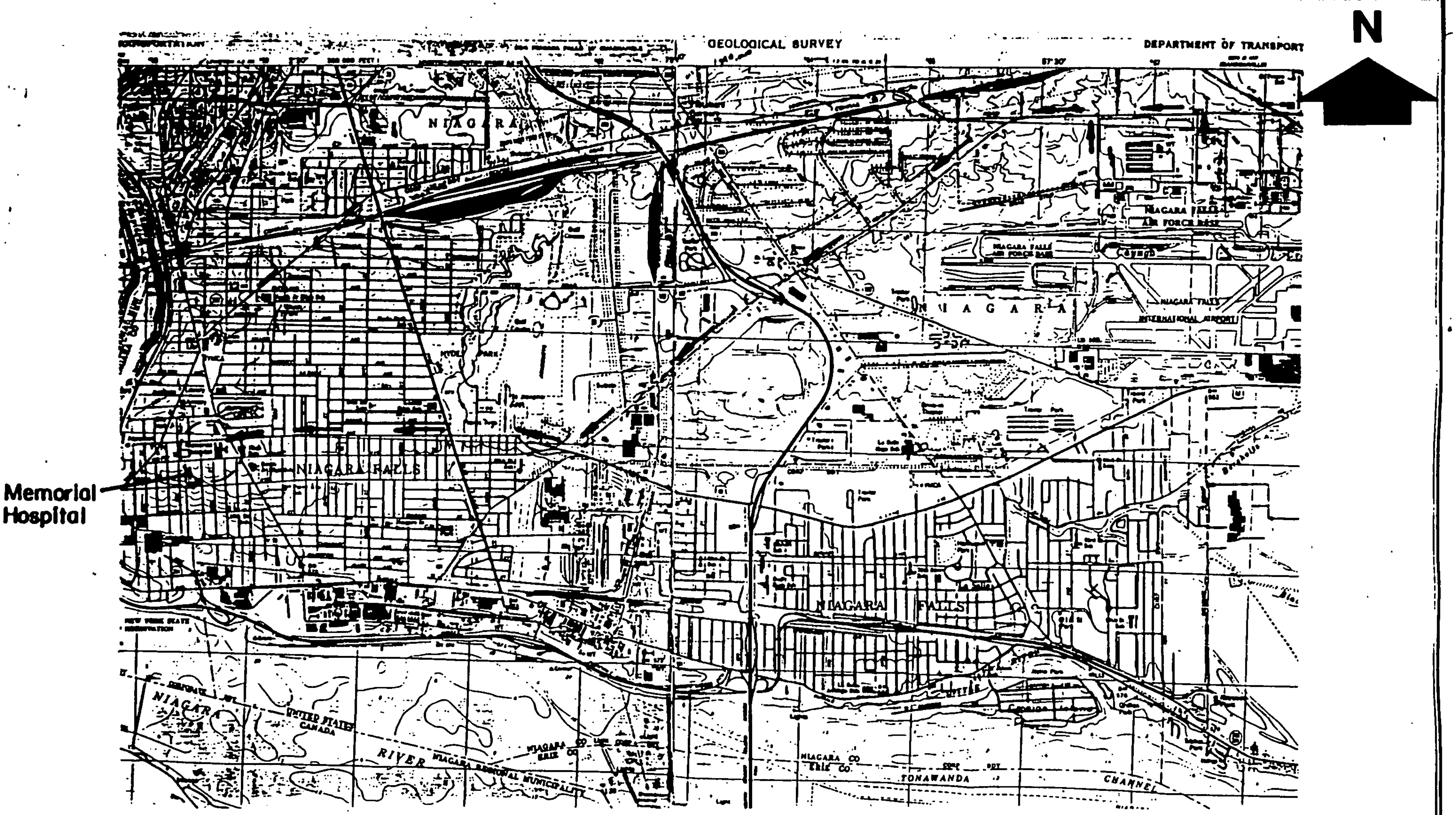


FIGURE No.
B5

PROJECT No.
R5957

NIAGARA FALLS AIR FORCE BASE
NIAGARA FALLS, NEW YORK
WORK PLAN REMEDIAL DESIGN FOR IRP
SITE 8 - BUILDING 202 DRUM STORAGE YARD
AND IRP SITE 13 - UNDERGROUND TANK PIT

EMERGENCY ROUTE TO NIAGARA FALLS MEMORIAL HOSPITAL

SCALE IN FEET
0 2000 4000 8000

DRAWN BY: ARH
DATE: JULY 1991

GZA GeoEnvironmental of New York

APPENDIX B-1

INSERTS FROM DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS, SAX, 1984

BENZEDRINE SULFATE

CAS RN: 156310 NIOSH #: SI 1225000
mf: $C_{18}H_{28}N_2 \cdot H_2O_4S$; mw: 368.54

SYNS:

PHENETHYLAMINE, ALPHA-METHYL-, SULFATE (2:1)
DIAMPHETAMINE SULFATE
DL-ALPHA-METHYLPHENETHYLAMINE SULFATE
1-PHENYL-2-AMINOPROPANE SULFATE

TOXICITY DATA: 3	CODEN:
ipr-rat LDLo:25 mg/kg	JPETAB 100,267,50
scu-rat LDLo:10 mg/kg	JPETAB 71,62,41
scu-mus LD50:14 mg/kg	JPETAB 87,214,46
ipr-gpg LDLo:50 mg/kg	JPETAB 100,267,50

THR: HIGH ipr, scu. See also sulfates.
Disaster Hazard: When heated to decomp it emits very tox fumes of SO_x and NO_x.

D-BENZEDRINE SULFATE

CAS RN: 51638 NIOSH #: SI 1400000
mf: $C_{18}H_{26}N_2 \cdot H_2O_4S$; mw: 368.54

SYNS:

AMPHEDRINE
AMPHEREX
(+)-AMPHETAMINE SULFATE
D-AMPHETAMINE SULFATE
DEXAMPHETAMINE SULFATE
DEXAMYL
DEXEDRINA
DEXEDRINE SULFATE
DEXIES
D-ALPHA-METHYLPHENETHYLAMINE SULFATE
OBESEDRIN
FASTBALLS
HEARTS
DEXTROAMPHETAMINE SULFATE
DEXTRO-ALPHA-METHYLPHENETHYLAMINE SULFATE
ORANGES
PHENEDRINE
PHENOPROMIN
D-1-PHENYL-2-AMINOPROPANE SULFATE
DEXTRO-1-PHENYL-2-AMINOPROPANE SULFATE
D-BETA-PHENYLISOPROPYLAMINE SULFATE
DEXTRO-BETA-PHENYLISOPROPYLAMINE SULFATE

TOXICITY DATA: 3	CODEN:
ipr-mus TDLo:50 mg/kg/(8D preg):TER	TJADAB 1,413,68
unk-mus TDLo:50 mg/kg/(8D preg):TER	TJADAB 1,413,68
orl-rat LD50:38 mg/kg	JOPDAB 69,663,66
ipr-rat LD50:70 mg/kg	TXAPA9 45(1),49,78
scu-rat LD50:200 mg/kg	12VXA5 8,335,68
ivn-rat LD50:30 mg/kg	JPETAB 110,180,54
orl-mus LD50:33 mg/kg	TXAPA9 21,302,72
ipr-mus LD50:72 mg/kg	JPETAB 128,176,60
scu-mus LD50:16 mg/kg	AIPTAK 184,34,70
ivn-mus LD50:30 mg/kg	JPETAB 137,365,62
orl-dog LD50:10 mg/kg	PSEBAA 118,557,65
ivn-dog LD50:3 mg/kg	PSEBAA 118,557,65
ivn-rbt LD50:10 mg/kg	JPETAB 110,180,54

Toxicology Review: ISYAM* -,343,70; 27ZTAP 3,46,69.
THR: An exper TER. HIGH orl, ipr, scu, ivn. A habit-forming stimulant. See also sulfates.
Disaster Hazard: When heated to decomp it emits very tox fumes of SO_x and NO_x.

L-BENZEDRINE SULFATE

CAS RN: 51627 NIOSH #: SI 1575000
mf: $C_{18}H_{28}N_2 \cdot H_2O_4S$; mw: 368.54

SYNS:

(-)-AMPHETAMINE SULFATE
L-AMPHETAMINE SULFATE
LEVEDRINE
L-1-PHENYL-2-AMINOPROPANE SULFATE

TOXICITY DATA: 3	CODEN:
scu-rat LDLo:160 mg/kg	JPETAB 71,62,41
ipr-mus LD50:232 mg/kg	JPETAB 158,135,67

THR: HIGH scu, ipr. See also sulfates.
Disaster Hazard: When heated to decomp it emits very tox fumes of SO_x and NO_x.

BENZENAMINE HYDROCHLORIDE

CAS RN: 142041 NIOSH #: CY 0875000
mf: $C_6H_7N \cdot ClH$; mw: 129.60

Crystals. vap. d: 4.46, d: 1.22, mp: 198°, bp: 245°, flash p: 380°F (OC).

SYNS:

ANILINE HYDROCHLORIDE
"ANILINE SALT"
CHLORHYDRATE D'ANILINE (FRENCH)
CHLORID ANILINU (CZECH)
NCI-C03736
USAF EK-442

TOXICITY DATA: 3	CODEN:
skn-rbt 500 mg/24H MOD	28ZPAK -,65,72
eye-rbt 20 mg/24H SEV	28ZPAK -,65,72
orl-rat TDLo:130 gm/kg/2Y-C:CARC	NCITR* NCI-CG-TR-130,78
orl-rat TD:238 gm/kg/2Y-C:CARC	NCITR* NCI-CG-TR-130,78
orl-rat LD50:1072 mg/kg	NTIS** PB214-270
ipr-rat LDLo:500 mg/kg	NCNSA6 5,11,53
orl-mus LD50:841 mg/kg	NTIS** PB214-270
ipr-mus LD50:300 mg/kg	NTIS** AD277-689
orl-rat TD:137 gm/kg/60W-C:ETA	IARC** 27,39,82
orl-rat TD:2163 gm/kg/2Y-C:CAR	IARC** 27,39,82
orl-rat TD:4326 gm/kg/2Y-C:CAR	IARC** 27,39,82

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 2,-,74. NCI Carcinogenesis Bioassay Completed; Results Positive: Rat (NCITR* NCI-CG-TR-130,78). NCI Carcinogenesis Bioassay Completed; Results Negative: Mouse (NCITR* NCI-CG-TR-130,78). Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.
THR: An exper CARC. HIGH ipr; MOD orl, ipr. MOD skn irr, SEV eye irr in rbt. See also aniline.
Fire Hazard: Slight, when exposed to heat or flame.
Spontaneous Heating: No.
Disaster Hazard: Dangerous; when heated to decomp, or on contact with acid or acid fumes, emits highly toxic fumes of aniline and chlorine compounds; can react vigorously with oxidizing materials.
To Fight Fire: Water, CO_2, water mist or spray, dry chemical.

BENZENE

CAS RN: 71432 NIOSH #: CY 1400000
mf: C_6H_6; mw: 78.12

ar colorless liquid. mp: 5.51°, bp: 80.093°-80.094°, sh p: 12°F (CC), d: 0.8794 @ 20°, autoign. temp.: 044°F, lel: 1.4%, uel: 8.0%, vap. press: 100 mm @ 1°, vap. d: 2.77, ulc: 95-100.

SYNS:

ANNULENE
BENZEEN (DUTCH)
BENZEN (POLISH)
BENZOL
BENZOLENE
BENZOLO (ITALIAN)
BICARBURET OF HYDROGEN
CARBON OIL
COAL NAPHTHA
CYCLOHEXATRIENE
FENZEN (CZECH)
MINERAL NAPHTHA
MOTOR BENZOL
NCI-C55276
PHENYL HYDRIDE
PYROBENZOLE

TOXICITY DATA: 3	CODEN:
skn-rbt 15 mg/24H open MLD	AIHAAP 23,95,62
eye-rbt 88 mg MOD	AMIHAB 14,387,56
eye-rbt 2 mg/24H SEV	28ZPAK -,23,72
cyt-rat-scu 12 gm/kg/12D-I	GTPZAB 17(3),24,73
mnt-mus-ipr 500 uL/kg	ENMUDM 2,43,80
cyt-mus-orl 100 uL/kg	ENMUDM 2,43,80
cyt-mus-ipr 100 uL/kg	ENMUDM 2,43,80
dlt-mus-ipr 5 mg/kg	TPKVAL 15,30,79
cyt-rbt-scu 8400 mg/kg	PSDTAP 15,275,74
scu-mus TDLo:2700 mg/kg/(13D preg):TER	AMBNAS 17,285,70
ihl-hmn TCLo:100 ppm/10Y-I:CAR	TRBMAV 37,153,78
orl-rat TDLo:52 gm/kg/52W-I:CAR	MELAAD 70,352,79
skn-mus TDLo:1200 gm/kg/49W-I:NEO	BJCAAI 16,275,62
scu-mus TDLo:600 mg/kg/17W-I:ETA	KRANAW 9,403,32
par-mus TDLo:670 mg/kg/19W-I:ETA	KLWOAZ 12,109,33
ihl-hmn TC:400 ppm/8Y-I:ETA	BLOOAW 52,285,78
ihl-man TC:2100 mg/m3/4Y-I:CAR	NEJMAG 271,872,64
orl-rat TD:10 gm/kg/52W-I:CAR	MELAAD 70,352,79
orl-hmn TDLo:130 mg/kg:CNS	AHYGAJ 31,336,1897
ihl-hmn LCLo:20000 ppm/5M	29ZUA8 -,-,53
ihl-hmn TCLo:210 ppm:BLD	27ZXA3 -,341,63
ihl-rat TCLo:670 mg/m3/24H (15D pre/1-22D preg)	HYSAAV 33,327,68
ihl-rat TCLo:56600 ug/m3/24H (1-22D preg)	HYSAAV 33,112,68
ihl-rat TCLO:50 ppm/24H (7-14D preg)	JHEMA2 24,363,80
ihl-rat TCLO:150 ppm/24H (7-14D preg)	JHEMA2 24,363,80
scu-mus TDLo:1100 mg/kg (12D preg)	TOXID9 1,125,81
scu-mus TDLo:2700 mg/kg/(13D preg) TFX:TER	AMBNAS 17,285,70
orl-mus TDLo:9 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-mus TDLo:12 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-rat TD:10 gm/kg/52W-I TFX:CAR	MELAAD 70,352,79
ihl-hmn TCLo:100 ppm:CNS	INMEAF 17,199,48
unk-man LDLo:194 mg/kg	85DCAI 2,73,70
orl-rat LD50:3800 mg/kg	TXAPA9 19,699,71
ihl-rat LC50:10000 ppm/7H	28ZRAQ -,113,60
ipr-rat LDLo:1150 mg/kg	TXAPA9 1,156,59
orl-mus LD50:4700 mg/kg	HYSAAV 32,349,67
ihl-mus LC50:9980 ppm	JIHTAB 25,366,43
ipr-mus LD50:990 ug/kg	AGGHAR 18,109,60
orl-dog LDLo:2000 mg/kg	HBAMAK 4,1313,35
ihl-dog LCLo:146000 mg/m3	HBTXAC 1,324,56
ihl-cat LCLo:170000 mg/m3	HBTXAC 1,324,56
ivn-rbt LDLo:88 mg/kg	JTEHD6 -(Suppl.2),45,77
ipr-gpg LDLo:527 mg/kg	HBTXAC 1,42,56
scu-frg LDLo:1400 mg/kg	HBAMAK 4,1313,35
ihl-mam LCLo:20000 ppm/5M	AEPPAE 138,65,28

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 2,-,74. Carcinogenic Determination: Human Suspected IARC** 7,203,74.

TLV: Air: 10 ppm DTLVS* 4,37,80. *Toxicology Review:* ARPAAQ 11,434,31; EVHPAZ 11,163,75; AEHLAU 22,373,71; PAREAQ 4,1,52; FNSCA6 2,67,73; MUREAV 47(2),75,78; AMSVAZ 118,354,44; ZHPMAT 166,113,78; JTEHD6 -(suppl.2),69,77; PHRPA6 41,1357,26; CTOXAO 11,531,77; BNYMAM 54, 413,78; KRANAW 9,403,32; 27ZTAP 3,22,69. OSHA Standard: Air: TWA 10 ppm; CL 25 ppm; Pk 50 ppm/10M/8H (SCP-U) FEREAC 39,23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Occupational Exposure to Benzene recm std: Air: CL 10 ppm/60M NTIS**. Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 3 S311. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8E NO:12770027-Followup Sent as of April, 1979.

THR: Poisoning occurs most commonly through inhal of the vapor, though benzene can penetrate the skin, and poison in that way. Locally, benzene has a comparatively strong irr effect, producing erythema and burning, and, in more severe cases, edema and even blistering. Exposure to high conc of the vapor (3000 ppm or higher) may result from failure of equipment or spillage. Such exposure, while rare in industry, may result in acute poisoning, characterized by the narcotic action of benzene on the CNS. The anesthetic action of benzene is similar to that of other anesthetic gases, consisting of a preliminary stage of excitation followed by depression and, if exposure is continued, death through respiratory failure. The chronic, rather than the acute form, of benzene poisoning is important in industry. It is a recog leukemogen. There is no specific blood picture occurring in cases of chronic benzol poisoning. The bone marrow may be hypoplastic, normal, or hyperplastic, the changes reflected in the peripheral blood. Anemia, leucopenia, macrocytosis, reticulocytosis, thromocytopenia, high color index, and prolonged bleeding time may be present. Cases of myeloid leukemia have been reported. For the supervision of the worker, repeated blood examinations are necessary, including hemoglobin determinations, white and red cell counts and differential smears. Where a worker shows a progressive drop in either red or white cells, or where the white count remains below 5,000 per cu mm or the red count below 4.0 million per cu mm, on two successive monthly examinations, he should be immediately removed from exposure. Following absorption of benzene, elimination is chiefly through the lungs, when fresh air is breathed. The portion that is absorbed is oxidized, and the oxidation products are combined with sulfuric and glycuronic acids and eliminated in the urine. This may be used as a diagnostic sign. Benzene has a definite cumulative action, and exposure to relatively high conc is not serious from the point of view of causing damage to the blood-forming system, provided the exposure is not repeated. On the other hand, daily exposure to conc of 100 ppm or less will usually cause damage if continued over a protracted period of time. In acute poisoning, the worker becomes confused and dizzy, complains of tightening of the leg muscles and of pressure over the forehead, then passes into a stage of excitement. If allowed to remain in exposure, he quickly becomes stupefied and lapses into coma. In non-fatal cases, recovery is usually complete and no permanent disability occurs. In chronic poisoning the onset is slow, with the symptoms vague; fatigue, headache, dizziness, nausea and loss of appetite, loss of weight and weakness are common complaints in early cases. Later, pallor, nosebleeds, bleeding gums, menorrhagia, petechiae and purpura may develop. There is great individual variation in the signs and symptoms of chronic benzene poisoning. Benzene is a common air contaminant. Exper MUT, CARC, TER, ETA, NEO.

Fire Hazard: Dangerous, when exposed to heat or flame; can react vigorously with oxidizing materials, such as BrF_5, Cl_2, CrO_3, O_2NClO_4, O_2, O_3, perchlorates, ($AlCl_3$ + $FClO_4$), (H_2SO_4 + permanganates), K_2O_2, ($AgClO_4$ + acetic acid), Na_2O_2.

Spontaneous Heating: No.

Explosion Hazard: Mod, when its vapors are exposed to flame. Use with adequate ventilation.

Disaster Hazard: Dangerous, highly flammable.

To Fight Fire: Foam, CO_2, dry chemical.

Incomp: diborane.

For further information see Vol. 2, No. 4 and Vol. 3, No. 3 of *DPIM Report.*

BENZENEACETALDEHYDE

CAS RN: 122781 NIOSH #: CY 1450000
mf: C_8H_8O; mw: 120.16

SYNS:
HYACINTHIN
PHENYLACETALDEHYDE
PHENYLETHANAL
ALPHA-TOLUALDEHYDE
ALPHA-TOLUIC ALDEHYDE

TOXICITY DATA: 2	CODEN:
skn-hmn 2%/48H	FCTXAV 17,357,79
orl-rat LD50:1550 mg/kg	FCTXAV 17,357,79
orl-mus LD50:3890 mg/kg	FCTXAV 17,357,79
orl-gpg LD50:3890 mg/kg	FCTXAV 17,357,79

Reported in EPA TSCA Inventory, 1980.

THR: MOD orl. Hmn skn irr. See also aldehydes.

Disaster Hazard: When heated to decomp it emits acrid smoke and irr fumes.

BENZENEARSONIC ACID

CAS RN: 98055 NIOSH #: CY 3150000
mf: $C_6H_7AsO_3$; mw: 202.05

Colorless crystals, water-sol. d: 1.760, mp: 160° decomp.

SYNS:
PHENYL ARSENIC ACID
PHENYLARSONIC ACID

TOXICITY DATA: 3	CODEN:
orl-rat LDLo:50 mg/kg	JPETAB 93,287,48
orl-mus LD50:270 ug/kg	CLDND*
ivn-rbt LD50:16 mg/kg	JPETAB 80,93,44

Reported in EPA TSCA Inventory, 1980.

THR: HIGH via oral and ivn routes. A deadly poison. See also arsenic compounds.

Disaster Hazard: When heated to decomp it emits to fumes of As.

BENZENEBORONIC ACID

CAS RN: 98806 NIOSH #: CY 857500
mf: $C_6H_7BO_2$; mw: 121.94

SYNS:
ACIDE PHENYLBORIQUE (FRENCH)
BOROPHENYLIC ACID
PHENYLBORIC ACID
USAF BO-2

TOXICITY DATA: 3-2	CODEN:
orl-rat LD50:740 mg/kg	14KTAK -,708,64
ipr-mus LD50:500 mg/kg	NTIS** AD277-689
ivn-mus LD50:320 mg/kg	CSLNX* NX#02033
ivn-dog LDLo:450 mg/kg	BANMAC 135,314,51
orl-rbt LDLo:600 mg/kg	14KTAK -,708,64
skn-rbt LDLo:4500 mg/kg	14KTAK -,708,64
ipr-gpg LD50:284 mg/kg	BANMAC 135,314,51

Reported in EPA TSCA Inventory, 1980.

THR: HIGH ivn, ipr. MOD orl, ipr, ivn, skn. See also boron compds.

Disaster Hazard: When heated to decomp it emits acrid smoke and irr fumes.

BENZENECARBOTHIOAMIDE

CAS RN: 63906898 NIOSH #: CV 5860000
mf: C_7H_7NS; mw: 137.21

SYNS:
BENZOTHIAMIDE
BENZOTHIOAMIDE
THIOBENZAMIDE
TIOBENZAMIDE (ITALIAN)

TOXICITY DATA: 3	CODEN:
orl-rat TDLo:6300 mg/kg/15W-C:ETA	BSIBAC 54,1027,78
ipr-mus LD50:500 mg/kg	PCJOAU 11,1383,77

THR: An exper ETA.

Disaster Hazard: When heated to decomp it emits very tox fumes of NO_x and SO_x.

BENZENECARBOXALDEHYDE

CAS RN: 63021329 NIOSH #: CU 3750000
mf: $C_{19}H_{15}N$; mw: 257.35

SYNS:
7-ETHYLBENZ(C)ACRIDINE
9-ETHYL-3,4-BENZACRIDINE
PHENYLMETHANAL

TOXICITY DATA: 3	CODEN:
scu-mus TDLo:200 mg/kg:ETA	VOONAW 1,52,55

THR: An exper ETA. See also aldehydes.

Disaster Hazard: When heated to decomp it emits to fumes of NO_x.

BENZENE CHLORIDE

CAS RN: 108907 NIOSH #: CZ 0175000
mf: C_6H_5Cl; mw: 112.56

Clear, colorless liquid. bp: 131.7°, lel = 1.3%, uel = 7.1%, @ 150°, mp: −45°, flash p: 85°F (CC), d: 1.113 @ 15.5°/15.5°, autoign. temp.: 1180°F, vap. press: 10 mm @ 22.2°, vap. d: 3.88.

SYNS:
CHLOORBENZEEN (DUTCH)
CHLORBENZENE
CHLORBENZOL
CHLOROBENZEN (POLISH)
CHLOROBENZENE
CLOROBENZENE (ITALIAN)
MONOCHLOORBENZEEN (DUTCH)
MONOCHLORBENZENE
MONOCHLORBENZOL (GERMAN)
MONOCHLOROBENZENE
MONOCLOROBENZENE (ITALIAN)
NCI-C54886
PHENYL CHLORIDE

TOXICITY DATA: 2-1	CODEN:
orl-rat LD50:2910 mg/kg	14CYAT 2,1334,63
ipr-rat LDLo:7400 mg/kg	RMSRA6 16,449,1896
scu-rat LDLo:7000 mg/kg	RMSRA6 16,449,1896
ihl-mus LCLo:15 gm/m3	GISAAA 20(8),19,55
orl-rbt LD50:2830 mg/kg	14CYAT 2,1394,63
ipr-gpg LDLo:4100 mg/kg	RMSRA6 16,449,1896

Aquatic Toxicity Rating: TLm96:100-1 ppm WQCHM* 2,-,74.

TLV: Air: 75 ppm DTLVS* 4,84,80. OSHA Standard: Air: TWA 75 ppm (SCP-I) FEREAC 39,23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. "NIOSH Manual of Analytical Methods" VOL 2 S133. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MOD orl; LOW ipr, scu, ihl. Monochlorobenzol is a fairly strong narcotic and possesses only slight irr qualities. For cats, conc of 1,200 ppm are quite narcotic, and conc of 3,700 ppm are fatal after several hours. The dichlorobenzols are strongly narcotic, 1,000 ppm causing narcosis in guinea pigs followed by death after 20 hrs exposure. Knowledge of the effects on man of repeated exposure to subnarcotic concentrations is meager. In general, it appears that the chlorobenzols are not as toxic as benzol. Some of the symptoms described (methemoglobinemia) suggest that other substances, such as nitrobenzol, may have been partially responsible for the few cases of industrial illness reported. It is possible that prolonged exposure to chlorobenzol may cause kidney and liver damage.

Somnolence, loss of consciousness, twitchings of the extremities, cyanosis, deep, rapid respirations and a small, irregular pulse are the chief symptoms occurring in acute exposures. The urine may be burgundy red, and the red blood cells show degenerative and regenerative changes.

Fire Hazard: Dangerous, when exposed to heat or flame. Also violent reaction with $AgClO_4$, dimethyl sulfoxide.

Spontaneous Heating: No.

Explosion Hazard: Mod, when exposed to heat or flame.

Disaster Hazard: Dangerous; see chlorine compounds; can react vigorously with oxidizing materials.

To Fight Fire: Foam, CO_2, dry chemical, water to blanket fire.

For further information see Chlorobenzene, Vol. 2, No. 4 of *DPIM Report.*

π-BENZENE-π-CYCLOPENTADIENYL IRON(II) PERCHLORATE

mf: $C_{11}H_{11}ClFeO_4$; mw: 298.51

Explosion Hazard: Shock sensitive; detonates on touching with spatula (dry material).

BENZENE DIAZONIUM-2-CARBOXYLATE

mf: $C_7H_4N_2O_2$; mw: 151.12

Fire Hazard: Self ignites.

Explosion Hazard: Explosive. Shock sensitive.

Incomp: Aniline, isocyanides, aryl isocyanides.

BENZENE DIAZONIUM CHLORIDE

mf: $C_6H_5ClN_2$; mw: 128.56

Explosive Hazard: The dry salt varies in explosivness depending on method of preparation.

BENZENE DIAZONIUM NITRATE

mf: $C_6H_5N_3O_3$; mw: 167.12

Explosion Hazard: Isolated salt is highly sensitive to friction and impact. Explodes at 90°.

BENZENE DIAZONIUM SALTS

mf: $C_6H_5N_2^+X^-$

Explosion Hazard: Self explodes.

Incomp: Ammonium sulfide, hydrogen sulfide, disodium sulfide.

BENZENE DIAZONIUM-4-SULFONATE

mf: $C_6H_4N_2O_3S$; mw: 180.22

Explosion Hazard: Pauly's reagent exploded violently on touching in dry state.

Incomp: Metals.

Storage and Handling: Store in small quantities under refrigeration in loosely plugged containers. Handle gently and use personal protection.

1,3-BENZENEDICARBONITRILE

CAS RN: 626175 NIOSH #: CZ 1900000
mf: $C_8H_4N_2$; mw: 128.14

Colorless crystals; water insol, sol in benzene, acetone; vap d: 4.42; mp: 138°; bp: subl.

SYNS:
M-PHTHALODINITRILE
M-DICYANOBENZENE
1,3-DICYANOBENZENE
ISOFTALODINITRIL (CZECH)
ISOPHTHALODINITRILE
ISOPHTHALONITRILE
NITRIL KYSELINY ISOFTALOVE (CZECH)

TOCICITY DATA: 3-2	CODEN:
orl-rat LD50:2900 mg/kg	MarJV# 29MAR77
ivn-mus LD50:56 mg/kg	CSLNX* NX#00202

Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information, Final Rule FEREAC 47,26992,82.
THR: HIGH ivn. MOD orl.
Disaster Hazard: Explosive. When heated to decomp it emits highly tox fumes of Cl^- and NO_x.

(o-((2,6-DICHLOROANILINO)PHENYL)ACETIC ACID SODIUM SALT

CAS RN: 15307796 NIOSH #: AG 6330000
mf: $C_{14}H_{10}ClNO_2 \cdot Na$; mw: 282.69

SYNS:
2-((2,6-DICHLOROPHENYL) AMINO)BENZENEACETIC ACID MONOSODIUM SALT
SODIUM (o-((2,6-DICHLOROPHENYL)AMINO)PHENYL) ACETATE

TOXICITY DATA: 3	CODEN:
orl-rat LD50:150 mg/kg	EXPEAM 15,4,73
orl-mus LD50:390 mg/kg	EXPEAM 15,4,73

THR: HIGH orl.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^- and NO_x.

3-(2,4-DICHLOROANILINO)-1-(2,4,6-TRICHLOROPHENYL)-2-PYRAZOLINE-5-ONE

CAS RN: 3182023 NIOSH #: UQ 9000000
mf: $C_{15}H_8Cl_5N_3O$; mw: 423.51

TOXICITY DATA: 2	CODEN:
ipr-rat LDLo:400 mg/kg	KODAK* -,-,71

Reported in EPA TSCA Inventory, 1980.
THR: MOD ipr.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^- and NO_x.

1,5-DICHLOROANTHRAQUINONE

CAS RN: 82462 NIOSH #: CB 6495000
mf: $C_{14}H_6Cl_2O_2$; mw: 277.10

SYNS:
1,5-DICHLORANTHRACHINON (CZECH)
1,5-DICHLORO-9,10-ANTHRAQUINONE

TOXICITY DATA: 2	CODEN:
eye-rbt 500 mg/24H MLD	28ZPAK -,87,72

Reported in EPA TSCA Inventory, 1980.
THR: An eye irr.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

1,8-DICHLOROANTHRAQUINONE

CAS RN: 82439 NIOSH #: CB 6496000
mf: $C_{14}H_6Cl_2O_2$; mw: 277.10

SYNS:
1,8-DICHLORANTHRACHINON (CZECH)
1,8-DICHLORO-9,10-ANTHRAQUINONE

TOXICITY DATA: 2	CODEN:
eye-rbt 500 mg/24H MOD	28ZPAK -,87,72

Reported in EPA TSCA Inventory, 1980.
THR: An eye irr.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

2-DICHLOROARSINOPHENOXATHIIN

CAS RN: 63834208 NIOSH #: SP 7000000
mf: $C_{12}H_7AsCl_2OS$; mw: 345.07

SYN: TL 472

TOXICITY DATA: 3	CODEN:
orl-rat LDLo:250 mg/kg	NCNSA6 5,13,53
ihl-mus LCLo:400 mg/m3/10M	NDRC** NDCrc-132,Dec,42

THR: HIGH orl, ihl. See also arsenic compounds.
Disaster Hazard: When heated to decomp it emits very tox fumes of As, Cl^- and SO_x.

O-DICHLOROBENZENE

CAS RN: 955501 NIOSH #: CZ 4500000
mf: $C_6H_4Cl_2$; mw: 147.00

Clear liquid. mp: −17.5°, bp: 180°-183°, fp: −22°, flash p: 151°F, d: 1.307 @ 20°/20°, vap. d: 5.05, autoign. temp.: 1198°F, lel = 2.2%, uel = 9.2%.

SYNS:
O-DICHLOR BENZOL
O-DICHLOROBENZENE
1,2-DICHLOROBENZENE
NCI-C54944

TOXICITY DATA: 2	CODEN:
eye-rbt 100 mg/30S rns MLD	AMIHAB 17,180,58
orl-rat LD50:500 mg/kg	WRPCA2 7,135,68
ihl-rat LCLo:821 ppm/7H	AMIHAB 17,180,58
ipr-rat LD50:840 mg/kg	MEPAAX 20,519,69
ivn-mus LDLo:400 mg/kg	JPBAA7 44,281,37
orl-rbt LD50:500 mg/kg	85ARAE 3,32,76
ivn-rbt LDLo:250 mg/kg	JPBAA7 44,281,37
orl-gpg LDLo:2000 mg/kg	14CYAT 2,1336,63
ihl-gpg LCLo:800 ppm/24H	JPBAA7 44,281,37

Carcinogenic Determination: Indefinite IARC** 7, 231,74.
TLV: Air: 50 ppm DTLVS* 3,76,71. *Toxicology Review:* 27ZTAP 3,49,69. OSHA Standard: Air: CL 50 ppm (SCP-J) FEREAC 39,23540,74. DOT: ORM-A, Label: None FEREAC 41,57018,76. Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. "NIOSH Manual of Analytical Methods" VOL 3 S135. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.
THR: MOD via inhal and oral routes. See chlorobenzene. The *o*-isomer is probably more toxic than the *m*- or *p*-forms. It is irr to skn and mu mem. Exper produced liver and kidney injury. An exper ± CARC. An eye irr.
Fire Hazard: Mod, when exposed to heat or flame.
Disaster Hazard: Dangerous; see chloride; can react vigorously with oxidizing materials.

To Fight Fire: Water, foam, CO_2 dry chemical.
Incomp: aluminium.

P-DICHLOROBENZENE

CAS RN: 106467 NIOSH #: CZ 4550000
mf: $C_6H_4Cl_2$; mw: 147.00

White crystals, penetrating odor. mp: 53°, bp: 173.4°, flash p: 150°F (CC), d: 1.4581 @ 20.5°/4°, vap. press: 10 mm @ 54.8°, vap. d: 5.08.

SYNS:
1,4-DICHLOORBENZEEN (DUTCH)
p-DICHLORBENZOL (GERMAN)
p-DICHLOROBENZOL
1,4-DICHLOROBENZENE
1,4-DICLOROBENZENE (ITALIAN)
NCI-C54955
PARADICHLOROBENZOL

TOXICITY DATA: 3	CODEN:
eye-hmn 80 ppm	AMIHAB 14,138,56
mmo-asn 200 mg/L	CJMIAZ 16,369,70
orl-hmn TDLo:300 mg/kg:SYS	PCOC** -,851,66
unk-man LDLo:221 mg/kg	85DCAI 2,73,70
orl-rat LD50:500 mg/kg	WRPCA2 9,119,70
ipr-rat LD50:2562 mg/kg	JAPMA8 38,124,49
orl-mus LD50:2950 mg/kg	GUCHAZ 6,183,73
scu-mus LD50:5145 mg/kg	TOIZAG 20(5/6),772,73
orl-gpg LDLo:2800 mg/kg	14CYAT 2,1338,63

Carcinogenic Determination: Indefinite IARC** 7, 231,74.

TLV: Air: 75 ppm DTLVS* 4,126,80. *Toxicology Review:* 31ZNAA 1(1),93,71; 27ZTAP 3,49,69. OSHA Standard: Air: TWA 75 ppm (SCP-T) FEREAC 39, 23540,74. DOT: ORM-A, Label: None FEREAC 41,57018,76. Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. "NIOSH Manual of Analytical Methods" VOL 3 S281. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MOD via ipr and inhal; HIGH oral. An insecticide. Has been reported to cause liver injury in hmns. An exper CARC. MUT data.

Fire Hazard: Mod, when exposed to heat, flame or oxidizers.

Spontaneous Heating: No.

Disaster Hazard: Dangerous; see chlorides; can react vigorously with oxidizing materials.

To Fight Fire: Water, foam, CO_2, dry chemical.

3,4-DICHLOROBENZENE DIAZOTHIOCARBAMID

CAS RN: 5836737 NIOSH #: XX 9625000
mf: $C_7H_6Cl_2N_4S$; mw: 249.13

SYNS:
(3,4-DICHLOOR-FENYL-AZO)-THIOUREUM (DUTCH)
3,4-DICHLOROBENZENEDIAZOTHIOUREA
3,4-DICHLOROPHENYLAZOTHIOUREA
3,4-DICHLOROPHENYL-AZO-THIOUREE (FRENCH)
(3,4-DICHLOR-PHENYL-AZO)-THIOHARNSTOFF (GERMAN)
(3,4-DICLORO-FENIL-AZO)-TIOUREA (ITALIAN)

TOXICITY DATA: 3	CODEN:
orl-rat LD50:280 ug/kg	FEPRA7 8,282,49
ipr-rat LD50:200 ug/kg	FEPRA7 8,282,49
orl-mus LD50:1 mg/kg	28ZEAL 5,188,76
ipr-mus LD50:1350 ug/kg	FEPRA7 8,282,49
orl-dog LD50:1 mg/kg	28ZEAL 5,188,76
ipr-rbt LD50:1750 ug/kg	FEPRA7 8,282,49
ipr-gpg LD50:1900 ug/kg	FEPRA7 8,282,49
unk-man LD50:500 ug/kg	30ZDA9 -,237,71

THR: HIGH orl, ipr, unk.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^-, NO_x and SO_x.

4,5-DICHLORO-m-BENZENEDISULFONAMIDE

CAS RN: 120978 NIOSH #: CZ 9200000
mf: $C_6H_6Cl_2N_2O_4S_2$; mw: 305.16

SYNS:
4,5-DICHLORO-1,3-DISULFAMOYLBENZENE
3,4-DICHLORO-5-SULFAMYLBENZENESULFONAMIDE
DICHLORPHENAMIDE
1,3-DISULFAMYL-4,5-DICHLOROBENZENE

TOXICITY DATA: 3-2	CODEN:
orl-rat TDLo:4642 mg/kg (1-22D Preg)	PSEBAA 126,6,67
orl-rat TDLo:6825 mg/kg/ (preg):TER	PSEBAA 126,6,67
orl-rat LD50:2600 mg/kg	29ZVAB -,41,69
orl-mus LD50:1710 mg/kg	29ZVAB -,41,69
ipr-mus LD50:304 mg/kg	THERAP 19,1423,64
ivn-mus LD50:643 mg/kg	29ZVAB -,41,69
ivn-dog LD50:200 mg/kg	29ZVAB -,41,69

THR: An exper TER. HIGH ivn, ipr; MOD ivn, orl.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^-, NO_x and SO_x.

2,2'-DICHLOROBENZIDINE

NIOSH #: DD 0524000
mf: $C_{12}H_{10}Cl_2N_2$; mw: 253.14

Crystals, needlelike, insol in water, sol in alcohol and ether. mp: 165°, vap. d: 8.73.

TOXICITY DATA:	CODEN:
dns-hmn:hla 100 nmol/L	CNREA8 38,2621,78

THR: MOD irr via oral and dermal routes. An allergen. MUT data.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^- and NO_x.

DICHLOROBENZIDINE BASE

CAS RN: 91941 NIOSH #: DD 0525000
mf: $C_{12}H_{10}Cl_2N_2$; mw: 253.14

Crystals, insol in water, sol in alcohol, benzene and glacial acetic acid. mp: 133°.

SYNS:
4,4'-DIAMINO-3,3'-DICHLOROBIPHENYL
3,3'-DICHLORBENZIDIN (CZECH)
3,3'-DICHLOROBENZIDINA (SPANISH)
O,O'-DICHLOROBENZIDINE
3,3'-DICHLOROBENZIDENE
3,3'-DICHLORO-4,4'-BIPHENYLDIAMINE
3,3'-DICHLOROBIPHENYL-4,4'-DIAMINE
3,3'-DICHLORO-4,4'-DIAMINOBIPHENYL

ihl-rat TCLo:100 ppm/8H (1-21D preg)	ANESAV 48,11,78
ihl-rat TCLo:400 ppm/8H (1-21D preg)	ANESAV 48,11,78
ihl-mus TCLo:2 ppm/4H (6-15D preg)	AACRAT 59,421,80
ihl-mus TCLo:2000 ppm/4H (6-15D preg)	AACRAT 59,421,80

Toxicology Review: ARVPAX 16,67,76; KDYIA5 10, 82,76; CANJAE 19,152,72; ARMCAH 25,411,74. Occupational Exposure to Waste Anesthetic Gases and Vapors recm std: Air: CL 2 ppm/1H NTIS**.

THR: An exper TER. Causes SYS in hmn via ihl. MOD orl. LOW ihl. An eye irr. See also esters.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and F⁻.

DICHLORODIFLUOROMETHANE

CAS RN: 75718 NIOSH #: PA 8200000

mf: CCl_2F_2; mw: 120.91

Colorless, almost odorless gas. mp: −158°, bp: −29°, vap. press: 5 atm @ 16.1°.

SYNS:

DICHLORODIFLUOROMETHANE (DOT)
DIFLUORODICHLOROMETHANE
DWUCHLORODWUFLUOROMETAN (POLISH)
FLUOROCARBON-12
FREON F-12
GENETRON 12
HALON

TOXICITY DATA: 1	CODEN:
ihl-hmn TCLo:200000 ppm/30M:EYE	JETOAS 9,385,76
ihl-hmn TCLo:200000 ppm/30M:CNS	JETOAS 9,385,76
ihl-rat LC50:80 pph/30M	JETOAS 9,385,76
ihl-mus LC50:76 pph/30M	JETOAS 9,385,76
ihl-rbt LC50:80 pph/30M	JETOAS 9,385,76
ihl-gpg LC50:80 pph/30M	JETOAS 9,385,76

Aquatic Toxicity Rating: TLm96:over 1000 ppm WQCHM* 3,-,74.

TLV: Air: 1000 ppm DTLVS* 4,128,80. *Toxicology Review:* FAZMAE 18,365,74; NYSJAM 74(11),1939,74. OSHA Standard: Air: TWA 1000 ppm (SCP-H) FEREAC 39,23540,74. DOT: Nonflammable Gas, Label: Nonflammable Gas FEREAC 41,57018,76. "NIOSH Manual of Analytical Methods" VOL 2 S111. Reported in EPA TSCA Inventory, 1980.

THR: A hmn EYE, CNS. LOW ihl. Narcotic in high conc.

Disaster Hazard: Dangerous; when heated to decomp it emits highly tox fumes of phosgene and fluorides. Can react violently with Al.

DICHLORODIFLUOROMETHANE AND METHANE, FLUOROTRICHLORO- MIXED WITH CHLORODIFLUOROMETHANE

NIOSH #: PA 8278500

SYN: DICHLOROFLUOROMETHANE-TRICHLOROMONOFLUOROMETHANE-MONOCHLORODIFLUOROMETHANE MIXTURE (DOT)

TOXICITY DATA:

DOT: Nonflammable Gas, Label: Nonflammable Gas FEREAC 41,57018,76.

THR: No data. See also components as listed.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and F⁻.

DICHLORODIFLUOROMETHANE MIXED WITH CHLORODIFLUOROMETHANE

CAS RN: 70281300 NIOSH #: PA 8220000

SYN: DICHLORODIFLUOROMETHANE-MONOCHLORODIFLUOROMETHANE MIXTURE (DOT)

TOXICITY DATA:

DOT: Nonflammable Gas, Label: Nonflammable Gas FEREAC 41,57018,76.

THR: NO data. See individual components as listed.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and F⁻.

DICHLORODIFLUOROMETHANE MIXED WITH DICHLOROTETRAFLUOROETHANE

CAS RN: 57197429 NIOSH #: PA 8250000

SYN: DICHLORODIFLUOROMETHANE-DICHLOROTETRAFLUOROETHANE MIXTURE (DOT)

TOXICITY DATA:

DOT: Nonflammable Gas, Label: Nonflammable Gas FEREAC 41,57018,76.

THR: NO data. See also components as listed.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and F⁻.

DICHLORODIFLUOROMETHANE MIXED WITH 1,1-DIFLUOROETHANE

CAS RN: 56275413 NIOSH #: PA 8260000

SYN: DICHLORODIFLUOROMETHANE-DIFLUOROETHANE MIXTURE (DOT)

TOXICITY DATA:

DOT: Nonflammable Gas, Label: Nonflammable Gas FEREAC 41,57018,76.

THR: No data. See also components as listed.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and F⁻.

DICHLORODIFLUOROMETHANE MIXED WITH FLUOROTRICHLOROMETHANE

NIOSH #: PA 8275000

SYN: DICHLORODIFLUOROMETHANE-TRICHLOROMONOFLUOROMETHANE MIXTURE (DOT)

TOXICITY DATA:

DOT: Nonflammable Gas, Label: Nonflammable Gas FEREAC 41,57018,76.

THR: No data. See also components as listed.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and F⁻.

DICHLORODIPROPYLSTANNANE

CAS RN: 867367 NIOSH #: WH 7255000
mf: $C_6H_{14}Cl_2Sn$; mw: 275.79

Colorless crystals. Sol in organic solvents. mp: 81°.

SYNS:
DICHLORODIPROPYLTIN
DIPROPYLTIN CHLORIDE
DI-N-PROPYLTIN DICHLORIDE
DIPROPYLTIN DICHLORIDE

TOXICITY DATA: 3	CODEN:
orl-rat LDLo:160 mg/kg	BJIMAG 15,15,58

OSHA Standard: Air: TWA 100 ug(Sn)/m3 (skin) (SCP-X) FEREAC 39,23540,74. Occupational Exposure to Organotin Compounds recm std: Air: TWA 0.1 mg(Sn)/m3 NTIS**.
THR: HIGH orl. See also tin compounds and chlorides.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

1,4-DICHLORO-2,3-EPOXYBUTANE

CAS RN: 3583479 NIOSH #: EJ 8050000
mf: $C_4H_6Cl_2O$; mw: 141.00

SYN: BUTANE, 1,4-DICHLORO-2,3-EPOXY

TOXICITY DATA: 2	CODEN:
mmo-klp 5 mmol/L	MUREAV 89,269,81
skn-rbt 10 mg/24H open MLD	AIHAAP 23,95,62
mma-sat 1 mmol/L	ARTODN 41,249,79
orl-rat LDLo:710 mg/kg	AIHAAP 23,95,62
skn-rbt LDLo:2830 mg/kg	AIHAAP 23,95,62

THR: An irr in rbt skn. MUT data. MOD via oral, inhal and dermal routes.
Disaster Hazard: Dangerous; see chlorides.

DICHLOROETHANE

CAS RN: 1300216 NIOSH #: KH 9800000
mf: $C_2H_4Cl_2$; mw: 98.96

Lel = 5.6%; uel = 11.4%.

TOXICITY DATA: 2	CODEN:
orl-rat LD50:1120 mg/kg	HYSAAV 32,349,67
orl-mus LD50:625 mg/kg	HYSAAV 32,349,67
ihl-mus LCLo:10 gm/m3	GISAAA 20(8),19,55
skn-rbt LD50:3890 mg/kg	UCDS** 3/23/70
ihl-rat TCLo:6000 ppm (6-15D preg) TER	TXAPA9 28,452,74
ihl-rat TCLo:6000 ppm (6-15D preg)	TXAPA9 28,452,74

THR: MOD orl in rat, mus. MOD skn in rbt.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^-.

1,2-DICHLOROETHANE

mf: $C_2H_4Cl_2$; mw: 98.96

Lel = 6.2%; uel = 15.9%; flash p: 55.4°F.

Incomp: Dinitrogen tetraoxide; metals.
For further information see Vol. 1, No. 4 of *DPIM Report.*

2,2-DICHLOROETHANOL

CAS RN: 598389 NIOSH #: KK 4100000
mf: $C_2H_4Cl_2O$; mw: 114.96

TOXICITY DATA:	CODEN:
mmo-omi 80 uL/plate	CBINA8 30,9,80
mmo-esn 20 uL/plate/2H	GBINA8 30,9,80

Reported in EPA TSCA Inventory, 1980.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

2,2-DICHLOROETHENYL DIETHYL PHOSPHATE

NIOSH #: TC 0280000
mf: $C_6H_{11}Cl_2O_4P$; mw: 249.04

SYNS:
DICHLORVOS-ETHYL
2,2-DICHLOROVINYL DIETHYL PHOSPHATE
O-(2,2-DICHLORVINYL)-O,O-DIETHYLPHOSPHAT (GERMAN)

TOXICITY DATA: 3	CODEN:
mmo-sat 5 uL/plate	MUREAV 28,405,75
ipr-mus LD50:12 mg/kg	ARZNAD 5,746,55

THR: MUT data. HIGH ipr. See also esters.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^- and PO_x.

DICHLORO(4-ETHOXY-o-PHENYLENEDIAMMINE)PLATINUM (II)

NIOSH #: TP 2497050
mf: $C_8H_{12}Cl_2N_2OPt$; mw: 418.21

TOXICITY DATA:	CODEN:
mmo-sat 2500 nmol/L	JMCMAR 23,459,80
mma-sat 2500 nmol/L	JMCMAR 23,459,80

THR: MUT data. See also platinum compounds.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^- and NO_x.

DI(2-CHLOROETHYL) ACETAL

CAS RN: 14689975 NIOSH #: KI 3600000
mf: $C_6H_{12}Cl_2O_2$; mw: 187.08

SYN: 1,1'-(ETHYLIDENE)BIS(OXY)BIS(2-CHLOROETHANE)

TOXICITY DATA: 3	CODEN:
orl-rat LD50:310 mg/kg	AIHAAP 30,470,69
skn-rbt LD50:200 mg/kg	AIHAAP 30,470,69

THR: HIGH orl. HIGH skn.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

4-DI-2''-CHLOROETHYLAMINOAZOBENZENE-2'-CARBOXYLIC ACID

NIOSH #: DG 7450000
mf: $C_{17}H_{17}Cl_2N_3O_2$; mw: 366.27

ihl-mus TC:55 ppm/43W-I:ETA	JTEHD6 4,15,78
ihl-hmn TCLo:25 ppm:SYS	CHINAG 11,463,76
orl-rat LD50:200 mg/kg	DCTODJ 1,63,77
ihl-rat LCLo:10000 ppm/24H	EXMPA6 20,187,74
ihl-mus LC50:98 ppm/22H	JTEHD6 3(5-6),913,77
orl-dog LDLo:5750 mg/kg	QJPPAL 7,205,34
ivn-dog LDLo:225 mg/kg	QJPPAL 7,205,34
scu-rbt LDLo:3700 mg/kg	QJPPAL 7,205,34

Aquatic Toxicity Rating: TLm96:1000-100 ppm WQCHM* 3,-,74. Carcinogenic Determination: Animal Positive IARC** 19,439,79.

TLV: Air: 10 ppm DTLVS* 4,432,80. *Toxicology Review:* CTOXAO 8,633,75; CMTVAS 10(3),49,73; NTIS** ORNL/TIRC-77/3. Occupational Exposure to Vinyl Halides recm std: Air: TWA 1 ppm; CL 5 ppm/15M NTIS**. NTP Carcinogenesis Bioassay Completed as of December 1980. "NIOSH Manual of Analytical Methods" VOL 4 266*. NIOSH Current Intelligence Bulletin 28, 1978. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: An exper MUT, ETA, NEO, CARC. HIGH acute orl, ihl. See also vinyl chloride.

Fire Hazard: Highly dangerous, when exposed to heat or flame.

Explosion Hazard: Mod, in the form of gas, when exposed to heat or flame. Also can explode spontaneously; reacts violently with chlorosulfonic acid, HNO_3, oleum.

Disaster Hazard: Highly dangerous; see chlorides; can react vigorously with oxidizing materials.

To Fight Fire: Alcohol foam, CO_2, dry chemical.

Incomp: Air; chlorotri-fluoroethylene; ozone; perchloryl fluoride.

cis-DICHLOROETHYLENE

CAS RN: 156592 NIOSH #: KV 9420000
mf: $C_2H_2Cl_2$; mw: 96.94

Colorless liquid, pleasant odor. mp: −80.5°, bp: 59°, lel = 9.7%, uel = 12.8%, flash p: 39°F, d: 1.2743 @ 25°/4°, vap. press: 400 mm @ 41.0°, vap. d: 3.34.

SYNS:
1,2-DICHLOROETHYLENE
ACETYLENE DICHLORIDE

TOXICITY DATA: 1	CODEN:
ihl-mus LCLo:65000 mg/m3/2H	AHBAAM 116,131,36
ihl-cat LCLo:20000 mg/m3/6H	AHBAAM 116,131,36

Reported in EPA TSCA Inventory, 1980.

THR: LOW via oral route. In high conc it is irr and narcotic. Has produced liver and kidney injury in exper animals.

Fire Hazard: Dangerous, when exposed to heat or flame. Reacts violently with N_2O_4, KOH, Na, NaOH.

Spontaneous Heating: No.

Explosion Hazard: Mod, in the form of vapor when exposed to flame.

Disaster Hazard: Dangerous; see chlorides; can react vigorously with oxidizing materials.

To Fight Fire: Water spray, foam, CO_2, dry chemical.

cis, 1,2-DICHLOROETHYLENE

mf: $C_2H_2Cl_2$; mw: 96.94

Flash p: 42.8°F; lel = 3.3%; uel = 15%.

trans-1,2-DICHLOROETHYLENE

mf: $C_2H_2Cl_2$; mw: 96.94

Flash p: 35.6°F; lel = 9.7%; uel = 12.8%.
Can cause fire hazard.

Incomp: Alkalies; difluoromethylene dihypofluorite; nitrogen tetraoxide.

1,2-DICHLOROETHYLENE CARBONATE

CAS RN: 3967553 NIOSH #: JH 7400000
mf: $C_3H_2Cl_2O_3$; mw: 156.95

TOXICITY DATA: 3	CODEN:
scu-mus TDLo:648 mg/kg/54W-I:ETA	JNCIAM 48,1431,72

THR: An exper ETA.

Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

DICHLORO(ETHYLENEDIAMMINE)-PLATINUM(II)

CAS RN: 14096516 NIOSH #: TP 2497100
mf: $C_2H_8Cl_2N_2Pt$; mw: 326.11

TOXICITY DATA: 3	CODEN:
mmo-sat 2 ug/plate	MUREAV 77,45,80
mma-sat 2 ug/plate	MUREAV 77,45,80
ipr-mus LDLo:14 mg/kg	BICHBX 2,187,73

THR: MUT data. HIGH ipr. See also platinum compounds.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^- and NO_x.

DI-2-CHLOROETHYL MALEATE

CAS RN: 63917066 NIOSH #: ON 1050000
mf: $C_8H_{10}Cl_2O_4$; mw: 241.08

TOXICITY DATA: 3	CODEN:
orl-rat LD50:71 mg/kg	TXAPA9 28,313,74
skn-rbt LD50:140 mg/kg	TXAPA9 28,313,74

THR: HIGH orl, skn.

Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

2,3-DICHLORO-N-ETHYLMALEINIMIDE

CAS RN: 20198770 NIOSH #: ON 5175000
mf: $C_6H_5Cl_2NO_2$; mw: 194.02

SYN: N-ETHYL-DICHLOROMALEINIMIDE

TOXICITY DATA: 3	CODEN:
ipr-mus TDLo:6200 ug/kg/(9D preg):TER	ARTODIN 37,15,76
ipr-mus LD50:15 mg/kg	ARTODN 37,15,76
ivn-mus LD50:5600 ug/kg	CSLNX* NX#03694

Disaster Hazard: Dangerous; when heated to decomp it emits highly tox fumes of aniline and NO_x; can react with oxidizing materials.
To Fight Fire: Foam, CO_2, dry chemical.

4-ETHYLANILINE

CAS RN: 589162 NIOSH #: BX 9900000
mf: $C_8H_{11}N$; mw: 121.20

d: 0.963; mp: 65.8°; bp: 205.5°; Insol in water; misc in alc and eth.

SYNS:
1-AMINO-4-ETHYLBENZENE
P-ETHYLANILINE

TOXICITY DATA: 3	CODEN:
ipr-mus LD50:133 mg/kg	JMCMAR 17,900,74
ivn-mus LD50:56 mg/kg	CSLNX* NX#02908
unk-mus LD50:133 mg/kg	JMCMAR 17,900,74

Reported in EPA TSCA Inventory, 1980.
THR: HIGH ivn, unk. See also o-ethylaniline.
Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

2-ETHYL-9,10-ANTHRACENEDIONE

CAS RN: 84515 NIOSH #: CB 0525000
mf: $C_{16}H_{12}O_2$; mw: 236.28

SYNS:
2-ETHYL-9,10-ANTHRAQUINONE
USAF SO-1

TOXICITY DATA: 3	CODEN:
ipr-mus LD50:200 mg/kg	NTIS** AD277-689

Reported in EPA TSCA Inventory, 1980.
THR: HIGH ipr.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

ETHYL ANTHRANILATE

CAS RN: 87252 NIOSH #: DG 2448000
mf: $C_9H_{11}NO_2$; mw: 165.21

SYN: ETHYL-O-AMINOBENZOATE

TOXICITY DATA: 2	CODEN:
skn-rbt 500 mg/24H MOD	FCTXAV 14,659,76
orl-rat LD50:3750 mg/kg	FCTXAV 14,659,76

Reported in EPA TSCA Inventory, 1980.
THR: MOD orl. MOD skn irr.
Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

ETHYL AZIDE

mf: $C_2H_5N_3$; mw: 71.08

THR: Very unstable.
Explosion Hazard: May explode on rapid heating.

ETHYL AZIDOFORMATE

mf: $C_3H_5N_3O_2$; mw: 115.09

Explosion Hazard: May explode if boiled at 114°.

2-ETHYLAZIRIDINE

CAS RN: 2549679 NIOSH #: CM 7875000
mf: C_4H_9N; mw: 71.14

SYNS:
1,2-BUTYLENIMINE
2-ETHYLETHYLENIMINE
N-METHYLCAPROLACTAM
1-METHYLCAPROLACTAM

TOXICITY DATA: 3-2	CODEN:
ihl-rat LCLo:1000 ppm/3.5H	NTIS** AD441-640
ipr-mus LD50:52 mg/kg	NTIS** AD441-640

Reported in EPA TSCA Inventory, 1980.
THR: HIGH ipr; MOD ihl.
Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

5-ETHYL-1,2-BENZANTHRACENE

CAS RN: 56961627 NIOSH #: CW 5850000
mf: $C_{20}H_{16}$; mw: 256.36

SYN: 8-ETHYLBENZ(A)ANTHRACENE

TOXICITY DATA: 3	CODEN:
skn-mus TDLo:650 mg/kg/27W-I:ETA	PRLBA4 123,343,37

THR: An exper ETA.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

10-ETHYL-1,2-BENZANTHRACENE

CAS RN: 3597301 NIOSH #: CW 5775000
mf: $C_{20}H_{16}$; mw: 256.36

SYN: 7-ETHYLBENZ(A)ANTHRACENE

TOXICITY DATA: 3	CODEN:
scu-mus TDLo:600 mg/kg:ETA	JNCIAM 1,303,40

THR: An exper ETA.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

12-ETHYLBENZ(a)ANTHRACENE

CAS RN: 18868661 NIOSH #: CW 5860000
mf: $C_{20}H_{16}$; mw: 256.36

TOXICITY DATA: 3	CODEN:
ims-rat TDLo:50 mg/kg:ETA	CNREA8 29,506,69

THR: An exper ETA.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

ETHYL BENZENE

CAS RN: 100414 NIOSH #: DA 0700000
mf: C_8H_{10}; mw: 106.18

Colorless liquid, aromatic odor. Misc in alcohol and ether, insol in NH_3; sol in SO_2. bp: 136.2°, fp: −94.9°, flash p: 59°F, d: 0.8669 @ 20°/4°, autoign. temp.: 810°F, vap. press: 10 mm @ 25.9°, vap. d: 3.66, lel = 1.2%, uel = 6.8%.

SYNS:
AETHYLBENZOL (GERMAN)
ETHYLBENZEEN (DUTCH)
ETHYLBENZOL
ETILBENZENE (ITALIAN)
ETYLOBENZEN (POLISH)
NCI-C56393
PHENYLETHANE

TOXICITY DATA: 2-1	CODEN:
skn-rbt 15 mg/24H open MLD	AIHAAP 23,95,62
eye-rbt 100 mg	AJOPAA 29,1363,46
ihl-rat TCLo:97 ppm/7H (15D preg)	BATTL* JAN,81
ihl-rat TCLo:985 ppm/7H (1-19D preg)	BATTL* JAN,81
ihl-rat TCLo:96 ppm/7H (1-19D preg)	BATTL* JAN,81
ihl-rbt TCLo:99 ppm/7H (1-18D preg)	BATTL* JAN,81
ihl-hmn TCLo:100 ppm/8H TFX:IRR	AIHAAP 31,206,70
orl-rat LD50:3500 mg/kg	AMIHAB 14,387,56
ihl-rat LCLo:4000 ppm/4H	AIHAAP 23,95,62
skn-rbt LD50:5000 mg/kg	FCTXAV 13,681,75
ihl-gpg LCLo:10000 ppm	PHRPA6 45,1241,30

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 2,-,74.

TLV: Air: 100 ppm DTLVS* 4,176,80. OSHA Standard: Air: TWA 100 ppm (skin) (SCP-C) FEREAC 39, 23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Selected by NTP Carcinogenesis Bioassay as of December 1980. "NIOSH Manual of Analytical Methods" VOL 2 S29. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MOD via irr to skn, eyes, mu mem and via oral and inhal routes. The liquid is an irr to the skn and mu mem. A conc of 0.1% of the vapor in air is an irr to the eyes of hmns, and a conc of 0.2% is extremely irr at first, then causes dizziness, irr of the nose and throat and a sense of constriction of the chest. Exposure of guinea pigs to 1% conc has been reported as causing ataxia, loss of consciousness, tremor of the extremities and finally death through respiratory failure. The pathological findings were congestion of the brain and lungs, with edema. No data are available regarding the effect of chronic exposure. An exper TER.

Erythema and inflammation of the skin may result from contact of the skn with the liquid. Exposure to the vapor causes lachrymation and irr of the nose and throat, dizziness, and a sense of constriction of the chest. The irr properties are sufficient to cause workers to leave an atmosphere containing 0.5% of the vapor.

Fire Hazard: Dangerous, when exposed to heat or flame; can react vigorously with oxidizing materials.

Spontaneous Heating: No.

Disaster Hazard: Dangerous; keep away from heat and open flame.

To Fight Fire: Foam, CO_2, dry chemical.

For further information see Vol. 2, No. 6 of *DPIM Report.*

alpha-ETHYLBENZENEMETHANOL

CAS RN: 93549 NIOSH #: DO 5470000
mf: $C_9H_{12}O$; mw: 136.21

SYNS:
ALPHA-ETHYLBENZYL ALCOHOL
ETHYL PHENYL CARBINOL
ALPHA-HYDROXYPROPYL-BENZENE
1-PHENYLPROPYL ALCOHOL
1-PHENYL-1-PROPANOL

TOXICITY DATA: 3-2	CODEN:
orl-rat LD50:1500 mg/kg	12VXA5 8,431,68
orl-mus LD50:1600 ug/kg	ARZNAD 12,347,62

THR: HIGH oral. MOD oral.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

2-ETHYLBENZIMIDAZOLE

CAS RN: 1848846 NIOSH #: DD 8925000
mf: $C_9H_{10}N_2$; mw: 146.21

TOXICITY DATA: 3	CODEN:
mmo-sat 250 ug/plate	CHIMAD 27,68,73
ivn-mus LD50:100 mg/kg	JPETAB 105,486,52

THR: HIGH ivn. MUT data.

Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

ETHYL BENZOATE

CAS RN: 93890 NIOSH #: DH 0200000
mf: $C_9H_{10}O_2$; mw: 150.19

Colorless, aromatic liquid. mp: −34.6°, bp: 213.4°, flash p: >204°F, d: 1.048 @ 20°/20°, vap. press: 1 mm @ 44.0°, vap. d: 5.17, autoign. temp.: 914°F. Insol in water; misc in pet, alc, chl, and eth.

SYNS:
BENZOIC ETHER
ESSENCE OF NIOBE

TOXICITY DATA: 2-1	CODEN:
skn-rbt 10 mg/24H MLD	AMIHBC 10,61,54
eye-rbt 500 mg	AMIHBC 10,61,54
orl-rat LD50:2100 mg/kg	JPETAB 84,358,45
skn-cat LDLo:10 gm/kg	JPETAB 84,358,45
orl-rbt LD50:2630 mg/kg	JPETAB 84,358,45

Reported in EPA TSCA Inventory, 1980.

THR: MOD dermal and oral. See also esters. MOD oral. LOW skin.

Fire Hazard: Low, when exposed to heat or flame; can react with oxidizing materials.

To Fight Fire: Foam, CO_2, dry chemical.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

2-ETHYL-BENZOXAZOLE

CAS RN: 6797133 NIOSH #: DM 4823500
mf: C_9H_9NO; mw: 147.19

TOXICITY DATA: 2	CODEN:
orl-cat LD40:1000 mg/kg	JACSAT 67,905,45

Reported in EPA TSCA Inventory, 1980.

THR: MOD oral.

Disaster Hazard: When heated to decomp it emits tox fumes such as NO_x.

SYNS:

4-AETHYL-1-PHOSPHA-2,6,7-TRIOXABICYCLO(2.2.2)OCTAN-1-OXID (GERMAN)
4-ETHYL-1-PHOSPHA-2,6,7-TRIOXABICYCLO(2.2.2)OCTANE-1-OXIDE
4-ETHYL-2,6,7-TRIOXA-1-PHOSPHABICYCLO(2.2.2)OCTANE-1-OXIDE

TOXICITY DATA: 3	CODEN:
orl-rat LD50:3080 ug/kg	ARTODN 35,149,76
ihl-rat LC50:30 mg/m3/1H	ARTODN 35,149,76
skn-rat LD50:50 mg/kg	ARTODN 35,149,76
ipr-rat LD50:960 ug/kg	ARTODN 35,149,76
orl-mus LD50:3550 ug/kg	ARTODN 35,149,76
ipr-mus LD50:1 mg/kg	SCIEAS 182,1135,73
ivn-mus LDLo:500 ug/kg	EJMCA5 13,207,78
orl-dog LD50:1 mg/kg	ARTODN 35,149,76
orl-cat LD50:5 mg/kg	ARTODN 35,149,76
orl-rbt LD50:5 mg/kg	ARTODN 35,149,76
orl-gpg LD50:2500 ug/kg	ARTODN 35,149,76
orl-ham LD50:13 mg/kg	ARTODN 35,149,76
orl-ckn LD50:75 mg/kg	ARTODN 35,149,76

THR: HIGH orl, ihl, skn, ipr, ivn.
Disaster Hazard: When heated to decomp it emits tox fumes of PO_x.

ETHYL 4-HYDROXY-3-MORPHOLINOMETHYLBENZOATE

NIOSH #: DH 2528000
mf: $C_{13}H_{19}NO_4$; mw: 253.33

SYN: 4-HYDROXY-3-MORPHOLINOMETHYLBENZOIC ACID ETHYL ESTER

TOXICITY DATA: 2	CODEN:
orl-mus LDLo:3000 mg/kg	ARZNAD 11,85,61
scu-mus LDLo:460 mg/kg	ARZNAD 11,85,61

THR: MOD orl, scu.
Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

3-ETHYL-4-HYDROXY-1,2,5-OXADIAZOLE

mf: $C_4H_6N_2O_2$; mw: 114.10

Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.
Incomp: Sodium hydroxide.

ETHYL(m-HYDROXYPHENYL) DIMETHYLAMMONIUM HYDROXIDE

CAS RN: 473370 NIOSH #: BQ 5900000
mf: $C_{10}H_{16}NO \cdot HO$; mw: 183.28

SYNS:

EDROPHONIUM
TENSILON

TOXICITY DATA: 3-2	CODEN:
orl-mus LD50:600 mg/kg	27ZIAQ -,102,73
ipr-mus LD50:37 mg/kg	27ZIAQ -,102,73
scu-mus LD50:130 mg/kg	27ZIAQ -,102,73
ivn-mus LD50:9 mg/kg	27ZIAQ -,102,73
ivn-rbt LD50:29 mg/kg	27ZIAQ -,102,73

THR: HIGH ivn, scu, ipr. MOD orl. See also ammonium hydroxide.
Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

ETHYL-p-HYDROXYPHENYL KETONE

CAS RN: 70702 NIOSH #: UH 1925000
mf: $C_9H_{10}O_2$; mw: 150.19

SYNS:

p-HYDROXYPHENYL-1-PROPANONE
1-(4-HYDROXYPHENYL)-1-PROPANONE
HYDROXYPROPIOPHENONE
p-HYDROXYPROPIOPHENONE
4-HYDROXYPROPIOPHENONE
p-OXYPROPIOPHENONE
PAROXYPROPIONE
p-PROPIONYLPHENOL
USAF EK-3302

TOXICITY DATA: 3-2	CODEN:
ipr-mus LD50:200 mg/kg	NTIS** AD277-689
scu-mus LD50:4100 mg/kg	ARZNAD 5,559,55

Reported in EPA TSCA Inventory, 1980.
THR: HIGH ipr; MOD scu.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

N-ETHYL-N-(3-HYDROXYPROPYL) NITROSAMINE

CAS RN: 61734881 NIOSH #: UB 5618000
mf: $C_5H_{12}N_2O_2$; mw: 132.19

TOXICITY DATA:	CODEN:
mma-sat 15 umol/plate	CNREA8 37,399,77

THR: MUT data.
Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

ETHYL HYPOCHLORITE

mf: C_2H_5ClO; mw: 80.52

THR: Very unstable.
Explosion Hazard: Self-explodes.
Incomp: Copper, light.

ETHYLIDENE DICHLORIDE

CAS RN: 75343 NIOSH #: KI 0175000
mf: $C_2H_4Cl_2$; mw: 98.96

Colorless liquid, aromatic, ethereal odor, hot saccharine taste. mp: −97.7°, lel = 5.6%, bp: 57.3°, flash p: 22°F (TOC), d: 1.174 @ 20°/4°, vap. press: 230 mm @ 25°, vap. d: 3.44, autoign. temp.: 856°F.

SYNS:

AETHYLIDENCHLORID (GERMAN)
CHLORINATED HYDROCHLORIC ETHER
CHLORURE D'ETHYLIDENE (FRENCH)
1,1-DICHLOORETHAAN (DUTCH)
CLORURO DI ETILIDENE (ITALIAN)
1,1-DICHLORAETHAN (GERMAN)
1,1-DICHLOROETHANE
1,1-DICLOROETANO (ITALIAN)
ETHYLIDENE CHLORIDE
NCI-C04535

TOXICITY DATA: 3	CODEN:
ihl-rat TCLo:6000 ppm/7H (6-15D preg)	TXAPA9 28,452,74
ihl-rat TCLo:6000 ppm/(6-15D preg):TER	TXAPA9 28,452,74
orl-mus TDLo:185 gm/kg/78W-I:ETA	NCITR* NCI-CG-TR-66,78

orl-mus TD:1300 gm/kg/78W-I:ETA	NCITR* NCI-CG-TR-66,78
orl-rat LD50:725 mg/kg	HYSAAV 32,349,67

TLV: Air: 200 ppm DTLVS* 4,130,80. *Toxicology Review:* AIHAAP 40,A46,79; 27ZTAP 3,49,69. OSHA Standard: Air: TWA 100 ppm (SCP-I) FEREAC 39,23540,74. NCI Carcinogenesis Bioassay Completed; Results Indefinite: Mouse, Rat (NCITR* NCI-CG-TR-66,78). "NIOSH Manual of Analytical Methods" VOL 2 S123. NIOSH Current Intelligence Bulletin 27, 1978. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: An exper TER, ETA. MOD orl. Liver damage report in exper animals.

Fire Hazard: Dangerous, when exposed to heat or flame.

Explosion Hazard: Mod, when exposed to heat or flame.

Disaster Hazard: Dangerous; when heated to decomp it emits highly tox fumes of phosgene; can react vigorously with oxidizing materials.

To Fight Fire: Alcohol foam, water, foam, CO_2, dry chemical.

ETHYLIDENE DIFLUORIDE

CAS RN: 75376 NIOSH #: KI 1410000

mf: $C_2H_4F_2$; mw: 66.06

Colorless gas. mp: −117.0°, bp: −26.5°, d: 1.004 @ 25°, vap. d: 2.28.

SYNS:

DIFLUOROETHANE

ETHYLENE FLUORIDE

ETHYLIDENE FLUORIDE

TOXICITY DATA: 1	CODEN:
sln-dmg-ihl 98 pph/10M	ENVRAL 7,275,74
ihl-rat LCLo:50 pph/10M	AIHOAX 2,335,50

Toxicology Review: FAZMAE 18,365,74. DOT: Flammable Gas, Label: Flammable Gas FEREAC 41,57018,76. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: LOW inhal; LOW to MOD irr. Narcotic in high conc. MUT data.

Fire Hazard: Dangerous, when exposed to heat or flame.

Disaster Hazard: Dangerous; see fluorides; can react vigorously with oxidizing materials.

ETHYLIDENE DIURETHAN

CAS RN: 539719 NIOSH #: FA 9460000

mf: $C_8H_{16}N_2O_4$; mw: 204.26

SYN: N,N'-ETHYLIDENE-BIS(ETHYL CARBAMATE)

TOXICITY DATA: 3	CODEN:
ipr-mus TDLo:6500 mg/kg/13W-I:ETA	JNCIAM 9,35,48

THR: An exper ETA.

Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

5-ETHYLIDENE-2-NORBORNENE

CAS RN: 16219753 NIOSH #: RB 9450000

mf: C_9H_{12}; mw: 120.21

SYN: 5-ETHYLIDENEBICYCLO(2.2.1)HEPT-2-ENE

TOXICITY DATA: 2	CODEN:
skn-rbt 445 mg open MLD	UCDS** 11/28/67
ihl-hmn TCLo:6 ppm/30M:IRR	TXAPA9 20,250,71
orl-rat LD50:2830 mg/kg	UCDS** 11/28/67
ihl-rat LC50:4000 ppm/4H	AIHAAP 30,470,69
ihl-rat LC50:1246 ppm/4H	TXAPA9 20,250,71
ihl-mus LC50:732 ppm/4H	TXAPA9 20,250,71
ihl-rbt LC50:3104 ppm/4H	TXAPA9 20,250,71
skn-rbt LD50:9170 mg/kg	UCDS** 11/28/67
ihl-gpg LC50:2896 ppm/4H	TXAPA9 20,250,71

TLV: Air: 5 ppm DTLVS* 4,188,80. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MLD skn. Ihl IRR in hmn. MOD orl, ihl, skn.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

N-ETHYL-2,2'-IMINODIETHANOL

CAS RN: 139877 NIOSH #: KK 9800000

mf: $C_6H_{15}NO_2$; mw: 133.22

TOXICITY DATA: 1	CODEN:
skn-rbt 10 mg/24H MLD	AMIHBC 10,61,54
eye-rbt 750 ug SEV	AMIHBC 10,61,54
orl-rat LD50:4570 mg/kg	AMIHBC 10,61,54

Reported in EPA TSCA Inventory, 1980.

THR: LOW orl in rat. MLD skn irr in rbt. SEV eye irr in rbt.

Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

ETHYL IODIDE

CAS RN: 75036 NIOSH #: KI 4750000

mf: C_2H_5I; mw: 155.97

Clear, colorless liquid, turns brown on exposure to light, refractive, heavy. mp: −108°, bp: 72.4°, d: 1.90-1.93 @ 25°/25°, vap. press: 100 mm @ 18.0°, vap. d: 5.38. Misc in alc and ether.

SYNS:

HYDRIODIC ETHER

IODOETHANE

TOXICITY DATA: 1	CODEN:
mmo-esc 20 umol/L	ARTODN 46,277,80
ihl-rat LC50:65000 mg/m3/30M	FAVUAI 7,35,75

Reported in EPA TSCA Inventory, 1980.

THR: MOD irr to skin, eyes, mu mem. Narcotic in high conc. LOW ihl tox in rat.

Fire Hazard: Mod, when exposed to heat or flame.

Disaster Hazard: Dangerous; when heated to decomp, emits highly toxic fumes of iodides; will react with water or steam to produce toxic and corrosive fumes; can react vigorously with oxidizing materials.

To Fight Fire: Water, CO_2, dry chemical.

TOXICITY DATA: 1 CODEN:

Aquatic Toxicity Rating: TLm96:over 1000 ppm WQCHM*. 3,-,74. DOT: Flammable Gas, Label: Flammable Gas FEREAC 41,57018,76. Reported in EPA TSCA Inventory, 1980.

THR: A simple asphyxiant. See argon.

Fire Hazard: Very dangerous, when exposed to heat or flame. Reacts violently with BrF_5, Cl_2, ClO_2, NF_3, liquid O_2, OF_2.

Spontaneous Heating: No.

Explosion Hazard: Dangerous, when exposed to heat or flame.

Disaster Hazard: Dangerous.

To Fight Fire: Stop flow of gas, CO_2 or dry chemical.

Incomp: halogens or interhalogens; oxidants, air (forms explosive mixtures).

METHANE DICHLORIDE

CAS RN: 75092 NIOSH #: PA 8050000

mf: CH_2Cl_2; mw: 84.93

Colorless volatile liquid. bp: 39.8°, lel = 15.5% in O_2, uel = 66.4% in O_2, fp: −96.7°, d: 1.326 @ 20°/4°, autoign. temp.: 1139°F, vap. press: 380 mm @ 22°, vap. d: 2.93.

SYNS:

CHLORURE DE METHYLENE (FRENCH)
DICHLOROMETHANE (DOT)
FREON 30
METHYLENE BICHLORIDE
METHYLENE CHLORIDE (DOT)
METHYLENE DICHLORIDE
METYLENU CHLOREK (POLISH)
NCI-C50102

TOXICITY DATA: 3	CODEN:
skn-rbt 810 mg/24H SEV	JETOAS 9,171,76
eye-rbt 162 mg MOD	JETOAS 9,171,76
eye-rbt 10 mg MLD	TXCYAC 6,173,76
eye-rbt 17500 mg/m3/10M	TXCYAC 6,173,76
mmo-sat 5700 ppm	MUREAV 56,245,78
mma-sat 5700 ppm	MUREAV 56,245,78
dni-hmn:fbr 5000 ppm/1H-C	MUREAV 81,203,81
dni-ham:lng 5000 ppm/1H-C	MUREAV 81,203,81
sce-ham:lng 5000 ppm/1H-C	MUREAV 81,203,81
ihl-rat TCLo:4500 ppm/24H (1-17D preg)	TXAPA9 52,29,80
ihl-rat TCLo:1250 ppm/7H (6-15D preg)	TXAPA9 32,84,75
ihl-mus TCLo:1250 ppm/7H (6-15D preg)	TXAPA9 32,84,75
ihl-rat TCLo:500 ppm/6H/2Y:ETA	TXAPA9 48,A185,79
ihl-hmn TCLo:500 ppm/1Y-I:CNS	ABHYAE 43,1123,68
ihl-hmn TCLo:500 ppm/8H:BLD	SCIEAS 176,295,72
orl-rat LD50:167 mg/kg	DOWSD* 1/26/76
ihl-rat LC50:88000 mg/m3/30M	FAVUAI 7,35,75
ihl-mus LC50:14400 ppm/7H	NIHBAZ 191,1,49
ipr-mus LD50:1500 mg/kg	TXAPA9 9,139,66
scu-mus LD50:6460 mg/kg	TXAPA9 4,354,62
orl-dog LDLo:3000 mg/kg	QJPPAL 7,205,34
ihl-dog LCLo:14108 ppm/7H	NIHBAZ 191,1,49
ipr-dog LDLo:950 mg/kg	TXAPA9 10,119,67
scu-dog LDLo:2700 mg/kg	QJPPAL 7,205,34
ivn-dog LDLo:200 mg/kg	QJPPAL 7,205,34
ihl-cat LCLo:43400 mg/m3/4.5H	AHBAAM 116,131,36
orl-rab LDLo:1900 mg/kg	HBTXAC 1,94,56
scu-rbt LDLo:2700 mg/kg	QJPPAL 7,205,34
ihl-gpg LCLo:5000 ppm/2H	FLCRAP 1,197,67

Aquatic Toxicity Rating: TLm96:1000-100 ppm WQCHM* 3,-,74. Carcinogenic Determination: Indefinite IARC** 20,449,79.

TLV: Air: 100 ppm DTLVS* 4,275,80. *Toxicology Review:* FAZMAE 18,365,74; 27ZTAP 3,94,69. OSHA Standard: Air: TWA 500 ppm; CL 1000; Pk 2000/5M/2H (SCP-J) FEREAC 39,23540,74. DOT-ORM-A, Label: None FEREAC 41,57018,76. Occupational Exposure to Methylene Chloride recm std: Air: TWA 75 ppm; Pk 500 ppm/15M NTIS**. Currently tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. "NIOSH Manual of Analytical Methods" Vol 1 127, Vol 3 S329. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MUT data. A skn, eye irr. An exper ETA, ± CARC. A hmn CNS, BLD. HIGH orl, ivn; MOD ipr, orl, scu, ihl; LOW ihl, scu. See also chlorinated aliphatic hydrocarbons. Very dangerous to the eyes. Except for its property of inducing narcosis, it has very few other acute toxicity effects. Its narcotic powers are quite strong, and in view of its great volatility, care should be taken in its use. It will not form explosive mixtures with air at ordinary temp. However, it can be decomp by contact with hot surfaces and open flame, and it can then yield toxic fumes, which are irr and will thus give warning of their presence. It has been used as an anesthetic in Europe and is still used there for local anesthesia. Exper have shown that 25,000 ppm conc for 2 hr exposures were not lethal. Conc of 7,200 ppm after 8 min caused paresthesia of the extremities; after 16 min, acceleration of the pulse to 100; during the first 20 min, congestion in the head, a sense of heat and slight irr of the eyes. At a level of 2,300 ppm, there was no feeling of dizziness during 1-hr exposures, but nausea did occur after 30 min of exposure. The limit of perception by smell is set at 25-50 ppm conc. Can cause a dermatitis upon prolonged skin contact. A respirator for organic vapors and fumes should be worn to avoid excessive inhal. Used as a food additive permitted in food for human consumption.

Fire Hazard: Reacts violently with Li, NaK, potassium-*tert*-butoxide, (KOH + *n*-methyl-*n*-nitrosourea).

Explosion Hazard: None under ordinary conditions, but will form explosive mixtures in atmosphere having high oxygen content, in liquid O_2, N_2O_4, K, Na, NaK.

Disaster Hazard: Dangerous; when heated to decomp, emits highly tox fumes of phosgene.

METHANESULFONIC ACID

CAS RN: 75752 NIOSH #: PB 1140000

mf: CH_4O_3S; mw: 96.11

Solid. Sol in water, alc and ether; d: 1.4812 @ 18°/4°; mp: 20°; bp: 167° @ 10 mm. Corrosive to iron, steel, brass, copper and lead.

SYN: WSQ 1 [illegible]

THR: MOD orl. A skn irr. See also aldehydes.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

TOLUENE

CAS RN: 108883 NIOSH #: XS 5250000
mf: C_7H_8; mw: 92.15

Colorless liquid, benzol-like odor. Flammable. mp: −95° to −94.5°, bp: 110.4°, flash p: 40°F (CC), ulc: 75-80, lel = 1.27%, uel = 7%, d: 0.866 @ 20°/4°, autoign. temp.: 896°F, vap. press: 36.7 mm @ 30°, vap. d: 3.14. Insol in water; sol in acetone; misc in absolute alc, ether, chloroform.

SYNS:

METHYLBENZENE
METHYLBENZOL
NCI-C07272
PHENYLMETHANE
TOLUEEN (DUTCH)
TOLUEN (CZECH)
TOLUOL
TOLUOLO (ITALIAN)

TOXICITY DATA: 3	CODEN:
cyt-rat-scu 12 gm/kg/12D-I	GTPZAB 17(3),24,73
ihl-rat TCLo:1500 mg/m3/24H (1-8D preg)	TXCYAC 11,55,78
ihl-rat TCLo:1000 mg/m3/24H (7-14D preg)	FMORAO 28,286,80
orl-mus TDLo:9 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-mus TDLo:15 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-mus TDLo:30 gm/kg (6-15D preg)	TJADAB 19,41A,79
ihl-mus TCLo:500 mg/m3/24H (6-13D preg)	TXCYAC 11,55,78
unk-rat LD50:6900 mg/kg	GISAAA 45(12),64,80
unk-mus LD50:2000 mg/kg	GISAAA 45(12),64,80
eye-hmn 300 ppm	JIHTAB 25,282,43
skn-rbt 435 mg MLD	UCDS** 7/23/70
eye-rbt 870 ug MLD	UCDS** 7/23/70
eye-rbt 2 mg/24H SEV	28ZPAK -,23,72
cyt-rat-ihl 610 mg/m3/16W-I	GISAAA 42(1),32,77
ihl-hmn TCLo:200 ppm:CNS	JAMAAP 123,1106,43
ihl-man TCLo:100 ppm:PSY	WEHSAL 9,131,72
orl-rat LD50:5000 mg/kg	AMIHAB 19,403,59
ihl-rat LCLo:4000 ppm/4H	AIHAAP 30,470,69
ipr-rat LDLo:800 mg/kg	TXAPA9 1,156,59
ihl-mus LC50:5320 ppm/8H	JIHTAB 25,366,43
ipr-mus LD50:1120 ug/kg	AGGHAR 18,109,60
skn-rbt LD50:14 gm/kg	UCDS** 7/23/70
scu-frg LDLo:920 mg/kg	AEPPAE 130,250,28

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 4,-,74.

TLV: Air: 100 ppm DTLVS* 4,400,80. *Toxicology Review:* AEHLAU 22,373,71; CTOXAO 11(5),549,77; FNSCA6 2,67,73; MUREAV 47(2),75,78; CTOXAO 11(5),549,77; 27ZTAP 3,144,69. OSHA Standard: Air: TWA 200 ppm; CL 300; Pk 500/10M (SCP-V) FEREAC 39,23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Occupational Exposure to Toluene recm std: Air: TWA 100 ppm; CL 200 ppm/10M NTIS**. Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. Reselected by NTP Carcinogenesis Bioassay as of December 1980. "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 3 S343. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80. EPA TSCA 8E No. 02780079P-Followup Sent as of April, 1979.

THR: MUT data. A skn, eye irr. A hmn CNS, PSY. MOD ihl, ipr, scu; HIGH ipr; LOW orl, skn. Toluene is derived from coal tar, and commercial grades usually contain small amounts of benzene as an impurity. Acute poisoning, resulting from exposures to high conc of the vapors, are rare with toluene. Inhal of 200 ppm of toluene for 8 hrs may cause impairment of coordination and reaction time; with higher conc (up to 800 ppm) these effects are increased and are observed in a shorter time. In the few cases of acute toluene poisoning reported, the effect has been that of a narcotic, the workman passing through a stage of intoxication into one of coma. Recovery following removal from exposure has been the rule. An occasional report of chronic poisoning describes an anemia and leucopenia, with biopsy showing a bone marrow hypoplasia. These effects, however, are less common in people working with toluene, and they are not as severe.

Exposure to conc up to 200 ppm produces few symptoms. At 200-500 ppm, headache, nausea, eye irr, loss of appetite, a bad taste, lassitude, impairment of coordination and reaction time are reported, but are not usually accompanied by any laboratory or physical findings of significance. With higher conc, the above complaints are increased and in addition, anemia, leucopenia and enlarged liver may be found in rare cases.

A common air contaminant.

Fire Hazard: Slight, when exposed to heat, flame or oxidizers.
Explosion Hazard: Mod, when exposed to flame or reacted with (H_2SO_4 + HNO_3), N_2O_4, $AgClO_4$, BrF_3, UF_6.
Disaster Hazard: Mod dangerous; when heated it emits irr fumes; can react vigorously with oxidizing materials.
To Fight Fire: Foam, CO_2, dry chemical.
For further information see Vol. 2, No. 1 of *DPIM Report.*

p-TOLUENEBORONIC ACID, CYCLIC-2-METHYL-2-PROPYLTRIMETHYLENE ESTER

CAS RN: 2430468 NIOSH #: XS 7875000
mf: $C_{14}H_{21}BO_2$; mw: 232.16

SYNS:

DIOSSOBORONO
2-METHYL-2-PROPYL-1,3-PROPANEDIOL-p-METHYLBENZENEBORONATE
5-METHYL-5-PROPYL-2-(p-TOLYL)-1,3,2-DIOXABORINANE

TOXICITY DATA: 2	CODEN:
ipr-rat LD50:1600 mg/kg	27ZQAG -,319,72
ipr-mus LD50:3350 mg/kg	27ZQAG -,319,72

THR: MOD ipr. See also boron compounds and esters.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

TOLUENEBORONIC ACID, CYCLIC NEOPENTANETETRYL ESTER

CAS RN: 7091410 NIOSH #: XS 7950000
mf: $C_{19}H_{22}B_2O_4$; mw: 336.03

4,5,7-TRICHLOROBENZTHIADIAZOLE-2,1,3

CAS RN: 1982554 NIOSH #: DL 0175000
mf: $C_6HCl_3N_2S$; mw: 239.50

SYN: 4,5,7-TRICHLORO-2,1,3-BENZOTHIADIAZOLE

TOXICITY DATA: 2	CODEN:
orl-rat LD50:1620 mg/kg	WRPCA2 9,119,70
orl-mus LD50:1500 mg/kg	31ZOAD 1,423,68

THR: MOD orl.
Disaster Hazard: When heated to decomp it emits very tox fumes of NO_x and SO_x.

TRICHLOROBENZYL CHLORIDE

CAS RN: 1344327 NIOSH #: XT 8575000
mf: $C_7H_4Cl_4$; mw: 229.91

SYN: TCBC

TOXICITY DATA: 2	CODEN:
orl-rat LD50:3075 mg/kg	28ZEAL 4,359,69

Toxicology Review: 27ZTAP 3,146,69. Reported in EPA TSCA Inventory, 1980.
THR: MOD orl.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

3,4,4′-TRICHLOROCARBANILIDE

CAS RN: 101202 NIOSH #: FE 1250000
mf: $C_{13}H_9Cl_3N_2O$; mw: 315.59

SYN: N-(3,4-DICHLOROPHENYL)-N′-(4-CHLOROPHENYL)UREA

TOXICITY DATA: 3	CODEN:
ipr-mus LD50:2100 mg/kg	LPPTAK 27,306,79

Toxicology Review: 27ZTAP 3,146,69. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.
THR: MOD ipr.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^- and NO_x.

4,5,6-TRICHLORO-2-(2,4-DICHLOROPHENOXY) PHENOL

NIOSH #: SL 0532000
mf: $C_{12}H_5Cl_5O_2$; mw: 358.42

SYN: 2-(2,4-DICHLOROPHENOXY)-4,5,6-TRICHLOROPHENOL

TOXICITY DATA:	CODEN:
slt-mus-ipr 140 umol/L	MUREAV 46,202,77

THR: MUT data.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

1,1,2-TRICHLORO-2,2-DIFLUOROETHANE

CAS RN: 354212 NIOSH #: KI 1435000
mf: $CHCl_3F_2$; mw: 157.37

SYN: UCON FLUOROCARBON 122

TOXICITY DATA: 2	CODEN:
orl-rat LDLo:7500 mg/kg	16CZAC 20,459,66
ihl-rat LCLo:4000 ppm/4H	UCMH** 11,15,62

THR: MOD orl, ihl.
Disaster Hazard: When heated to decomp it emits very tox fumes of F^- and Cl^-.

TRICHLORODINITROBENZENE

CAS RN: 8003461 NIOSH #: CZ 7960000
mf: $C_6HCl_3N_2O_4$; mw: 271.44

SYNS:

BRASSISAN (GERMAN)
DINITROTRICHLOROBENZENE ISOMERIC MIXTURE

TOXICITY DATA: 2	CODEN:
orl-rat LD50:425 mg/kg	GUCHAZ 6,516,73
skn-rat LD50:425 mg/kg	GUCHAZ 6,516,73

THR: MOD, via oral and dermal routes. See also benzene and nitrobenzene. A pesticide.
Fire Hazard: Mod, when exposed to heat or flame. See nitrates.
Explosion Hazard: See nitrates.
Disaster Hazard: Dangerous; when heated to decomp it emits highly tox fumes of NO_x and Cl^-; can react vigorously with reducing materials.

TRICHLORO ESTERTIN

NIOSH #: WH 8240000

SYN: ESTERTRICHLOROSTANNANE

TOXICITY DATA: 1	CODEN:
unk-rat LD50:5500 mg/kg	TIUSAD 107,1,76

Occupational Exposure to Organotin Compounds recm std: Air: TWA 0.1 mg(Sn)/m3 NTIS**.
THR: LOW unk. See also tin compounds and esters.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

1,1,1-TRICHLOROETHANE

CAS RN: 71556 NIOSH #: KJ 2975000
mf: $C_2H_3Cl_3$; mw: 133.40

Colorless liquid. bp: 74.1°, fp: −32.5°, flash p: none, d: 1.3376 @ 20°/4°, vap. press: 100 mm @ 20.0°. Insol in water; sol in acetone, benzene, carbon tetrachloride, methanol, ether.

SYNS:

CHLOROETHENE
CHLOROTHANE NU
CHLOROTHENE
METHYL CHLOROFORM
METHYLTRICHLOROMETHANE
NCI-C04626
1,1,1-TRICHLOORETHAAN (DUTCH)
1,1,1-TRICHLORAETHAN (GERMAN)
TRICHLORO-1,1,1-ETHANE (FRENCH)
ALPHA-TRICHLOROETHANE
1,1,1-TRICLOROETANO (ITALIAN)

TOXICITY DATA: 2-1	CODEN:
ihl-rat TCLo:2100 ppm/24H (14D pre/1-20D preg)	TOXID9 1,28,80
eye-man 450 ppm/8H	BJIMAG 28,286,71
skn-rbt 5 gm/12D-I MLD	AIHAAP 19,353,58

skn-rbt 500 mg/24H MOD	28ZPAK -,28,72
eye-rbt 100 mg MLD	AIHAAP 19,353,58
eye-rbt 2 mg/24H SEV	28ZPAK -,28,72
ihl-man LCLo:27 gm/m3/10M	JOCMA7 8,358,66
ihl-man TCLo:350 ppm:PSY	WEHSAL 10,82,73
orl-hmn TDLo:670 mg/kg:GIT	NTIS** PB257-185
ihl-hmn TCLo:920 ppm/70M:CNS	AIHAAP 19,353,58
orl-rat LD50:10300 mg/kg	NTIS** PB257-185
ihl-rat LCLo:1000 ppm	FMCHA2 -,D317,80
ipr-rat LD50:5100 mg/kg	NTIS** PB257-185
orl-mus LD50:11240 mg/kg	NTIS** PB257-185
ihl-mus LCLo:11000 ppm/2H	HBTXAC 5,72,59
ipr-mus LD50:4700 mg/kg	TXAPA9 13,287,68
orl-dog LD50:750 mg/kg	FMCHA2 -,D317,80
ipr-dog LD50:3100 mg/kg	TXAPA9 10,119,67
ivn-dog LDLo:95 mg/kg	HBTXAC 5,72,59
orl-rbt LD50:5660 mg/kg	AIHAAP 19,353,58
scu-rbt LDLo:500 mg/kg	HBTXAC 5,72,59
orl-gpg LD50:9470 mg/kg	AIHAAP 19,353,58

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 3,-,74. Carcinogenic Determination: Indefinite IARC** 20,515,79.

TLV: Air: 350 ppm DTLVS* 4,269,80. *Toxicology Review:* FAZMAE 18,365,74; EATR** EB-TR-75047; AIHAAP 40,A46,79. OSHA Standard: Air: TWA 350 ppm (SCP-J) FEREAC 39,23540,74. DOT: ORM-A, Label: None FEREAC 41,57018,76. Occupational Exposure to 1,1,1-Trichloroethane recm std: Air: CL 350 ppm/15M NTIS**. NCI Carcinogenesis Bioassay Completed; Results Negative (NCITR* NCI-CG-TR-3,77). Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 3 S328. NIOSH Current Intelligence Bulletin 27, 1978. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: In hmn it causes PSY, GIT, CNS effects. A MOD skn irr, a SEV eye irr in rbts. LOW orl, ipr, ihl in rat, mus. MOD orl, ipr dog; Narcotic in high conc. Causes a proarrhythmic activity which sensitizes the heart to epinephrine-induced arrhythmias. This sometimes will cause a cardiac arrest particularly when this material is massively inhaled as in drug abuse for euphoria. Reacts violently with N_2O_4, O_2, O_2 liquid, Na, NaOH, Na-K alloy.

Disaster Hazard: Dangerous; see chlorides.

For further information see Vol. 2, No. 1 of *DPIM Report.*

1,1,2-TRICHLOROETHANE

CAS RN: 79005 NIOSH #: KJ 3150000

mf: $C_2H_3Cl_3$; mw: 133.40

Liquid, pleasant odor. bp: 114°, fp: −35°, d: 1.4416 @ 20°/4°, vap. press: 40 mm @ 35.2°.

SYNS:

ETHANE TRICHLORIDE
NCI-C04579
BETA-TRICHLOROETHANE
1,2,2-TRICHLOROETHANE
TROJCHLOROETAN(1,1,2) (POLISH)
VINYL TRICHLORIDE

TOXICITY DATA: 3	CODEN:
skn-rbt 500 mg open MLD	UCDS** 6/28/72
skn-rbt 810 mg/24H SEV	JETOAS 9,171,76
eye-rbt 162 mg MLD	JETOAS 9,171,76
skn-gpg 1440 mg/15M	APTOA6 41,298,77
cyt-gpg-skn 2880 ug/kg	APTOA6 41,298,77
orl-mus TDLo:76 gm/kg/78W-I:CAR	NCITR* NCI-CG-TR-74,78
orl-mus TD:152 gm/kg/78W-I:CAR	NCITR* NCI-CG-TR-74,78
orl-rat LD50:1140 mg/kg	UCDS** 6/28/72
ihl-rat LCLo:500 ppm/8H	AIHAAP 30,470,69
ipr-mus LD50:994 mg/kg	TXAPA9 9,139,66
scu-mus LD50:227 mg/kg	JPETAB 123,224,58
orl-dog LDLo:500 mg/kg	AJHYA2 16,325,32
ipr-dog LD50:450 mg/kg	TXAPA9 10,119,67
ivn-dog LDLo:95 mg/kg	QJPPAL 7,205,34
ihl-cat LCLo:13100 mg/m3/4.5H	AHBAAM 116,131,36
scu-rbt LDLo:500 mg/kg	QJPPAL 7,205,34

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 3,-,74. Carcinogenic Determination: Animal Positive IARC** 20,533,79.

TLV: Air: 10 ppm (skin) DTLVS* 4,406,80. *Toxicology Review:* FAZMAE 18,365,74; AIHAAP 40,A46,79; 27ZTAP 3,146,69. OSHA Standard: Air: TWA 10 ppm (skin) (SCP-J) FEREAC 39,23540,74. NCI Carcinogenesis Bioassay Completed; Results Positive: Mouse (NCITR* NCI-CG-TR-74,78). NCI Carcinogenesis Bioassay Completed; Results Negative: Rat (NCITR* NCI-CG-TR-74,78). "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 2 S134. NIOSH Current Intelligence Bulletin 27, 1978. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45, 13646,80.

THR: HIGH ivn, scu and MOD orl, ihl, ipr and dermal. MOD skn irr and SEV eye irr in rbts. Trichloroethane has narcotic properties and acts as a local irr to the eyes, nose and lungs. It may also be injurious to the liver and kidneys. A fumigant. An exper CARC. MUT data.

Disaster Hazard: Dangerous; see chlorides.

Incomp: K.

For further information see Vol. 2, No. 6 and Vol. 3, No. 2 of *DPIM Report.*

1,1,1-TRICHLOROETHANE mixed with TETRACHLOROETHYLENE (3:1)

NIOSH #: KJ 3950000

SYNS:

DOWCLENE
EC CLEANER

TOXICITY DATA: 2-1	CODEN:
orl-rat LD50:15 gm/kg	AIHAAP 24,541,63
ihl-rat LC50:3700 ppm/7H	AIHAAP 24,541,63
orl-mus LD50:10 gm/kg	AIHAAP 24,541,63
orl-rbt LD50:13 gm/kg	AIHAAP 24,541,63
orl-gpg LD50:6 gm/kg	AIHAAP 24,541,63

THR: LOW orl, ihl in rat; LOW orl in mus; orl in rbt and orl in gpg.

Disaster Hazard: When heated to decomp it emits very tox fumes of Cl^-.

TRICHLOROETHANOL

CAS RN: 115208 NIOSH #: KM 3850000
mf: $C_2H_3Cl_3O$; mw: 149.40

Liquid. mp: 17.8°, bp: 150° @ 765 mm, d: 1.54 @ 25°/4°, vap. press: 1 mm @ 20°, vap. d: 5.16.

SYNS:
2,2,2-TRICHLOROETHANOL
TRICHLOROETHYL ALCOHOL
2,2,2-TRICHLOROETHYL ALCOHOL

TOXICITY DATA: 3-2	CODEN:
mmo-asn 5 uL/plate/2H	CBINA8 30,9,80
orl-rat LD50:600 mg/kg	12VXA5 8,1069,68
ipr-rat LDLo:300 mg/kg	JPETAB 63,453,38
ivn-mus LD50:201 mg/kg	28ZPAK -,78,72
ivn-rbt LDLo:50 mg/kg	JPETAB 63,453,38

Reported in EPA TSCA Inventory, 1980.
THR: HIGH via ivn and ipr routes. MOD via oral route. An anesthetic. MUT data.
Disaster Hazard: Dangerous; see chlorides.

TRICHLOROETHENYLSILANE

CAS RN: 75945 NIOSH #: VV 6125000
mf: $C_2H_3Cl_3Si$; mw: 161.49

Fuming liquid. bp: 90.6°; d: 1.265 @ 25°/25°; flash p: 16°F.

SYNS:
TRICHLORO(VINYL)SILANE
TRICHLOROVINYL SILICANE
VINYLSILICON TRICHLORIDE
VINYL TRICHLOROSILANE

TOXICITY DATA: 2	CODEN:
skn-rbt 1 mg/24H	AMIHBC 10,61,54
skn-rbt 625 mg open SEV	UCDS** 1/19/72
eye-rbt 50 ug SEV	AMIHBC 10,61,54
orl-rat LD50:1280 mg/kg	AMIHBC 10,61,54
ihl-rat LCLo:500 ppm/4H	UCDS** 1/19/72
orl-mus LD50:3160 mg/kg	HYSAAV 34,334,69
ihl-mus LC50:3020 mg/m3/4H	HYSAAV 34,334,69
skn-rbt LD50:680 mg/kg	AMIHBC 10,61,54

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 4,-,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Reported in EPA TSCA Inventory, 1980.
THR: MOD orl, ihl, skn. A skn, eye irr. See also chlorosilanes.
Fire Hazard: Dangerous; reacts violently with water, moist air.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl⁻. Will react with water or steam to produce tox and corrosive fumes.

2,2,2-TRICHLORO-1-ETHOXYETHANOL

CAS RN: 515833 NIOSH #: KM 4725000
mf: $C_4H_7Cl_3O_2$; mw: 193.46

Crystals, less sol in water than chloral hydrate, sol in organic solvents. d: 1.143, mp: 47.5°, bp: 116°.

SYNS:
CHLORAL ALCOHOLATE
CHLORAL ETHYLALCOHOLATE
CHLORAL, ETHYL HEMIACETAL
TRICHLOROACETALDEHYDE MONOETHYLACETAL

TOXICITY DATA: 2	CODEN:
orl-rat LD50:880 mg/kg	JPETAB 78,340,43
orl-dog LDLo:1200 mg/kg	JPETAB 78,340,43
orl-cat LDLo:500 mg/kg	JPETAB 78,340,43
orl-rbt LDLo:1100 mg/kg	JPETAB 78,340,43

Reported in EPA TSCA Inventory, 1980.
THR: MOD via oral route.
Disaster Hazard: When heated to decomp it emits tox fumes of Cl⁻.

TRICHLOROETHYLAMINE

NIOSH #: KR 9850000
mf: $C_2H_4Cl_3N$; mw: 148.41

SYN: TCEA

TOXICITY DATA:	CODEN:
mmo-asn 1700 umol/L	SOGEBZ 6,220,70

THR: MUT data.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and NO_x.

TRICHLOROETHYL CARBAMATE

CAS RN: 107697 NIOSH #: FD 1750000
mf: $C_3H_4Cl_3NO_2$; mw: 192.43

SYN: CARBAMIC ACID 2,2,2-TRICHLOROETHYL ESTER

TOXICITY DATA: 3	CODEN:
ipr-mus TDLo:3250 mg/kg/13W-I TFX:NEO	JNCIAM 8,99,47
ipr-mus LD50:500 mg/kg	JNCIAM 8,99,47

THR: An exper NEO. MOD ipr. See also esters, carbamates.
Disaster Hazard: When heated to decomp it emits very tox fumes of Cl⁻ and NO_x.

TRICHLORO ETHYLENE

CAS RN: 79-01-6 NIOSH #: KX 4550000
mf: C_2HCl_3; mw: 131.38

Mobile liquid; characteristic odor of chloroform. d: 1.4649 @ 20°/4°; bp: 86.7°; flash p: 89.6°F; lel = 12.5%; uel = 90% @ above 30°; mp: −73°; fp: −86.8°; autoign. temp.: 788°F; vap. press: 100 mm @ 32°; vap. d: 4.53.

SYNS:
ACETYLENE TRICHLORIDE
1-CHLORO-2,2-DICHLOROETHYLENE
1,1-DICHLORO-2-CHLOROETHYLENE
DOW-TRI
ETHYLENE TRICHLORIDE
NCI-C04546
TRICHLOORETHEEN (DUTCH)
TRICHLORAETHEN (GERMAN)
TRI-CLENE
TRICLORETENE (ITALIAN)
VESTROL

SKIN AND EYE IRRITATION DATA: 3	CODEN:
eye-hmn 5 ppm	JOCMA7 2,383,60
skn-rbt 500 mg/24H SEV	28ZPAK -,28,72
eye-rbt 20 mg/24HSEV	28ZPAK -,28,72

MUTATION DATA:	CODEN:
mmo-sat 100 uL/plate	NIOSH* 5AUG77
mma-sat 5 pph/2H	ARTODN 41,249,79
mma-smc 10 mL/L	MUREAV 48,173,77

slt-mus-ipr 1 mmol/L	MUREAV 46,202,77
dns-mus-orl 2500 mg/L	NTIS** AD-A080-636
dns-mus:bmr 1 mmol/L	NTIS** AD-A080-636
hma-mus/smc 400 mg/kg	JEPTDQ 1,411,78

REPRODUCTIVE EFFECTS DATA:	CODEN:
ihl-rat TCLo:1800 ppm/24H (1-2D preg)	APTOD9 19,A22,80
ihl-rat TCLo:100 ppm/4H (6-22D preg)	JPHYA7 276,24P,78
ihl-rat TCLo:1800 ppm/6H (1-20D preg)	TXCYAC 14,153,79

TUMORGENIC DATA:	CODEN:
ihl-rat TCLo:500 ppm/6H/77W-I:ETA	ARTODN 43,237,80
orl-mus TDLo:455 g/kg/78W-I:CAR	NCITR* NCI-CG-TR-2,76
ihl-mus TCLo:100 ppm/6H/77W-I:ETA	ARTODN 43,237,80
ihl-ham TCLo:100 ppm/6H/77W-I:ETA	ARTODN 43,237,80
orl-mus TD:912 g/kg/78W-I:CAR	NCITR* NCI-CG-TR-2,76
ihl-mus TC:500 ppm/6H/77W-I:ETA	ARTODN 43,237,80

TOXICITY DATA:	CODEN:
orl-hmn LDLo:7 g/kg	ARTODN 35,295,76
ihl-hmn TCLo:6900 mg/M^3/10M:CNS	AHBAAM 116,131,36
ihl-hmn TCLo:160 ppm/83M:CNS	AIHAAP 23,167,62
ihl-hmn TDLo:812 mg/kg:SYS	BMJOAE 2,689,45
ihl-man TCLo:110 ppm/8H:IRR	BJIMAG 28,293,71
ihl-man LCLo:2900 ppm	NZMJAX 50,119,51
orl-rat LD50:4920 mg/kg	AIHAAP 30,470,69
ihl-rat LCLo:8000 ppm/4H	AIHAAP 30,470,69
orl-mus LD50:2402 mg/kg	NTIS** AD-A080-636
ihl-mus LCLo:3000 ppm/2H	AEPPAE 141,19,29
ipr-mus LD50:3000 mg/kg	JETOAS 7(4),247,74
ivn-mus LD50:34 mg/kg	CBCCT* 6,141,54
orl-dog LDLo:5860 mg/kg	12VXA5 8,1069,68
ipr-dog LD50:1900 mg/kg	TXAPA9 10,119,67
scu-dog LDLo:150 mg/kg	HBTXAC 5,76,59
ivn-dog LDLo:150 mg/kg	QJPPAL 7,205,34
orl-cat LDLo:5866 mg/kg	NBTXAC 5,76,59
ihl-cat LCLo:32500 mg/M^3/2H	AMBAAM 116,131,36
orl-rbt LDLo:7330 mg/kg	HBTXAC 5,76,59
scu-rbt LDLo:1800 mg/kg	QJPPAL 7,205,34
ihl-gpg LCLo:37200 ppm/40M	HBTXAC 5,76,59

Aquatic Toxicity Rating:TLm96:1000-100 ppm WQCHM* 3,-,74. Carcinogenic Determination: Animal Positive IARC** 20,545,79; IARC** 11,263, 76.

TLV: TWA 50 ppm; STEL 150 ppm DTLVS* 4,406, 80.

Toxicology Review: JTEHD6 2(3),671,77; CLPTAT 8, 91,67; JOCMA7 16(3),194,74; JOCMA7 17(9),603,75; FNSCA6 2,67,73; BNYMAM 54,413,78; 27ZTAP 3,146,69. OSHA Standard: Air: TWA 100 ppm; C1200; Pk 300/5M/2H (SCP-J) FEREAC 39,23540,74. DOT: ORM-A, Label: None FEREAC 41,57018,76. Occupational Exposure to Trichloroethylene recm std: Air: TWA 100 ppm; CL 150 ppm/10M NTIS**. Occupational Exposure to Waste Anesthetic Gases and Vapors recm std: Air: CL 2 ppm/1H NTIS**. NCI Carcinogenesis Bioassay Completed; Results Positive: Mouse (NCITR*NCI-CG-TR-2,76); Results Negative: Rat (NCITR(NCI-CG-TR-2,76). Currently tested by NTP for carcinogenesis by Standard Bioassay Protocol as of April 1982. NTP Carcinogenesis Bioassay Completed as of April 1982. "NIOSH Manual of Analytical Methods" VOL 1 127, Vol 3, S336. NIOSH Current Intelligence Bulletin 2, 1975. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8e NO: 05780146. Followup sent as of April, 1979.

THR: A strong skn, eye irr. MUT data. An exper TER, ETA, CARC. HIGH ivn, scu, ihl; MOD ihl, orl, ipr; LOW orl, ihl. Inhal of high conc causes narcosis and anesthesia. A form of addiction has been observed in exposed workers. Prolonged inhal of mod conc causes headache and drowsiness. Fatalities following severe, acute exposure have been attributed to ventricular fibrillation resulting in cardiac failure. There is damage to liver and other organs from chronic exposure. Cases have been reported but are of questionable validity. Determination of the metabolites trichloracetic acid and trichloroethanol in urine reflects the absorption of trichloroethylene. A food additive permitted in food for human consumption. A common air contaminant.

Fire Hazard: Low, when exposed to heat or flame. High conc of trichloroethylene vapor in high-temp air can be made to burn mildly if plied with a strong flame. Though such a condition is difficult to produce, flames or arcs should not be used in closed equipment which contains any solvent residue or vapor.

Spontaneous Heating: No.

Disaster Hazard: Dangerous. When heated to decomp it emits tox fumes of Cl^-. See chlorides.

For further information see Vol. 1, No. 2 and Vol. 3, No. 1 of *DPIM Report.*

Incomp: Can react violently with Al, Ba, N_2O_4, Li, Mg, liquid O_2, O_3, KOH, KNO_3, Na, NaOH, Ti.

alpha-TRICHLOROETHYLIDENE GLYCEROL

CAS RN: 4692493 NIOSH #: JI 3380000

mf: $C_5H_7Cl_3O_3$; mw: 221.47

SYN: ALPHA-2-(TRICHLOROMETHYL)-1,3-DIOXOLANE-4-METHANOL

TOXICITY DATA:	2	CODEN:
ipr-mus LD50:920 mg/kg		JPETAB 81,72,44
ivn-mus LD50:520 mg/kg		JPETAB 81,72,44

THR: MOD ipr, ivn.

Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

beta-TRICHLOROETHYLIDENE GLYCEROL

CAS RN: 4692493 NIOSH #: JI 3440000

mf: $C_5H_7Cl_3O_3$; mw: 221.47

SYN: BETA-2-(TRICHLOROMETHYL)-1,3-DIOXOLANE-4-METHANOL

TOXICITY DATA:	2	CODEN:
ipr-mus LD50:959 mg/kg		JPETAB 81,72,44
ivn-mus LD50:518 mg/kg		JPETAB 81,72,44

THR: MOD ipr, ivn.

Disaster Hazard: When heated to decomp it emits tox fumes of Cl^-.

VINYL CHLORIDE

CAS RN: 75014 NIOSH #: KU 9625000
mf: C_2H_3Cl; mw: 62.50

Colorless liquid or gas (when inhibited), faintly sweet odor. mp: −160°; bp: −13.9°, lel = 4%, uel = 22%; flash p: 17.6°F (COC), fp: −159.7°, d(liquid): 0.9195 @ 15°/4°, vap. press: 2600 mm @ 25°, vap d: 2.15, autoign. temp.: 882°F. Slightly sol in water; sol in alc; very sol in ether.

SYNS:

CHLOROETHENE
CHLOROETHYLENE
CHLORURE DE VINYLE (FRENCH)
CLORURO DI VINILE (ITALIAN)
ETHYLENE MONOCHLORIDE
MONOCHLOROETHENE
MONOCHLOROETHYLENE (DOT)
VINYLCHLORID (GERMAN)
VINYL CHLORIDE (DOT)
VINYL CHLORIDE MONOMER
VINYL C MONOMER
WINYLU CHLOREK (POLISH)

TOXICITY DATA: 3	CODEN:
mma-smc 25000 ppm	MUREAV 91,381,81
otr-rat-ihl 2000 ppm/14W-I	ARTODN 47,71,81
hma-rat/smc 1 pph/24H-C	MUREAV 91,381,81
ihl-man TCLo:30 mg/m3 (5Y male)	GTPZAB 24(5),28,80
ihl-rat TCLo:500 ppm/7H (6-15D preg)	TXAPA9 33,134,75
ihl-rat TCLo:1500 ppm/24H (1-9D preg)	TXCYAC 11,45,78
ihl-rat TCLo:6000 ppm/4H (12-18D preg):ETA	ANYAA9 271,431,76
ihl-man TCLo:500 ppm/4Y-I:CAR	JOCMA7 16,809,74
orl-rat TDLo:10 gm/kg/52W-I:CAR	APDCDT 3,216,76
ihl-rat TCLo:50 ppm/52W-I:CAR	ANYAA9 271,431,76
ihl-rat TCLo:6000 ppm/4H/(12-18D preg):CARC	ANYAA9 271,431,76
ipr-rat TDLo:21 mg/kg/65W-I:ETA	APDCDT 3,216,76
scu-rat TDLo:21 mg/kg/67W-I:ETA	APDCDT 3,216,76
ihl-mus TCLo:50 ppm/30W-I:CAR	ANYAA9 271,431,76
ihl-ham TCLo:50 ppm/4H/30W-I:CAR	APDCDT 3,216,76
ihl-mus TC:2500 ppm/26W-I:NEO	ENVRAL 16,285,78
ihl-rat TC:250 ppm/52W-I:CAR	JTEHD6 4,15,78
ihl-mus TC:50 ppm/47W-I:CAR	JTEHD6 4,15,78
orl-rat TD:34 gm/kg/3Y-I:CAR	EVHPAZ 21,1,77
ihl-mus TC:2500 ppm/26W-I:NEO	ENVRAL 16,285,78
ihl-mus TC:2500 ppm/35W-I:CAR	ENVRAL 7,387,74
ihl-rat TC:250 ppm/2Y-I:CAR	AANLAW 56,1,74
ihl-ham TC:500 ppm/48W-I:NEO	MELAAD 65,421,74
ihl-rat TC:250 ppm/80W-I:CAR	MELAAD 65,421,74
ihl-rat TC:50 ppm/37W-I:CAR	MELAAD 65,421,74
orl-rat LD50:500 mg/kg	DOWCC*
ihl-gpg LCLo:20 ppm/30M	85DVA7 -,1160,38

Aquatic Toxicity Rating: TLm96:over 1000 ppm WQCHM* 3,-,74.

Carcinogenic Determination: Human Positive IARC** 19,377,79.

TLV: Air: 5 ppm DTLVS* 4,427,80. *Toxicology Review:* FAZMAE 18,365,74; JTEHD6 1(1),47,75; CMTVAS 10(3),49,73; CHWEAP 70,5,74; CANCAR 39,1792,77; MUREAV 32(2),93,76; ZHPMAT 166,113,78; BNYMAM 54,413,78; ABMHAM 35,585,77; CBINA8 22,117,78. OSHA Standard: Air: TWA 1 ppm; CL 5 ppm/15M FEREAC 40,27073,75. DOT: Flammable Gas, Label: Flammable Gas FEREAC 41,57018,76. Occupational Exposure to Vinyl Halides recm std: Air: TWA 1 ppm; CL 5 ppm/15M NTIS**. "NIOSH Manual of Analytical Methods" VOL 1 178. NIOSH Current Intelligence Bulletin 28, 1978. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8E No. 03780104—Followup Reply Received as of April, 1979.

THR: HIGH irr via inhal route and to skn, eyes and mu mem. In high conc, it acts as an anesthetic. Causes skn burns by rapid evaporation and consequent freezing. Chronic exposure has shown liver injury in rats and rbts. Circulatory and bone changes in the fingertips reported in workers handling unpolymerized materials. A hmn brain CARC and an exper brain CARC, NEO, ETA via inhal route. May cause local irr.

Fire Hazard: Dangerous, when exposed to heat, flame or oxidizers. Large fires of this material are practically inextinguishable.

Spontaneous Heating: No.

Explosion Hazard: Severe, in the form of vapor, when exposed to heat or flame. Also, on standing, forms peroxides in air and can then explode.

Disaster Hazard: Very dangerous; when heated to decomp it emits highly tox fumes of phosgene; can react vigorously with oxidizing materials. Before storing or handling this material, instructions for its use should be obtained from the supplier.

To Fight Fire: Stop flow of gas.

For further information see Vol. 1, No. 3 of *DPIM Report.*

VINYL CROTONATE

CAS RN: 14861064 NIOSH #: GQ 5850000
mf: $C_6H_8O_2$; mw: 112.14

Slightly sol in water. d: 0.9, vap. d: 4.0, bp: 134°, flash p: 78°F (OC).

SYNS:

CROTONIC ACID, VINYL ESTER
2-BUTENOIC ACID, ETHENYL ESTER

TOXICITY DATA: 1	CODEN:
skn-rbt 500 mg open MLD	UCDS** 11/15/71
eye-rbt 500 mg	AMIHBC 10,61,54
orl-rat LD50:6500 mg/kg	UCDS** 11/15/71

THR: Skn, eye irr in rbt. See also ester. LOW via oral route. Probably very irr.

Fire Hazard: Dangerous, when exposed to heat, flame or oxidizers.

To Fight Fire: Alcohol foam.

VINYLCYCLOHEXANE MONOXIDE

CAS RN: 106865 NIOSH #: RN 8770000
mf: $C_8H_{12}O$; mw: 124.20

Liquid, very slightly sol in water. d: 0.9598 @ 20°/20°, bp: 169°, flash p: 136°F, fp: −100°.

SYNS:

1,2-EPOXY-4-VINYLCYCLOHEXANE
4-VINYLCYCLOHEXANE, 1,2-EPOXIDE
4-VINYLCYCLOHEXENE-1,2-EPOXIDE
VINYLCYCLOHEXENE MONOXIDE
4-VINYLCYCLOHEXENE MONOXIDE
1-VINYL-3,4-EPOXYCYCLOHEXANE
3-VINYL-7-OXABICYCLO(4.1.0)HEPTANE

SYNS:

DL-4-BENZAMIDO-N,N-DIPROPYLGLUTARAMIC ACID
(±)-4- (BENZOYLAMINO)-5-(DIPROPYLAMINO)-5-OXOPENTANOIC ACID
N-BENZOYL-N',N'-DI-N-PROPYL-DL-ISOGLUTAMINE

TOXICITY DATA: 2-1	CODEN:
orl-mus LD50:7350 mg/kg	12VXA5 9,1007,76
ivn-mus LD50:2211 mg/kg	12VXA5 9,1007,76

THR: MOD ivn; LOW orl.
Disaster Hazard: When heated to decomp it emits tox fumes of NO_x.

XYLENE

CAS RN: 1330207 NIOSH #: ZE 2100000
mf: C_8H_{10}; mw: 106.18

SYNS:

DIMETHYLBENZENE
KSYLEN (POLISH)
XILOLI (ITALIAN)
XYLENEN (DUTCH)
XYLOL
XYLOLE (GERMAN)

TOXICITY DATA: 3-2-1	CODEN:
ihl-rat TCLo:1000 mg/m3/24H (9-14D preg)	TXCYAC 11,55,78
eye-hmn 200 ppm	JIHTAB 25,282,43
skn-rbt 100% MOD	AMIHAB 14,387,56
skn-rbt 500 mg/24H MOD	28ZPAK -,24,72
eye-rbt 87 mg MLD	AMIHAB 14,387,56
eye-rbt 5 mg/24H SEV	28ZPAK -,24,72
ihl-hmn TCLo:200 ppm:IRR	JIHTAB 25,282,43
ihl-man LCLo:10000 ppm/6H	BMJOAE 3,442,70
orl-rat LD50:4300 mg/kg	AMIHAB 14,387,56
ihl-rat LC50:5000 ppm/4H	NPIRI* 1,123,74
scu-rat LD50:1700 mg/kg	NPIRI* 1,123,74
ipr-mus LD50:1570 ug/kg	AGGHAR 18,109,60
ipr-gpg LDLo:2000 mg/kg	AIHAAP 35,21,74
ipr-mam LDLo:2000 mg/kg	AJHYA2 7,276,27

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 2,-,74.
Toxicology Review: 27ZTAP 3,153,69. OSHA Standard: Air: TWA 100 ppm (SCP-U) FEREAC 39,23540,74. Occupational Exposure to Xylene recm std: Air: TWA 100 ppm; CL 200 ppm/10M NTIS**. "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 3 S318. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.
THR: A hmn eye irr; A skn eye irr. A hmn IRR and MOD ipr, scu, ihl; LOW orl.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

XYLENE

CAS RN: 1330207 NIOSH #: ZE 2190000

A clear liquid. bp: 138.5°, flash p: 100°F (TOC), d: 0.864 @ 20°/4°, vap. press: 6.72 mm @ 21°. Composition as nonaromatics .07%, toluene 14%, ethyl benzene 19.27%, p-xylene 7.84%, m-xylene 65.01%, o-xylene 7.63%, C9 and aromatics .04% (TXAPA9 33,543,75)

SYNS:

AROMATIC HYDROCARBONS, MIXED
NCI-C55232

TOXICITY DATA: 2	CODEN:
ihl-rat LC50:6700 ppm/4H	TXAPA9 33,543,75

Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8E No. 12770025—Status Report Prepared as of April, 1979.
THR: MOD via inhal and oral routes. Some temporary corneal effects are noted, as well as some conjunctival irr by instillation. Irr can start @ 200 ppm. Very little dermal toxicity.
Fire Hazard: Mod, in the presence of heat or flame; can react with oxidizing materials.
To Fight Fire: Foam, CO_2, dry chemical.
Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

m-XYLENE

CAS RN: 108383 NIOSH #: ZE 2275000
mf: C_8H_{10}; mw: 106.18

Colorless liquid; mp: −47.9°; bp: 139°; lel = 1.1%; uel = 7.0%; flash p: 77°F; d: 0.864 @ 20°/4°; vap press: 10 mm @ 28.3°; vap d: 3.66; autoign temp: 986°F. Insol in water; misc with alc, ether and some organic solvents.

SYNS:

M-DIMETHYLBENZENE
1,3-XYLENE
1,3-DIMETHYLBENZENE
M-XYLOL

TOXICITY DATA: 3-2	CODEN:
ihl-rat TCLo:3000 mg/m3/24H (7-14D preg)	TXCYAC 18,61,80
orl-mus TDLo:12 mg/kg (12-15D preg)	APTOD9 19,A22,80
orl-mus TDLo:30 mg/kg (6-15D preg)	APTOD9 19,A22,80
ihl-man TCLo:424 mg/m3/6H/6D	TOLED5 1000(Sp. Iss. I),74,8
skn-rbt 10 ug/24H open SEV	AIHAAP 23,95,62
orl-rat LD50:5000 mg/kg	AMIHAB 19,403,59
ihl-rat LCLo:8000 ppm/4H	AIHAAP 23,95,62
ihl-mus LCLo:2010 ppm/24H	JPBAA7 46,95,38

TLV: Air: 100 ppm DTLVS* 4,439,80. *Toxicology Review:* MUREAV 47(2),75,78. Occupational Exposure to Xylene recm std: Air: TWA 100 ppm; CL 200 ppm/10M NTIS**. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.
THR: HIGH-MOD orl, ihl. A common air contaminant. Eye irr @ 200 ppm.
Fire Hazard: Dangerous, when exposed to heat or flame, can react with oxidizing materials.
Explosion Hazard: MOD, in the form of vapor when exposed to heat or flame.
Disaster Hazard: Dangerous; keep away from open flame. When heated to decomp it emits acrid smoke.
To Fight Fire: Foam, CO_2, dry chemical.
For further information see Vol. 1, No. 7 of *DPIM Report*.