REMEDIAL ACTION COMPLETION REPORT – APPENDIX E
OPERATIONS MAINTENANCE AND MONITORING PLAN

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LIST OF ABBREVIATIONS

bgs	below ground surface
BSA	Buffalo Sewer Authority
ESA	Environmental Site Assessment
ESDS	Explanation of Significant Differences
FOIL	Freedom of Information Law
Gernatt	Gernatt Asphalt Products, Inc.
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response Standard
HVE	High Vacuum Extraction
LDR	Land Disposal Requirement
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
O&M	Operations and Maintenance
OM&M	Operations, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PM	Project Manager
RA	Remedial Action
RACR	Remedial Action Completion Report
RAP	Remedial Action Plan
Sovereign	Sovereign Specialty Chemicals
SVOC	Semi-volatile Organic Compound
TAGM	Technical Administrative Guidance Manual
TCL	Target Compound List

TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
URS	URS Corporation
VOC	Volatile Organic Compound

SIGNATURES OF URS ENVIRONMENTAL PROFESSIONALS INVOLVED IN THE PREPARATION OF THIS REPORT

REPORT TITLE: Operations, Maintenance and Monitoring Plan
Sovereign Specialty Chemicals, Inc.
710 Ohio Street
Buffalo, NY 14203

Patricia M. Bryan, P.G.
Project Manager

License Professional Engineer Affirmation

Based on the observations of URS personnel under my supervision, the Remedial Work Plan for the Sovereign Specialty Chemical site at 710 Ohio Street in the city of Buffalo, NY, was implemented and the construction activities were completed in accordance with the NYSDEC approved RWP. I am a duly licensed engineer in New York State.

Engineer Name: JAMES A. LANZO Professional Engineer's Stamp:

Company: URS CORPORATION

Registration Number: 065478

Signature: License Expiration Date: 3-31-09

1.0 INTRODUCTION

The purpose of this Operations, Maintenance and Monitoring (OM&M) Plan is to provide for the ongoing regular monitoring and maintenance of the remediation system installed at the site. The plan includes:

- Provisions for the proper operation and maintenance of the installed system;
- A plan to obtain the appropriate data to track the progress of the remediation;
- Remediation goals/closure concentrations for contaminants of concern.

Conducting the most effective monitoring and maintenance of the system requires accurate tracking of the operation of the treatment system and a good understanding of the pre-remediation conditions, and the changes to subsurface biological and geochemical conditions that have resulted from the remedial actions (RAs) taken.

Soil remediation in Areas B and C included soil excavation and offsite disposal. A groundwater collection system, consisting of horizontal piping laid down on a gravel base at the bottom of each excavation (B and C) was installed to prevent recontamination of clean fill by potentially impacted perched groundwater and to maintain groundwater levels. Areas B and C were then backfilled with clean local blue clay. High vacuum extraction (HVE) points were installed on the west wall of Area C and in Area A. The HVE system was designed to remove residual volatile organic compounds (VOCs) from the soils. The design called for groundwater, if encountered, to be pumped from the extraction points into a holding tank where it would be combined with water from the groundwater collection system in Areas B and C. Water would then be discharged to the sanitary sewer.

In 2005, a Buffalo Sewer Authority (BSA) Discharge permit was obtained whereby all waters were directly discharged to the sewer without treatment.

This document presents a program to monitor the soil cleanup pursuant to the Remedial Action Plan (RAP) dated May 2002. To perform this monitoring and to provide for effective cleanup involves an evaluation of:

- pre-remediation conditions
- the impact of the remediation system
- the limitations of the remediation effort
- actions that can be taken to promote the remediation of residual VOCs in soil and groundwater.

Pre-remediation soil and groundwater data was used to determine the extent of impacted media and to define the extent of excavation and the location of the HVE system. This delineation was based on regulatory goals set forth in the RAP, and subsequently modified in June 2003 using total organic carbon (TOC) adjusted cleanup objectives pursuant to New York State Department of Environmental Conservation (NYSDEC) Technical Administrative Guidance Manual (TAGM) 4046.

1.1 Project Description

The project site is located at 710 Ohio Street, Buffalo, NY 14203. The site location is depicted on **Figure 1-1**. A site map is attached as **Figure 1-2.** The site underwent RA activities beginning in May 2003. The RA was divided into underground and aboveground activities. Underground activities began on May 1, 2003 with site mobilization and continued until August 1, 2003. Underground activities included excavation of contaminated soils from Areas B and C. A HVE system was installed along of the west wall of Excavation C, where contaminated soils remained due to the proximity of an aboveground tank farm. An HVE system was also installed as a stand-alone treatment for the impacts in Area A which was not excavated due to the proximity to a nitrogen tank and piping system. Based on the pilot test of the HVE system conducted in Area A, HVE wells were installed where necessary. Groundwater collection systems were installed in Excavation B and C prior to backfilling with clean material as a measure to prevent recontamination of clean fill by potentially impacted perched groundwater and to maintain groundwater levels.

Aboveground activities began at the completion of the underground activities and continued until November 2004, during which time the HVE treatment system was completed and equipment was housed in a temporary shelter, electrical power was connected to the treatment building and system, and the discharge from the groundwater collection and HVE treatment systems was connected to the local sanitary sewer.

1.2 Purpose of OM&M Plan

The purpose of this OM&M Plan is to provide for the ongoing regular monitoring and maintenance of the remediation system installed at the site. The plan includes:

- provisions for the proper operation and maintenance of the installed system;
- a plan to obtain the appropriate data to track the progress of the remediation; and
- remediation goals/closure concentrations for contaminants of concern.

Conducting the most effective monitoring and maintenance of the system requires accurate tracking of the operation of the treatment system and a good understanding of the pre-

remediation conditions, and the changes to subsurface biological and geochemical conditions that have resulted from the RAs taken.

1.3 Special Site-Specific Safety Warnings (do's and don'ts)

All staff conducting work outlined in this OM&M Plan will participate in Sovereign Site Safety training prior to conducting the work. Staff should contact the URS Corporation (URS) Project Manager (PM) for details. All OM&M work will be completed in accordance with the URS site-specific Health and Safety Plan (HASP) (URS, 2006a). The URS HASP can be found in **Appendix A** of this report.

1.4 Records Management

Records will be maintained on behalf of Sovereign Specialty Chemicals, Inc. (Sovereign) by URS, 100 South Wacker Drive, Suite 500, Chicago, IL 60606.

1.4.1 OM&M Needs Summary

The OM&M for this project will consist of weekly and monthly site visits to monitor and maintain the HVE system and associated groundwater collection system.

Annual sampling will be conducted to monitor the remediation effectiveness and to determine when closure of the HVE system and associated groundwater collection system is warranted. Annual sampling will consist of soil sampling along the west and southwest wall of Area C. Groundwater monitoring will be conducted up to quarterly from the nearby monitoring wells.

1.4.2 OM&M Needs Summary List of Official Records and References

1. IT Corporation. 1996a. *Phase I Environmental Site Assessment, Pierce and Stevens Corporation, Buffalo, New York.* Chicago, Illinois.
2. IT Corporation. 1996b. *Phase II Environmental Site Assessment, Pierce and Stevens Corporation, Buffalo, New York*. June. Chicago, Illinois.
3. IT Corporation. 1997. *Site Investigation Report for the Tank Farm Footprint, 710 Ohio Street, City of Buffalo, County of Erie, New York.* Chicago, Illinois.
4. IT Corporation. 1999a. *Groundwater Investigation Work Plan, Pierce and Stevens Facility, Buffalo, New York*. January. Chicago, Illinois.
5. IT Corporation. 1999b. *Removal Action Work Plan for the Tank Farm Footprint, 710 Ohio Street, City of Buffalo, County of Erie, New York*. Chicago, Illinois.

6. IT Corporation. 1999c. *Revised Removal Action Work Plan for the Tank Farm Footprint, 710 Ohio Street, City of Buffalo, County of Erie, New York.* June. Chicago, Illinois.

7. IT Corporation. 1999d. *Groundwater Investigation Report, Pierce and Stevens Facility, Buffalo, New York.* October. Chicago, Illinois.

8. IT Corporation. 2000a. *Groundwater Investigation Report, Pierce and Stevens Facility, Buffalo, New York.* March. Chicago, Illinois.

9. IT Corporation. 2000b. *Site Investigation Work Plan, Pierce and Stevens Facility, Buffalo, New York.* May. Chicago, Illinois.

10. IT Corporation. 2000c. *Draft Removal Action Plan Implementation Report, Pierce and Stevens Facility, Buffalo, New York.* April. Chicago, Illinois.

11. IT Corporation. 2001a. *Site Investigation Report, Pierce and Stevens Facility, Buffalo, New York.* January. Chicago, Illinois.

12. IT Corporation. 2001b. *Supplemental Site Investigation Work Plan, Pierce and Stevens Facility, Buffalo, New York.* March. Chicago, Illinois.

13. IT Corporation. 2001c. *Supplemental Site Investigation Report, Pierce and Stevens Facility, Buffalo, New York*. June. Chicago, Illinois.

14. IT Corporation. 2002. *Remedial Action Plan Areas of Contamination "A", "B", and "C", 710 Ohio Street, Buffalo, New York.* January. Chicago, Illinois.

15. URS Corporation. 2002a. *Sovereign Packaging Group (Formerly Pierce & Stevens), Remedial Action Plan, 710 Ohio Street, Buffalo, New York.* May. Chicago, Illinois.

16. URS Corporation. 2002b. *Sovereign Packaging Group (Formerly Pierce & Stevens), Off-site Sampling Results, 710 Ohio Street, Buffalo, New York.* September. Chicago, Illinois.

17. URS Corporation. 2006a. *Health and Safety Plan, Sovereign Specialty Chemicals, Buffalo, New York*. June. Chicago, Illinois.

18. URS Corporation. 2006b. *Remedial Action Completion Report, Areas of Contamination "A", "B", and "C".* October. Chicago, Illinois

2.0 SITE DESCRIPTION

2.1 History

The history of environmental investigations conducted on the Site is presented in detail in the RAP (URS, 2002a). As discussed in the RAP, environmental investigations have been ongoing at the Site since 1996. Preliminary investigations included Phase I and Phase II Environmental Site Assessments (ESAs) completed in 1996 for the Pierce and Stevens facility (IT, 1996a; IT, 1996b). The ESAs found soil and groundwater impacts from VOCs and semi-volatile organic compounds (SVOCs). The ESA provided the background for the investigations and RAs to follow.

Early investigations focused on the soils of the tank-farm footprint. A site investigation of the tank farm footprint was completed in 1997 (IT, 1997) to further assess the impacts discovered during the ESA. A Removal Action Work Plan (IT, 1999b) was provided to NYSDEC in May 1999 to act as a guidebook for conducting the soil removal action associated with the construction of the new tank farm at the facility. A revision of the work plan (IT, 1999c) was provided to NYSDEC in June 1999. The tank farm footprint soil removal action was completed in the summer of 1999 as summarized in the April 2000 submittal of the draft Removal Action Implementation Report (IT, 2000c).

A groundwater investigation was conducted across the site in 1999 and 2000. A work plan outlining the procedures and sampling requirements for the installation of groundwater monitoring wells at the Site was submitted to NYSDEC in January 1999 (IT, 1999a). The draft groundwater investigation report was submitted to NYSDEC in October 1999 (IT, 1999d). The groundwater investigation observed a low hydraulic gradient at the site. The investigation indicated the presence of impacts on the site; however, impacts were likely to remain on-site due to the hydraulic conductivity. A final version of the investigation report was submitted to NSYDEC in March 2000 (IT, 2000a).

In March 2000 a Site Investigation Work Plan (IT, 2000b) was submitted to NYSDEC. The work plan laid out the strategy for defining the nature and extent of contamination for the portion of the site not included in the Tank Farm Footprint. The site investigation report (IT, 2001a), submitted in January 2001 revealed the presence of three VOC "hot spots." These "hot spots" were identified for future RA and are the subject of this report. As requested by NYSDEC a supplemental site investigation was completed. The scope of work for the supplemental investigation was outlined in the May 2001 work plan (IT, 2001b). The results of the supplemental site investigation (IT, 2001c) were reviewed during the preparation of

the RAP. The RAP was submitted by IT in January 2002 (IT, 2002). Final revisions were completed by URS in May 2002 (URS, 2002a).

An off-site investigation was completed in June 2002 in accordance with the RAP to evaluate abutting properties adjacent to areas of elevated organic contamination at the Site. The two areas of investigation include the CSX railroad property along the east boundary of the Site and the Rigidized Metals property bordering the Site to the northwest. Results of the offsite investigation were presented to NYSDEC in the September 2002 report "Sovereign Packaging Group (Formerly Pierce & Stevens) Off-site Sampling Results" (URS, 2002b).

The CSX railroad property showed exceedances of cleanup objectives for methylene chloride in soil samples and 1,1,1-trichloroethane, 1,1-dichloroethane, and chloroethane in groundwater samples. Rigidized Metals property showed exceedances of cleanup objectives for methylene chloride and acetone in soil samples and benzene, ethylbenzene, toluene, and total xylenes in groundwater samples. A summary of results from this investigation is presented in **Figure 2-1**.

2.2 Hydrogeology (including well logs)

2.2.1 Regional Hydrogeological Setting

The Sovereign property is located approximately 2,400 ft east of Lake Erie and the Buffalo River is approximately 1,000 ft to the north and east of the site. A shipping channel is approximately 600 ft west of the property. Lake Erie is the ultimate discharge zone for local groundwater found in the unconsolidated overburden deposits. Locally, shallow groundwater is typically found in coarser grained glacially derived sediments or as perched water over deposits of fine grained sediments of lower permeability. Perched groundwater was encountered in the fill material placed over the finer grained native soils at the site. Contributions of groundwater from bedrock units underlying the site were not considered as bedrock wells were not installed during the assessment.

Groundwater yield in glacial deposits varies widely depending upon the nature of the material; significant yields are possible in well-sorted sand and gravel deposits, while glacial till and/or lacustrine clay yields are low.

Bedrock underlying the site is mapped as Devonian age Onondaga Limestone, a massive limestone with cherty interbeds, which is frequently fossiliferous. No attempt was made to confirm the depth to or type of bedrock underlying the site. The five groundwater monitoring wells installed during this investigation were completed in the overburden, primarily in the fill material.

Groundwater in the Onondaga limestone occurs primarily in joint sets paralleling original bedding planes and solutionally enlarged fractures. Yield from the Onondaga aquifer is commonly average in the vicinity of 30 gallons per minute. Recharge to the Onondaga aquifer is from precipitation infiltration in areas where the unit outcrops and recharges from overlying glacial deposits. Regional horizontal groundwater flow is from areas of high elevation toward Lake Erie.

2.2.2 Site-Specific Hydrogeology

In the immediate facility area approximately seven to eight ft of varied fill material has been placed over native soils as seen in the five soil borings that were installed in 1999 and converted to monitoring wells. Soil borings logs for these borings/monitoring wells are presented in **Appendix B**. It was reported that the site and surrounding area was previously used as a landfill for burned municipal waste and the composition of the material seems to confirm this interpretation. Underlying native soil is composed of moist, firm to stiff silty clay and clayey silt which increases in moisture content and becomes softer and sandier with depth.

Fill material mantles the facility and ranges in thickness from approximately six ft (as seen in MW-1) to approximately eight ft. This material consists of a mixture of sand, gravel, silt, ash, brick fragments, bottles, slag, wood, coal and ceramic chips. Native soils encountered below the fill consists of a heterogeneous mixtures of silty-clay to clayey silt with little to some silty fine sand and plastic clay. No attempt was made to confirm the depth to or type of bedrock underlying the site. The typical geologic profile across the site consists of four ft to eight ft of fill overlying dark gray to olive brown silty clay. Water was typically encountered at the clay/fill interface. The heterogeneous nature of the fill material and the range of depth to clay and depth to groundwater data suggest that groundwater beneath the site may consist of multiple perched zones with little communication between the zones.

On May 26, 1999 depth to groundwater ranged between 4.30 ft and 8.94 ft below top of casing in MW-1 through MW-5, which are located at the northern boundary of the property, and was found in the unconsolidated fill materials. Similar depth to groundwater readings were noted in subsequent years with generally higher depth to groundwater levels recorded for the very wet years from 2003 to 2005. Recharge of the water table is provided by meteoric precipitation infiltrating the unpaved areas of the property.

Data from 1999 indicated a groundwater divide directed groundwater flow towards the west and east property boundaries. Flow direction was generally to the west from MW-2 towards MW-3 and trended to the east-northeast as measured in wells MW-1, MW-4 and MW-5. The groundwater gradient is relatively flat. This variance in flow directions probably reflects the

influence of the surrounding Buffalo River and nearby shipping canal as discharge zones for perched groundwater moving through the unconsolidated fill materials.

The 2006 groundwater flow map indicates groundwater flows to the west across the site **(Figure 2-2)**.

Slug tests were conducted to measure the horizontal hydraulic conductivity (K_h) at five monitoring wells (MW-1, MW-2, MW-3, MW-4, and MW-5) and their values range from 0.75 ft/day to 13.2 ft/day. Their arithmetic average is 7.79 ft/day. The hydraulic gradient is 0.006 ft/ft and using an assumed effective porosity (φ_e) 0.25 value, the ground water velocity (U) is 0.19 ft/day. The main ground water flow is directed towards the Buffalo Outer Harbor. Excluding dispersion affects, it would take approximately fourteen years for a water particle to reach the 1,000 ft distance from the hot spot area to the Buffalo Outer Harbor. For contaminant transport migration, this estimate does not include dispersion effects, which will be discussed later.

Groundwater monitoring to date does not indicate contamination in the most downgradient well on the site (MW-3) which is approximately 450 ft from the hot spot area.

3.0 SITE REMEDIAL ACTION

3.1 Description of Remedial Action

The project was performed in two phases: underground installation and aboveground installation. The underground portion of the RA began on May 1, 2003 with mobilization to the site and continued until August 1, 2003, during which time contaminated soils were excavated and disposed of properly, clean backfill was put in place, a groundwater collection system was installed, and HVE wells were installed where necessary. **Figure 3-1** provides an overview of the underground RA discussed in this section.

Soil excavation began on May 8, 2003 and was completed July 31, 2003. As established in the RAP, three different areas (Area A, B, and C) were to be excavated; however, due to the proximity of Area A to a nitrogen tank and piping system it was not excavated as a safety precaution. Sovereign and NYSDEC approved this course of action. Excavations were limited to Areas B and C as seen in **Figure 3-2**.

Soil was excavated, loaded and disposed of as a non-hazardous waste in accordance with NYSDEC TAGM 3028 ("Contained-In" Criteria for Environmental Media). As established in this TAGM, media may be disposed of as a non-hazardous material if the following requirements are met:

- Concentrations of all constituents in the soil are below the Action Levels for soil/sediment (TAGM 3028 – Appendix I);
- Toxicity Characteristic Leaching Procedure (TCLP) analysis shows potential leachate concentrations of all constituents are below the Action Levels for groundwater (TAGM 3028 – Appendix I).

The soil met all requirements for the non-hazardous classification. Soil was excavated and directly loaded into tractor-trailer trucks and transported to Modern Landfill, in Niagara Falls, New York, a licensed sub-title D landfill, in accordance with all Land Disposal Requirements (LDR) (6 New York Codes, Rules, and Regulations (NYCRR) Part 376). A total of 3760.48 tons of material were removed from Areas B and C.

Figure 3-3 and **Figure 3-4** provide a profile of the backfilled excavations. As the figures show, the bottoms of the excavations were lined with a geotextile liner. The groundwater collection system was placed in crushed #2 gravel on top of the geotextile liner. A geotextile liner was used to cover the groundwater collection system. The excavation was then backfilled with blue clay fill, brown clay fill, and select granular clay. The original

specification called for the use of blue clay to backfill the excavation; however, the blue clay fill was deemed too wet and brown clay was substituted. Density tests were completed in the field by CME. **Table 3-1** provides an overview of backfill quantities. Excavations were backfilled to 95% compaction. Crushed run stone was placed on the surface of the excavation to bring it to grade. Approximately 5,200 tons of material was used in the excavations. Gernatt Asphalt Products, Inc. (Gernatt) provided the blue clay fill, select granular clay, crushed #2 gravel, and <1" crushed run stone backfill materials. Brown clay fill was provided by Modern Disposal Services, Inc.

A groundwater collection system was installed in the Area B and C excavations to prevent re-contamination of clean fill by potentially impacted perched groundwater. Original plans also called for the installation of the system in Area A; however, Area A was not excavated, therefore, the groundwater collection system was not installed. The groundwater collection system was installed in the excavations for Area B and C in accordance with the Water Collection Plan/ High Vacuum Extraction System presented in the RAP. A layout of the system is presented in **Figure 3-1**. **Figure 3-3** shows details of the groundwater collection system installation including a profile of the excavation.

The HVE system was designed and installed as a stand-alone treatment in Area A and along the west wall of the Area C excavation to mitigate the remaining VOC impacts. Original plans called for the installation of the system surrounding all excavations; however, the excavation of impacted soil from Area B and Area C was successful and the installation of the HVE system in Area B and C (except the west wall) was unnecessary.

A pilot test of the HVE system in Area A was conducted the week of July 21, 2003 in accordance with the RAP. Air samples were collected for the pilot test and sent to Microseeps of Pittsburgh, Pennsylvania for analysis. The final layout of the HVE system can be found on **Figure 3-1**. **Figure 3-4** shows details of the HVE system installation including a profile of the excavation. The system was installed the week of July 28, 2003.

Aboveground remediation activities began August 2, 2003 and continued until November 2004, during which time the HVE treatment system was completed. An overview of the aboveground remediation activities is presented in **Figure 3-5**.

H2K was contracted to design and fabricate the HVE system, including the temporary shelter to house the equipment. Due to the high groundwater table, the system was designed to treat liquid and vapor phases for VOC impacts. The design provided for discharge of treated groundwater to the local sanitary sewer along with groundwater from the groundwater

collection system. All discharges to the local sanitary sewer are in accordance with the BSA temporary discharge permit.

In order to complete the installation of the remediation system it was necessary to connect the treatment effluent to the local sanitary sewer and to connect power to the treatment building.

Sewer trenching was completed to allow for discharge of groundwater from the groundwater collection system and HVE system to the local sanitary sewer. The discharge line was previously started and stubbed as part of the underground RA. Approximately 160 ft of pipe was trenched by Marcor to connect the stubbed discharge line to the existing sanitary sewer in November 2003. Upon connection of the discharge line to the sanitary sewer Marcor noted the existing sanitary sewer line was eighty to ninety percent blocked with sediment.

National Vacuum was contracted to clean the plugged sewer line. National Vacuum's attempts to flush the plugged sewer line with a low pressure, high volume sewer flusher were unsuccessful. National Vacuum proceeded to video the line and discovered that the line was plugged with concrete. The discharge point of the sewer line could not be determined by dye tests. The existing sewer line was abandoned and a new sewer line was installed in May 2004 by Pinto Construction.

Woodard Engineering, an electrical subconsultant to URS, reviewed H2K's electrical design plans and provided recommendations as necessary. Gordon and Zoerb, an electrical subcontractor to URS, installed electrical power lines to the equipment shelter from the existing pump house. To facilitate routing of the power lines from the pump house it was necessary to decommission some existing overhead pipes. These pipes were decommissioned by Marcor Remediation. Once power was supplied to the temporary shelter, Marcor completed the electrical hookup of the treatment system.

A summary of all vendors used during the remedial activities can be found in **Appendix C** of this report.

3.2 Goals of Remedial Action

The target compounds of concern for remediation of the Site soils in Areas A, B, and C were specific VOCs were identified in the RAP and previous Site work. Site specific chemicals of concern include:

Toluene

1,1-Dichloroethane

Xylenes

Methylene Chloride

1,1,1-Trichloroethane

Ethylbenzene

Acetone

The RAP recommended target soil cleanup goals that were consistent with those established for the tank farm soil removal action, were:

Individual VOCs 1 part per million (ppm)

Total VOCs 10 ppm

Laboratory analysis for VOCs included the target compound list (TCL), pursuant to NY method ASP-1.

However, as the remediation activities progressed, the calculation of Site-specific cleanup action levels became necessary. With the approval of the NYSDEC and in accordance with TAGM 4046, compound specific cleanup action levels were established using the TOC levels of the Site. These compound-specific cleanup action levels were not universal across the Site, but were specific to different excavations and areas within the excavations. The following equation was used to calculate the new cleanup objectives:

$$\text{Calculated Allowable Soil Concentration} = CF \times f \times C_w \times K_{oc}$$

Where CF = Correction Factor (100), f = Total Organic Carbon,

C_w = Groundwater Standards, and K_{oc} = Partition Coefficient

Site-specific cleanup action levels can be found in **Table 3-2**.

4.0 SAMPLING ANALYSIS

4.1 Monitoring Plan

The soil remediation phase of the project removed contaminated soils from Areas B and C pursuant to the action levels described in the RAP and amended in June 2003 (1 ppm per compound, 13 ppm toluene and 10 ppm total VOCs). There are no corresponding groundwater action levels identified in the RAP.

4.1.1 Elements of Monitoring Plan

Monitoring of the remediation system will consist of the following elements:

- Monitoring the vacuum influence;
- Tracking the hydrocarbon removal rate through the HVE system;
- Tracking HVE operational parameters;
- Sampling soil in Areas A and C to evaluate compliance with RAP cleanup objectives, and
- Monitoring groundwater.

4.1.1.1 Monitoring Vacuum Influence

4.1.1.1.1 Monitoring Schedule

It is anticipated that monitoring will continue for six months to a year. Monitoring will focus on whether VOC concentrations are being reduced to below the baseline concentration and the overall mass removal rate. The following outlines the initial schedule of monitoring activities:

- Pressure/Vacuum readings will be collected from individual HVE wells at the start-up of the system, and will be recorded on a weekly basis following start-up.
- Extraction well flow rates as determined by a pitot tube, and extraction well vacuum will be recorded weekly.

These monitoring protocols are to determine changes in the soil vapor chemistry. If changes are not observed and monitoring data indicate that steady state conditions are reached, the frequency of monitoring will be reduced accordingly.

4.1.1.2 Tracking VOC Removal Rates

VOC removal rates will be tracked to determine if the HVE system is effectively removing VOCs from the subsurface. The HVE header pipe from Area "C" will be sampled as necessary to evaluate the effectiveness and coverage of the HVE treatment. This data will be used to evaluate and modify operations by adjusting the system valving to apply consistent vacuum and VOC removal throughout the treatment zone.

4.1.1.3 Tracking HVE Operational Parameters

The HVE system has a number of gauges and meters to provide feedback on its operation. To ensure effective removal of VOCs from the subsurface, the operations need to be optimal. Presented below are the various measurements to be taken and monitored for effective operation of the treatment system. The inspection and sampling form and checklist to be used during OM&M is attached as **Appendix D**.

Monitoring Point	Units	Frequency	Comments
Blower discharge	in Hg	weekly	Ensure consistent operation
Vacuum at wells	in Hg	weekly	Ensure vacuum is equally applied
Blower amp draw	amps	weekly	Evaluate wear and tear on motor
Blower voltage	volts	weekly	Use with above to evaluate power demand
Pressure drop across filter	psi	weekly	Evaluate need for filter change out
System inlet temperature	^{o}F or ^{o}C	weekly	Compare to ambient
System exhaust temperature	^{o}F or ^{o}C	weekly	Evaluate working of blower system and retention on carbon absorbers.
System flow rate	SCFM	weekly	Evaluate leakage
Vacuum at blower	in Hg	weekly	Evaluate leakage

4.1.2 Basis of Design

The elements of the monitoring plan are based on the soil remediation objectives originally established in the RAP and modified in June 2003.

4.2 Environmental Effectiveness Monitoring

4.2.1 General

The site will be considered remediated when soil in Areas C and A meet the TOC-adjusted cleanup levels as outlined in the Remedial Action Completion Report (RACR) (URS, 2006b). Once the cleanup criteria are met, the Site remediation system will be closed. Based on the May 2005 effectiveness soil sampling and analysis, Area A meets the established cleanup objectives. As such, we recommend the HVE system associated with Area A be discontinued.

Area B remediation was completed in July 2004. Confirmation samples collected in 2004 met the cleanup criteria, therefore, the HVE system was not installed in Area B. No further sampling or remediation is warranted for Area B.

The May 2005 effectiveness soil sampling and analysis in Area C indicates that the remediation is not complete in Area C.

4.2.2 Sampling Program

Annual sampling of the soil in Area C and, if necessary, final sampling of Area A will be conducted via geoprobe and analyzed for VOCs and certain physical parameters to evaluate the effectiveness of the treatment system. In addition to soil sampling, up to quarterly groundwater sampling of the five existing monitoring wells in the project area will be conducted for VOCs.

4.2.2.1 Soil Sampling & Procedures

Soil borings will be advanced to the top of the clay till (approximately 10 ft below ground surface (bgs)) in the vicinity of confirmation soil samples CWW-1 and CNW-1 in Area C. These soil samples exceeded the TOC-adjusted cleanup objective for toluene. Soil in this area could not be excavated and removed offsite because of its proximity to the tank farm foundation wall. Soil in this area is the only soil that was not remediated.

The entire site will be considered remediated when the soil in Area C meets the TOC-adjusted cleanup objectives; at this time the site remediation system will be closed.

During confirmation sampling in Area C, soil samples will be collected continuously and screened with a photoionization detector (PID). Each boring will be logged using the unified soil classification system. The samples with the highest PID readings will be forwarded

under proper chain-of-custody procedures to the laboratory for VOC analysis via USEPA Method 8260. Up to four borings will be placed in Area C annually.

4.2.2.2 Field Documentation

The following documentation will be completed on an on-going basis during field activities:

- Soil Boring sampling records;
- Daily Field Log;
- Chain-of-custody forms.

All equipment used to make the measurements and collect samples will be identified on the daily field log along with calibration measurements, as appropriate.

4.2.2.3 Chain-of-Custody Form

During field sampling activities, samples will be tracked from the time the samples are collected until laboratory data is issued. Information on the custody, transfer, handling, and shipping of samples will be recorded on the chain-of-custody form.

The sample handler will be responsible for initiating and completing the chain-of-custody form. The chain-of-custody will be signed by the sampler when the sampler relinquishes the samples to anyone else. It is not necessary for the delivery courier to sign the chain-of-custody; however, the airbill will be retained by the sample handler for tracking purposes. A chain-of-custody form will be completed for each set of samples collected daily, and will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of sample collection
- Sample identification number
- Sample type
- Preservation method
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times (laboratory)
- Method of shipment (e.g., Fed-Ex or overnight carrier)

The person responsible for delivery of the samples to the air carrier will sign the chain-of-custody form, retain a copy of the chain-of-custody form, document the method of shipment, and send the original and the second copy of the chain-of-custody form with the sample (taped in re-sealable plastic bag to inner cooler lid). Upon receipt at the laboratory, the person receiving the samples will sign the chain-of-custody form and return the second copy to the PM. Copies of the chain-of-custody forms and all custody documentation will be received and kept in the central files. The original chain-of-custody forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting.

4.2.2.4 Laboratory Procedures

Laboratory analyses will be performed in accordance with the following analytical methods for the physical parameters, natural attenuation parameters and VOCs, respectively. For specific information regarding sample methods, hold times, preservatives, and sample size, refer to **Table 4-1**.

4.2.2.5 Quality Control Samples

4.2.2.5.1 Soil

The following quality control samples will be collected at the specified frequencies:

- Field duplicate - one per 10 field investigative sample; if less than 10 field samples are collected 1 field duplicate will be collected.
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples - one per 20 field investigative samples; if less than 20 field samples are collected 1 field duplicate will be collected.
- Equipment Blank – one per type of sampling operation, such as stainless steel bowl and plastic compositing container.

4.2.2.5.2 Groundwater

The following quality control samples will be collected at the specified frequencies:

- Field duplicate - one per 10 field investigative sample; if less than 10 field samples are collected 1 field duplicate will be collected.
- MS/MSD Samples - one per 20 field investigative samples; if less than 20 field samples are collected 1 field duplicate will be collected.
- Trip Blank – one per cooler.

4.2.2.6 Decontamination

The split-spoon samplers and other non-disposable equipment that come into contact with the samples will be decontaminated between samples by scrubbing with a brush using a non-phosphate detergent-water solution followed by several rinses with distilled water. The decontamination will consist of scrubbing to remove any encrusted materials using tap water or distilled water. Equipment will be rinsed with distilled water. Detergents that may be used for decontamination include Alconox, Liquinox, or equivalent products. A decontamination area will be constructed for steam-cleaning of the drilling augers. The water generated during decontamination will be contained and then disposed of by Sovereign. Personal protective equipment and decontamination procedures are discussed in the HASP (**Appendix A**).

The decontaminated equipment should be air-dried, weather permitting, but clean, no print paper towels may be used in rainy weather or subfreezing temperatures. Decontaminated equipment will be wrapped in aluminum foil until the next use.

4.2.2.7 Investigation-Derived Waste

All soil cuttings generated during drilling activities will be contained in 55-gallon drums and stored on-site until analytical results are available. If soil sample analytical results exceed regulatory soil limits, the associated soil cuttings will be transported to an approved disposal facility. All containers used for solids storage will be labeled, sealed and appropriately stored at the site for disposal in an environmentally safe manner.

The water generated during decontamination and well purging will be contained and disposed of by Sovereign.

4.2.2.8 References

"Standard Methods for Examination of Water and Wastewater", APHA-AWWA-WPCF, 17th Edition, 1989 and 1991 Supplement.

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," USEPA Publication Number SW-846 (Third Edition, November 1986) as amended by updates I and IIA (document No. 955-001-00000-1)

4.2.2.9 Groundwater Sampling & Procedures

Groundwater sampling events will be conducted up to quarterly as part of the remediation effectiveness monitoring. Samples from the five existing monitoring wells on site (MW-1,

MW-2, MW-3, MW-4 and MW-5) and the north and south sumps will be analyzed for VOCs. Additional sampling will be conducted as outlined in **Section 4.4.1**. Prior to groundwater sampling, each well will be purged until pH, temperature, and conductivity readings are stabilized. In addition to chemical analysis, groundwater levels and groundwater flow mapping will be completed. The frequency of the groundwater sampling will be based on the results from the initial round of sampling and consideration of the timing and effectiveness of the treatment system.

4.2.2.10 Gas Monitoring & Procedures

Vapor sampling from the HVE system will be collected up to annually. Monitoring of the HVE system will be completed on a weekly and monthly basis and will be recorded on the gas monitoring forms found in **Appendix D**.

4.3 On-Site Treatment Plant Performance Monitoring

4.3.1 Influent Sampling and Procedures

No influent water samples will be collected for effectiveness monitoring

4.3.2 Effluent Sampling & Procedures

No effluent water samples will be collected for effectiveness monitoring

4.3.3 Discharge Monitoring

Pursuant to Sovereign's BSA Discharge Permit No.05-01-BU108, samples of discharge will be collected biannually and analyzed for VOCs. BSA sampling is conducted for permit compliance only. Discharge monitoring activities will be recorded in the daily field reports found in **Appendix D**.

4.3.4 Water Level Measurements

Water level measurements will be collected periodically to determine what affect, if any, the remediation system is having on groundwater elevation and flow. Water level measurement activities will be recorded in the daily field reports found in **Appendix D**.

4.4 Analytical Program

4.4.1 Analytical Schedules and Methods

Annually in May or June, soil samples will be collected in the remaining hot spot location in Area "C" using a geoprobe. Samples will be taken continuously from the surface to approximately 10 ft bgs. Drilling will not penetrate the clay layer that is present at approximately 10 ft bgs. The number of samples and proposed analytical methods are summarized in the following table:

Soil

Schedule	Matrix	Parameter	Method[1]	Number of Samples
Annually May-June	Soil	TCL VOCs	ASP-2000	8-- Up to 2 samples per boring plus 1 QC sample and 1 duplicate [2]
Annually May-June	Soil	TOC		1-- (one from Area C)
Annually May-June	Soil	Manganese, Sulfate		1-- (one from Area C)

Note: [1] All methods reference NYSDEC ASP / 95 NYSDEC CLP
[2] Soil sample to be taken from four geoprobe® locations.

In addition to soil monitoring, groundwater monitoring will be collected up to quarterly. Samples will be collected from the five existing monitoring wells on-site (MW-1, MW-2, MW-3, MW-4 and MW-5), and the north and south sumps. The number of samples and proposed analytical methods are summarized in the following table:

Groundwater

Schedule[1]	Matrix	Parameter	Method[2]	Number of Samples
Quarterly (maximum)	Groundwater	TCL VOCs	ASP-2000	7 -- Plus 1 QC sample and 1 duplicate
Quarterly (maximum)	Groundwater	Water Elevation		5

Notes: [1]Frequency will be based on the results from the initial round of sampling and consideration of the timing and effectiveness of the treatment system.

Additional parameters may be collected if analytical results from the groundwater sampling indicate contamination is present. The following parameters would be collected to determine if bioremediation or chemical oxidation were appropriate methods of remediation.

Parameter	Frequency[1]	Method	Comments
Produced Water (Groundwater Composite, North & South Sump)			
HCO_3	Quarterly (maximum)	EPA 310.1	Indicator of bioactivity
SO_4	Quarterly (maximum)	IC Method E300	Determination of presence of electron acceptor
Fe	Quarterly (maximum)	EPA 200.7	Determination of presence of electron

Parameter	Frequency[1]	Method	Comments
			acceptor
Mn	Quarterly (maximum)	EPA 200.7 or EPA 200.9	Determination of presence of electron acceptor
COD	Quarterly (maximum)	EPA 410.1-2	Indicator of bio-activity
BOD	Quarterly (maximum)	EPA 405.1	Indicator of bioactivity
VOCs	Quarterly (maximum)	SW 8260	Track changes with time
Flow Rate	Quarterly (maximum)	Gauge	Report monthly
Hardness	Quarterly (maximum)		BSA
Total Suspended Solids	Quarterly (maximum)		BSA
Monitoring Wells			
HCO_3	Quarterly (maximum)	EPA 310.1	Indicator of bioactivity
SO_4	Quarterly (maximum)	IC Method E300	Determination of presence of terminal electron acceptors
Fe	Quarterly (maximum)	EPA 200.7	Determination of redox conditions
Mn	Quarterly (maximum)	EPA 200.7 or EPA 200.9	Determination of redox conditions
Chloride	Quarterly (maximum)	IC Method E300	Dehalogenation product from breakdown of chlorinated ethenes and ethanes
VOCs	Quarterly (maximum)	SW 8260	Track changes with time
Methane	Quarterly (maximum)	SW3810	Determination of Redox conditions
Redox,	Quarterly (maximum)	A2580B, Field Probe noting probe type.	Field determination of Redox conditions
Temperature	Quarterly (maximum)	Field Probe	Determine if limiting conditions present
Specific Conductance	Quarterly (maximum)	Field Probe	Filed check on changes in total dissolved solids
pH	Quarterly (maximum)	Field Probe	

Notes: [1]Frequency will be based on the results from the initial round of sampling and consideration of the timing and effectiveness of the treatment system.

4.5 Evaluation of Monitoring Results

Soil effectiveness monitoring results will be compared to the TOC-adjusted site specific cleanup objectives for soil. Sovereign will propose shutting down the remediation system (HVE and groundwater collection systems) when these cleanup objectives for soil have been met. Results will be reported as required to NYSDEC.

4.6 Records

Sampling and analysis records will be maintained by URS on behalf of Sovereign.

5.0 SITE MAINTENANCE

5.1 Maintenance Activities

Sovereign will maintain the remediation site area, in addition to maintaining the remediation equipment pursuant to the manufacturer's manual. The perimeter fence will be maintained in good condition and periodic checks will be made with respect to its condition. Settlement and subsidence of the clay backfill will also be maintained to prevent excessive standing water. There are no other physical structures or systems in the remediation area.

5.1.1 Site Fence

The site fence will be maintained in good condition.

5.1.2 Signs

There are no applicable signs other than those directly associated with the remediation equipment. The remediation equipment will be maintained pursuant to the manufacturer's manual.

5.1.3 Cover

There is no cover associated with the site.

5.1.4 Runoff Control Structures

There are no run-off control structures associated with the site.

5.1.5 Settlement & Subsidence Control

Settlement and subsidence of the clay backfill will be maintained to prevent excessive standing water.

5.1.6 Flexible Membrane Liner Repairs

There are no flexible membrane liners on the site.

5.1.7 Groundwater Monitoring System

Five monitoring wells exist on-site. These monitoring wells will be inspected up to quarterly to ensure they are intact and available for sampling. If any well is damaged or found to be compromised in any way, the need for a replacement well will be evaluated.

5.1.8 Gas Venting System

There is no gas venting system on the site.

5.1.9 Groundwater Collection System

The groundwater collection system will be "operational" as necessary to facilitate cleanup in Area C.

5.1.10 Vehicle Access Road

The vehicle access road on the site will be maintained by Sovereign.

5.1.11 Vermin and Vector Observations

Vermin and vector have not been observed on the site.

5.1.12 Treatment Plant Maintenance

The HVE Treatment system will be monitored pursuant to the manufacturer's Operations and Maintenance (O&M) manual (**Appendix E**). The HVE O&M checklist can be found in **Appendix D**.

5.1.13 Description of Maintenance Requirements of Each Component of the Treatment Facility

The maintenance requirements for each component in the treatment facility can be found in the manufacturer's O&M manual (**Appendix E**).

5.1.14 Maintenance Schedule

The maintenance schedule for the HVE treatment system can be found in the manufacturer's O & M manual (**Appendix E**).

5.2 Inspections and Maintenance

5.2.1 Operating Records

Operating records from May 2003 to June 2006 are provided in Appendix A of the RACR (URS, 2006b). Subsequent monitoring records will be maintained by URS on behalf of Sovereign.

5.2.2 Monthly Check List

The monthly inspection checklist is attached as **Appendix D.**

5.2.3 Quarterly Check List

The quarterly inspection checklist is attached as **Appendix D.**

5.2.4 Yearly Check List

The annual inspection checklist is attached as **Appendix D.**

5.3 Preventive Maintenance Schedules

Preventative maintenance of the HVE system will be performed in accordance with the manufacturer's O & M manual **(Appendix E)**. Preventative maintenance of the site features will be conducted to maintain all features in good condition.

5.4 Disposal of Used Material and Waste

Sovereign is responsible for disposal of used material and waste.

6.0 REPORTS

An annual OM&M report will be completed that will include all inspection, monitoring and maintenance that was performed at the site.

7.0 CITIZEN PARTICIPATION

7.1 OM&M Citizen Participation Plan

The OM&M Citizen Participation Plan is included in the table below:

Project Phase	Document to Repository	Notice	Fact Sheet	Comment Period	Other
Before Approval of Remedial Action Report	Yes	Yes	Yes	NR	
Issuance of Certificate of Completion if IC/EC part of remedy	NR	Yes	Yes	NR	Within 10 days of issuance

NR = Not Required

7.2 Contact List

The Citizen Contact List is included in **Appendix F.** The NYSDEC will provide notice to the Citizen Contact List, as required by the Citizen Participation Plan.

7.3 FOIL Packet

Not applicable.

8.0 PERSONNEL

8.1 Organization

The project organization chart is presented in **Appendix G.**

8.1.1 Chain of Command

8.2 Manpower Requirements

The project team consists of the Owner's Representative, PM and the OM&M field team.

8.3 Responsibilities and Duties

The responsibilities and duties of the project team are as follows:

Role	Responsibility	Name
Owner's Representative	Oversight of project for owner	Kevin Johnston
Project Manager	Oversight of project, manage implementation of project objectives (achieve clean closure of site)	Staff from Sovereign or contractor.
OM&M Field Team	Conduct periodic inspections (weekly, monthly, quarterly and annually) as required. Maintain HVE equipment, inspect site for maintenance issues and report irregularities to the PM. Prepare field reports, fill out inspection/monitoring forms and send to PM.	Staff from Sovereign and / or contractor.

8.4 Training (including Health and Safety)

All onsite personnel are required to have 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) training and the site safety training required by Sovereign.

8.5 Material Safety Data Sheets

Material Safety Data Sheets are provided in the project HASP.

9.0 HEALTH AND SAFETY PLAN

The URS HASP is attached as **Appendix A.**

10.0 RECORDS AND FORMS

All inspection, monitoring, and maintenance forms are attached as **Appendix D.**

11.0 EMERGENCY CONTINGENCY PLAN

The emergency contingency plan is presented in the URS' HASP

11.1 Emergency Telephone Numbers, Map and Directions to Nearest Health Facility.

The emergency telephone numbers are as follows:

Organization / Name	Title / Location	Telephone
Sovereign/Kevin Johnston	Director, Americas Safety, Health, Environment and Quality	716-856-4941 ext. 288
URS/Patricia M. Bryan	Project Manager/Chicago	312-697-7240 office 312-403-0846 cell
URS/Scott McCone or Ed Dinsmore	Field Technician/Buffalo	716-856-5636 office
URS/Kenneth Yates	URS Regional Health and Safety Manager	979-238-7490 office 979-415-4089 cell
URS/Jeanette Schrimsher	URS Occupational Health Specialist	512-419-6440 office 866-326-7321 hotline
Emergency Services		
Local Ambulance	-	911
Hospital	Mercy Hospital 565 Abbott Rd Buffalo, NY 14220-2039	716-826-7000
Local Police	Emergency Non Emergency	911 716-851-4415
Local Fire Department	-	911
EPA Region II	-	212-637-3000
Poison Control Center - ATSDR	-	404-639-0615
National Response Center	-	800-424-8802
Center for Disease Control	-	404-488-4100
CHEMTREX	-	800-424-9555

Directions to Mercy Hospital are as follows:

1. Turn Right from Site and go north on OHIO ST 0.4 miles
2. Continue on LOUISIANA ST 0.8 miles
3. Bear Right to take the I-190 SOUTH ramp 0.2 miles
4. Merge on I-190 SOUTH 1.6 miles
5. Take the SENECA ST(RT-16) exit, exit #3 0.2 miles
6. Continue on KEATING ST 0.0 miles
7. Turn Left on ELK ST 0.1 miles
8. Turn Right on BAILEY AVE 0.4 miles
9. Bear Left on MCKINLEY PKY 0.3 miles
10. Continue on SOUTHSIDE PKY 0.0 miles
11. Turn Left on ABBOTT RD 0.8 miles
12. Mercy Hospital is located at 565 Abbott Rd, Buffalo, NY 14220-2039

12.0 RECORD DRAWINGS

As-Built drawings of the remediation system are attached as **Figures 3-1** through **3-5**. Additional as-built drawings, created by H2K, of the HVE treatment system can be found in the manufacturer's O&M manual (**Appendix E**).

12.1 AutoCAD Drawings on Disk

A compact disc containing AutoCAD files of the as-built drawings can be found in **Appendix E.** AutoCAD files of **Figure 3-1** through **3-5** are unavailable. Pdfs of these figures can be found on the compact disc.

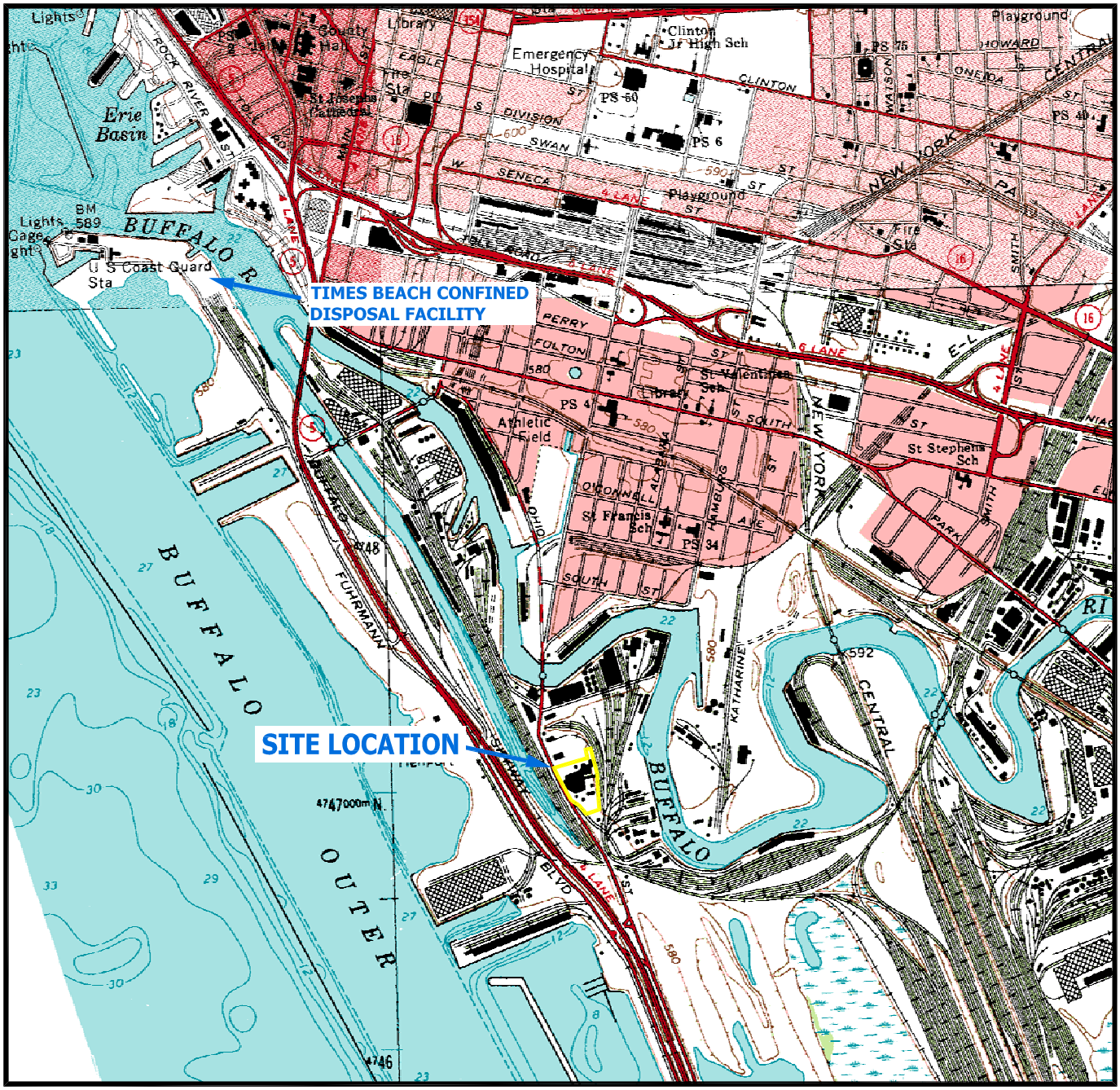
13.0 ROD(S), CONSENT ORDERS, AND / OR ANY EXPLANATION OF SIGNIFICANT DIFFERENCES (ESDS)

This OM&M Plan is based on the May 2003 RAP prepared by IT Corporation and finalized by URS. Variations to the remedial actions presented in the RAP are detailed in the RACR (URS, 2006b). Remedial actions proposed in the RAP included the removal of impacted soil from Areas A, B and C. Area A was not excavated due to the proximity to a nitrogen tank and piping system. A HVE system was to be placed along the walls of each excavation to handle remaining VOC impacts. Excavations of impacted materials from Areas B and C were successful and the installation of the HVE system was not necessary with the exception of the west wall of Area C. The HVE system was placed in Area A as a stand alone treatment. Groundwater collection systems were to be installed in each excavation to control the water levels in and prevent recontamination of clean fill by potentially impacted perched groundwater. Groundwater collection systems were installed in excavations B and C. Area A was not excavated so a groundwater collection system was not installed.

14.0 ELECTRONIC COPIES OF OFFICIAL RECORDS AND REFERENCES

Electronic records are maintained by URS on behalf of Sovereign.

Figures



SCALE: 1:24 000

1 1/2 0 1 MILE

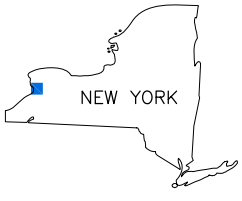
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

NORTH

MAP REFERENCE:

PORTION OF U.S.G.S. QUADRANGLE MAP
7 ½ MINUTE SERIES (TOPOGRAPHIC)
BUFFALO NE, NY 1965 & BUFFALO NW, NY 1965
& BUFFALO SE, NY 1965



QUADRANGLE LOCATION

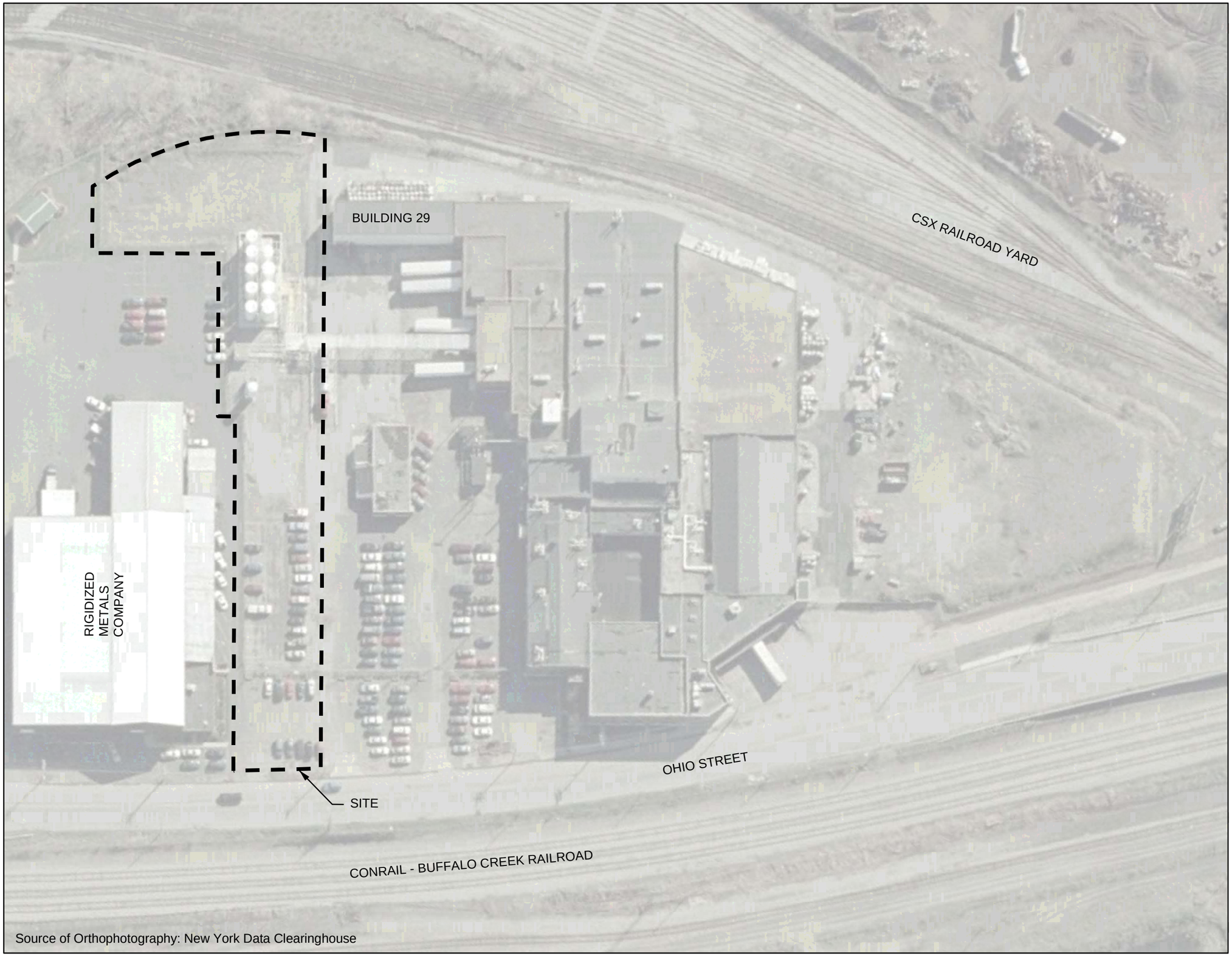
SOVEREIGN SPECIALTY CHEMICALS
710 OHIO STREET
BUFFALO, NEW YORK

FIGURE 1-1
SITE LOCATION MAP

DATE: Oct 20, 2006	
JOB NO.: 25364871	
DRAWN BY: BKR	CHK'D BY: KDPR
SCALE: AS SHOWN	

URS
100 SOUTH WACKER DRIVER, SUITE 500
CHICAGO, ILLINOIS 60606
PHONE: (312) 939-1000
FAX: (312) 939-4198

I:\2003_Projs\25364871\5_Data\5130 Maps&Figures\Sovereign – Buffalo NY – Figure 1 – Site Location Map.dwg



Source of Orthophotography: New York Data Clearinghouse

80 40 0 80

Feet

1 inch equals 80 feet

Legend

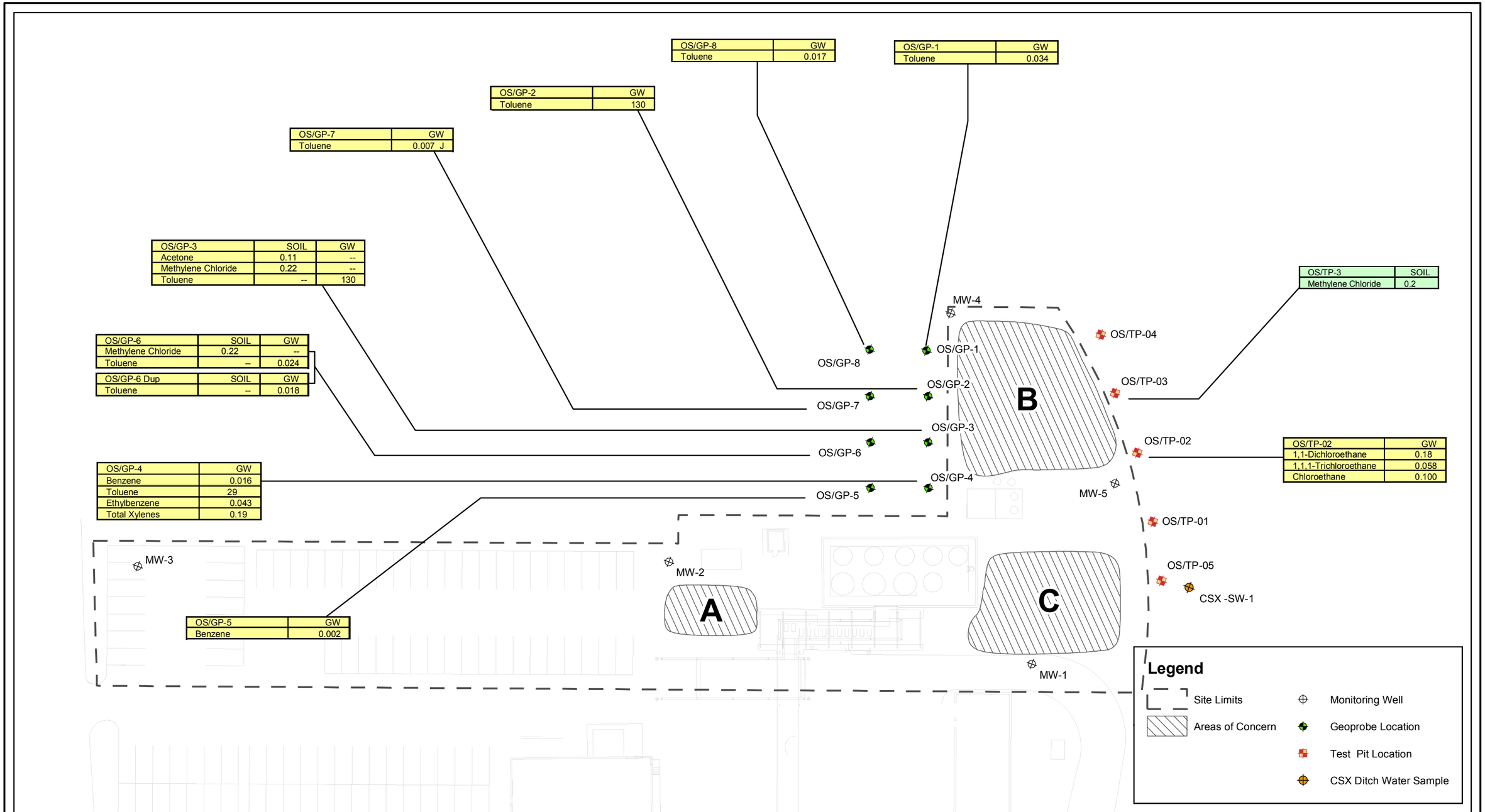
Site Limits

URS 100 South Wacker Drive, Suite 500 Chicago, Illinois 60606

SITE MAP
SOVEREIGN SPECIALTY CHEMICALS
710 OHIO STREET
BUFFALO, NEW YORK

DESIGN: PMB	CHK'D: KDPR	PROJECT NO. 25364871	FIG NO. 1-2
DRAWN: BKR	DATE: 08/22/06		

O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - Fig2-1 Site Map_052406.mxd



Notes:
1. Concentrations shown are for compounds exceeding TAGM Standards or TOGS Groundwater Standards.
2. Analytical results are shown in ppm.

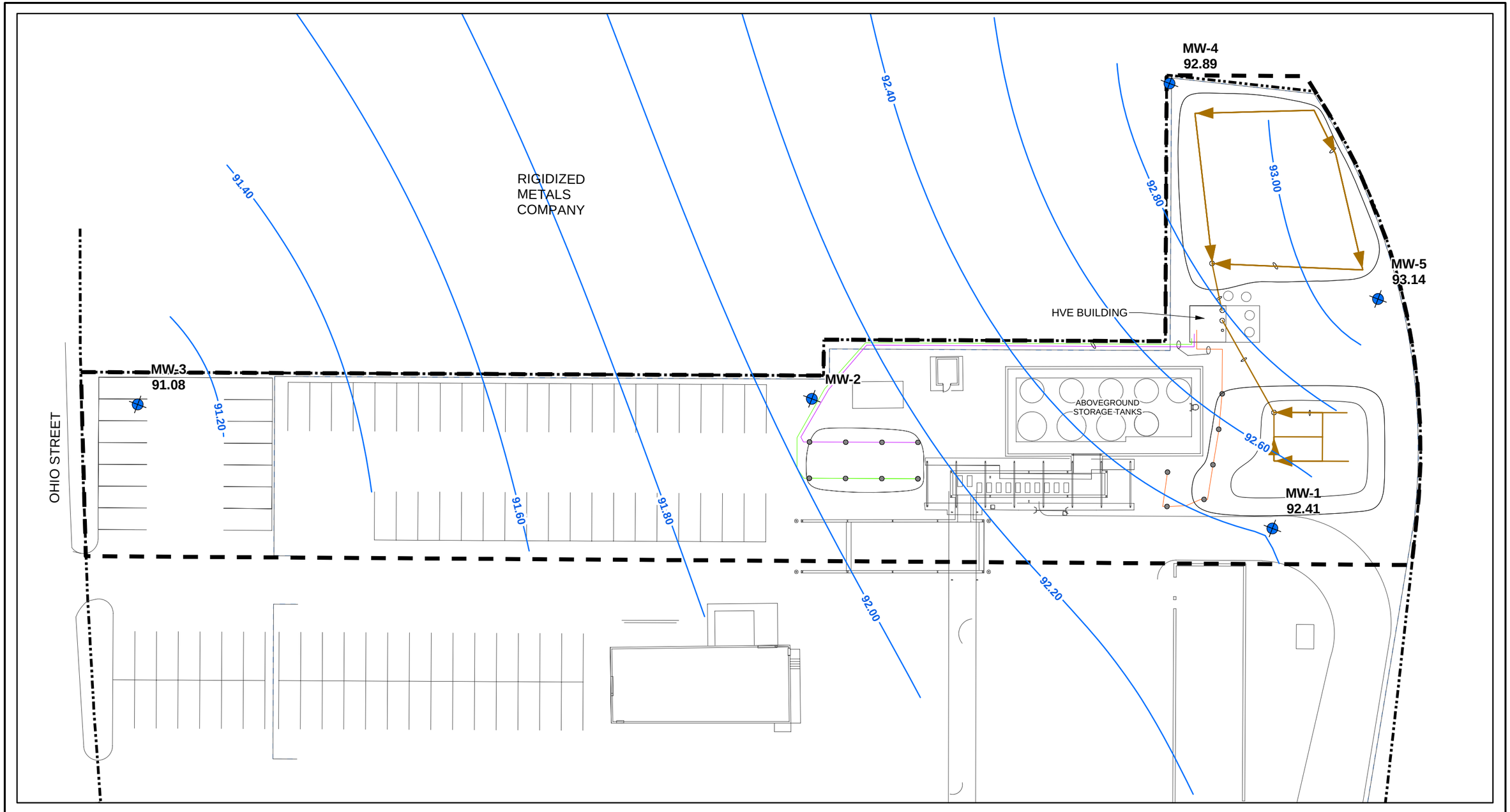
50 25 0 50
Feet
1 inch equals 50 feet

URS 100 South Wacker Drive, Suite 500 Chicago, Illinois 60606

OFFSITE INVESTIGATION
SOVEREIGN SPECIALTY CHEMICALS
710 OHIO STREET
BUFFALO, NEW YORK

DESIGN: PMB	CHK'D: KDPR	PROJECT NO. 25364871	FIG NO. 2-1
DRAWN: BKR	DATE: 10/18/06		

O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - Fig2-2 Offsite.mxd



Legend

- Monitoring Wells
- Groundwater Contours
- Site Limits
- Fenceline
- Property Boundary

0 20 40
Feet

1 inch equals 40 feet

URS
100 South Wacker Drive, Suite 500
Chicago, Illinois 60606

GROUNDWATER CONTOUR MAP
MARCH 2006
SOVEREIGN SPECIALTY CHEMICALS
710 OHIO STREET
BUFFALO, NEW YORK

DESIGN: KDPR	CHK'D: PMB	PROJECT NO. 25364871	FIG NO. 2-2
DRAWN: BKR	DATE: 10/18/06		

O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - GW Contour.mxd

RIGIDIZED
METALS
COMPANY

4" PVC PERFORATED
LATERAL
(see detail)

12" SCH 40 PVC
SUMP TYP
(see detail)

4" PVC PERFORATED
PVC PIPE

1" DIA. SCH 40
PVC PIPE

12" SCH 40 PVC
SUMP TYP
(SEE DETAIL)

4" DIA. PERFORATED
PVC PIPE

FRAC TANK

ABOVEGROUND
STORAGE TANKS

URS
FIELD TRAILER

Legend

- Property Boundary
- Fenceline
- Ground Water Collection Piping
- Site Limits

HVE Areas

- HVE1
- HVE2
- HVE3

HVE Pipes

- HVE 1
- HVE 2
- HVE 3
- PVC

0 20 40
Feet

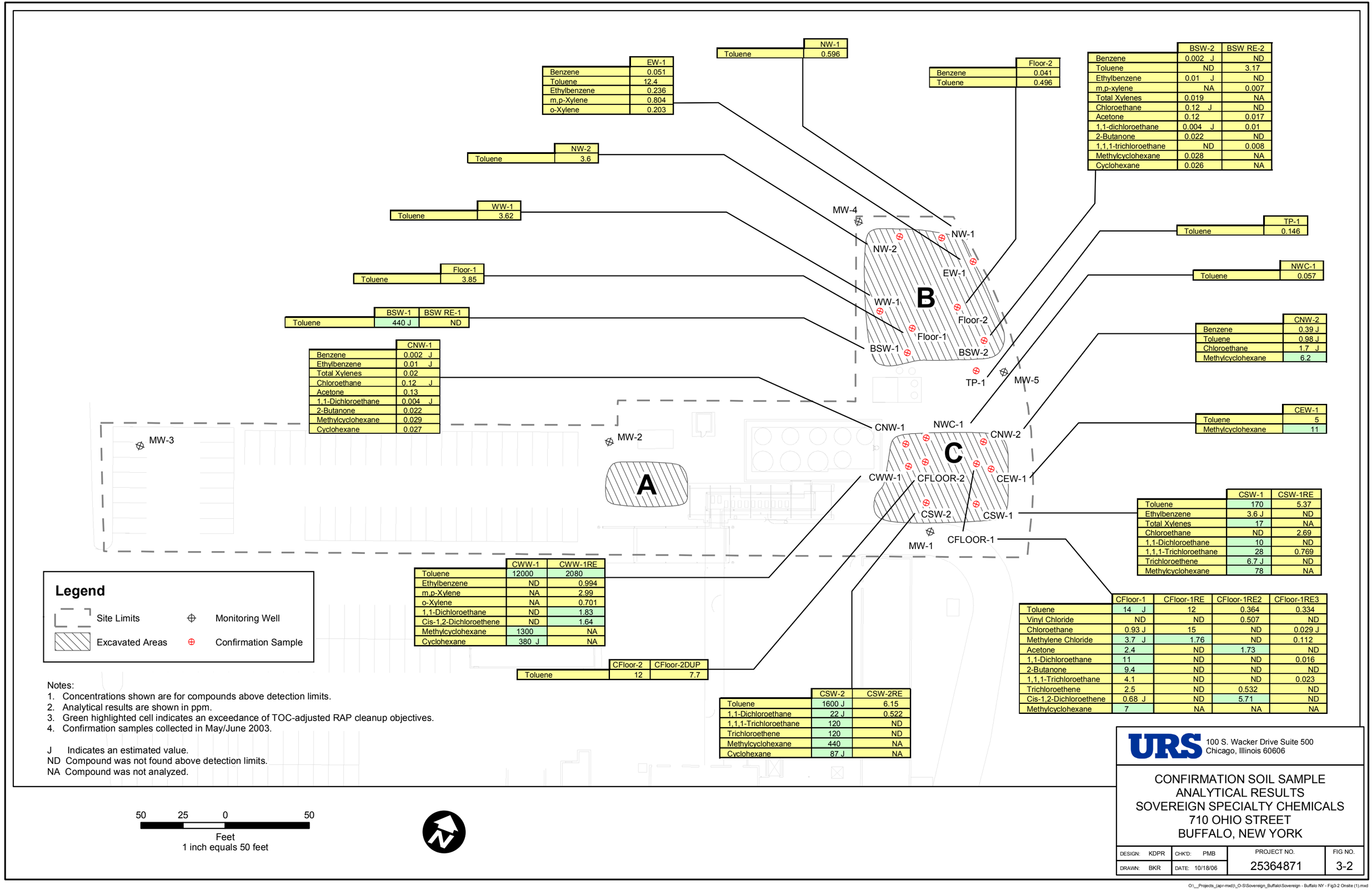
1 inch equals 40 feet

URS 100 S. Wacker Drive Suite 500
Chicago, Illinois 60606

UNDERGROUND REMEDIATION
SOVEREIGN SPECIALTY CHEMICALS
710 OHIO STREET
BUFFALO, NEW YORK

DESIGN: KDPR	CHK'D: PMB	PROJECT NO. 25364871	FIG NO. 3-1
DRAWN: BKR	DATE: 10/18/06		

O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - Fig3-1 Under_sm1.mxd



	EW-1
Benzene	0.051
Toluene	12.4
Ethylbenzene	0.236
m,p-Xylene	0.804
o-Xylene	0.203

	NW-1
Toluene	0.596

	Floor-2
Benzene	0.041
Toluene	0.496

	BSW-2	BSW RE-2
Benzene	0.002 J	ND
Toluene	ND	3.17
Ethylbenzene	0.01 J	ND
m,p-xylene	NA	0.007
Total Xylenes	0.019	NA
Chloroethane	0.12 J	ND
Acetone	0.12	0.017
1,1-dichloroethane	0.004 J	0.01
2-Butanone	0.022	ND
1,1,1-trichloroethane	ND	0.008
Methylcyclohexane	0.028	NA
Cyclohexane	0.026	NA

	NW-2
Toluene	3.6

	WW-1
Toluene	3.62

	TP-1
Toluene	0.146

	Floor-1
Toluene	3.85

	NWC-1
Toluene	0.057

	BSW-1	BSW RE-1
Toluene	440 J	ND

	CNW-1
Benzene	0.002 J
Ethylbenzene	0.01 J
Total Xylenes	0.02
Chloroethane	0.12 J
Acetone	0.13
1,1-Dichloroethane	0.004 J
2-Butanone	0.022
Methylcyclohexane	0.029
Cyclohexane	0.027

	CNW-2
Benzene	0.39 J
Toluene	0.98 J
Chloroethane	1.7 J
Methylcyclohexane	6.2

	CEW-1
Toluene	5
Methylcyclohexane	11

	CSW-1	CSW-1RE
Toluene	170	5.37
Ethylbenzene	3.6 J	ND
Total Xylenes	17	NA
Chloroethane	ND	2.69
1,1-Dichloroethane	10	ND
1,1,1-Trichloroethane	28	0.769
Trichloroethene	6.7 J	ND
Methylcyclohexane	78	NA

	CWW-1	CWW-1RE
Toluene	12000	2080
Ethylbenzene	ND	0.994
m,p-Xylene	NA	2.99
o-Xylene	NA	0.701
1,1-Dichloroethane	ND	1.83
Cis-1,2-Dichloroethene	ND	1.64
Methylcyclohexane	1300	NA
Cyclohexane	380 J	NA

	CFloor-1	CFloor-1RE	CFloor-1RE2	CFloor-1RE3
Toluene	14 J	12	0.364	0.334
Vinyl Chloride	ND	ND	0.507	ND
Chloroethane	0.93 J	15	ND	0.029 J
Methylene Chloride	3.7 J	1.76	ND	0.112
Acetone	2.4	ND	1.73	ND
1,1-Dichloroethane	11	ND	ND	0.016
2-Butanone	9.4	ND	ND	ND
1,1,1-Trichloroethane	4.1	ND	ND	0.023
Trichloroethene	2.5	ND	0.532	ND
Cis-1,2-Dichloroethene	0.68 J	ND	5.71	ND
Methylcyclohexane	7	NA	NA	NA

	CFloor-2	CFloor-2DUP
Toluene	12	7.7

	CSW-2	CSW-2RE
Toluene	1600 J	6.15
1,1-Dichloroethane	22 J	0.522
1,1,1-Trichloroethane	120	ND
Trichloroethene	120	ND
Methylcyclohexane	440	NA
Cyclohexane	87 J	NA

Legend

Site Limits — Monitoring Well

Excavated Areas — Confirmation Sample

Notes:
1. Concentrations shown are for compounds above detection limits.
2. Analytical results are shown in ppm.
3. Green highlighted cell indicates an exceedance of TOC-adjusted RAP cleanup objectives.
4. Confirmation samples collected in May/June 2003.

J Indicates an estimated value.
ND Compound was not found above detection limits.
NA Compound was not analyzed.

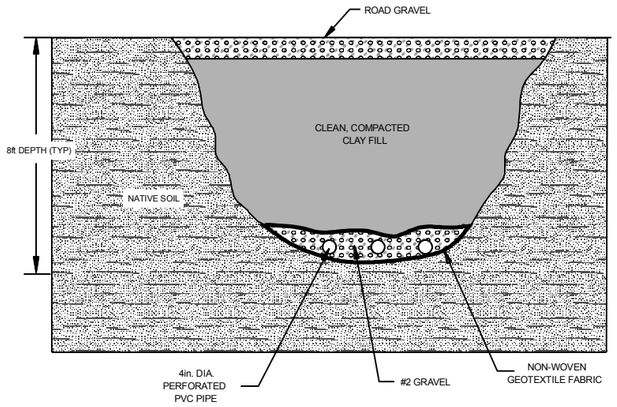
50 25 0 50
Feet
1 inch equals 50 feet

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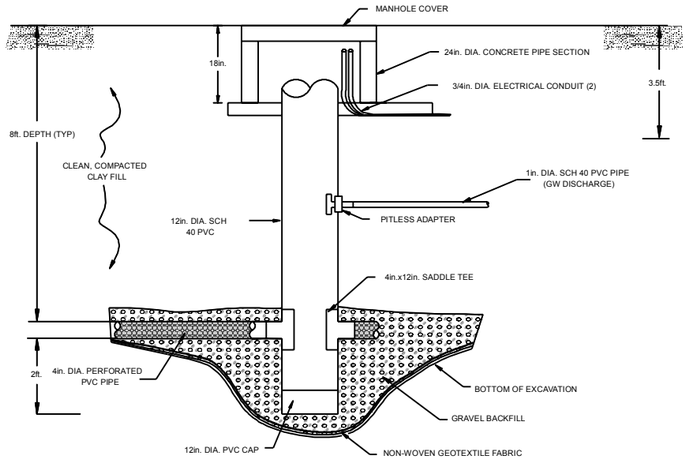
CONFIRMATION SOIL SAMPLE ANALYTICAL RESULTS SOVEREIGN SPECIALTY CHEMICALS 710 OHIO STREET BUFFALO, NEW YORK

DESIGN: KDPR	CHK'D: PMB	PROJECT NO. 25364871	FIG NO. 3-2
DRAWN: BKR	DATE: 10/18/06		

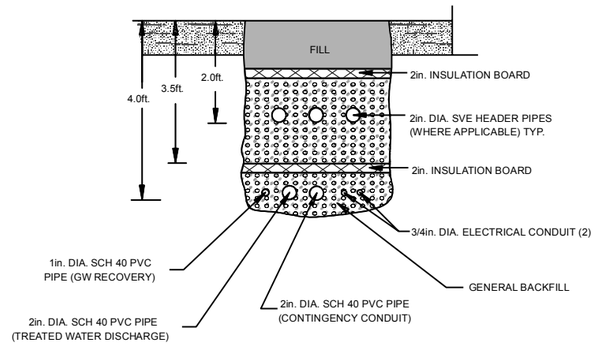
O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - Fig3-2 Onsite (1).mxd



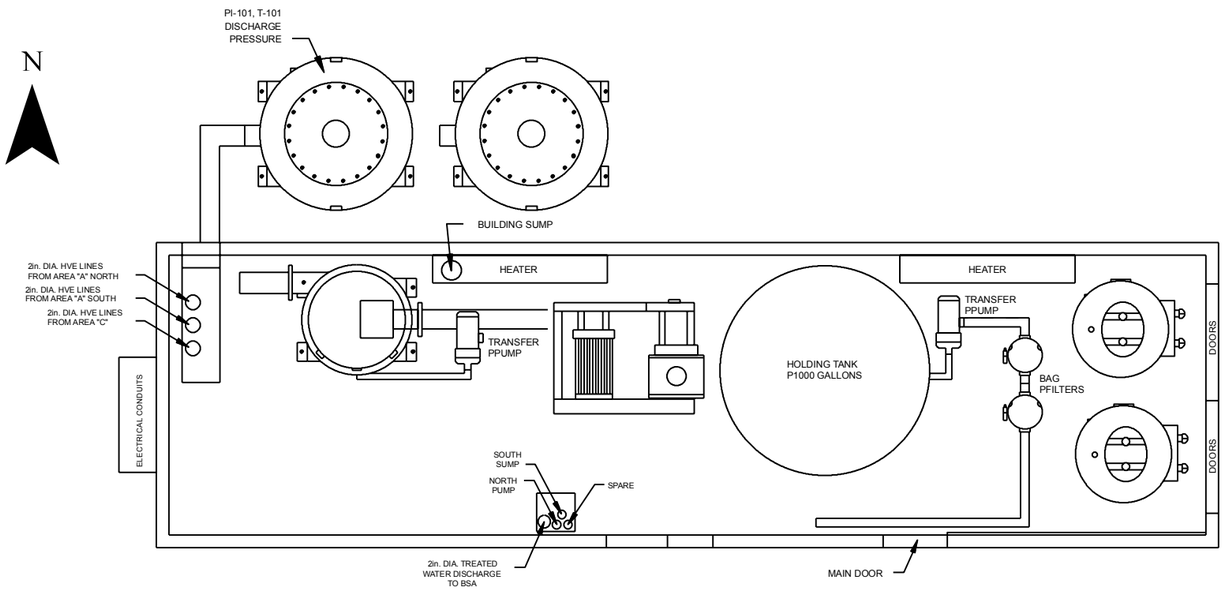
EXCAVATION PROFILE - WATER COLLECTION SYSTEM



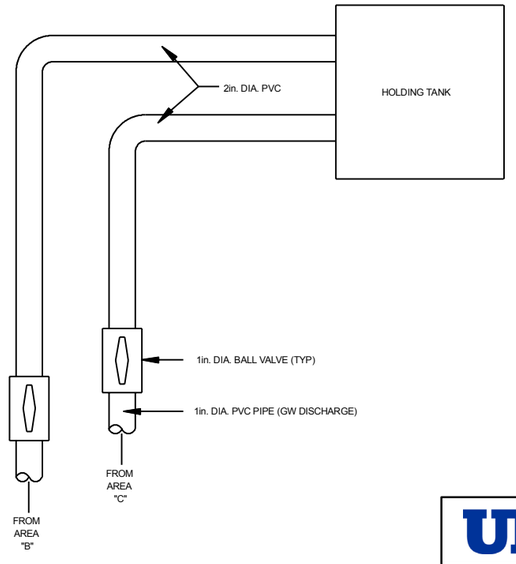
WATER COLLECTION SUMP DETAIL (TYP)



WATER COLLECTION PIPING TRENCH DETAIL



FLOOR PLAN OF TEMPORARY EQUIPMENT SHELTER



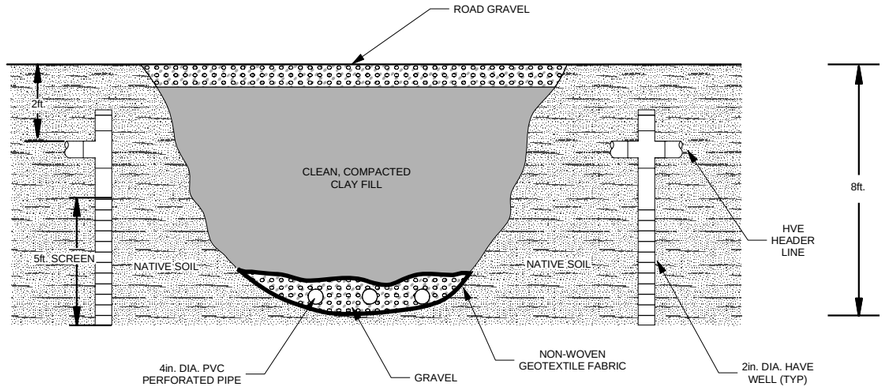
WATER COLLECTION DETAIL

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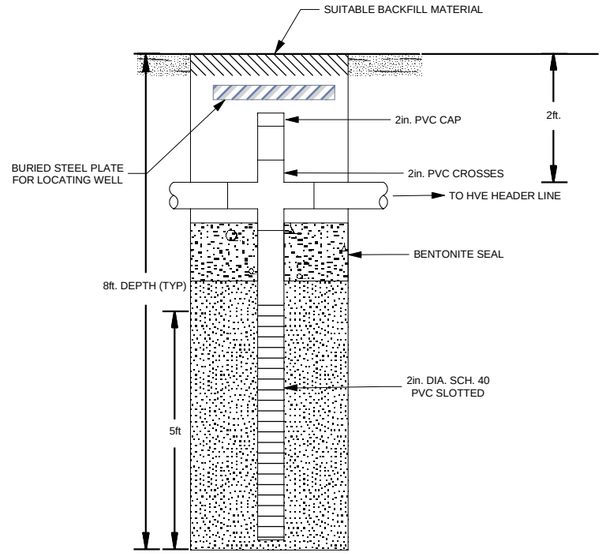
GROUNDWATER COLLECTION
SYSTEM DETAILS
SOVEREIGN SPECIALTY CHEMICALS
710 OHIO STREET
BUFFALO, NEW YORK

DESIGN: KDPR	CHK'D: PMB	PROJECT NO. 25364871	FIG NO. 3-3
DRAWN: BKR	DATE: 10/18/06		

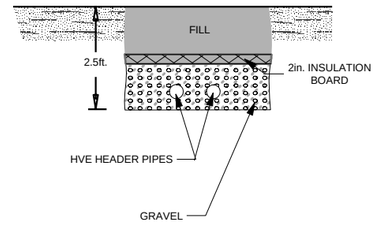
O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - Fig3-3 GW Collection.mxd



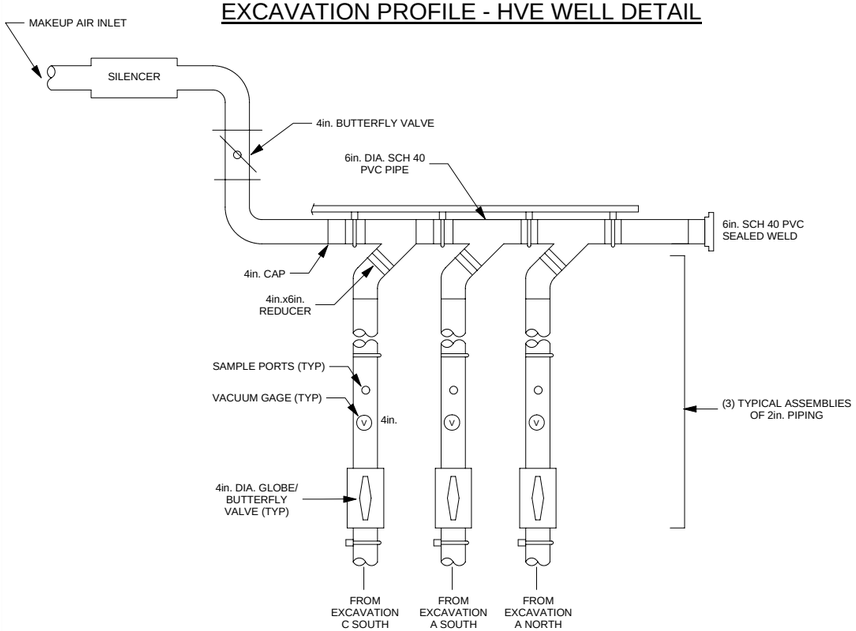
EXCAVATION PROFILE - HVE WELL DETAIL



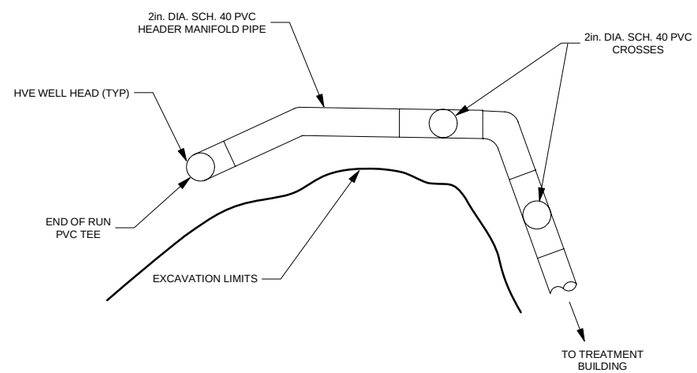
HVE WELL HEAD DETAIL



HVE HEADER PIPE TRENCH DETAIL



HVE MANIFOLD DETAIL



HVE HEADER PIPE DETAIL - PLAN VIEW

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HVE SYSTEM DETAILS
SOVEREIGN SPECIALTY CHEMICALS
710 OHIO STREET
BUFFALO, NEW YORK

DESIGN: KDPR	CHK'D: PMB	PROJECT NO. 25364871	FIG NO. 3-4
DRAWN: BKR	DATE: 08/22/06		

O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - Fig3-4 HVE System.mxd

RIGIDIZED
METALS
COMPANY

TEMPORARY
EQUIPMENT SHELTER

ABOVEGROUND
STORAGE TANKS

PERMANENT
SURVEY
MARKER

SEWER DISCHARGE
LOCATION
AND
SAMPLE POINT

Legend

- Sewer Discharge
- Sewer Line
- Site Limits
- Fenceline

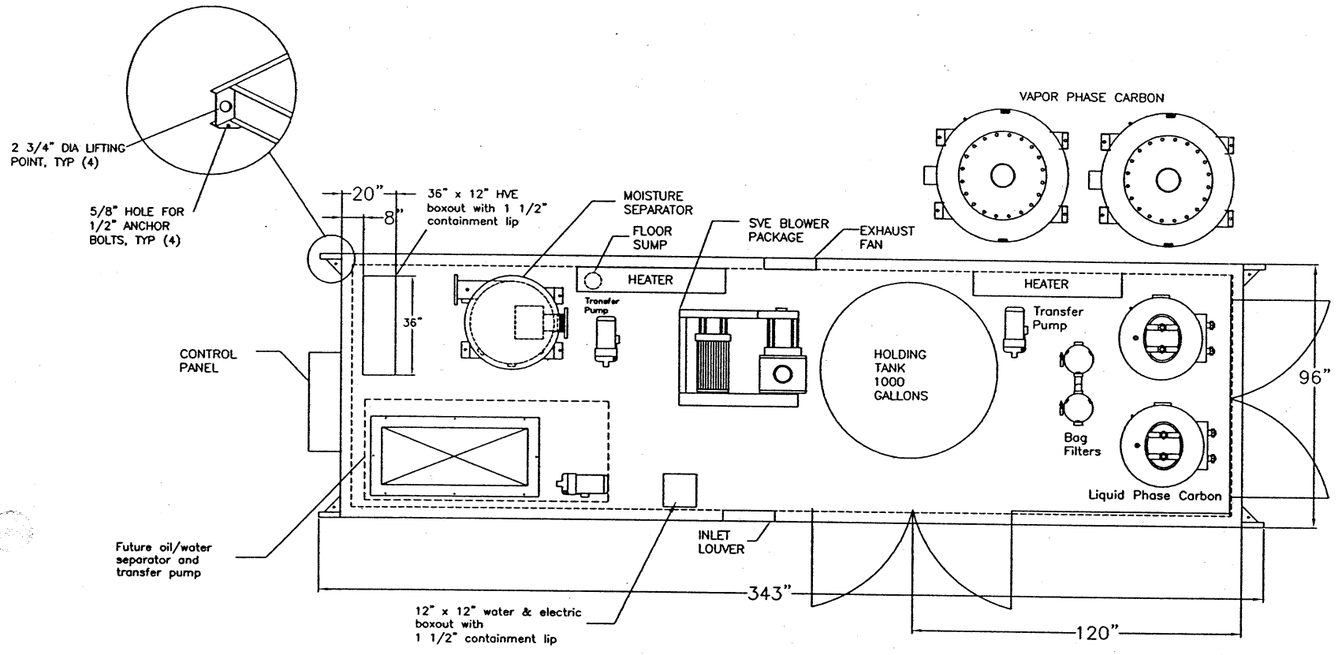
0 20 40
Feet
1 inch equals 40 feet

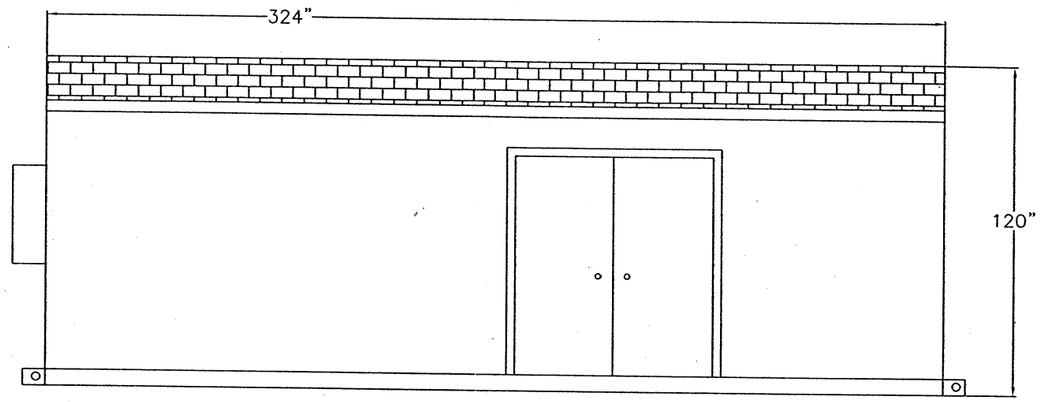
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ABOVEGROUND REMEDIATION SYSTEM DETAILS SOVEREIGN SPECIALTY CHEMICALS 710 OHIO STREET BUFFALO, NEW YORK

DESIGN: KDPR	CHK'D: PMB	PROJECT NO.	FIG NO.
DRAWN: BKR	DATE: 10/18/06	25364871	3-5

O:__Projects_(apr-mxd)_O-S\Sovereign_Buffalo\Sovereign - Buffalo NY - Fig3-5 Above.mxd





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UNLESS SPECIFIED OTHERWISE
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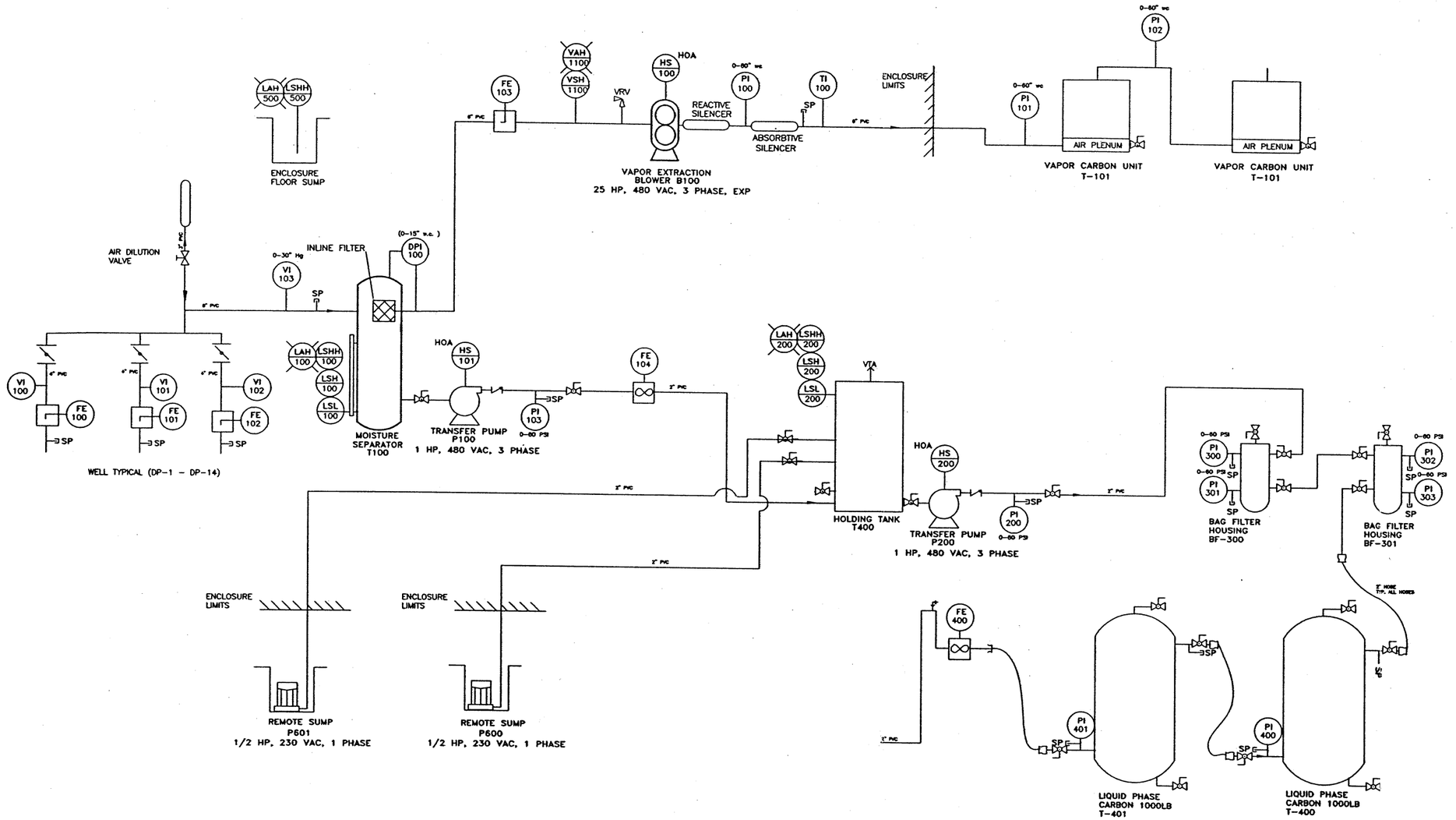
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PROJECT TITLE:
MARCOR ENV. - URS - GWTS ENCL. BUFFALO, NY

DRAWING TITLE:
GWTS Enclosure Elevation/Layout Drawing

SHEET 1 OF 1

DRAWING NO.:
1288-02



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PROJECT TITLE:
MARCOR ENV. - URS - GWTS ENCL.
BUFFALO, NY

DRAWING TITLE:
GWTS P&ID Drawing

SHEET 1 OF 1

DRAWING NO.:
1288-03

Tables

Table 3-1
Summary of Backfill Materials
Sovereign Specialty Chemicals
Buffalo, New York

Select Granular Clay Fill (Tons)	Brown Clay Fill (Estimated Tons)	Blue Clay Fill (Tons)	Crushed #2 Gravel (Tons)	<1" Crushed Run Stone (Tons)	Total (Tons)
304.06	3146.00	526.77	453.19	750.27	**5180.29**

Table 3-2
TOC-adjusted RAP Cleanup Objectives
Sovereign Specialty Chemicals
Buffalo, New York

PARAMETER	TAGM 4046 Soil Cleanup Objective (ppm)	RAP Cleanup Objective* (ppm)	GW Standard, C_w (ppm)	Partition Coefficient, K_{oc}	TOC adjusted RAP Cleanup Objective (ppm)
1,1-Dichloroethane	0.2	1	0.005	30	1.3305
1,1,1-Trichloroethane	0.76	1	0.005	152	6.7412
Acetone	0.11	1	0.05	2.2	0.9757
Ethylbenzene	5.5	1	0.005	1100	48.7850
Methylene Chloride	0.1	1	0.005	21	0.9314
Toluene	1.5	1	0.005	300	13.3050
Xylenes (total)	1.2	1	0.005	240	10.6440
Vinyl Chloride	0.12		0.002	57	1.0112
Chloroethane	1.9		0.05	37	16.4095
2-Butanone	0.3		0.05	4.5	1.9958
Trichloroethene	0.7		0.005	126	5.5881
cis-1,2-Dichloroethene	NE		NE	NE	NE
Methylcyclohexane	NE		NE	NE	NE
Cyclohexane	NE		NE	NE	NE
Benzene	0.06		0.0007	83	0.5153

Notes:

***** Site-specific cleanup objective specified in the RAP

GW = Groundwater

NE = Not Established

TAGM = Technical Administrative Guidance Memorandum

TOC = Total Organic Carbon

RAP = Remediation Action Plan

VOCs = Volatile Organic Compounds

** Calculated allowable soil concentration = CF x f x C_w x K_{oc}

where: CF = Correction Factor (100 is used as per TAGM 4046)

f = TOC (88,700 mg/kg)

C_w = Groundwater standard

K_{oc} = Partition Coefficient

Example calculation: CF = 100

f = 0.0887

Cw = 0.002

Koc = 57

Calculated allowable soil concentration = 100 x 0.0887 x 0.002 x 57

Calculated allowable soil concentration = 1.01118

Representative soil samples were collected for TOC analysis on June 13, 2003

Table 4-1
Sampling and Analysis Quality Assurance/Quality Control

Sovereign Specialty Chemicals
Buffalo, New York

Sample Container, Preservation, and Holding Time Requirements						Sample Collection and Quality Control Samples						
Parameter	Method	Container	QC	Preservative	Holding Time	Location	Frequency /Date	Number	Field Duplicate	MS/MSD	Equipment Blank	Trip Blank
HVE Vapor System (Vapor)												
CO_2	Carbon Dioxide Meter		N/A	None	None		Monthly	1	1 in 10 samples			
Volatile Organics	EPA TO-14	Summa Canister					Monthly	1	1 in 10 samples			
Methane	Methane Meter		N/A	None	None		Monthly	1	1 in 10 samples			
Vacuum	Gauge						Weekly					
Air Flow Rate	Gauge						Weekly					
Up/Down Time	Tracking System						Daily					
Operation Issues	Operator Observations						As needed					
Parameter	Method	Container	QC	Preservative	Holding Time	Location	Frequency /Date	Number	Field Duplicate	MS/MSD	Equipment Blank	Trip Blank
Effectiveness Testing of HVE System												
Volatile Organics	5035/8260B[1]	Three, 5-gram, sampling devices (e.g., Encore or equivalent)	Three, additional 5-gram, sampling devices required.	Minimal headspace; Cool 4°C±2°	Test for effervescence if affected. Transfer and freeze within 48 hours. Analyze within 14 days	Near west wall of C	Annually	3	1 in 10 samples	1 in 20 samples		

Notes:

1. SW846 - Test Methods for Evaluating Solid Wastes, Physical/Chemical.
Update III (1996). United States Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

Appendix A

Health and Safety Plan

HEALTH AND SAFETY PLAN
HENKEL BUFFALO FACILITY
710 OHIO STREET
BUFFALO, NEW YORK

JUNE 23, 2006
25364871



Prepared By:
URS Corporation
100 South Wacker Drive, Suite 500
Chicago, Illinois 60606

HEALTH AND SAFETY PLAN
HENKEL CORPORATION
BUFFALO, NY 14203

Job No.:25364871
Prepared by: Kimberly Rentz
Date: July 1, 2006

HEALTH AND SAFETY PLAN
(#)

PHONE

Project Number: **25364871**

Project Manager: **Patty M. Bryan**

Site Manager:

Site Safety Officer:

Plan Preparer: **Kimberly Rentz**

Preparation Date: **June 23, 2006**

Expiration Date: **June 23, 2007**

APPROVALS

Health, Safety, and Environment Representative:

11 Sept 06

Douglas V. Cail **(DATE)**

Regional Health, Safety, and Environment Manager:

Ceee Weldon, CSP **(DATE)**

Project Manager:

9-7-06

Patty Bryan, PG **(DATE)**

This Health and Safety Plan is valid only for this specific project as described in Section 3.0. It is not to be used for other projects or subsequent phases of this project without the written approval of the Regional Health, Safety, and Environment Manager. A copy of this plan is to be maintained at the site at all times.

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Attachments

Attachment A Hospital Route Map

Attachment B Safety Plan Compliance Agreement and Medical Emergency Contact Sheet

Attachment C Material Safety Data Sheets

GLOSSARY OF TERMS, ACRONYMS, AND ABBREVIATIONS

^{o}C	degrees centigrade
^{o}F	degrees Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
analyzer	field instrument described in Section 6.1
atm	atmosphere
C	ceiling
Carcinogen	a substance that can cause cancer
cc	cubic centimeter
CGI	combustible gas indicator
CNS	central nervous system
CSP	Certified Safety Professional
CRZ	contaminant reduction zone
DERA	Designated Emergency Response Authority
DOT	Department of Transportation
ESLI	End-of-Service-Life Indicator
eV	electron volts
EZ	Exclusion Zone
FID	flame ionization detector
HEPA	high-efficiency particular arrestor
Hnu	ionizing radiation detection device
HSM	Health and Safety Manager
HSP	Health and Safety Plan
kg	kilogram
LEL	lower explosive limit
Lpm	liters per minute
m	meter
mg	milligram
mg/M^3	milligrams per cubic meter
ml	milliliter
mm	millimeter
MSDS	Material Safety Data Sheet
ND	not detected
NIOSH	National Institute for Occupational Safety and Health

GLOSSARY OF TERMS, ACRONYMS, AND ABBREVIATIONS (Continued)

O_2	oxygen
OBZ	operator's breathing zone
OEL	occupational exposure limit
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
OVM	organic vapor monitor
PEL	permissible exposure limit
PID	photoionization detector
PM	project manager
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
REL	recommended exposure limit
RSO	Radiation Safety Officer
RHSEM	Regional Health, Safety, and Environment Manager
SMS	Safety Management Standard
SSO	Site Safety Officer
SSR	Subcontractor's Safety Representative
STEL	short term exposure limit
TLV	threshold limit value
TWA	time-weighted average
UEL	upper explosive limit
URS	URS Corporation and subsidiaries
VOC	volatile organic compound

1.0 PLAN-AT-A-GLANCE

HEALTH AND SAFETY PLAN SUMMARY SHEET

THIS SUMMARY SHEET IS PROVIDED AS A QUICK-REFERENCE/OVERVIEW ONLY. THE REMAINDER OF THIS SITE-SPECIFIC HEALTH AND SAFETY PLAN (HSP) IS INTEGRAL TO THE SAFE CONDUCT OF SITE OPERATIONS AND MUST BE APPLIED IN ITS ENTIRETY.

EMERGENCY INFORMATION

Ambulance:	**911**
Fire:	**911**
Police:	**911**
Hospital:	**911**

Project Manager:	**Patty M. Bryan**	**312-697-7240** **312-403-0846 (cell)**
Health, Safety, and Environment Representative:	**Doug Cail**	**312-697-7247** **630-333-7742 (cell)**
Regional Health, Safety, and Environment Manager:	**Cece Weldon**	**248-994-7466** **248-752-3405 (cell)**
Occupational Health Specialist	**Jeanette Schrimsher, RN**	**866-326-7321**

Alternates:

National Response Center: **(800) 424-8802**

HOSPITAL DIRECTIONS:

To reach the hospital from the site, go north on Ohio Street (0.4 miles). Continue on Louisiana Street (0.8 miles), bear Right to take the I-190 South ramp (0.2 miles), merge on I-190 South (1.6 miles). Take the Seneca St (Rt-16) exit, exit #3 (0.2 miles), continue on Keating Street. Turn Left on Elk Street (0.1 miles). Turn Right on Bailey Avenue (0.4 miles). Bear Left on McKinley Pky (0.3 miles), continue on Southside Pky. Turn Left on Abbott Rd (0.8 miles). Mercy Hospital is located at 565 Abbott Rd, Buffalo, New York 14220-2039.

Additional information concerning emergency procedures is located in Section 11.0, and the hospital route map is located in Attachment A. A copy of the hospital route map must be readily available in each site vehicle that may be used to transport accident victims to the hospital.

CONSTITUENTS OF CONCERN

1. **Acetone**
2. **Benzene**
3. **Chloroethane**
4. **1,1-Dichloroethane**
5. **Ethyl benzene**
6. **Methylene Chloride**
7. **Toluene**
8. **1,1,1-Trichloroethane**
9. **Xylene**

Additional information regarding site history, constituents of concern, and scope of work activities is located in sections 2.0 and 5.0.

PROJECT HAZARD ANALYSIS

Task Descriptions:

1. Discharge Sampling
2. Soil Sampling
3. Groundwater Sampling
4. Monitoring Well Installation / Abandonment
5. High Vaccum Extraction (HVE) Well Installation / Abandonment
6. Remediation Oversight
7. HVE Equipment Maintenance
8. Asbestos Survey / Sampling

Hazard Potential

Task	Chemical Hzds.	Heat/Cold Stress	Noise	Slip/Trip/ Fall	Lifting Hzds.	Mechanical Hzds.	Electro-cution	Explosion	Excav-ation
1.	**Low**	**Med**	**Low**	**Low**	**Med**	**Low**	**Low**	**Low**	**n/a**
2.	**Med**	**Med**	**Med**	**Low**	**Low**	**Med**	**Low**	**Low**	**n/a**
3.	**Med**	**Med**	**Low**	**Low**	**Low**	**Low**	**Low**	**Low**	**n/a**
4.	**Low**	**Med**	**Med**	**Low**	**Low**	**Med**	**Low**	**Low**	**n/a**
5.	**Low**	**Med**	**Med**	**Low**	**Low**	**Med**	**Low**	**Low**	**n/a**
6.	**Low**	**Med**	**Med**	**Med**	**Low**	**Med**	**Low**	**Low**	**Med**
7.	**Low**	**Med**	**High**	**Med**	**Low**	**Low**	**Low**	**Low**	**n/a**
8.	**Med**	**Med**	**Med**	**Low**	**Low**	**Low**	**Low**	**Low**	**n/a**

High - Exposure likely more than 50% of the time
Med - Exposure likely 10 to 50% of the time
Low - Exposure likely less than 10% of the time
n/a – Exposure not anticipated

Additional information concerning project hazards and their control can be found in Section 5.0.

Task	Minimum Protective Clothing/Equipment Requirements
1.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
2.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
3.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
4.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
5.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
6.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
7.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.
8.	Steel-toed boots, hard hat, safety glasses, hearing protection, work gloves, nitrile gloves when handling potentially contaminated materials, surgical nitriles for handling samples.

PROTECTIVE CLOTHING (FIRST ACTION LEVEL)

Chemical Protective Clothing
Outer Coveralls: **Kleenguard® or Tyvek®***
Outer Gloves: **Nitrile**
Inner Gloves: **Surgical Nitriles**
Chemical protective steel-toed boots or chemical-resistant boot covers over steel-toed boots

*** Substitute poly-Coated Tyvek® if there is a potential for contact with liquids (groundwater, mud, etc.)**

The HSP Preparer has conducted a Hazard Assessment for this project based on information provided by the Project Manager, in accordance with 29 CFR 1910.132(d).

For more information on Personal Protective Equipment (PPE) and respiratory protection requirements, see the Action Levels table (Page 4) and Section 7.0.

ENGINEERING CONTROLS TO BE USED (AS APPLICABLE)

- **Water spray for dust suppression**
- **Natural wind forces to reduce exposure to airborne contaminants**
- **Forced air ventilation (fans) to reduce potential airborne exposures**
- **Light-colored PPE to reduce solar load for heat stress control**
- **Dining canopy to provide shaded work/rest area for heat stress control**

For more information, see Section 5.0.

INSTRUMENTATION TO BE USED

__ **HNu Photoionization Detector (PID) w/ __ eV probe**
__ **Organic Vapor Monitor (OVM), PID w/ __ eV lamp**
__ **Photovac Microtip PID w/ __ eV lamp**
X **MiniRAE PID w/ 10.6 eV lamp**
__ **Combustible Gas/O_2 Indicator**
__ **Foxboro Organic Vapor Analyzer (OVA) Flame Ionization Detector (FID)**
__ **Miniram Real-time Dust Monitor**
__ **Other _____**

For more information, see Section 6.0

PERSONAL EXPOSURE SAMPLING

__ **Will be conducted**
X Will be conducted if PID readings require the use of respiratory protection as described in the Action Level Table (page 4) and in Section 6.1.1
__ **Is not anticipated**

For more information on monitoring, see Section 6.0.

HAZ-COM MATERIALS INVENTORY

- **TSP or Alconox (decontamination)**
- **Methane (calibration gas)**
- **Sulfuric Acid (sample preservative)**
- **Isobutylene (calibration gas)**
- **Nitric Acid (sample preservative)**
- **Hydrochloric Acid (sample preservative)**

ACTION LEVELS (FOR PHOTOIONIZATION DETECTOR)

Analyzer Reading (above background)	Location	Duration	Action	Personal Protective Equipment
<1 ppm	Point of Operations/Release Source point	-----	Continued periodic monitoring.	Minimum site ensemble
> 2 ppm	**OBZ**	**>1 minute**	**Use colormetic tubes to determine the presence of benzene. If benzene is not detected, continue monitoring for benzene every 15 minutes to confirm absence of benzene.**	**If benzene is present at levels greater than 0.5 ppm, upgrade to a full-face respirator with P100/organic vapor cartridges. If benzene is not present, follow action levels below.**
>5 ppm **(1st Action Level)**	Point of Operations/Release Source point	> 1 minute	Monitor OBZ; don protective clothing; establish work zones as described in Section 8.1.	Minimum Site Ensemble, PLUS: Chemical-resistant boot covers or steel-toed boots, Tyvek ® coveralls*, Nitrile Outer Gloves, and Nitrile Inner (surgical) gloves
>5 ppm **(2nd Action Level)**	OBZ (Operators Breathing Zone)	> 1 minute	Provide respiratory protection; establish decon area as described in 10.0. **Contact the RHSEM to perform personal monitoring as described in Section 6.1.1.**	Add full-face respirators with organic vapor cartridges
>20 ppm **(3rd Action Level)** 100 ppm	OBZ OBZ	>1 minute Instantaneous	Stop work; move upwind while vapors dissipate. If elevated levels remain, cover boring and cuttings, evacuate upwind, and notify RHSEM or PM.	As specified by RHSEM

* Substitute poly-coated Tyvek® if there is potential for contact with liquids (groundwater, mud, etc).

OBZ = Operator's Breathing Zone
ppm = parts per million

For additional information on Action Levels and their implementation, see Sections 6.0 and 7.0.

HEALTH AND SAFETY EQUIPMENT LIST

Required	Not Required	
X		URS SMSs (relevant to project - see next page)
	X	Occupational Safety and Health Administration (OSHA) “Safety on the Job” Posters
X		Hardhats
X		Safety glasses
X		Ear plugs or muffs
	X	Cotton coveralls
	X	Traffic safety vest
	X	Tyvek® coveralls
	X	Polycoated Tyvek® Q-23 coveralls
X		Steel-toed boots
X		Chemical-resistant steel-toed boots or chemical-resistant boot covers
X		Work gloves
X		Nitrile outer gloves
	X	Surgical nitrile inner gloves
X		Plastic sheeting (visqueen)
	X	55-gallon 17-H drums (for contaminated solids)
	X	55-gallon 17-E drums (for liquids)
	X	Drum liners
	X	Barricade tape and barricades
X		Wash tubs and scrub brushes
X		Decontamination solution (i.e., TSP)
	X	Folding chairs
	X	5- or 10-gallon portable eyewash
	X	Respirator sanitizing equipment
X		First aid kit
	X	Infection control kit
X		Drinking water
X		Gatorade or similar drink
	X	Type ABC fire extinguishers
	X	Half-face respirators approved by National Institute for Occupational Safety and Health (NIOSH)
X		Full-face respirators (NIOSH-approved)
X		Respirator cartridges GMC P100
X		PID w/[10.6] lamp and calibration kit
		Combustible gas indicator (CGI) and calibration kit
	X	Garden sprayer
	X	Compressed gas horn
X		Duct tape
X		Paper towels and hand soap
	X	Spill sorbent
X		Plastic garbage bags
	X	Broom and/or shovel

SAFETY MANAGEMENT STANDARDS REFERENCED BY THIS HSP

SMS	TOPIC	HSP SECTION
2	Worker Right to Know	5.1.2
18	Heat Stress	5.2.1
26	Noise and Hearing Conservation	5.2.3
69	Manual Material Handling	5.2.5
19	Heavy Equipment Operations	5.2.6
34	Utility Clearances	5.2.7
32	Traffic Control	5.2.8
13	Excavation Safety	5.2.9
43	Industrial Hygiene Monitoring	6.1.1
29	Personal Protective Equipment	7.0
42	Respiratory Protection	8.3/8.9
30	Sanitation	10.1
14	Fire Prevention	12.2
49	Incident Reporting	12.6
65	Injury Management	12.6

These SMSs can be found attached to Attachment B. Copies of the SMSs referenced by this HSP are to be maintained on site. Project Managers (PMs) are responsible to see that other SMSs relevant to field activities, but not directly referenced by this HSP, also are available on site.

2.0 FACILITY BACKGROUND/WORK PLAN

2.1 SITE HISTORY

Environmental investigations have been ongoing at the Site since 1996. Preliminary investigations included Phase I and Phase II Environmental Site Assessments (ESAs) completed in 1996 for the Pierce and Stevens facility. The ESAs found soil and groundwater impacts from volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The ESA provided the background for the investigations and remedial actions to follow.

Early investigations focused on the soils of the tank-farm footprint. A site investigation of the tank farm footprint was completed in 1997 to further assess the impacts discovered during the ESA. A Removal Action Work Plan was provided to New York State Department of Environmental Conservation (NYSDEC) in May 1999 to act as a guidebook for conducting the soil removal action associated with the construction of the new tank farm at the facility. A revision of the work plan was provided to NYSDEC in June 1999. The tank farm footprint soil removal action was completed in the summer of 1999 as summarized in the April 2000 submittal of the draft Removal Action Implementation Report.

A groundwater investigation was conducted across the site in 1999 and 2000. A work plan outlining the procedures and sampling requirements for the installation of groundwater monitoring wells at the Site was submitted to NYSDEC in January 1999. The draft groundwater investigation report was submitted to NYSDEC in October 1999. The groundwater investigation observed a low hydraulic gradient at the site. The investigation indicated the presence of impacts on the site; however, impacts were likely to remain on-site due to the hydraulic conductivity. A final version of the investigation report was submitted to NSYDEC in March 2000.

In March 2000 a Site Investigation work Plan was submitted to NYSDEC. The work plan laid out the strategy for defining the nature and extent of contamination for the portion of the site not included in the Tank Farm Footprint. The site investigation report (IT, 2001a), submitted in January 2001 revealed the presence of three VOC "hot spots." These "hot spots" were identified for future remedial action and are the subject of this report. As requested by NYSDEC a supplemental site investigation was completed. The scope of work for the supplemental investigation was outlined in the May 2001 work plan. The results of the supplemental site investigation were reviewed during the preparation of the RAP. The RAP was submitted by IT in January 2002. Final revisions were completed by URS in May 2002.

An off-site investigation was completed in June 2002 in accordance with the RAP to evaluate abutting properties adjacent to areas of elevated organic contamination at the Site. The two areas of investigation include the CSX railroad property along the east boundary of the Site and the Rigidized Metals property bordering the Site to the northwest. Results of the offsite investigation were presented to NYSDEC in the September 2002 report "Sovereign Packaging Group (Formerly Pierce & Stevens) Off-site Sampling Results."

The Rigidized Metals property showed exceedances of cleanup objectives for methylene chloride in soil samples and 1,1,1-trichloroethane, 1,1-dichloroethane, and chloroethane in groundwater samples. CSX railroad property showed exceedances of cleanup objectives for methylene chloride and acetone in soil samples and benzene, ethylbenzene, toluene, and total xylenes in groundwater samples.

The RA activities were divided into underground and aboveground activities. Underground activities began on May 1, 2003 with site mobilization and continued until August 1, 2003. Underground activities

included excavation of contaminated soils from Areas B and C, therefore, the installation of a HVE system was unnecessary with the exception of the west wall of Excavation C. A HVE system was installed as a stand-alone treatment for the impacts in Area A which was not excavated due to the proximity to a nitrogen tank. Based on the pilot test of the HVE system conducted in Area A, HVE wells were installed where necessary. Groundwater collection systems were installed in Excavation B and C prior to backfilling with clean material.

Aboveground activities began at the completion of the underground activities and continued until July 16, 2004, during which time the HVE treatment system was completed and equipment was housed in a temporary shelter, electrical power was connected to the treatment building and system, and the groundwater collection and HVE systems were connected to the local sanitary sewer.

2.2 PURPOSE AND SCOPE OF WORK

This Health and Safety Plan (HASP) will be used for all fieldwork at the Henkel Corporation in Buffalo, New York. The program outlined in this document will assist all personnel as to the applicable health and safety procedures for their site activities. This HASP applies to all URS personnel performing fieldwork at the site and any URS subcontractors. However, URS may require specific subcontractors to provide additional site specific health and safety plans that address the activities of their employees relative to this project. All other Health and Safety plans must be consistent with or more stringent than the provisions of this plan.

Field activities at the Henkel Buffalo site focus on the operation, maintenance and monitoring of the HVE system on-site. Activities include but are not limited to sampling of discharge into the Buffalo Sewer Authority sewer system, soil and groundwater sampling, monitoring well installation and abandonment, HVE well installation and abandonment, remediation oversight, HVE equipment maintenance and asbestos survey/sampling.

This plan complies with, but does not replace, Federal Health and Safety Regulations as set forth in 29 CFR 1910 and 1926, and applicable state regulations. Due to changing or unanticipated site conditions, this plan may be subject to modification. Any proposed changes to this plan shall be reviewed by the URS Regional Health and Safety Manager prior to implementation. Under no circumstances will modifications to this plan conflict with federal, state, or other governmental health and safety regulations.

3.0 APPLICABILITY

The purpose of this HSP, which was developed specifically for operations at the Henkel Corporation site [Buffalo, New York], is to assign responsibilities, establish personal protection standards and mandatory safety procedures, and provide for contingencies that may arise while operations are being conducted at the site. This HSP complies with, but does not replace, Federal Health and Safety Regulations, as set forth in 29 CFR 1910 and 1926, and applicable state regulations. This HSP is to be used by URS personnel as a supplement to these rules, regulations, and guidance. This HSP is to be augmented by the URS Health, Safety, and Environment Program and Management System; relevant standards from that program and system are required to be available on site during all activities.

The provisions of the HSP are mandatory for all onsite URS employees engaged in hazardous material management activities associated with this project, which may involve health and safety hazards.

Changing and/or unanticipated site conditions may require modification of this HSP to maintain a safe and healthful work environment. Any proposed changes to this plan will be reviewed with a URS health, safety, and environment professional prior to their implementation. If this is not feasible, the Site/Project Manager may modify the plan and record all changes in the field log book; under no circumstances will modifications to this plan conflict with federal, state, or other governmental health and safety regulations.

URS is providing a copy of this HSP to each site subcontractor to fulfill its obligation under 29 CFR 1910.120(b) to inform subcontractors of site hazards. In turn, each subcontractor will provide documentation to URS that describes their plan for addressing applicable the health and safety requirements for activities that are unique to their scope of services (for example: drill rig operation, excavation safety, electrical safety, etc).

4.0 RESPONSIBILITIES

URS will have site safety and health oversight and coordination responsibilities for URS personnel; each subcontractor will be held accountable for the safe and healthful performance of work by each of its employees, subcontractors, or support personnel who may enter the site.

URS will adhere strictly to the provisions of this HSP, along with applicable regulations issued by governmental entities.

4.1 PROJECT MANAGER (URS)

The PM will direct URS onsite operations. The PM may delegate all or part of these duties to a properly qualified URS employee who is designated as the Site Manager. At the site, the PM, assisted by the Site Safety Officer (SSO), has primary responsibility for the following.

- Seeing that appropriate PPE and monitoring equipment are available and properly used by all onsite URS employees.
- Establishing that URS personnel are aware of the provisions of this HSP, are instructed in the work practices necessary to ensure safety, and are familiar with planned procedures for dealing with emergencies.
- Establishing that all URS onsite personnel have completed a minimum of 40 hours of health and safety training, have appropriate medical clearance, as required by 29 CFR 1910.120, and have been fit tested for the appropriate respirators.
- Seeing that URS personnel are aware of the potential hazards associated with site operations.
- Monitoring the safety performance of all URS personnel to see that required work practices are employed.
- Correcting any URS work practices or conditions that may result in injury or exposure to hazardous substances.
- Preparing any accident/incident reports for URS activities (see Section 12.6).
- Seeing to the completion of Safety Plan Compliance Agreements by URS personnel (See Attachment B).
- Halting URS site operations, if necessary, in the event of an emergency or to correct unsafe work practices.
- Seeing that utility clearances are obtained prior to the commencement of work (see Section **5.2.7**).
- Seeing that the appropriate SMSs are appended to this HSP and are available on site (see "Plan-at-a-Glance").
- Reviewing and approving this project HSP.

4.2 SITE SAFETY OFFICER (URS)

The SSO's duties may be carried out by the PM or another qualified URS Site Manager. The SSO is responsible for the following.

- Implementing the project HSP and reporting any deviations from the anticipated conditions described in that plan to the PM and, if necessary, the RHSEM.
- Determining that monitoring equipment is used properly by URS personnel and calibrated in accordance with manufacturer's instructions or other standards and that results are properly recorded and filed.
- Checking with a URS Health, Safety, and Environment Representative to assure URS personnel have current medical clearance and training.
- Assuming any other duties as directed by the PM or RHSEM.
- Coordinating with a URS health, safety, and environment professional to identify URS personnel on site for whom special PPE, exposure monitoring, or work restrictions may be required.
- Conducting safety meetings for all site personnel in accordance with Section 13 of this HSP.
- Conducting daily site inspections prior to the start of each shift. All inspections must be documented (preferably in a bound field logbook).
- Providing ongoing review of protection level needs as project work is performed and informing the PM of the need to upgrade/downgrade protection levels, as appropriate.
- **Contacting the RHSEM to perform personal industrial hygiene monitoring for aromatic hydrocarbons if the second action level is reached (>5 ppm in the OBZ), as described in the Action Level Table (page 4) and Section 6.1.1.**
- Seeing that decontamination procedures described in Section 10.0 are followed by URS personnel.
- Establishing monitoring of URS personnel and recording the results of exposure evaluations.
- Halting URS site operations, if necessary, in the event of an emergency or to correct unsafe work practices.
- Maintaining the visitor log.
- Posting OSHA "Safety of the Job" and other required posters at the site.

4.3 REGIONAL HEALTH, SAFETY, AND ENVIRONMENT MANAGER (URS)

The RHSEM is responsible for:

- Determining the need for periodic audits of the operation to evaluate compliance with this plan; and
- Providing health and safety support as requested by the SSO and PM.

4.4 PROJECT PERSONNEL (URS)

Project personnel involved in onsite investigations and operations are responsible for:

- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees;
- Performing only those tasks that they believe they can do safely and immediately reporting any accidents and/or unsafe conditions to the SSO or PM;
- Implementing the procedures set forth in the HSP and reporting any deviations from the procedures described in that HSP to the SSO or PM for action;
- Notifying the PM and SSO of any special medical problems (i.e., allergies) and seeing that all onsite URS personnel are aware of such problems; and
- Reviewing the project HSP and signing the Safety Plan Compliance Agreement.

4.5 SUBCONTRACTOR'S SAFETY REPRESENTATIVE

Subcontractors are requested to designate an on-site employee (preferably a manager) who will serve as the Safety Representative (SSR) for their company. In this capacity, the SSR is responsible for providing health and safety oversight of their personnel participating on the project team. In addition, the SSR will perform routine work area inspections, conduct safety meetings, provide safety orientations for new employees and investigate incidents involving their employees. The SSR will attend periodic safety meetings with the URS SSO.

5.0 JOB HAZARD ANALYSIS

5.1 CHEMICAL HAZARDS

Two categories of chemical hazards are associated with site activities:

- Site constituents; and
- Chemicals used to conduct the site work.

Site constituents are those that exist at the site and are the cause for conducting site activities. The chemicals that are brought on site to conduct the work may be hazardous and subject to regulation under OSHA's Hazard Communication Standard (29 CFR 1910.1200).

5.1.1 Site Constituents

From an occupational health standpoint, given that any potential exposure to site personnel will be only for a short period of time (intermittent for several days), the levels of contaminants that have been, or could be, encountered during site activities should not represent a significant concern if the provisions of this HSP are appropriately implemented. However, given that the site is still under monitoring, the potential for exposure to elevated levels of these contaminants may exist. Exposure to elevated levels of these contaminants may pose hazards. Overviews of these hazards are presented here in terms of the following types of occupational exposure limits:

- PEL Permissible Exposure Limit (OSHA Standard)
- TLV Threshold Limit Value (American Conference of Governmental Industrial Hygienists [ACGIH] Guidance)
- REL Recommended Exposure Limit (NIOSH Guidance)
- STEL Short Term Exposure Limit
- C Ceiling

OSHA PELs, ACGIH TLVs, and NIOSH RELs are time-weighted averages (TWAs), which are defined as concentrations for a normal 8-hour work day and 40-hour work week to which almost all workers can be exposed repeatedly without suffering adverse health effects.

STEL is defined as the concentration to which workers can be exposed for short time periods without irritation, tissue damage, or narcosis sufficient to be likely to cause impairment of self-rescue or to precipitate accidental injury. The STEL is a 15-minute TWA that will not be exceeded at any time during the workday. STELs are used by OSHA, ACGIH, and NIOSH for chemical exposure criteria.

A ceiling value (C) is a concentration that will not be exceeded at any time in any workday. Ceiling limits are used by OSHA, ACGIH, and NIOSH for chemical exposure criteria.

Summaries on the site constituents of concern follow:

Chemical	Flashpoint (F)	Vapor Pressure (mmHg @ 20 C)	Occupational Exposure Limit	Critical Effects	Dermal Hazard	Inhalation Hazard
Acetone CAS# 67-64-1	15	182	500 ppm 8 hr TWA-TLV, 750 ppm STEL	Irritation	No	No
Benzene CAS # 71-43-2	12	76	0.5 ppm 8 hr TWA-TLV, 2.5 ppm STEL, A1	Cancer	Yes	Yes
Chloroethane CAS# 75-00-3	-58 open cup	1000	100 ppm TWA	Liver	Yes	Yes
1,1-Dichloroethane CAS #75-34-3	57 open cup	182	100 ppm 8 hr TWA-TLV	Liver, kidney, irritation, dermal irritation	Yes	Yes
Ethyl benzene CAS #100-41-4	64	7	100 ppm 8 hr TWA-TLV, 125 ppm STEL, A3	Irritation, CNS	No	No
Methylene Chloride CAS# 75-09-2	Non flammable	349	25 ppm 8 hr TWA PEL, 12.5 ppm 8 hr TWA Action Level, 125 ppm STEL, A3	CNS, anoxia	No	No
Toluene CAS # 108-88-3	40	22	50 ppm 8 hr TWA-TLV, Skin A4	Irritation	No	Yes
1,1,1-Trichloroethane CAS# 71-55-6	Non flammable	100	350 ppm 8 hr TWA-TLV, 450 ppm STEL, A4	Anesthia, CNS, dermal irritation	Yes	Yes
Xylene CAS #s 95-47-6, 108-38-3, 106-42-3	77	18 @ 38 C	100 ppm	Odor	No	No

Material Safety Data Sheets (MSDSs) for the hazardous constituents listed in the table above, will be maintained and kept up-to-date by the PM, with assistance from the SSO.

Skin contact with potentially contaminated materials will be minimized by the use of personal protective clothing (as described in Sections 1.0 and 7.0). Inhalation of vapors or particulates during site activities will be minimized by air monitoring and the use of engineering controls, and respiratory protection will be used if the action levels described in Section 1.0 are exceeded. Ingestion of contaminated materials will be minimized by the use of appropriate personal hygiene procedures during decontamination (i.e., thoroughly washing face and hands with soap and water after leaving the work area and prior to eating or drinking).

5.1.2 Hazard Communication Materials

Materials that are considered hazardous materials under the OSHA Hazard Communication Standard (29 CFR 1910.1200) may be used during this project. In accordance with the URS Hazard Communication Program, the MSDSs for the hazardous materials listed in Section 1.0 are included in Attachment E. The SSO will make copies of these MSDSs available to any subcontractors (i.e, drillers, excavators) on this project.

URS' written Hazard Communication Program is located in SMS 002, a copy of which is to be maintained on site.

5.2 PHYSICAL HAZARDS

Physical hazards at this work site include:

- Heat stress and cold stress;
- Noise from the operation of site equipment;
- Slip-trip-fall types of accidents;
- Back injuries resulting from improper lifting;
- Being caught in or struck by moving equipment;
- Electrocution or explosion hazards associated with drilling or excavation activities**,** such as contact with overhead or underground power lines or pipelines;
- Excavation hazards; and
- Muscle strains from hand-auger work.

5.2.1 Heat Stress Recognition and Control

Heat stress monitoring will commence when personnel are wearing PPE, including Tyvek®-type coveralls, and the ambient temperature exceeds 70°F. If standard work garments (cotton coveralls) are worn, monitoring will commence at 85°F. Heat stress monitoring and control guidance can be found in Attachment F. Additional information regarding heat stress is provided in SMS 018, a copy of which is to be maintained on site.

5.2.2 Cold Stress Recognition and Control

Protection against cold stress will be initiated when temperatures drop below 45°F. Cold stress guidance is provided below [and in Attachment F].

Exposure to cold working conditions can result in cold stress (hypothermia) and/or injury (frostbite) to hands, feet, and head. Hypothermia can result when the core body temperature drops below 36°C (96.8°F). Lower body temperature will be likely to result in dizziness, drowsiness, disorientation, slurred speech, or loss of consciousness, with possible fatal consequences. Pain in the extremities may be the first warning of danger from cold stress. Shivering develops when the body temperature falls to 35°C (95°F).

Hypothermia can be brought on by exposure to cold air, immersion in cold water, or a combination of both. The wind chill factor, which is the cooling power of moving air, is a critical factor in cold stress.

Workers must wear adequate insulating clothing if work is performed in temperatures below 4°C (40°F). At temperatures of 2°C (35.6°F or less), workers whose clothing becomes wet will be provided immediately with a change of clothing and, if necessary, treated for hypothermia. Treatment includes warming the victim (with skin-to-skin contact or by providing warm blankets or other coverings) and providing warm liquids for the victim to drink. Skin exposure will not be permitted at temperatures of -32°C (-25°F) or below.

If fine work is to be performed with bare hands for more than 10 to 20 minutes at temperatures below 16°C (60°F), provisions will be made for keeping the workers' hands warm. If equivalent chill temperatures fall below 40°F, and fine manual dexterity is not required, gloves will be worn. Metal handles of tools will be covered with insulating material at air temperatures below -1°C (30°F).

If work is to be performed continuously in the cold when the wind chill factor is at or below -7°C (19°F), heated warming shelters (tents, trailers, vehicle cabs) will be made available nearby.

5.2.3 Noise Hazards

Previous surveys indicate that heavy equipment, such as drilling equipment, may produce continuous and impact noise at or above the action level of 85 dBA. All URS personnel within 25 feet of operating equipment or near an operation that creates noise levels high enough to impair conversation will wear hearing protective devices (either muffs or plugs). URS personnel who are in the Medical Surveillance Program are automatically enrolled in the URS Hearing Conservation Program and have had baseline and, where appropriate, annual audiograms. Personnel will wash their hands with soap and water prior to inserting earplugs to avoid initiating ear infections. Additional information regarding the URS Hearing Conservation Program is located in SMS 026, a copy of which is to be maintained on site.

5.2.4 Slip/Trip/Fall Hazards

Workers should exercise caution when walking around the site to avoid fall and trip hazards. If there are holes or uneven terrain in the work area that could cause site personnel to fall or trip, they must be covered, flagged, or marked to warn workers. Workers should exercise caution around open excavations, such as test pits, and avoid getting closer than 2 feet to the edge of an unsloped excavation unless guardrails or fall protection is provided. If conditions become slippery, workers should take small steps with their feet pointed slightly outward to decrease the probability of slipping. Gravel or sand will be spread in muddy areas to reduce slipperiness. Workers should watch where they are walking and walk only in areas of good stability.

5.2.5 Lifting Hazards

The following guidelines will be followed whenever lifting equipment such as portable generators, coolers filled with samples, and any other objects that are of odd size or shape or that weigh over 40

pounds. Safe lifting procedures are described in SMS 069, a copy of which is to be available on site. The procedures include the following.

- Get help when lifting heavy loads. Lift portable generators using a two-person lift.
- When moving heavy objects, such as drums or containers, use a dolly or other means of assistance.
- Plan the lift. If lifting a heavy object, plan the route and where to place the object. In addition, plan communication signals to be used (i.e., "1,2,3, lift," etc.)
- Wear sturdy shoes that are in good condition and supply traction when performing lifts.
- Keep your back straight and head aligned during the lift, and use your legs to lift the load – do not twist or bend from the waist. Keep the load in front of you – do not lift or carry objects from the side.
- Keep the heavy part of the load close to your body to help maintain your balance.

5.2.6 Heavy Equipment

Operation of heavy equipment during site activities presents potential physical hazards to personnel. Issues associated with heavy equipment operations are addressed in SMS 019, a copy of which is to be maintained on site.

The following precautions must be observed whenever heavy equipment is in use:

- Wear PPE, such as steel-toed shoes, safety glasses or goggles, and hard hats, whenever such equipment is present.
- At all times, be aware of the location and operation of heavy equipment, and take precautions to avoid getting in the way of its operation. Never assume that the equipment operator sees you. Make eye contact and use hand signals to inform the operator of your intent, particularly if you intend to work near or approach the equipment.
- Traffic safety vests ARE REQUIRED for URS personnel working near mobile heavy equipment, such as backhoes and other excavators.
- Never walk directly in back of or to the side of heavy equipment without the operator's acknowledgment.
- When an equipment operator must operate in tight quarters, the equipment subcontractor will provide a person to assist in guiding the operator's movements.
- Keep all non-essential personnel out of the work area.

5.2.7 Underground and Aboveground Utilities

The Site Manager or SSO is responsible for locating underground utilities before the commencement of any subsurface (> 0.3 meter [1 ft.]) activities. Resources include site plans, utility companies, and regional utility locating services. The proper utility company personnel will certify in writing to the Site Manager or SSO that underground utilities have been deactivated, and the certification will be retained in the project files.

Procedures for activities conducted proximate to utility locations are located in SMS 034, a copy of which is to be maintained on site.

Excavation, drilling, crane work, or similar operations adjacent to overhead lines will not be initiated until operations are coordinated with utility officials. Operations adjacent to overhead lines are prohibited unless one of the following conditions is satisfied.

Power has been shut off and positive means (e.g., lockout/tagout) have been taken to prevent lines from being energized. Wherever possible, the URS SSO will observe power shut off and place a lock and tag on the switch. In all cases, utility company personnel will certify in writing to the Site Manager or SSO that the overhead utilities have been deactivated, and the certification will be retained in the project files. The Site Manager or SSO must also attempt to verify power shut off by checking that power is no longer available to the affected building or equipment.

Equipment, or any part of the equipment, cannot come within the following minimum clearance from energized overhead lines:

Power Lines Nominal System (kv)	Minimum Required Clearance
0-50	**10 feet**
51- 200	**15 feet**
201-300	**20 feet**
301-500	**25 feet**
501-750	**35 feet**
751-1000	**45 feet**

5.2.8 Work Area Protection

Project operations may be undertaken in a roadway or parking lot, causing motor vehicles to pose a hazard. Guidance on properly coning and flagging the work area is provided in Attachment G. Consideration should be given to parking work vehicles within the coned area between the work area and oncoming traffic. Procedures for work zone traffic control are provided in SMS 032, a copy of which is to be maintained on site.

5.2.9 Trenching and Excavation

All URS personnel are prohibited from entering a trench or excavation until it has been inspected by a competent person in accordance with 29 CFR 1926.650-651. If personnel are required to enter a trench or excavation that is deeper than ***5*** feet, the contractor who created the excavation must provide the following prior to personnel entry.

- If hazardous atmospheres are suspected, any trench or excavation more than 4 feet deep must be monitored.
- Adequate shoring, sloping, or benching techniques must be employed.
- Adequate means of employee access and egress must be used.
- The contractor's trained, competent person must inspect the trench or excavation daily, before work commences and on an as-needed basis throughout the day.

A copy of the Fed-OSHA Excavation Standard can be obtained from the Regional Health, Safety, and Environment Manager. Compliance with all provisions of this regulation must be maintained when

working in a trench or excavation. Additional information regarding URS procedures for excavation activities is located in SMS 013, a copy of which is to be maintained on site.

5.2.10 Hand Augering

Muscle strains can occur with hand augering. To minimize the occurrence of injury, the following will be observed.

- Keep augers sharp – a dull auger requires more work to advance through the soil.
- Before beginning work, stretch or warm up the body as you would prior to exercising.
- Try to avoid excessive twisting or wrenching motions when using the auger.

6.0 EXPOSURE MONITORING PLAN

Heat stress, noise, and chemical exposures may be encountered at this site. Heat stress monitoring and prevention is addressed in Section 5.2.1. Noise levels will not be monitored; URS personnel will wear hearing protection as described in Section 5.2.3.

6.1 CHEMICAL EXPOSURE MONITORING

The field instrumentation described in this HSP has been specifically selected for the contaminants that may be reasonably anticipated to be encountered during the course of this project. Selection factors include anticipated airborne concentrations, potential interference, ionization potentials, instrument sensitivity, and occupational exposure limits. The action levels specified in Section 1.0 were established with the expectation that specific instruments will be used. DO NOT SUBSTITUTE INSTRUMENTS WITHOUT THE CONSENT OF THE HSP PREPARER OR THE REGIONAL HEALTH, SAFETY, AND ENVIRONMENT MANAGER.

The monitoring equipment specified in Section 1.0 will be used on a regular basis to evaluate the potential for exposure to airborne contaminants, typically every five to ten minutes. Monitoring will be conducted in the immediate vicinity of the contaminant source point or work area (e.g., at the borehole and cuttings adjacent to the borehole). If readings exceed the first action level (>5 ppm> one minute), monitoring will start immediately in the OBZ of the person working nearest the point of operations/contaminant source, and site personnel will don protective clothing.

A reading in the OBZ above the second action level (>5 ppm > one minute) will require the use of full-face respirators with appropriate cartridges. If the monitoring instrument reads more than the third action level (>20 ppm > one minute, or 100 instantaneously), work will stop, and workers will move upwind while the airborne contaminants dissipate. If elevated levels remain for more than five minutes, the source of the airborne contamination will be covered with clean soil, plastic sheeting, or foam (or be controlled in an appropriate manner), and the Health, Safety, and Environment Representative or PM will be contacted for further guidance.

6.2 PERSONAL EXPOSURE MONITORING

In accordance with 29 CFR 1910.120(h), a URS industrial hygienist will perform quantitative personal monitoring of personnel at the greatest risk of exposure (i.e., those working in the EZ). The industrial hygienist will determine who to sample based on site conditions at the time of the sampling; monitoring will commence when the second action level is exceeded.

Personnel will be monitored for VOCs in accordance with NIOSH Method 2549. A laboratory accredited by the American Industrial Hygiene Association will perform analyses; results will be reported and records will be maintained in accordance with OSHA criteria.

Procedures for personal monitoring are located in SMS 043, a copy of which is to be maintained on site.

6.3 BACKGROUND READINGS

All direct-reading instrument readings will be evaluated relative to background readings, not “meter zero.” Prior to the start of work at each shift, and whenever there is a significant shift in wind direction,

instrument readings will be obtained upwind of the site work zone to determine the level of "background" readings from such things as local vehicle traffic or emissions from nearby operations unrelated to the site. Site readings will be evaluated against these background readings (i.e., if an action level is listed as 20 parts per million [ppm], it is evaluated as 20 ppm above background). The SSO will consult with the industrial hygienist regarding the potential health hazards associated with background readings above 5 ppm.

6.4 DATA LOGGING

All monitoring data, including background readings, will be logged in the field logbook. The results of daily instrument calibrations can be logged either on the form provided in Attachment C or in the field logbook. All monitoring instruments will be calibrated in accordance with the manufacturers' instructions prior to the start of each shift. Calibration also will be performed when inconsistent or erratic readings are obtained. **IF AN INSTRUMENT CANNOT BE CALIBRATED TO SPECIFICATION OR BECOMES OTHERWISE INOPERABLE, ALL INVASIVE SITE WORK (I.E., DRILLING, EXCAVATING) WILL CEASE UNTIL THE INSTRUMENT IS APPROPRIATELY REPAIRED OR REPLACED,** and the PM or RHSEM will be contacted for further guidance.

6.5 DUST CONTROL

High winds and site operations can cause airborne dust hazards. If site operations generate sustained visible dust, a water mist will be applied to reduce dust generation. If the mist is not effective in reducing dust generation, personnel will don respirators (half-face or full-face, as appropriate for analyzer readings) with combination organic vapor/high efficiency particulate arrestor (HEPA) cartridges (such as MSA's GMC-H cartridges).

Sand and Portland cement that may be used in groundwater monitoring well construction may contain free silica (quartz). Airborne exposure to silica dust may occur during the handling of these materials. Half-face respirators with HEPA cartridges will be worn for operations that pose a reasonable possibility of exposure to sustained airborne dust from the pouring and mixing of dry sand or cement.

7.0 PERSONAL PROTECTIVE EQUIPMENT

The minimum Personal Protective Equipment (PPE) for site personnel includes:

- Hardhat;
- Safety glasses with side shields (or impact-resistant goggles);
- Steel-toed boots or chemical-resistant steel-toed boots;
- Ear protection in the vicinity of noisy equipment;
- Work gloves and/or chemical-resistant gloves; and
- Traffic safety vest in the vicinity of heavy equipment.

As the various monitoring action levels are reached, additional PPE is required. Section 1.0 describes the incremental PPE requirements relative to specific action levels and the specific kinds of PPE to be used. Procedures for the use and selection of PPE are provided in SMS 029, a copy of which is to be maintained on site.

7.1 LIMITATIONS OF PROTECTIVE CLOTHING

The protective equipment ensembles selected for this project are anticipated to provide protection against the types and concentrations of hazardous materials that may be encountered during field operations. However, no protective garment, glove, or boot is resistant to all chemicals at any concentration; in fact, chemicals may continue to permeate or degrade a garment even after the source of the contamination is removed.

To obtain optimal usage from PPE, the following procedures are to be followed by all URS personnel.

- When using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift.
- Inspect all clothing, gloves and boots both prior to and during use for:
  - Imperfect seams;
  - Non-uniform coatings;
  - Tears; and
  - Poorly functioning closures**.**
- Inspect reusable garments, boots, and gloves prior to and during use for:
  - Visible signs of chemical permeation, such as swelling, discoloration, stiffness, or brittleness; and
  - Cracks or any signs of puncture or abrasion.

Reusable garments exhibiting any of these characteristics will be discarded.

7.2 DURATION OF WORK TASKS

The SSO will establish the duration of work tasks in which personnel use PPE ensembles that include chemical protective clothing (including uncoated Tyvek®). Variables to be considered include ambient temperature and other weather conditions, the capacity of individual personnel to work in the required level of PPE in heat and cold, and the limitations of specific PPE ensembles. Recommended rest breaks are as follows:

- Fifteen minutes midway between shift startup and lunch;
- Lunch break (30 to 60 minutes); and
- Fifteen minutes midway between lunch and shift end.

Rest breaks are to be taken in the support zone or other clean area after personnel have completed the decontamination process, including washing the hands and face with soap and water. Additional rest breaks will be scheduled according to heat stress monitoring protocols as described in SMS 18.

8.0 RESPIRATORY PROTECTION

8.1 RESPIRATOR SELECTION

Engineering controls and safe work practices (e.g., elimination of the source of contamination, ventilation equipment, working upwind, limiting exposure time, etc). always must be the primary control for air contaminants. Respirators will be used if engineering or work practice controls are not feasible for controlling airborne exposures below acceptable concentrations and as an interim control measure while engineering or work practice controls are implemented.

Once the need for respirators has been established, the respirators will be selected on the basis of the hazards to which the worker is exposed. Only NIOSH-approved respirators will be issued. Selection criteria established in 29 CFR 1910.134 have been used by the Preparer of this HSP in determining respirator requirements for this project.

> *CAUTION: Full-face piece or half-face piece air-purifying respirators are not to be used where there is an oxygen deficiency. Only air-supplied respirators with an emergency escape cylinder or self-contained breathing apparatus will be worn when an oxygen deficiency exists.*
>
> *CAUTION: A respirator does not protect against excessive heat or against a hazardous substance that can attack the body through the skin.*

Airborne contaminants have been evaluated based on the suspected contaminants of concern. The concentration of the airborne chemical hazard will be evaluated using direct-reading instruments to determine what type of respirator will be used. Airborne readings will be compared to the action levels in the table in Section 1.0. See action level/respirator requirements in Section 6.1.

8.2 MEDICAL SCREENING

Project employees are enrolled in the URS Medical Surveillance Program and are medically evaluated in compliance with the requirements of 29 CFR 1910.134(a)(10). Employees not medically cleared to wear respirators will not be assigned to this project.

The medical status of each employee is reviewed annually and as may be deemed necessary by the examining physician if the physical status of the employee changes.

8.3 FIT TESTING

A person wearing a respirator must be clean-shaven in the area of the face-piece seal. Long hair, sideburns, and skullcaps that extend under the seal are not allowed. Glasses with temple pieces extending under the seal are not allowed for full-face respirators. Persons with facial conditions that prevent a proper seal are not allowed to wear a respirator until the condition is corrected. Facial conditions that may cause a seal problem include missing dentures, scars, severe acne, etc. Contact lenses may be worn with respiratory protection.

No individual will enter an area where the use of respiratory protective equipment is required unless the person has been fit tested within the last year. Fit testing will be performed in accordance with accepted fit test procedures defined in SMS 042, a copy of which is to be maintained at the site.

Records of fit testing will be maintained on site or by the employee's office and/or corporate medical surveillance program.

Respirator wearers will perform a user seal check each time they put on the respirator. For air-purifying respirators, the positive user seal check is performed by removing the exhalation valve cover, placing the palm over the respirator exhalation valve, and exhaling gently. The respirator mask should puff out without noticeable leakage. The negative user seal check is performed by placing the palms over both of the respirator cartridges, inhaling gently, and holding the breath for 10 seconds. The respirator mask should remain collapsed on the face without noticeable leakage.

8.4 RESPIRATOR USE INSTRUCTIONS

Only those employees who have been properly trained and qualified on the specific type of respirator to be worn may use respirators. No individual will enter an area where the use of respiratory protective equipment is required unless the person has been trained.

All employees whose job assignments require the use of respirators are trained in accordance with 29 CFR 1910.134 during an initial 40-hour and annual refresher training for hazardous waste operations.

Hands-on training in inspecting and donning a respirator, including user seal checks, also is provided at the time of fit testing. Retraining is performed annually on each type of respirator worn by the individual. In addition, site-specific respirator training is provided during site safety briefings conducted by the SSO. Training records are kept in the employee's training file.

A particulate respirator cartridge will be changed out when the wearer has difficulty breathing through the cartridge. Chemical gas or vapor respirator cartridges will be changed out at least daily.

The fit of a chemical gas or vapor respirator will be rechecked, and the cartridges will be changed, if the wearer detects chemical odor or feels chemical irritation on the skin, both of which are indicators of leakage or cartridge breakthrough. Where available, an End-of-Service Life Indicator (ESLI) will be used on chemical respirator cartridges. Cartridges will be changed as soon as the ESLI indicates that the cartridge is saturated and no longer effective in absorbing airborne chemicals**.**

8.5 RESPIRATOR INSPECTION

The user will inspect respirators before and after each day's use. The inspection procedure for air-purifying respirators (full-face piece and half-face piece cartridge respirators) follows.

Examine the face piece for:

- Excessive dirt;
- Cracks, tears, holes, or distortion from improper storage;
- Inflexibility;
- Cracked or badly scratched lenses (full-face only);
- Incorrectly mounted eyeglass lenses or broken or missing mounting clips (full-face only); and
- Cracked or broken air-purifying element holder, badly worn threads, or missing gaskets.

Examine the head straps or head harness for:

- Breaks or cracks;
- Broken or malfunctioning buckles; and
- Excessively worn serration on the headstraps, which may permit slippage.

Examine the two inhalation valves and the exhalation valve for:

- Foreign material (e.g., hairs, particles, etc.);
- Improper insertion of the valve body in the face piece;
- Cracks, tears, or chips in the valve body, particularly in the sealing surface; and
- Missing or defective exhalation valve covers.

Examine the air-purifying cartridge for:

- Missing or worn cartridge-holder gasket;
- Incorrect cartridge/canister for the hazard;
- Incorrect cartridge installation, loose connections, or cross threading in the holder; and
- Cracks or dents in the outside case or threads of the filter or cartridge/canister.

8.6 CLEANING OF RESPIRATORS

Respirators assigned and worn by one individual must be dismantled and thoroughly cleaned and disinfected after each day's use. Visitors' respirators or respirators assigned to several individuals must be cleaned and disinfected after each use. A disinfectant spray or wipe is approved as a disinfectant between uses during the day but not for cleaning and sanitizing after each day's use. Care must be taken to prevent damage from rough handling during the cleaning procedure. After cleaning, respirators must be reassembled. The procedures for cleaning respirators follow.

!	Washing:	Disassemble and wash with a mild liquid detergent in warm water (not to exceed 110°F). A stiff bristle (not wire) brush may be used.
!	Rinsing:	Rinse in clean water (110°F maximum) to remove all traces of detergent. This is important to prevent dermatitis.
!	Disinfecting:	Thoroughly rinse or immerse in a sanitizer provided by the manufacturer. Alternatively, a weak chlorine bleach solution (1 milliliter of liquid bleach per liter of water) may be used.
!	Final Rinsing:	Rinse thoroughly in clean water (110°F maximum) to remove all traces of disinfectant. This is important to prevent dermatitis.
!	Drying:	Drain and dry by hanging by the straps from racks (take care to prevent damage) or by towel drying with clean, soft cloths or paper towels.

8.7 MAINTENANCE OF RESPIRATORS

Routine respirator maintenance, such as replacing missing valves, gaskets, and nosecups, must only be performed by trained respirator users or a respirator manufacturer's representative. Only approved replacement parts must be used. The substitution of parts from a different brand or type of respirator is generally not possible, invalidates the technical approval of the respirator, and is not permitted. Any respirator suspected of being defective must be removed from service and replaced.

8.8 STORAGE OF RESPIRATORS

When not in use, respirators must be stored to protect them from dust, sunlight, heat, extreme cold, excessive moisture, damaging chemicals, and physical damage. Respirators must be stored in sealable (e.g., Ziplock® or twist-tie) reusable plastic bags between shifts.

The respirator storage environment must be clean, dry, and away from direct sunlight. Onsite cabinets or cases are suggested. Storing bagged respirators in vehicles is discouraged because of the potential for damage from other material or equipment.

8.9 ADDITIONAL INFORMATION

Additional information on the URS Respiratory Protection Program is located in SMS 042, a copy of which is to be available on site.

9.0 SITE CONTROL

9.1 GENERAL

Barricade tape and/or barricades will be used to delineate a work zone for safety purposes around the work area. The barriers will be set in a 25-foot radius (as practical) around the work area to provide sufficient maneuvering space for personnel and equipment. A short piece of barricade tape can be affixed to a secure upright (e.g., a drill rig mast or a vehicle antenna) to serve as a wind direction telltale. A 5-foot opening in the barricades at the support zone (upwind of the work area) will serve as the personnel and equipment entry and exit point. The personnel decontamination station will be established at this point if formal decontamination procedures are required (see Section 9.0). All entry and exit from the work area will be made at this opening to control potential sources of contamination and leave contaminated soil and debris in the work area.

At the end of the shift, all boring/sampling holes and excavations must be covered or otherwise secured. All cuttings and decontamination fluids are to be handled in accordance with relevant regulations and instructions from the PM.

The PM or SSO (with the assistance of the facility representative) will determine an upwind evacuation area prior to each shift, and all personnel will be notified of its location. A horn or other signaling device will be used to signal an evacuation in the event of an emergency. Three blasts of the horn will be the signal to immediately stop work and proceed to the evacuation area.

The SSO will verify that all site visitors sign the visitors' log. In addition, all URS personnel and site visitors entering the work area must present evidence of their participation in a medical surveillance program and completion of health and safety training programs that fulfill the requirements of this HSP.

The SSO will provide site hazard and emergency action information to all site visitors before they enter the site. This can be done by providing a copy of this HSP to the visitor.

9.2 WORK ZONES

If monitoring instrument readings exceed the first action level (>5 ppm > one minute), requiring the use of chemical protective equipment, work zones must be established as described below.

- EZ – A 25-foot circle (as practical) around the work area will be defined before work starts. The encircled area will constitute the EZ. This zone is where potentially hazardous contaminants and physical hazards to the workers will be contained. Appropriate personal protection, as described in Section 1.0, will be required in this area. Plastic sheeting (visqueen) and/or tarps may be used as necessary to control contaminated materials spilled to the ground during site operations. The size of the EZ may be altered to accommodate site conditions and to ensure contaminant containment.

- CRZ – A corridor leading from the EZ will be defined; it will lead from the work area to a break area. All decontamination activities will occur in the CRZ. A waste container will be placed at the end of the corridor so that contaminated disposable equipment can be placed inside and covered. Surface/soil contamination in this area will be controlled using plastic sheeting. No one will be permitted into the CRZ or EZ unless he/she is in full compliance with the requirements of this HSP.

- Support Zone – A Support Zone, the outermost part of the site, must be defined for each field activity. Support equipment is located in this uncontaminated or clean area. Normal work clothes are

appropriate within this zone. The location of this zone depends on factors such as accessibility, wind direction (upwind of work area), and resources (i.e., roads, shelter, utilities).

10.0 DECONTAMINATION PROCEDURES

If the monitoring instrument readings indicate respirator use (the second action level [>5 ppm > one minute]) in the OBZ, the following steps will be followed whenever personnel leave the EZ/work area.

- Remove all equipment, sample containers, and notes to the CRZ. Obtain decontamination solutions and decontaminate the tools (shovels, auger flights, etc.) by brushing them under a water rinse. A high-pressure steam cleaner also may be used for decontamination. All waste and spent decontamination solutions will be properly contained.
- Scrub boots with a stiff bristle brush and water. Washtubs and chairs will be provided.
- Remove outer gloves (and boot covers, if used).
- Remove Tyvek® coveralls; discard in provided container.
- Remove hardhat and eye protection.
- Remove respirator.
- Remove inner gloves.
- Wash hands and face.

The decontamination area will be covered with plastic sheeting that will be replaced when torn or heavily soiled and at the end of each shift.

Each worker will be responsible for cleaning, sanitizing, and storing his/her own respirator in accordance with the manufacturer's guidance (i.e., washing in warm water and detergent or sanitizing solution, air drying, and storing in a plastic storage bag; see Sections 8.6 - 8.8). Cartridges will be changed in accordance with the procedures described in Section 8.4.

All spent decontamination fluids (rinse waters, etc.) will be handled as directed by the PM and in accordance with relevant regulations.

10.1 SANITATION

Potable water will be made available at the site, either from a pressurized source or as commercially available bottled water. Drinking cups will be supplied; personnel will not drink directly from the source of water or share drinking cups. Sources of non-potable water will be labeled clearly.

Unless toilet facilities are available on site, or transportation is readily available (within five minutes) to transport personnel to nearby toilet facilities, portable toilet facilities, such as chemical toilets, will be provided on site.

Washing facilities will be provided on site and be located in the decontamination area or in the support area. Soap, clean water, wash basins, and single-use towels will be available for personnel use.

URS procedures for site sanitation are located in SMS 030, a copy of which is to be maintained on site.

10.2 DECONTAMINATION – MEDICAL EMERGENCIES

In the event of physical injury or other serious medical concerns, immediate first aid is to be administered in lieu of further decontamination efforts.

See the Emergency Decontamination chart for a decision tree for emergency decontamination.

10.3 DECONTAMINATION OF TOOLS

When all work activities have been completed, contaminated tools used by URS personnel will be appropriately decontaminated or properly disposed of as hazardous waste.

It is expected that all tools will be constructed of non-porous, non-absorbent materials. This will aid the decontamination process. Any tool or part of a tool that is made of a porous/absorbent material will be discarded and disposed of as a hazardous waste if it cannot be properly decontaminated.

Tools will be placed on a decontamination pad or into a bucket and thoroughly washed using a soap solution and brush; washing will be followed by a fresh water rinse. All visible particles are to be removed before the tool is considered clean.

11.0 SAFE WORK PRACTICES

11.1 GENERAL SITE RULES

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the contaminated or potentially contaminated area or where the possibility for the transfer of contamination exists.
- Alcohol consumption is prohibited during work hours. Excessive drinking is strongly discouraged at all times while the team is in the field. Use of prescription medications that impair judgment or affect motor skill and all illegal drugs are also prohibited. For additional information, please review the URS Substance Abuse Policy. Behavior that could endanger the health or safety of any individual of the field team will not be tolerated. Any individual violating these requirements will be subject to disciplinary action that may include termination.
- All personnel will enter designated work areas only through the CRZ. All personnel leaving an EZ/work zone must exit through the CRZ and pass through the decontamination station, as described in Section 10.0.
- Personnel will wash their hands and faces thoroughly with soap and water prior to eating, drinking, or smoking.
- Personnel will avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, etc. Avoid, whenever possible, kneeling, leaning, or sitting on contaminated surfaces. Do not place monitoring equipment on potentially contaminated surfaces (i.e., the ground, etc.)
- All field crew members should remain alert to potentially dangerous situations in which they should not become involved (i.e., note the presence of strong, irritating, or nauseating odors, etc.).
- Only those vehicles and the equipment required to complete work tasks should be permitted within the EZ/work zone (drill rigs, excavators, and similar items). All non-essential vehicles should remain within the support zone.
- Containers, such as drums, will be moved only with the proper equipment and will be secured to prevent dropping or the loss of control during transport.
- Field survey instruments, such as PIDs, will be covered with plastic or similar coverings to minimize the potential for contamination.
- No matches or lighters are permitted in the work area/EZ or CRZ.
- Contaminated protective equipment, such as respirators, hoses, boots, and disposable protective clothing, will not be removed from the work area/EZ or decontamination area until it has been cleaned or properly packaged and labeled.
- Spills should be prevented, to the extent possible. Should a spill occur, any liquid should be contained, if possible.
- Splashing of contaminated materials should be prevented.
- Field crew members should be familiar with the physical characteristics of the site operations including:

  - Wind direction in relation to the contaminated area;
  - Accessibility to equipment and vehicles;
  - Areas of known or suspected contamination;
  - Site access; and
  - Nearest water sources.

- The number of personnel and equipment in the EZ should be minimized, but only to the extent consistent with workforce requirements for safe site operations.
- All wastes generated by URS activities at the site will be disposed of as directed by the PM.
- All personal protective equipment will be used as specified and required.
- The buddy system will be used at all times when sampling for hazardous material, when the first action level criteria have been exceeded, or when working in remote areas.
- Personnel are to immediately notify the SSO or Site Manager if any indications of potential explosions or unusual conditions are observed.

11.2 SAMPLING PRACTICES

For all sampling activities, the following standard safety procedures will be employed:

- All sampling equipment will be cleaned before proceeding to the site.
- At the sampling site, sampling equipment will be cleaned after each use.
- Work in "cleaner" areas will be conducted first, where practical.
- All unauthorized personnel will remain outside the EZ at all times.

11.3 SAMPLE SHIPMENT/HAZARDOUS MATERIALS SHIPMENT

If samples to be collected during the course of this project fall under criteria that define them as hazardous materials under Department of Transportation (DOT) regulations 49 CFR Parts 171-177 (see URS guidelines for determination), then they must be shipped in accordance with those regulations by an individual who is certified as having been "function-specific" trained, as required under the DOT regulations.

12.0 EMERGENCY RESPONSE PLAN

It is URS policy to evacuate personnel from areas of hazardous material emergencies and to summon outside assistance from agencies with personnel trained to respond to the specific emergency. This section outlines the procedures to be followed by URS personnel in the event of a site emergency. These procedures are to be reviewed during the onsite safety briefings conducted by the SSO.

In the event of a fire or medical emergency, the emergency numbers identified in Section 1.0 (page 1) can be called for assistance.

12.1 PLACES OF REFUGE

In the event of a site emergency requiring evacuation, all personnel will evacuate to a pre-designated area a safe distance from any health or safety hazard (typically, the URS field office, unless conditions dictate otherwise). The SSO (in cooperation with a facility representative) will designate a primary assembly area prior to the start of work each day. The assembly area may have to be re-designated by the SSO in the event that the area of influence of an emergency affects the primary assembly area. Once personnel are assembled, the SSO will do a head count. The SSO will evaluate the assembly area to determine whether it is outside of the influence of the situation; if it is not, the SSO will redirect the group to a new assembly area where a new head count will be taken.

During any site evacuation, all employees will be instructed to observe wind direction indicators. During evacuation, employees will be instructed to travel upwind or crosswind of the area of influence. The SSO will provide site personnel with specific evacuation instructions via the site emergency radio, if necessary, specifying the actual site conditions.

12.2 FIRE

Fire prevention procedures are described in SMS 14, a copy of which is to be maintained on site. To protect against fires, the following special precautions must be taken.

- Before any flame-producing devices (i.e., cutting torches or welding irons) are used in the EZ, the SSO must be contacted. In some cases, the client may require to be contacted as well, to determine whether a hot work permit is required. A detailed inspection of the work area will be conducted to determine whether potential fire sources exist; if they do, they must be removed to at least 35 feet away before work can commence.
- Two 2A10B:C fire extinguishers must be located at the work area when cutting or welding is being conducted, and a fire watch will be posted.
- Upon completion of the cutting/welding activities, the area will be inspected for hot metal, slag, etc. The fire watch will remain at its station for at least 15 minutes after the hot work is completed.

Type ABC fire extinguishers will be available on site to contain and extinguish small fires. The local or facility fire department will be summoned in the event of any fire on site.

12.3 COMMUNICATION

A communication network must be set up to alert site personnel of emergencies and to summon outside emergency assistance. Where voice communication is not feasible, an alarm system (i.e., sirens, horns, etc.) will be set up to alert employees of emergencies. Radio communication also may be used to communicate with personnel in the EZ. Where phone service is not readily available, radios or portable telephones will be used to communicate with outside agencies. Site personnel will be trained on the use of the site emergency communication network. Emergency phone numbers will be posted at the phone or radio used for outside communication. The SSO is responsible for establishing the communication network prior to the start of work and for explaining it to all site personnel during the site safety briefing.

In the event of an emergency, personnel will use the following hand signals where voice communications are not feasible:

Signal	Definition
Hands clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm all right/I understand
Thumbs down	No/negative
Arms waving upright	Send back support
Grip partner's wrist	Exit area immediately

12.4 EMERGENCY RESPONSE PROCEDURES

The emergency response team will consist of employees who assume the following roles:

- Emergency care provider(s)
- Provide first aid/CPR as needed
- Communicator

  The role of the communicator is to maintain contact with appropriate emergency services and to provide as much information as possible, such as the number injured, the type and extent of injuries, and the exact location of the accident scene. The communicator will be located as close to the scene as possible to transmit to the emergency care providers any additional instructions that may be given by emergency services personnel in route.

- Site Supervisor

  The site supervisor (usually the SSO) will survey and assess existing and potential hazards, evacuate personnel as needed, and contain the hazard. Follow up responsibilities include replacing or repairing damaged equipment, documenting the incident, and notifying appropriate personnel/agencies described under Incident Reporting. Responsibilities also include reviewing and revising site safety and contingency plans as necessary.

  In the event of an emergency, follow the procedures outlined in Figure 12-1. Notify site personnel of the situation, survey the scene to determine whether the situation is safe, to determine what happened, and to search for other victims. The Emergency Response Checklist can be used to help remember the things to do in an emergency.

12.5 MEDICAL EMERGENCY RESPONSE PLAN

At least one URS employee on site will hold a current certificate in American Red Cross Standard First Aid. This training provides six and one-half hours of instruction in adult CPR and basic first aid. If a medical emergency exists, personnel should:

! Consult the emergency phone number list and request an ambulance immediately;

! Perform First Aid/CPR as necessary;

! Stabilize the injured; decontaminate if necessary, and extricate *only* if the environment the injured/ill person is in is dangerous or unsafe and ONLY if the rescuers are appropriately protected from potential hazards that might be encountered during the rescue.

! When emergency services personnel arrive, communicate all first aid activities that have occurred.

! Transfer responsibility for the care of the injured/ill to the emergency services personnel.

The following items and emergency response equipment will be located within easy access at all times:

- First aid kit and infection control kit;
- Eyewash – A 15 minute eyewash (required if corrosives are present), or an appropriate amount of portable sterile eyewash bottles, will be available on site for flushing foreign particles or contaminants out of eyes. The SSO will demonstrate the proper operation of the unit(s) prior to the start of work;
- Emergency telephone numbers list; and
- Portable radios for emergency communications in remote areas.

Drugs, inhalants, or medications will not be included in the first aid kit.

Supplies should be reordered as they are used. A monthly inventory must be done on the first aid kit and infection control kit contents, and supplies that have been used must be reordered.

12.6 INCIDENT REPORT

ALL site injuries and illnesses must be reported to the SSO and PM immediately following first-aid treatment. The SSO will notify the Occupational Health Specialist (866-326-7321) and the RHSEM (248-752-3405). Work is to be stopped until the PM or SSO have determined the cause of the incident and have taken the appropriate action to prevent a recurrence. Any injury or illness, regardless of severity, is to be reported (see SMS 049 and SMS 065).

12.7 OPERATION SHUTDOWN

In certain extremely hazardous situations, the SSO or SSR may request that site operations be temporarily suspended while the underlying hazard is corrected or controlled. During operations shutdowns, all personnel will be required to stand upwind to prevent exposure to fugitive emissions. The SSO, with concurrence from the RHSEM, will have ultimate authority for operations shutdown and restart.

12.8 SPILL OR HAZARDOUS MATERIALS RELEASE

Small spills are immediately reported to the SSO and are dealt with according to the chemical manufacturer's recommended procedures, which are found on the MSDS. Steps will be taken to contain and/or collect small spills for approved storage and disposal.

In the unlikely event of a larger release of hazardous materials as a result of site activities, site personnel will evacuate to the predesignated assembly area. The local Designated Emergency Response Authority (DERA) will be notified by the SSO immediately, and appropriate actions will be taken to protect public health and mitigate the contaminant release. The DERA can be reached through the local police or fire department. The Site Manager will make the following emergency contacts:

Regional Health, Safety, and Environment Manager	–	Cece Weldon (248) 994-7466
		Cell (248) 752-3405
Health, Safety, and Environment Representative	–	Doug Cail (312) 697-7247
		Cell (630) 333-7742
Project Manager	–	Patty Bryan (312) 697-7240,
		Cell (312) 403-0843
EPA Response Center (if reportable quantity is exceeded)	–	(800) 424-8802.

EMERGENCY RESPONSE CHECKLIST

In an Emergency	Yes	No
Confirm the reported incident		
Evacuate and secure the area		
Render first aid/emergency medical care		
Notify promptly:		
Project Manager		
Fire Department		
Police Department		
Nearest Hospital or Medical Care Facility		
Start Documentation		
If spill or leak occurs:		
Don the proper PPE		
Stop the source		
Contain the spill		
Clean up the spill		
Upon evacuating, take attendance at the assembly area		
Authority given:		
Leave the site		
Restart the operations		
Debrief and document the incident		
Submit a copy of the document to the Health and Safety Manager		

13.0 TRAINING, MEDICAL SURVEILLANCE, SITE INSPECTIONS

13.1 TRAINING AND MEDICAL SURVEILLANCE

All URS site personnel will have met the requirements of 29 CFR 1910.120(e), including:

- Forty hours of initial off-site training or its recognized equivalent
- Eight hours of annual refresher training for all personnel (as required);
- Eight hours of supervisor training for personnel serving as SSOs; and
- Three days of work activity under the supervision of a trained and experienced supervisor.

All URS site personnel are participating in medical surveillance programs that meet the requirements of 29 CFR 1910.120(f). Current copies of training certificates and statements of medical program participation for all URS personnel are maintained by the local office.

In addition, all URS site personnel will review this HSP and sign a copy of the Safety Plan Compliance Agreement provided in Attachment B. The PM will maintain these agreements at the site and place them in the project file at the conclusion of the operation.

Prior to the start of operations at the site, the SSO will conduct a site safety briefing, which will include all personnel involved in site operations. At this meeting, the SSO will discuss:

- Contents of this HSP;
- Types of hazards at the site and means for minimizing exposure to them;
- The type of monitoring that will be performed;
- Action levels for upgrade and downgrade of PPE;
- PPE that will be used;
- Site-specific respiratory protection requirements;
- Decontamination protocol;
- Site control measures, including safe operating practices and communication;
- Location and use of emergency equipment; and
- Evacuation signals and procedures.

All site personnel, including subcontractor personnel, are to attend the briefings and sign the briefing form.

Subsequent site safety briefings will be conducted at least weekly, or whenever there is a change in task or significant change in task location. Briefings also will be conducted whenever new personnel report to the site.

13.2 SITE INSPECTIONS

The URS Site Manager or SSO is to conduct a daily site inspection prior to the start of each shift. It is the responsibility of the PM or Site Manager to resolve discrepancies immediately, contacting the RHSEM if necessary for assistance. Inspections are to be documented and maintained on site until the completion of the project, at which time they are placed in the project files.

14.0 RECORDKEEPING

The PM and SSO are responsible for site recordkeeping. Prior to the start of work, they will review this HSP; if no changes are needed, they will sign the approval form (PM) or acceptance form (SSO) and forward a copy to the RHSEM.

All URS personnel will review the HSP and sign the Safety Plan Compliance Agreement in Attachment B; copies of these forms will be maintained in the project file as noted in Section 12.

The SSO will conduct a Site Safety Briefing in accordance with Section 13 and have all attendees sign the form in Attachment B; copies will be maintained in the project file.

Any incident or exposure incident will be investigated and the Incident Report form (SMS 049) will be completed and forwarded to the Office Human Resources Representative and the RHSEM.

All instrument readings and calibrations, PPE use and changes, health and safety-related issues, and deviations from or problems with this HSP will be recorded in the field log.

ATTACHMENT A

HOSPITAL ROUTE MAP

YAHOO! LOCAL Maps Sign In New User? Sign Up Maps Hon



Yahoo! Driving Directions

Starting from: A 710 Ohio St, Buffalo, NY 14203-3112

Arriving at: B 565 Abbott Rd, Buffalo, NY 14220-2039

Distance: 4.7 miles **Approximate Travel Time:** 9 mins

Your Directions

1.	Start at **710 OHIO ST, BUFFALO** going toward **CHILDS ST,GANSON ST** - go **0.4** mi
2.	Bear R on **LOUISIANA ST** - go **0.8** mi
3.	Bear R onto **I-190 SOUTH** - go **1.8** mi
4.	Take exit **#3** onto **JAMES P COPPOLA SR BLVD** toward **SENECA ST** - go **0.3** mi
5.	Bear L on **ELK ST** - go **0.1** mi
6.	Turn R on **BAILEY AVE[US-62]** - go **0.4** mi
7.	Turn L on **MCKINLEY PKY** - go **0.3** mi
8.	Continue on **SOUTHSIDE PKY** - go < **0.1** mi
9.	Turn L on **ABBOTT RD** - go **0.8** mi
10.	Arrive at **565 ABBOTT RD, BUFFALO,** on the R

When using any driving directions or map, it's a good idea to do a reality check and make sure the road still exists, watch out for construction, and follow all traffic safety precautions. This is only to be used as an aid in planning.

Your Full Route **Your Destination**





Address:
565 Abbott Rd
Buffalo, NY 14220-2039

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ATTACHMENT B
SAFETY PLAN COMPLIANCE AGREEMENT AND
MEDICAL EMERGENCY CONTACT SHEET

I, _____, have received a copy of the Health and Safety Plan for this Project. I have reviewed the plan, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the health and safety requirements specified in the plan.

SIGNED: _____ _____
Signature Date

Firm: URS Corp.

This brief Medical Emergency Contact Sheet will be kept in the Support Zone during site operations. It is in no way a substitute for the Medical Surveillance Program requirements of the URS Health, Safety, and Environment Program. This data sheet will accompany injured personnel when medical assistance or transport to hospital facilities is necessary.

Emergency Contact: _____ Phone #: _____

Relationship: _____

Do you wear contact lenses? _____

SAFETY MANAGEMENT STANDARD
Worker Right-to-Know (Hazard Communication)

1. Applicability

This procedure applies to URS office and field operations.

2. Purpose and Scope

The worker right-to-know program provides URS personnel with information and training about safety and health hazards associated with the chemicals they might encounter in the workplace. This procedure describes how chemical safety hazards are communicated to URS personnel working in offices and at field site locations, and how information is to be provided to employees of other employers working at the location. The requirements include steps to acquire this information, maintain it, and train everyone to use it.

3. Implementation

Office Locations: Implementation of this program is the responsibility of the Office Manager.

Field Activities: Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Hazardous Material Inventory

1. Maintain a hazardous material inventory that lists all of the hazardous materials used at each workplace (i.e., office/field location). Use chemical names consistent with the applicable material safety data sheet (MSDS).

2. File a copy of the chemical inventory with the Project Safety Plan or with the local URS Health, Safety, and Environment (HSE) Representative.

B. Material Safety Data Sheets (MSDS)

1. Obtain a MSDS for each chemical before it is used.

2. Review each MSDS when it is received to evaluate whether the information is complete and to determine if existing protective measures are adequate.

3. Maintain a collection of all applicable and relevant MSDS where they are accessible by all employees at all times.

4. Replace MSDS when updated sheets are received. Communicate any significant changes to those who work with the chemical.

5. MSDS are required for all hazardous materials used on site by project personnel.

C. Labels

Unless each container has appropriate labeling, label all chemical containers with:

1. Identity of the hazardous chemical(s),

2. Appropriate hazard warnings, and

3. Name and address of the chemical manufacturer, importer, or other responsible party.

D. Hazardous Nonroutine Tasks

Periodically, employees are required to perform hazardous non-routine tasks. Prior to starting work on such projects, provide each employee with information about hazards to which they may be exposed during such an activity.

This information will include:

1. Specific chemical hazards.

2. Protective/safety measures which must be utilized; and

3. Measures that have been taken to lessen the hazards including ventilation, respirators, presence of another employee and emergency procedures.

E. Informing Contractors/Subcontractors

Provide contractors/subcontractors the following information on chemicals used by or provided to URS personnel:

1. Names of hazardous chemicals to which they may be exposed while on the jobsite.

2. Precautions the employees may take to lessen the possibility of exposure by usage of appropriate protective measures.

3. Location of URS MSDS and written chemical inventory.

F. Training

1. Conduct training of all employees potentially exposed to hazardous materials on the following schedule:

   a. Before new employees begin their jobs.

   b. Whenever new chemicals are introduced into the workplace, or

   c. Annually thereafter.

2. This training will include:

   a. Applicable regulatory requirements.

   b. Names of those responsible for implementing this program.

   c. Location of the program, inventory and MSDS.

   d. Chemicals used and their hazards (chemical, physical and health).

   e. How to detect the presence or release of chemicals.

   f. Safe work practices.

   g. How to read an MSDS.

3. Document the training.

5. Documentation Summary

A. File these records with the local URS HSE Representative:

1. Chemical Inventory.

2. Location of the MSDS inventory.

3. Training records.

4. Contractor/Subcontractor notifications.

B. File these records in the Project Safety File.

1. Chemical Inventory.
2. Location of the MSDS inventory.
3. Training records.
4. Contractor/Subcontractor notifications.

6. Resources

A. U.S. OSHA Technical Links - Hazard Communication

B. U.K. - Control of Substance Hazardous to Health - Regulations

References to the UK legislation listed above can be found at the link provided:

www.tionestop.com
username: Thorburn
password: Dames
enter search criteria – (see underlined text)
select the checkbox for Construction Information Service (CIS)

C. National Paint and Coatings Association (NPCA) Hazardous Materials Identification System (HMIS) Version III

D. National Fire Protection Association (NFPA) Standard 704 (Standard System for the Identification of Hazardous Materials for Emergency Response)

SAFETY MANAGEMENT STANDARD

Excavation Safety

1. Applicability

This procedure applies to projects where URS controls trenching and excavation activities and/or where URS employees are exposed to hazards associated with trenching and excavation activities.

2. Purpose and Scope

This procedure is intended to protect personnel from the hazards associated with excavation entry activities.

3. Implementation

Field Operations - Implementation of this program is the responsibility of the Project Manager and field staff.

An approach that does not require employees or subcontractors to enter an excavation is always preferred. If employees or subcontractors must enter an excavation, compliance with this SMS or similar client/contractor procedures is required.

4. Requirements

A. Competent Person

Appoint an Excavation Competent Person when URS controls excavation activities. The Excavation Competent Person:

1. Is responsible for conducting daily inspections of excavations, adjacent areas, and protective systems prior to each shift.
2. Is responsible for inspection after every rainstorm or other hazard.
3. Must have knowledge of soils and soil classification.
4. Understands design and use of protective systems.
5. Has authority to stop work and take corrective actions when conditions change.
6. Has the ability to recognize and test hazardous atmospheres.

7. Has formal documentation of training as an Excavation Competent Person.

8. Is physically located at the excavation while work is in progress.

B. Access/Egress

Trench excavations will have ramps or ladders within 25 feet (8 meters) of the entrants.

C. Soil Classification

Soil classifications must be conducted in accordance with Attachment 13-1, if a sloping or benching system is issued. For the purposes of this standard all soils will be classified by a person meeting the qualifications of a competent person as described in 29 CFR 1929 Subpart P. The competent person shall consult with a Registered Professional Engineer in the event the soil classification requires additional technical expertise.

D. Protective Systems

Protect employees in excavations deeper than 4 feet (1.2 meters) by means of properly designed protective systems. All protective systems must comply with 29 CFR 1926 Subpart P Appendices B, C, D, and E.

1. Sloping and Benching

See Attachment 13-2.

2. Timber Shoring for Trenches

Timber shoring for trenches must be designed and stamped by a Registered Professional Engineer in accordance with 29CFR Subpart P, Appendix C.

3. Aluminum Hydraulic Shoring for Trenches

Aluminum hydraulic shoring for trenches must be approved by a Registered Professional Engineer in accordance with 29CFR 1926 Subpart P, Appendix D.

4. Alternatives to Timber Shoring

Trench shields and boxes must be either be pre-manufactured with listed load ratings or designed, stamped and constructed under the

direction of a Registered Professional Engineer. See 29 CFR 1926 Subpart C, Appendix E for examples.

5. Protective systems designed to protect employees in excavations deeper than 20 feet (6.1 meters) must be designed and stamped by a Registered Professional Engineer.

6. Excavations will be clearly identified and barricaded to keep unauthorized individuals out.

E. Permit Authorization and Inspections

1. Use the Excavation Authorization Form (Attachment 13-3) of this procedure that requires the following issues to be addressed:

   a. Employee training/briefings.

   b. Electrical safety.

   c. Surface encumbrances.

   d. Underground installations and utilities.

   e. Protective systems.

   f. Access and egress.

   g. Exposure to vehicular traffic.

   h. Exposure to falling loads.

   i. Warning systems for mobile equipment.

   j. Testing for hazardous atmospheres.

   k. Emergency rescue equipment.

   l. Protection from hazards associated with water accumulation.

   m. Stability of adjacent structures.

   n. Protection of employees from loose rock.

   o. Inspections.

p. Fall protection.

2. Require daily inspections of excavations to be conducted by Competent Person using Attachment 13-4.

F. Excavating at Potential MEX/UXO Sites

If the project site is suspected of munitions and explosives of concern (MEC) or unexploded ordinance (UXO) contamination, the UXO team will conduct a reconnaissance and MEC/UXO avoidance to provide clear access routes to each site prior to excavation crews entering the area.

MEC/UXO sites with planned excavation activities will not be conducted until a complete plan for the site is prepared and/or approved by URS UXO Safety Officer. MEC/UXO avoidance must be conducted during excavation operations on known or suspect MEC/UXO sites (SMS 039)

G. Training/Briefings

Conduct daily safety briefings for all employees associated with excavation activities and document on Attachment 13-3. Discuss excavation hazards, protective measures, and work practices that will be applicable to the day's activities.

5. Documentation Summary

Records required for the Project Safety File:

A. Competent person qualifications.

B. Excavation Authorization Form.

C. Daily Competent Person inspections.

D. Daily worker briefing documentation.

E. Daily inspection records.

6. Resources

A. U.S. OSHA Standard - Excavations - 29 CFR 1926, Subpart P

1. Appendix B, Sloping and Benching

2. Appendix C, Timber Shoring

3. Appendix D, Aluminum Hydraulic Shoring

4. Appendix E, Alternatives to Timber Shoring

B. U.S. OSHA Technical Links - Trenching and Excavation

C. US Army Corp of Engineers projects, the requirements of EM 385-1-1, Section 25 (PDF file)

D. Queensland Workplace Health and Safety – Workplace Health and Safety Regulation Part 17 (Excavations)

E. Attachment 13-1 - Soils Classification

F. Attachment 13-2 - Simple Slopes

G. Attachment 13-3 - Excavation Authorization Form

H. Attachment 13-4 - Daily Excavation/Trench Inspection Form

SAFETY MANAGEMENT STANDARD
Fire Prevention

1. Applicability

This procedure applies to URS office and project locations.

2. Purpose and Scope

The purpose of this procedure is to reduce/eliminate potential fire hazards in the workplace and to provide for a rapid, effective response should a fire occur.

3. Implementation

Office Locations – Implementation of this procedure is the responsibility of the Office Manager.

Field Activities – Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

General

A. Develop an Emergency Action Plan as outlined in SMS 3, "Emergency Action Plans."

B. Maintain good housekeeping to reduce fire hazards and to provide safe routes of egress should a fire occur.

C. Provide the appropriate number and types of fire extinguishers for the operations being performed. Refer to Attachment 14-1 for guidance.

D. Inspect fire extinguishers monthly and maintain an inspection log.

E. Conduct frequent periodic inspections to identify fire hazards such as:

1. Unnecessary accumulation of combustibles.

2. Unnecessary storage of flammables.

3. Sources of ignition (e.g., faulty wiring, sparks, open flame, etc.).

F. Remove all fire hazards promptly.

G. Prohibit smoking and other ignition sources in flammable storage and other fire hazard areas.

H. Post emergency numbers near telephones and evacuation maps in appropriate locations.

I. Conduct evacuation drills.

J. Train employees in:

1. Fire hazard recognition.
2. Fire hazard prevention.
3. Fire extinguisher use.
4. Emergency and evacuation procedures.

6. Documentation Summary

File the following in the Office/Project Health and Safety File:

A. Emergency Action Plans.

B. Fire extinguisher inspection logs.

C. Employee training documentation.

D. Site audits.

E. Evacuation drills.

7. Resources

A. U.S. OSHA Standard - Means of Egress - 29 CFR 1910, Subpart E

B. U.S. OSHA Standard – Exit Routes, Emergency Action Plans, and Fire Prevention Plans - 29 CFR 1910.38

C. U.S. OSHA Standard - Fire Protection - 29 CFR 1910, Subpart L

D. U.S. OSHA Technical Links - Fire Safety

E. U.S. OSHA Construction Standard - Fire Protection and Prevention 29 CFR 1926, Subpart F

F. U.K. Statutory Instrument 1997 No. 1840 - Fire Precautions (Workplace) Regulations

G. Australian Standards AS 1851.1-1995 - Maintenance of Fire Protection Equipment - Portable Fire Extinguishers and Fire Blankets

H. USACE EM 385-1-1 Section 9 - Fire Prevention and Protection

I. Attachment 14-1 - Fire Extinguisher Placement Guidelines

URS **SAFETY MANAGEMENT STANDARD**

Heat Stress

1. Applicability

This procedure applies to URS field projects where ambient (not adjusted) temperatures exceed 70°F (21°C) for personnel wearing chemical protective clothing, including Tyvek coveralls, and 90°F (32°C) for personnel wearing normal work clothes.

2. Purpose and Scope

The purpose of this procedure is to protect project personnel from the effects of heat related illnesses.

3. Implementation

Field Activities - Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. Monitor ambient temperatures and conduct heat stress monitoring when threshold temperatures (see Section 1) are reached.

B. Conduct initial monitoring to determine first rest break.

1. Measure the air temperature with a standard thermometer with the bulb shielded from radiant heat; this yields T (actual).

2. Estimate the fraction of sunshine by judging what percent time the sun is not shielded by clouds that are thick enough to produce a shadow, as follows:

   a. 100 percent sunshine (e.g., no cloud cover) = 1.0

   b. 50 percent sunshine (e.g., 50 percent cloud cover) = 0.5

   c. 0 percent sunshine (e.g., full cloud cover) = 0.0

3. Plug these variables into the following equation to determine the adjusted temperature:

   T (adjusted) = T (actual) + (13 x fraction sunshine)

C. Body Temperature Monitoring

1. Monitor oral body temperature to determine if employees are adequately dissipating heat buildup. Ear probe thermometers which are adjusted to oral temperature are convenient and the preferred method of measurement. Determine work/rest regimen as follows:

    a. Measure oral body temperature at the end of the work period.

    b. If temperature exceeds 99.6 ^{o}F (37.5 ^{o}C), shorten the following work period by 1/3 without changing the rest period.

    c. If temperature still exceeds 99.6 ^{o}F (37.5 ^{o}C), shorten the following work period by 1/3.

    d. Do not allow a worker to wear impermeable PPE when his/her oral temperature exceeds 100.6 ^{o}F (38.1^{o}C).

2. Oral body temperatures are to be obtained prior to the employee drinking water or other fluids.

D. Pulse Rate Monitoring

1. Take the radial (wrist) pulse as early as possible in the rest period.

    a. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third.

    b. If the heart rate still exceeds 110 beats per minute at the next rest cycle, shorten the following work cycle by an additional one-third.

E. Record monitoring results on Heat Stress Monitoring Form (Attachment 18-2).

F. Investigate the use of auxiliary cooling devices in extreme heat conditions.

G. Conduct briefings for employees regarding health hazards and control measures associated with heat stress whenever conditions require the implementation of heat stress monitoring. Review the information provided in Attachment 18-3.

H. Provide water and electrolyte replacement drinks fluids as described in Attachment 18-3.

I. Allow employees who are not accustomed to working in hot environments appropriate time for acclimatization (see Attachment 18-3).

J. Provide break areas as described in Attachment 18-3.

5. Documentation Summary

File these records in the Project Safety File.

A. Heat Stress Monitoring Forms.

B. Employee Safety Briefing Verification Forms.

6. Resources

A. NIOSH - "Working in Hot Environments"

B. AFL-CIO Building Trades Division - "Heat Stress in Construction"

C. Attachment 18-1 - Initial Work Monitoring Cycles

D. Attachment 18-2 - Heat Stress Monitoring Record

E. Attachment 18-3 -Informational Supplement

URS SAFETY MANAGEMENT STANDARD
Heavy Equipment Operations

1. Applicability

This procedure applies to URS field projects where heavy equipment is in operation.

2. Purpose and Scope

The purpose of this procedure is to require that heavy equipment is operated in a safe manner, that the equipment is properly maintained and that ground personnel are protected.

3. Implementation

Field Activities - Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. Authorized Operators

1. Evaluate operators through documentable experience (resume) and a practical evaluation of skills.

2. Allow only qualified operators to operate equipment.

3. Prohibit equipment from being operated by any personnel who have not been specifically authorized to operate it.

4. Maintain a list of operators for the project and the specific equipment that they are authorized to operate.

5. Require operators to use seat belts at all times in all equipment and trucks.

6. Prohibit personnel other than the operator from riding in or on the equipment unless additional seating (with seat belts) is provided by the manufacturer.

7. Operators shall maintain three points of contact whenever entering and exiting a piece of equipment.

8. Brief operators on the following rules of operation:

    a. Operators are in control of their work area.

b. Equipment will be operated in a safe manner and within the constraints of the manufacturer's Operation Manual.

c. Operators will stop work whenever unauthorized ground personnel or equipment enter their work area and only resume work when the area has been cleared.

B. Ground Personnel

1. Require that ground personnel on the site have received training and comply with the following rules of engagement:

a. All ground personnel must wear high visibility protective vests when in work areas with any operating equipment.

b. Ground personnel will stay outside of the swing zone or work area of any operating equipment.

c. Ground personnel may only enter the swing or work area of any operating equipment when:

1. They have attracted the operator's attention and made eye contact.

2. The operator has idled the equipment down and grounded all extensions.

3. The operator gives the ground personnel permission to approach.

d. Ground personnel shall never walk or position themselves between any fixed object and running equipment or between two running pieces of equipment.

C. Equipment

1. Maintain operations manuals at the site for each piece of equipment that is present on the site and in use.

2. Require that operators are familiar with the manual for the equipment and operate the equipment within the parameters of the manual.

3. Require that all equipment is provided with roll-over protection systems (ROPS). Tracked excavators are exempt from ROPS requirements but must have a cab which provides protection from overhead hazards

4. Verify that seatbelts are present and functional in all equipment.

5. Prohibit the use of equipment which has cab glass which is cracked, broken or missing.

6. Require that backup alarms are functional on all trucks and equipment. Tracked excavators must have bidirectional alarms or the operator must be provided with a spotter whenever tracking in either direction.

7. Require all extensions such as buckets, blades, forks, etc. to be grounded when not in use.

8. Require brakes to be set and wheels chocked (when applicable) when not in use.

D. Inspection and Maintenance

1. Require daily inspections of equipment by operators using Attachment 19-1.

2. Prohibit use of equipment deemed to be unsafe as a result of daily inspection until required repairs or maintenance have been completed.

3. Conduct maintenance as prescribed by the manufacturer in the Operations Manuals for each piece of equipment.

4. During maintenance/repair, require that:

   a. Motors are turned off.

   b. All extensions are grounded or securely blocked.

   c. Controls are in a neutral position.

   d. Brakes are set.

5. Documentation Summary

File the following documents in the Project Health and Safety File.

A. List of authorized operators.

B. Operator qualifications.

C. Daily Equipment Inspection Logs.

D. Site briefing documentation for operator rules and ground personnel "rules of engagement".

6. Resources

A. U.S. OSHA Standard - Motorized Vehicles and Mechanized Equipment - 29 CFR 1926, Subpart O

B. National Association of Demolition Contractors – Safety Manual

C. Queensland Workplace Health and Safety - Competency Standard for Users & Operators of Industrial Equipment

D. Attachment 19-1 - Equipment Inspection Form

URS **SAFETY MANAGEMENT STANDARD**

Noise and Hearing Conservation

1. Applicability

This procedure applies to URS Corporation facilities and field operations where URS Corporation personnel may encounter noise exposures that may exceed 85 decibels, measured using an "A" weighted scale (dBA), as an 8-hour time weighted average (TWA).

2. Purpose and Scope

The purpose of this procedure is to protect employees from hazardous noise exposures and to prevent hearing loss.

3. Implementation

Office/Lab locations - High noise is unlikely to be encountered at URS offices; however, if applicable, the implementation of this program is the responsibility of the Office Manager.

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. General

The use of hearing protectors is required in any location where powered or motorized equipment or any other noise source could reasonably be expected to exceed 85 dBA. Use of hearing protectors may only be discontinued when noise levels are verified to be less than 85 dBA through a properly conducted noise survey. Whenever information indicates that any employee's exposure may equal or exceed an 8-hour TWA of 85 dBA, the project manager or location manager will be responsible to enforce the proper use of hearing protectors.

B. Hearing Protectors

1. Require that at least two (2) types of hearing protectors are available to employees free of charge, preferably a plug and a muff type.

2. Minimum Noise Reduction Ratings (NRR)

   Hearing protectors issued must have the following minimum NRR:

Ear Plug	Muffs
29 dBA	27 dBA

3. Require that hearing protectors are used in accordance with manufacturer's specifications and thus effectively protect hearing.

C. Noise Surveys

1. Noise surveys must be conducted in a manner that reasonably reflects the exposure of the affected employees. Surveys must be conducted under the supervision of a URS Health, Safety, and Environment (HSE) Representative.

2. Sound level meters and audio dosimeters used to determine employee exposure to noise sources must be Type II (accurate to within +/- 2 dBA), operated in "slow" response, on the "A" scale, and be calibrated to factory guidelines (including periodic factory recalibration).

D. Noise Controls

Eliminate noise sources to the extent possible. Examples of controls that must be considered include:

1. Addition or replacement of mufflers on motorized equipment.

2. Addition of mufflers to air exhausts on pneumatic equipment.

3. Following equipment maintenance procedures to lubricate dry bearings.

4. Isolation of loud equipment with barriers.

5. Replacement of loud equipment with newer and quieter models.

E. Audiometric Exams

1. Tests

   Details on the medical surveillance program (including audiometric testing) are included in SMS 24.

Audiometric tests shall be performed by a person meeting the requirements described in 29 CFR 1910.95(g)(3). Within 6 months of an employee's first exposure at or above the action level, a valid baseline audiogram shall be established against which subsequent audiograms can be compared. Testing to establish a baseline audiogram shall be preceded by 14 hours without exposure to noise. Hearing protectors may be used as a substitute for the requirement that baseline audiogram shall be preceded by 14 hours without exposure to workplace noise. The medical surveillance provider shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination. For multi-year projects, an annual audiogram shall be obtained for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if there is a standard threshold shift (STS). A standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear. If the annual audiogram shows that an employee has suffered a STS, the employer will obtain a retest within 30 days and consider the results in assessing an STS as the annual audiogram. The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. If an STS has occurred, the medical surveillance provider will notify the employee within 21 days of the determination.

2. Standard Threshold Shifts

   If an employee's test results show a confirmed STS, their hearing protection will be evaluated and refitted, and a medical evaluation may be required.

F. Training

Verify that each employee who must work in a noisy environment is current on required Hearing Conservation Training. Training must include the following topics:

1. The effects of noise on hearing.

2. The purpose of hearing protectors.
3. The advantages and disadvantages of various types of hearing protectors.
4. The attenuation of various types of hearing protection.
5. The selection, fitting, care, and use of hearing protectors.
6. The purpose of audiometric testing.
7. An explanation of the audiometric testing procedure.

5. Documentation Summary

A. File these records in the Office Safety Filing System:

1. Noise surveys, when applicable.
2. Training Records.

B. File noise surveys, when applicable, in the Project Safety File:

6. Resources

A. U.S. OSHA Standard – Occupational noise exposure – 29 CFR 1910.95

B. U.S. OSHA Construction Standard – Occupational noise exposure – 29 CFR 1926.52

C. U.S. OSHA Technical Links - Noise and Hearing Conservation

D. American Industrial Hygiene Association: The Occupational Environment – Its Evaluation and Control, Chapter 20. Fairfax, VA: 1997

E. National Hearing Conservation Association web site

F. URS SMS 24 - Medical Screening and Surveillance

URS **Safety Management Standard**

Personal Protective Equipment

1. Applicability

This program applies to URS Corporation office, shop, laboratory and field operations where the use of personal protective equipment (PPE) is warranted. Refer to SMS 42, "Respiratory Protection", for respiratory hazards. Hearing protection issues are addressed in SMS 26, "Noise and Hearing Conservation."

2. Purpose and Scope

This procedure provides information on recognizing those conditions that require PPE as well as selecting PPE for hazardous activities.

3. Implementation

Office/Shop/Lab Locations - Implementation of this program is the responsibility of the Office Manager.

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Perform hazard assessments for those work activities that are likely to require the use of PPE.

   1. Use Attachment 29-1 to perform the assessment.

   2. Reevaluate completed hazard assessments when the job changes.

B. Eliminate the hazards identified in Attachment 29-1, if possible, through engineering or administrative controls.

C. Select PPE that will protect employees if hazards cannot be eliminated.

   1. See Attachment 29-1 for recommended PPE.

   2. Review Material Safety Data Sheets for chemicals used for PPE recommendations.

   3. If needed, consult with the URS Health, Safety, and Environment (HSE) Representative for assistance in selecting PPE.

D. Provide required PPE to employees free of charge (excluding in some instances components of standard work attire such as steel-toed boots),

assuring that it fits properly and giving them a choice if more than one type is available.

E. Whenever a hazard is recognized and PPE is required, the employees will be provided with the appropriate PPE. However, when PPE is not required and the employee elects to wear his or her own PPE, the project or office manager shall ensure that the employee is properly trained in the fitting, donning, doffing, cleaning, and maintenance of his or her employee owned equipment.

F. Conduct and document employee training.

1. Train all employees who are required to wear PPE.

2. Require that training includes:

   a. When PPE is to be worn.

   b. That PPE necessary for the task to be completed.

   c. How to properly don, doff, adjust and wear PPE.

   d. Limitations of PPE.

   e. Proper care, maintenance, useful life and disposal of PPE.

3. Training must be conducted before PPE is assigned.

4. Refresher training is needed when:

   a. New types of PPE are assigned to the worker.

   b. Worker cannot demonstrate competency in PPE use.

5. Keep written records of the employees trained and type of training provided, including the date of training.

G. Maintain Protective Equipment

1. Check PPE for damage, cracks, and wear prior to each use. Replace or repair equipment not found in good condition.

2. Wash off contaminated PPE with water and mild soap, as necessary, to prevent degradation of the equipment.

H. Periodically inspect worksites where employees are using PPE using Attachment 29-2.

   1. Field activities – inspect work sites at least monthly.

   2. Office/laboratory/shop locations – inspect work sites semi-annually.

5.0 Documentation Summary

A. Records required in the Project Safety File:

   1. Completed Hazard Assessment Certification Forms (Attachment 29-1)

   2. Completed Personal Protective Equipment Inspection Sheet (Attachment 29-2)

   3. Documentation of employee training.

B. Records required in the Office/Laboratory Safety Filing System:

   1. Completed Hazard Assessment Certification Forms (Attachment 29-1)

   2. Completed Personal Protective Equipment Inspection Sheet (Attachment 29-2)

   3. Documentation of employee training.

6.0 Resources

A. U.S. OSHA Standards - Personal Protective Equipment -29 CFR 1910, Subpart I

B. U.S. OSHA Construction Standard - Personal Protective Equipment –29 CFR 1926 Subpart E

C. U.S. OSHA Technical Links - Personal Protective Equipment

D. Australian Standards SAA HB9-1994 - Occupational Personal Protection

E. American National Standards Institute, ANSI Z89.1-2003, Protective Headwear

F. American National Standards Institute, ANSI Z87.1 - 1989, Eye and Face Protection

G. American Society for Testing and Materials, ASTM F13-WK4519, Specification for Personal Protective Footwear

H. SMS 40 - Fall Protection

I. Queensland Workplace Health and Safety - Personal Protective Equipment

J. Attachment 29-1 Hazard Assessment Form

K. Attachment 29-2 PPE Inspection Form

L. Attachment 29-3 – Eye and Face Protector Selection Guide

URS SAFETY MANAGEMENT STANDARD
Sanitation

1. Applicability

This procedure applies to URS field operations.

2. Purpose and Scope

The purpose of this program is to provide employees on field assignments with appropriate personal hygiene facilities, including toilets, wash rooms and eating facilities, and to protect employees from unsanitary conditions.

3. Implementation

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Arrange for the installation of adequate toilet and wash facilities during the planning stage of field projects. Note: Mobile crews having transportation readily available to nearby toilet facilities need not be provided with facilities.

1. For job sites without sanitary sewers, provide one of the following:
    a. Privies (where their use will not contaminate ground or surface water).
    b. Chemical toilets.
    c. Combustion toilets.

2. Provide toilets for employees of each sex at field sites according to the following ratio:

Number of Employees	Minimum # of toilets (1)
1 - 15	1
16 - 35	2
36 - 55	3
56 - 80	4
81 - 110	5
111 - 150	6
Over 150	(2)

Footnotes:
(1) *Where toilet facilities will not be used by women, urinals may be provided instead of the minimum specified.*
(2) *One (1) additional fixture for each additional 40 employees.*

B. Provide a means for washing hands next to or near toilet areas.

C. Arrange for fresh potable water to be available.

1. Fixed Facilities

   Require backflow prevention devices, testing and administrative controls to be used for all potable water supply branches.

2. Field Sites

   a. Require an adequate supply of potable water to be available.

   b. Water containers must be tightly closed and marked as to the contents. Containers must have a tap and be refilled daily.

D. Maintain existing toilet and wash facilities.

1. Maintain toilets and toilet area in good repair and in a clean and sanitary condition.

2. Provide paper towels and soap or other suitable sanitizing material for washing hands.

E. Maintain availability and cleanliness of drinking water.

1. Maintain backflow devices in a sanitary condition.

2. Water coolers and water dispensers are to be kept in a sanitary condition and filled only with potable water.

3. Provide fountain-type dispensers or one-use cups at each water dispenser.

F. Maintain lunchrooms in a clean condition.

1. Require microwave ovens to be used for food only.

2. Require refrigerators that are designated for food storage to be used for food only (i.e., no chemical or samples storage).

3. Do not allow workers to eat or store foods in areas where toxic materials are handled or stored.

4. Periodically clean lunchrooms.

G. Manage waste generated on site.

1. Release sanitary sewage into sanitary sewer lines or to other proper disposal channels.

2. Do not discharge hazardous waste into the sanitary sewer or storm sewer system.

3. Collect garbage and trash daily.

a. Garbage containers located outside buildings should have lids and remained closed. Transport garbage offsite at least weekly.

b. At remote field sites where bears and similar wild animals are a hazard, remove garbage from the site daily. Do not let garbage remain on site overnight.

H. Prevent pests and vermin from multiplying on site. Eliminate unsanitary conditions that propagate insects or vermin.

I. Inspect work sites using the inspection sheet provided as Attachment 30-1 for compliance at the beginning of the project and mid-project.

5. Documentation Summary

File completed inspection sheets in the Project Safety File.

6. Resources

A. U.S. OSHA Construction Standard - Sanitation - 29 CFR 1926.51

B. U.S. OSHA General Industry Standard - Sanitation - 29 CFR 1910.141

C. National Interim Primary Drinking Water Regulations 40 CFR 141

D. Attachment 30-1 - Sanitation Inspection Checksheet

E. Queensland Workplace Health and Safety - Construction Project Amenities

URS SAFETY MANAGEMENT STANDARD
Work Zone Traffic Control

1. Applicability

This procedure applies to URS field operations involving work performed on roads, highways, and similar areas where motor vehicles may be a hazard.

2. Purpose and Scope

This procedure is intended to protect personnel from the hazards associated with work performed on or next to highways and roads.

3. Implementation

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Review the project in the planning phase to determine if any work will be performed on or adjacent to any road that will disrupt normal traffic flow.

B. Hire a qualified contractor or have an in house Competent Person devise a traffic control plan based on the work to be performed.

1. Competent persons are those who are knowledgeable about the fundamental principles of temporary traffic control and the work activities to be performed.

2. Traffic control plans will be designed to meet requirements as set in the Manual on Uniform Traffic Control Devices (MUTCD) as well as those rules set by state, county and cities in which work is performed.

3. Require that the plan is commensurate with the complexity of the project.

C. Submit the traffic control plan to the road authority for approval.

1. Submissions will be made to the state department of transportation or highways if state or federal highways are impacted as well.

2. Local county representatives.

3. Local city representatives, if within city limits.

4. For U.K. operations, submittal is to be made to County Council or local authority.

D. Decide whether to have qualified in house personnel or contract personnel implement the traffic control plan in the field.

1. Certified flaggers may set up work zones.

   Flaggers must attend an eight-hour work zone traffic control course as taught by an ATSSA certified instructor (or equivalent).

2. Obtain appropriate traffic control equipment as described in the MUTCD.

3. For U.K. operations, all operative must be trained in accordance with 'New Road and Street Works' Act.

E. Execute the traffic control plan developed for the job site. Require all personnel who work on/or adjacent to the roadway to wear bright orange, strong yellow-green or fluorescent versions of these colors of approved work zone clothing, including:

1. Vests, at a minimum.

2. Coveralls, if desired.

3. Rainwear or other apparel as needed.

F. Require a Competent Person who is certified as a Worksite Traffic Supervisor supervises flaggers at least once a day.

G. Develop a plan for the periodic inspection and maintenance of the Traffic Control Zone utilizing Attachment 32-1.

5. Documentation Summary

Records required in the Project Safety File:

A. Copies of traffic control plans used on site.

B. Training certificates for URS flaggers and Competent Persons.

C. Qualifications of contracted flaggers and Competent Persons.

D. Inspection records.

6. Resources

A. Part VI of the Manual on Uniform Traffic Control Devices (MUTCD)

B. American Traffic Safety Services Association

C. ATTSA Flagger Train the Trainer Program

D. U.K. - 'New Road and Street Works' Act

E. Australian Standards HB81.1-2003 - Field Guide for Traffic Controls at Work on Roads

F. Australian Standards AS1742.3-2002 - Manual of Uniform Traffic Control Devices

G. Australian Standards HB69.13-1995. Guide to Traffic Engineering Practice - Pedestrian

I. Attachment 32-1 - Traffic Control Inspection Checklist

URS SAFETY MANAGEMENT STANDARD

Utility Clearances And Isolation

1. Applicability

This procedure applies to URS projects where personnel may encounter subsurface or overhead utilities.

2. Purpose and Scope

Many field activities are conducted near aboveground and underground utilities. The primary purpose of this Standard is to establish operating requirements that will permit employees to work safely in the vicinity of electrical, natural gas, fuel, water, and other utility systems and installations. The secondary purpose is to prevent economic damage to utility systems from operations associated with project-related activities.

The term "utility clearance" includes

A. The positive locating of utility systems in or near the work area.

B. A signed statement by an appropriate representative attesting to the location of underground utilities and/or the positive de-energizing (including lockout) and testing of electrical utilities.

Note that in some cases, utility representatives may deem it appropriate or necessary to use insulating blankets to isolate a power line. This is an acceptable alternative to positive de-energizing; however, only utility representatives can make the determination.

"Contact" with overhead power lines is considered to occur when equipment is closer to power lines than permitted by the criteria in the table in Section 4.0.C.2.b below. (See note for U.K. operations).

3. Implementation

Field Operations - Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. Time for Completion

Complete utility clearances prior to the start of any work in the area of the utility that could feasibly result in contact with or damage to that utility.

B. Local Regulations

Research local and state codes and regulations regarding utility locating and isolation requirements. Utility companies and locating services are among the appropriate resources.

C. Overhead Power Lines

1. Proximity to Power Lines

   No work is to be conducted within 50 feet (15 meters) of overhead power lines without first contacting the utility company to determine the voltage of the system. No aspect of any piece of equipment is to be operated within 50 feet (15 meters) of overhead power lines without first making this determination.

2. Operations adjacent to overhead power lines are **PROHIBITED** unless one of the following conditions is satisfied:

   a. Power has been shut off, positive means (such as lockout) have been taken to prevent the lines from being energized, lines have been tested to confirm the outage, and the utility company has provided a signed certification of the outage.

   b. The minimum clearance from energized overhead lines is as shown in the table below, or the equipment will be repositioned and blocked so that no part, including cables, can come within the minimum clearances shown in the table.

MINIMUM DISTANCES FROM POWERLINES	
Nominal System kV	Minimum Required Distance
0-50	10 feet (3 meters)
51-100	12 feet (3.6 meters)
101-200	15 feet (4.6 meters)
201-300	20 feet (6.1 meters)
301-500	25 feet (7.6 meters)
501-750	35 feet (10.7 meters)
751-1000	45 feet (13.7 meters)

Note: For U.K. operations, the specific safe distance is determined by the utility company.

   c. The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine

the minimum safe operating distance; get this determination in writing with the utility representative's signature.

3. All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the Project Manager prior to the start of the task which may impact the utility.

D. Underground Utilities

1. Do not begin subsurface work (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted. The use of as-built drawings must be confirmed with additional geophysical or other surveys.

2. Contact utility companies or the state/regional utility protection service at least two (2) working days prior to excavation activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation. Where these services are unavailable (e.g., private properties), contract with an independent utility locating service to perform an evaluation of subsurface utilities.

3. Obtain utility clearances for subsurface work on both public and private property. Clearances are to be in writing, signed by the party conducting the clearance.

4. Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company, utility protection service, or the utility locating service to inform them that the markings have been destroyed.

5. Do not conduct mechanical-assisted subsurface work (e.g., powered drill rig, mechanical excavator, etc.) within five (5) feet (1.5 meters) of a confirmed or suspected utility or other subsurface structure. Confirm minimum distances for mechanical-assisted subsurface work with the utility owner, as distances beyond this five foot minimum may be required.

6. Subsurface work within five feet (1.5 meters) of a confirmed or suspected utility or other subsurface structure must be done by

hand (e.g., hand auger, shovel) to the point where the obstruction is visually located and exposed. Once the obstruction location is confirmed in this manner, mechanical-assisted work may commence.

7. Reference SMS 013, "Excavation Safety" for additional information regarding subsurface operations.

E. Training

Conduct a briefing for site employees regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.

5. Documentation Summary

File these records in the Safety Filing System:

1. Documents requesting utility clearance.
2. Documents confirming utility clearance.
3. Training/briefing documentation of each isolation.

6. Resources

A. Utility Locating Services (typically under "Utility" in the Yellow Pages)

B. NIOSH Alert - Preventing Electrocutions from Contact Between Cranes and Power Lines

C. One Call Utility Locating List

D. National Utility Locating Contractor's Association

E. U.K. - Health and Safety Executive GS6

URS SAFETY MANAGEMENT STANDARD
Respiratory Protection

1. Applicability

This program defines responsibilities and procedures and is applicable to URS operations that may require the use of respiratory protection including Immediately Dangerous to Life and Health (IDLH) and emergency conditions. This program also addresses the voluntary use of respirators.

2. Purpose and Scope

The purpose of this procedure is to protect those employees performing operations for which exposures can not be controlled by use of conventional engineering or administrative controls and prior to establishing a negative air exposure assessment, and to require that respiratory protective equipment is selected, used, maintained, and stored in accordance with acceptable practices.

3. Implementation

Laboratory/Office/Shop Locations -	Implementation of this program is the responsibility of the Office Manager.
Field Activities -	Implementation of this program is the responsibility of the Project Manager.
Program Administration-	URS Health and Safety Director is responsible for the development and annual review of this program.

URS Health and Safety Program Representatives are responsible to:

Assist responsible employees in the implementation of the program.

Assessing local compliance with the program.

4. Requirements

A. Determine if respirators are needed or going to be used for hazardous jobs before assigning that job to an employee.

1. If the determination is that a potential for respiratory hazards exists with any portion of that job activity then, complete Attachment 42-1.

2. Contact a URS Health and Safety Program Representative if any of the questions in Attachment 42-1 are checked "yes."

3. Follow instructions in Attachment 42-2 for employees who wish to voluntarily use dust masks.

4. Follow all the requirements of this procedure for employees who wish to voluntarily use tight-fitting (e.g., air purifying) respirators.

5. Required respirators will be paid for by URS and will be provided without cost to the employee.

B. Select the proper respirator for the job.

1. For those jobs identified in Attachment 42-1, contact a URS Health and Safety Program Representative for assistance in respirator selection.

2. Contact a URS Health and Safety Program Representative for follow up if there are any problems implementing the recommendations made.

C. Require employees who will use respirators to be medically qualified before fit testing and assigning them a respirator.

1. For program details, refer to SMS 24, Medical Screening and Surveillance.

2. Require that employees have a current and accurate Medical Surveillance form (Attachment 24-2)

3. Obtain a copy of the employee's Health Status Medical Report from the Health and Safety Representative. The consulting occupational physician of the medical service provider following each work related examination issues the Health Status Medical Report. Employees cannot be assigned respirators unless they are medically cleared for respirator use.

D. Require respirator users to receive appropriate training.

1. All respirator users must be trained:

a. Before they are assigned a respirator.

b. Annually thereafter.

c. Whenever a new hazard or job is introduced.

d. Whenever employees fail to demonstrate proper use or knowledge.

2. Training must address, at a minimum, the following:

a. Why the respirator is necessary, and what conditions can make the respirator ineffective.

b. What the limitations and capabilities of the respirators are.

c. How to use respirators effectively in emergency situations.

d. How to inspect, put on and remove, and check the seals of the respirator.

e. What the respirator maintenance and storage procedures are.

f. How to recognize medical signs and symptoms that may limit or prevent effective use of the respirator.

E. Require respirator users to be fit tested.

1. Any employee who has been assigned a reusable respirator must be fit tested on an annual basis (no more than one year may elapse between fit tests), or when the employee is assigned a respirator of a different make, type or size from that previously tested.

2. Fit testing can be performed by contract or in house personnel.

3. Obtain a signed written copy of the fit test results. The fit test results should include:

a. Employee's name and social security number.

b. Respirator brand, model and size fitted for.

c. Date fit tested.

d. Method of fit testing used.

e. Name and signature of fit tester.

f. Statement that fit test protocol met the requirements of 29 CFR 1910.134.

g. Manufacturer and serial number of fit testing apparatus.

A fit test results form is available at Attachment 42-5.

F. Provide qualified employees with respirator(s) and adequate amounts of parts and cartridges.

1. Assign employees whose duties require respirators their own respirator for which they have been fit tested.

2. Provide special eyeglass inserts designed for the respirator if an employee must wear eyeglasses with a full facepiece respirator. Contact lenses may be worn when wearing a full facepiece respirator.

G. Require respirators to be used properly.

1. Prohibit facial hair where the respirator-sealing surface meets the wearer's face.

2. Require employees to perform a positive and negative fit check every time the respirator is put on.

3. Employees will leave the area where respirators are being used:

a. Before removing the facepiece for any reason.

b. To change cartridges.

c. If any of the following is detected:

1. Vapor or gas breakthrough.

2. Leakage around the facepiece.

3. Changes in breathing resistance.

4. Use cartridges with End of Service Life Indicators or determine the respirator cartridge changeout schedule. See Attachment 42-4 for Guidance.

H. Require respirators to be cleaned and stored properly.

1. Clean and disinfect respirators after each use.

2. Store respirators in a plastic bag or case and in a clean location.

3. Inspect respirators before use and after each cleaning.

I. Address issues associated with special use respirators self-contained breathing apparatus; air supply respirators; emergency use respirators).

1. Self Contained Breathing Apparatus

   Inspect self-contained breathing apparatus and other emergency use respirators monthly and after each use in accordance with manufacturer's instructions.

2. Air Supplied Respirators

   a. Air used for atmosphere-supplying respirators must meet or exceed the requirements for Type 1 - Grade D breathing air. Never use oxygen.

      1. A certificate of analysis must accompany bottled air.

      2. Compressors used to supply breathing air must:

         i. Prevent entry of contaminated air into the air supply.

         ii. Minimize moisture content.

         iii. Have suitable in-line sorbent beds and filter to provide appropriate air quality.

         iv. Have a high carbon monoxide alarm that sounds at 10 ppm.

   b. Couplings on air hose lines must be incompatible with other gas systems.

J. Require follow up training and medical surveillance to be provided as directed.

   1. Provide follow-up physical examinations as directed by the SMS 24-3, Medical Screening and Surveillance Exam Protocol table.

   2. Provide follow-up physicals as directed by the Regional Medical Surveillance Administrator.

3. Provide annual refresher training.

4. Provide annual fit testing.

5. Documentation Summary

A. Laboratory

1. File these records in the Laboratory Safety Filing System

   a. Completed forms:

      1. "Identifying When A Respirator Is Needed" - Attachment 42-1; and,

      2. "Respirator Standard Operating Procedure" - Attachment 42-3.;

   b. Employee Health Status Medical Report includes clearance for respirator use.

   c. Employee Fit Test Records; and,

   d. Employee Respirator Training Records.

2. Send a copy of the following records to the Regional Health and Safety Manager:

   a. Completed "Voluntary Use of Respirators" form - Attachment 42-2.

   b. Employee Fit Test Records.

   c. Employee Respirator Training Records.

B. Field

1. File these records in the Project Health and Safety File:

   a. Completed forms:

      1. "Identifying When A Respirator Is Needed" - Attachment 42-1; and,

2. "Respirator Standard Operating Procedure" - Attachment 42-3.

3. Employee Health Status Medical Report includes clearance for respirator use.;

4. Employee Fit Test Records; and,

5. Employee Respirator Training Records.

2. Send a copy of the following records to the Regional Health and Safety Manager:

   a. Completed "Voluntary Use of Respirators" form - Attachment 42-2;.

   b. Employee Fit Test Records; and,

   c. Employee Respirator Training Records.

6. Resources

A. U.S. OSHA Standard - Respiratory Protection - 29 CFR 1910.134

B. U.S OSHA Technical Links - Respiratory Protection

C. ANSI Z88.6, Respirator Use – Physical Qualifications for Personnel, Current Revision

D. ANSI Z88.2, Respiratory Protection, Current Revision

E. 3M Cartridge Service Life Interactive Program

F. Australian Standards AS/N25 1715 - 1994. Selection, Use, and Maintenance of Respiratory Protection Devices

G. Australian Standards HB9-1994. Occupational Personal Protection

H. AIHA, The Occupational Environment - Its Evaluation and Control

The following documents are PDF files which must be read with Adobe Reader:

I. NIOSH Respirator Decision Logic

J. NIOSH Guide to Industrial Respiratory Protection

K. Attachment 42-1 - Identifying When a Respirator is Needed

L. Attachment 42-2 - Voluntary Use of Respirators

M. Attachment 42-3 - Respirator Standard Operating Procedure

N. Attachment 42-4 - Respiratory Cartridge Change Schedule

O. Attachment 42-5 - Fit Test Results Form

P. Medical Screening and Surveillance Program - SMS 24

URS **SAFETY MANAGEMENT STANDARD**

Personal Monitoring (Industrial Hygiene)

1. Applicability

This standard applies to URS operations where employees may be exposed to unacceptable concentrations of hazardous air contaminants.

2. Purpose and Scope

This standard is intended to assist and provide guidance to URS personnel that need to conduct personal industrial hygiene monitoring

Personal monitoring is to be conducted under the following conditions:

A. Where directed by a site-specific health and safety plan.

B. Where employees are exposed to known or suspected human carcinogens.

C. Where regulations require "initial exposure assessments." The only exception to conducting an "initial exposure assessment" where there is a regulatory requirement to do so is when similar exposure assessments have been conducted under similar site conditions within one year prior to the start of work on the current project.

Retain a copy of the referenced initial exposure assessment and place it in the Project Safety File.

2. Implementation

Laboratory Locations - Implementation of this standard is the responsibility of the Laboratory Manager.

Field Activities - Implementation of this standard is the responsibility of the Project Manager.

3. Requirements

A. Procedures for Personal Industrial Hygiene Monitoring

1. Collect samples using the applicable methodologies established by either NIOSH or OSHA. Require the selected laboratory to utilize the applicable analytical methodologies.

2. Document personal monitoring activities using a URS Industrial Hygiene Monitoring Form (Attachment 43-1) and require that all Chain of Custody forms are properly completed.

B. Evaluation of Personal Monitoring Results

1. Require that the analytical results be evaluated by a URS Health and Safety Program Representative.

2. Obtain a written evaluation report from the URS Health and Safety Program Representative. If exposures exceed the Action Level and/or Permissible Exposure Limit for the air contaminant(s) of concern, a verbal report is to be made to the Project Manager immediately, and the evaluation report will include required corrective actions.

3. Evaluation reports are to be completed within five working days of the receipt of the analytical results.

C. Communication of Sample Results and Evaluation

1. Provide copies of the evaluation report to the employee(s) monitored and to employees working in the area for whom the exposures could be representative.

2. Provide a copy of the evaluation report and monitoring data to the Medical Surveillance Administrator.

D. Corrective Actions

Implement required corrective actions immediately.

4. Documentation Summary

Maintain in the Project Safety File:

A. Calibration data

B. Completed IH Monitoring Form(s)

C. Evaluation Report with sample results

D. Relevant prior initial exposure assessments

E. Provide to affected employees:

Evaluation Report with sample results

F. Provide to the Medical Surveillance Administrator:

Evaluation Report with sample results

List of employees affected by the sampling

5. Resources

A. OSHA Analytical Methods

B. OSHA Chemical Sampling Information

C. American Industrial Hygiene Association, The Occupational Environment, Its Evaluation and Control.

D. American Conference of Governmental Industrial Hygienists. Air Sampling Instruments for Evaluation of Atmospheric Contaminants.

E. U.K. - 'Control of Substances Hazardous to Health'

F. NIOSH Analytical Methods

G. Attachment 43-1 - IH Monitoring Form

URS SAFETY MANAGEMENT STANDARD
Injury / Illness / Incident Reporting & Notifications

1. Applicability

This procedure applies to URS Corporation offices and field operations.

2. Purpose and Scope

The purpose of this procedure is to provide guidance for the timely reporting of work related injuries, illness, and incidents. This procedure also defines incident notification procedures for URS employees. Note – For incidents involving motor vehicles, the reporting and notification requirements of URS SMS 057 – Vehicle Safety Program may also apply.

For significant incidents (e.g., fatality, serious injury, injury to members of the public), SMS 066 – Incident Investigation is also required.

3. Implementation

Office Locations - Implementation of this program is the responsibility of the employee's Supervisor.

Field Activities - Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Reporting: All employees shall immediately notify their appropriate level of management (line, project, and/or office) of a reportable incident. A reportable incident includes the following:

1. An injury or illness to any URS employee or subcontractor, even if the injury does not require medical attention;
2. An injury to a member of the public, including clients, occurring on a URS controlled work site;
3. Illness resulting from suspected chemical exposure;
4. Chronic or re-occurring conditions such as back pain or cumulative trauma disorders (example: carpal tunnel syndrome);
5. Fire, explosion, or flash;
6. Any vehicle accidents occurring on site, while traveling to or from client locations, or with any company-owned, rented, or leased vehicle (including personal vehicles used for company business);

7. Property damage resulting from any URS or subcontractor activity;
8. Structural collapse or potential structural hazards;
9. Unexpected release or imminent release of a hazardous material;
10. Unexpected chemical exposures to workers or the public;
11. A safety related complaint from the public regarding URS activities.
12. Incidents that could result in adverse public media interest concerning URS or a URS project.
13. Any incident that could result in, or any actual investigation by, OSHA, DOT, EPA, or State, Federal, or local law enforcement agency.
14. Any other significant occurrence that could impact safety – including a near-miss.

Note: A near-miss is defined as an incident having the potential to cause significant injury or property damage as listed above – but did not. Examples of a near-miss include:

A worker steps off a ledge and falls three feet (1 meter) to the floor – and is uninjured.

A crane drops a 1,000-pound (454 kg) beam during a lift – and nobody is hurt, no equipment is damaged.

A work crew is conducting a survey along the highway. A vehicle leaves the roadway (driver asleep) and the vehicle enters the survey area at 50 mph (80 kph). The vehicle misses an employee by 3-feet (1 meter), the driver recovers control of the vehicle and leaves the area.

B. Actions: The following actions will be taken following a reportable incident:

1. Employees:

   a. If necessary, suspend operations and secure and/or evacuate the area;

   b. Immediately notify your supervisor and/or project manager

   c. Record information pertaining to the incident (e.g., time, date, location, name and company of person(s) involved witnesses,

description of event, and actions taken) and initiate either an Incident Report (49-1) or Near-Miss Report (49-2);

d. Assist with incident investigation as directed by management;

e. Implement corrective actions as directed by management;

f. *Do not* discuss the incident with members of the news media or legal representatives (except URS legal counsel or your personal legal advisor) unless directed to do so by URS management;

g. *Do not* make statements pertaining to guilt, fault, or liability.

2. Line/Project Management:

a. For instances involving serious accidents, injuries, or other significant consequences, verbally notify the URS H&S Management Team as soon as possible at the following numbers:

In the U.S., Canada, and Mexico: (866) 326-7321
Fax +1 (512) 419 6413

In Europe: +44-1291-621768
Fax +44 1291 621768

In Asia/Pacific: +61 (3) 8699 7500
Fax +61 (3) 8699 7550

Notification should in no case occur later than the end of the work shift. Follow-up notification by faxing an SMS 49-1 Incident Report Form within 24 hours to the URS Occupational Health Manager (OHM) at +1-512.419.6413. Also, assure copies of the report are distributed as outlined on the form.

URS Corporate H&S Management will make notification to Federal and State authorities as appropriate.

b. For minor incidents involving only first aid treatment, minor damage to vehicle of equipment, etc., make notifications to the above number as soon as reasonable during normal business hours and fax the SMS 49-1 Incident Report Form to the URS

OHM within 24 hours at +1-512.419.6413. Also, assure copies of the report are distributed as outlined on the form.

c. For a near-miss incident, complete the Near-Miss Report Form (49-2) and give it to the Office or Project Health and Safety Representative. Also, assure copies of the report are distributed as outlined on the form.

d. Review circumstances (i.e., who, what, when, where, and how) of the incident with applicable employee(s) to determine apparent causes and to develop recommended corrective actions;

e. Discuss with department or project staff the circumstances surrounding the incident and corrective actions taken.

3. Local Office or Project Health And Safety Representative

a. Assist with incident evaluation;

b. With management, identify cause(s) of incident and identify corrective actions needed to avoid recurrence;

c. Review injury/incident report or the near-miss report for completeness and accuracy. Assure the reports are distributed properly.

d. Assure notifications are made in a timely manner.

e. Assure that the injured employee is properly counseled/advised as directed by SMS 65 - Injury Management. Communicate with the OHM at (866) 326-7321.

4. Occupational Health Manager

a. Report work-related injuries and illness to workers' compensation carrier.

b. Assure that the employee's injury is managed in accordance with SMS 065. Provide guidance for the affected Office or Project Health and Safety Representative.

c. Periodically disseminate near-miss reporting summary information to the Regional and Corporate H&S Managers.

5. Corporate Health and Safety Management

    a. Notify URS management of any significant occurrence including lost-time injuries, deaths, or other serious result or circumstance.

    b. The Occupational Health Manager (OHM) will review all reported incidents to determine OSHA reporting and recording requirements with input from the appropriate Corporate Health and Safety Manager. For a determination of recordability in those infrequent instances where there is not a clear answer, the Vice President, Health, Safety, and Environment shall make the final determination. All decisions will be based strictly on current Federal OSHA guidelines.

    c. Official records (including required reports and logs for all reported incidents) will be maintained at one central location by the OHM.

    d. Each January the OHM will prepare and distribute, to each URS establishment, the appropriate government injury/illness reports. These reports will summarize all required government information for incidents that occurred during the preceding calendar year.

5. Documentation Summary

A. File these records in the Office Safety File:

1. Attachment 49-1 - Incident Report Form
2. Attachment 49-2 – Near-Miss report

B. File these records in the Project Health and Safety File

1. Attachment 49-1 - Incident Report Form
2. Attachment 49-2 – Near-Miss report

SAFETY MANAGEMENT STANDARD
INJURY MANAGEMENT

1. Applicability

This standard applies to all U.S. based URS field and office locations.

2. Purpose and Scope

This standard is designed to ensure that employees receive appropriate, immediate, and high-quality health care services that will minimize disability, promote rapid recovery and save lives.

3. Implementation

Office Locations – Implementation of this program is the responsibility of the Office Manager.

Field Activities – Implementation of this program is the responsibility of the Project Manager.

4. Requirements

A. Pre-Injury Management

The following pro-active plans and procedures shall be in place before an injury or illness occurs.

1. Work Site Evaluation

Project and office locations shall evaluate their location for first aid and medical requirements. The following factors should be considered:

Types of accidents that could reasonably occur

Location of local clinics and hospitals

Response time for external emergency services

If corrosive or hazardous materials are in use

Any industry specific requirements

Types of training for employees and first aid responders

What first aid supplies should be available

2. First Aid Services

a. First Aid Responders

At least one person, and preferably two or more, trained in first aid must be available at the worksite if either of these conditions exist:

(1). If life threatening injuries can reasonably be expected, trained personnel must be available within 3 to 4 minutes. This generally means that community emergency medical services cannot be relied on since their response time is usually greater than 3 minutes.

(2). If no life threatening injuries can reasonably be expected, the response time for trained personnel is extended to 15 minutes.

The trained first aid responders should be designated so that the other employees know who they are and how to contact them. The trained responder must have a current first aid certificate and be trained in Bloodborne Pathogens (See SMS 51).

b. First Aid Kits

Each site shall maintain a first aid kit in accordance with SMS 24-9.

c. Emergency Information

Each location shall post a current list of emergency telephone numbers and maps to access local medical emergency providers (SMS 003). Advance contact with ambulance services to ensure they are familiar with location, access routes, and hospital locations is advised in remote or new locations.

d. Eyewash Facilities

If corrosive materials are used, eyewash and body flush facilities must be provided. Where possible, these should provide large quantities of clean water. The water source must be pressure controlled and clearly identified. Portable eyewash stations must contain a minimum of 1 gallon of potable water.

e. Identification of Medical Facilities

Field and office location shall identify a suitable local clinic, preferably specializing in occupational medicine, to treat non-emergency injuries and illnesses. In addition, a local hospital emergency room shall be

identified for treatment of life threatening or after hours injuries. The URS Occupational Health Specialist (OHS) or the workers' compensation insurance carrier pre-injury consultant should be contacted to provide a listing of recommended medical facilities.

The URS H&S Representative should visit the medical facility and meet with the medical provider in order to establish expectations. Clinics should be conveniently located, clean, professionally staffed, offer multiple services and be supportive of early return to work practices.

Field/construction projects shall make appropriate arrangements with local ambulance/emergency service providers prior to the start of work activities to ensure appropriate transportation can be provided in the event of an emergency. These arrangements include establishment of an identifiable project address and emergency access point (i.e. location to meet emergency personnel).

B. Post-Injury Management

1. Transportation

When employees require urgent medical attention as the result of a work-related injury/illness, transportation shall be provided to the doctor's office, clinic, or hospital. Employees should not be permitted to drive unless safe to do so.

2. Emergency Injury/Illness Treatment

In all cases, critical injuries must be immediately referred for professional medical attention. The manner in which the referral is accomplished, and the person responsible for the referral, should be clearly defined in either a project safety plan and/or an office Emergency Action Plan (SMS 003). Critical injuries/illnesses include, but may not be limited to, the following:

Loss of consciousness

Unexplained chest pain

Breathing difficulty

Uncontrolled bleeding

Fractured bones

Suspected internal injuries

Suspected exposure to chemical/biological hazard

Second or third degree thermal or chemical burns (i.e. blistering)

Electrocution

Unexplained change in mental state following an injury (may indicate shock or other internal injuries)

3. Non-Emergency Injury/Illness Treatment

When a work-related incident results in a non-critical injury/illness, the primary objective is to provide appropriate medical services to diagnose and treat the injury/illness. Options available to the employee and project/office management in these situations include the following:

First aid treatment and/or review by a qualified first aid responder

First aid treatment and/or review by a qualified first aid responder followed by a referral to the Occupational Health Specialist (866-326-7321).

Additional support for the employee and managers in these situations can also be obtained from a URS H&S professional.

Attachment 065-1 provides a flow chart to assist employees and managers in determining the most appropriate option for obtaining medical services for non-emergency injuries/illnesses.

Note – Some states allow injured workers to choose their own initial medical provider. Employees are to be cautioned that not all medical providers accept workers' compensation insurance and coverage should be verified prior to treatment if an employee lives in a state that permits him/her to elect to see their personal doctor rather than the company recommended physician.

C. Workers' Compensation Case Management

1. Health and Safety

a. URS Occupational Health Specialist will:

(1). Evaluate and file workers' compensation claims for cases covered by the URS insurance program. Evaluate and provide consultation for injuries occurring in Monopolistic states (Ohio, Washington, West Virginia, North Dakota, and Wyoming).

(2). Provide date of injury support to employees and supervisors, including Monopolistic state claims.

(3). Coordinate regular follow-up of all cases, including Monopolistic state claims, to ensure effective case management.

(4). Offer pre-injury consultation for offices and project sites.

(5). Provide training and communication regarding the workers' compensation process.

b. The Regional and Corporate H&S Managers will assist with the early return to work program by interfacing with the supervisor and employee to evaluate if appropriate and safe temporary transitional work is available.

c. Local H&S Representatives will:

(1). Provide support to the local office or project to ensure that the requirements of this SMS are in place.

(2). Provide training on this SMS to the local office or project site staff.

(3). Ensure proper reporting of incidents in accordance with SMS 049.

(4). Ensure that requirements of this SMS are incorporated into all project H&S plans.

2. Human Resources

a. Local HR Representatives will:

(1). Provide on-site contact for injured employees by maintaining necessary forms and referring employee to OHS to file the workers' compensation claim.

(2). Act as the on-site point of contact for the workers' compensation insurance carrier adjuster.

(3). Forward any external communication (clinic bills, Monopolistic state forms, etc.) to the OHS upon receipt.

b. Regional HR Managers will coordinate any Short Term Disability benefits owed to employees disabled from working over one week because of a work-related injury/illness.

3. Supervisor

The Supervisor (or HR or H&S Representative) will:

a. Sign the Medical Treatment Referral form (065-2) prior to the employee leaving the site for medical treatment (this will not be necessary in an emergency). The employee will also be given the Medical Authorization Form (065-3) to be signed with copy provided to the employee, health care provider and OHS.

b. Provide transitional job assignments, with consultation and approval of the office manager, whenever possible to enable an injured worker to return to work (URS Return to Work Policy 065-4). Transitional employment is defined as temporary modified or light duty work that covers the time from the injury until the release to full duty from the doctor. The return to work hierarchy includes:

(1). Return to own job

(2). Return to own job with accommodations/modifications

(3). Return to another job at URS with or without accommodations/modifications

(4). Placement in alternate jobs through telecommuting or other job assignments determined on a case by case basis.

c. Provide, when requested by the treating physician or insurance carrier, the Description of Employee's Job Duties form (065-5).

d. Maintain regular contact with employees who are temporarily disabled (contact at least weekly by phone or email).

4. Employee

The employees will:

a. Report injuries as soon as possible to their supervisors. Employees are encouraged to contact their supervisor and/or the OHS prior to seeking any medical services for non-emergency injuries and illnesses.

b. Provide the Medical Treatment Referral form to the treating physician. If employees are unable to obtain the form prior to being treated (i.e. onset of symptoms during non-work hours, work in remote locations, etc.) they must notify their supervisor as soon as possible on the next scheduled workday.

c. Provide their supervisor with written return to work and follow up paperwork from the treating physician immediately following each doctor appointment.

5. Documentation Summary

A. The following documents shall be maintained by the H&S Representative:

Posting of medical services providers and emergency phone numbers

List of qualified first aid providers

Documentation of coordination between URS and emergency service providers for field/construction projects.

Completed Injury/Illness/Incident Report Form (SMS 49-1) (copy to OHS)

Description of Employee's Job Duties form (copy to OHS) – 065-5

Medical Treatment Referral form – 065-2

Medical Authorization Letter – 065-3

B. The following documents shall be maintained by the HR Representative and copied to the OHS.

Physician's First Report of Injury and follow up reports

Medical Treatment Referral form

Medical Authorization Letter

Description of Employee's Job Duties form

6. Resources

OSHA 1910.151 Medical Services and First Aid

OSHA Instruction CPL 2-2.53 Guidelines for First Aid Programs

OSHA Safety & Health Topics: Medical and First Aid

Red Cross Health & Safety Services www.redcross.org/services/hss/

SMS 003 Emergency Action Plans

SMS 024 Medical Surveillance

SMS 049 Incident Reporting

SMS 051 Bloodborne Pathogens

URS Medical Services Provider – WorkCare 1-800-455-6155

URS workers' compensation insurance provider AIG – www.aigcs.net

URS Occupational Health Specialist – Jeanette Schrimsher, RN COHN-S

Phone 866-326-7321

Confidential Fax 512-419-6413

Attachments

065-1 Injury Management Procedures (Flow Chart)

065-2 Medical Treatment Referral form

065-3 Medical Authorization Letter

065-4 URS Return to Work Policy

065-5 Description of Employee's Job Duties

URS **SAFETY MANAGEMENT STANDARD**

Manual Material Handling

1. Applicability

This procedure applies to URS operations where personnel perform manual handling of materials. For this procedure, manual material handling (MMH) is defined as the movement of items by lifting, lowering, pushing, pulling, carrying, holding, or restraining.

2. Purpose and Scope

The purpose of this procedure is to prevent common injuries caused by the practice of MMH. Immediate or short-term effects include lacerations, bruises, and muscle fatigue. Long-term effects include chronic pain, typically in the lower back.

3. Implementation

Office/Warehouse Locations– Implementation of this procedure is the responsibility of the Office/Warehouse Manager.

Field Activities– Implementation of this procedure is the responsibility of the Project Manager.

4. Requirements

A. General

1. Prior to lifting, lowering, pushing, pulling, carrying, holding, or restraining an object of any significant size or weight, employees must evaluate the object and the required task to determine if they can handle the object safely.
2. If the employee has any doubt about whether than can safely move the object by themselves, additional manual or mechanical help should be obtained.
3. Healthy employees with no physician imposed restrictions should lift and carry a maximum of 50 pounds (23 kilograms) using proper lifting and carrying techniques. Physical and workplace factors may reduce this recommended weight limit (RWL) significantly and should be considered prior to attempting lifts of this magnitude.
4. An employee's personal "safe" MMH capability is defined as the employee's personal capability to manually lift, carry, push, or pull an object alone. This "safe" limit must consider the employee's past experience and training with MMH, health status, and any other personal or environmental characteristics affecting the employee's ability to perform these tasks. An employee's "safe" MMH capability is typically at or below the calculated RWL.
5. An MMH task that exceeds an employee's personal "safe" MMH capability or RWL should be brought to the attention of the Project Manager.
6. If, due to a medical or health condition, the employee's physician or the employee has set a personal "safe" MMH capability, then appropriate medical documentation must be provided to the Project Manager to define these limits.
7. A recommended RWL can be calculated using the factors described in Attachment 69-1. The weight limit derived from these calculations is considered to be a load that over 99% of men and over 75% of women can safely handle without application of engineering or administrative controls. **Implementation of the calculations in Attachment 69-1 should only be attempted with the assistance of a safety professional knowledgeable in the application of**

these factors. The calculations are intended to determine RWLs for repetitive lifting scenarios rather than occasional lifts.

B. Pre-Planning

1. If a heavy object is to be moved to another location, the safest transport route should be determined prior to the activity.
2. The area around the object and the route over which it will be transported should be checked for slip, trip, and fall hazards. Hazards should be removed prior to initiation of the task.
3. The object to be moved should be inspected for grasping or handling hazards, including slivers, sharp edges, grease, water, etc. Eliminate or abate any identified hazards where possible. Safe grasping or handling points on the object should be determined.
4. The distance to be traveled and the length of time which a grip on the object must be maintained should be considered before moving objects.

C. Lifting/Lowering Guidelines

1. Reduce or eliminate manual lifting and lowering tasks where possible. Determine if there are ways to abate the safety and ergonomic hazards associated with manual lifting.
2. The recommended technique for manual lifting/lowering involves five maneuvers:
   a. Get a firm footing. Keep your feet apart for a stable base. Put one foot slightly in front of the other.
   b. Bend your knees. Do not bend at the waist. When grasping the object, a firm grip should be obtained before lifting/lowering.
   c. Lift/lower with your legs. Lift/lower the load slowly and in a straight line, avoiding sudden movements.
   d. Keep the load close to the body. Generally, the closer the load is to the body, the less force it exerts on your back.
   e. Keep your back straight. Do not add the weight of your body to the load. Avoid twisting.
3. When a turn or change of direction is necessary, the object should be lifted or lowered into a carrying position, then the whole body should be turned with the feet, avoiding any trunk twisting motion.
4. Objects to be lifted to shoulder height should first be lifted to waist height, then rested on a level surface so the grasping position can be changed prior to lifting to a higher level.
5. Employees should never lift a load above their head.

D. Carrying/Holding Guidelines

1. Manual carrying is an inefficient way of transporting materials in the work place. Where possible, reduce or eliminate manual carrying tasks.
2. Employees should never carry a load above their head.

3. Carry an object close to the body using both hands. One-handed carries are awkward and tend to unbalance the employee.
4. Do not carry objects that are so large they will obstruct visibility.
5. Grips on an object should not be changed while carrying or holding an object. Rest the object on a secure surface prior to changing grip.
6. Avoid two person carries where possible. If an object is of a size, shape, or mass that it requires two people to carry, use two people of similar size and physique. Perform lifting of the item in unison.
7. Avoid carrying objects on stairs, particularly where the line of sight may be obstructed or the object can interfere with leg movement.

E. Pushing/Pulling Guidelines

1. Check the condition of the floor, ground, or other surface prior to pushing or pulling an object across it.
2. Be aware of the “break out” force of the object - the force at which a push or pull overcomes the frictional force between the surface and object. Adjust posture to avoid losing balance when this point is reached.
3. Get assistance when moving or guiding a large load.
4. Where possible, always push rather than pull a load.

F. Workplace Design

1. Store heavy or bulky materials at heights between the knee and shoulder to avoid the need to stretch or bend.
2. Pack or arrange items to be lifted to avoid shifting of weight in the package.
3. Design work areas to avoid the need to lift, carry, push, or pull heavy or bulky materials for extended distances.
4. Design workplaces with the following in mind.
   a. Lifts from the floor should be avoided.
   b. The torso should never twist while handling loads.
   c. Asymmetrical or unbalanced one-handed lifts should be avoided.
   d. Loads should not be lifted with sudden movements.
   e. Loads should not be lifted over obstacles.
   f. Loads should not be lifted at extended reaches.
   g. Uncomfortable postures should not be necessary throughout the work cycle.
   h. Environmental factors (e.g., task lighting, dry work surfaces, heat stress) should be considered.

G. Training

1. Require that personnel who may have MMH as part of their duties receive training that includes the following topics:

a. Showing personnel how to avoid unnecessary physical stress and strain during MMH operations.

b. Teaching personnel to become aware of what they can comfortably handle without undue strain.

c. Instructing personnel on the proper use of equipment.

d. Teaching personnel to recognize potential hazards and how to prevent or correct them.

2. This training must be completed prior to an employee being assigned to a task that involves MMH activities.

5. Documentation Summary

Training rosters or other proof of completion of MMH training will be filed in the Project or Office Health and Safety File.

6. Resources

A. Recommended Weight Limit Calculations (RWL) – Attachment 69-1

B. Work Practices Guide for Manual Lifting, NIOSH
http://www.cdc.gov/niosh

C. Canadian Centre for Occupational Health and Safety
http://www.ccosha.ca/oshaanswers/ergonomics/mmh/

D. Oregon OSHA “Ergonomics of Manual Materials Handling”
http://www.cbs.state.or.us/external/osha/pdf/workshops/206w.pdf

E. North Carolina Department of Labor “A Guide to Manual Materials Handling and Back Safety http://www.nclabor.com/osha/etta/indguide/ig26.pdf

F. European Agency for Safety and Health at Work
http://uk.osha.eu.int/good_practice/msd.stm

ATTACHMENT C

MATERIAL SAFETY DATA SHEETS

MSDS Number: **A0446** * * * * * *Effective Date: **04/10/01*** * * * * * *Supercedes: **04/09/98***

MSDS Material Safety Data Sheet

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

Mallinckrodt CHEMICALS | J.T.Baker

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

National Response In Canada
CANUTEC: 613-996-6666

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

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

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

ACETONE

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal
CAS No.: 67-64-1
Molecular Weight: 58.08
Chemical Formula: (CH3)2CO
Product Codes:
J.T. Baker: 5356, 5580, 5805, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9036, 9125, 9254, 9271, A134, V655
Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2445, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Acetone	67-64-1	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY

CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

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

Health Rating: 1 - Slight
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.
Ingestion:
Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.
Skin Contact:
Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.
Eye Contact:
Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.
Chronic Exposure:
Prolonged or repeated skin contact may produce severe irritation or dermatitis.
Aggravation of Pre-existing Conditions:
Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT

INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

---

5. Fire Fighting Measures

Fire:
Flash point: -20C (-4F) CC
Autoignition temperature: 465C (869F)
Flammable limits in air % by volume:
lel: 2.5; uel: 12.8
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Acetone:
-OSHA Permissible Exposure Limit (PEL):
1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless, volatile liquid.
Odor:
Fragrant, mint-like
Solubility:
Miscible in all proportions in water.
Specific Gravity:
0.79 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
56.5C (133F) @ 760 mm Hg
Melting Point:
-95C (-139F)
Vapor Density (Air=1):
2.0
Vapor Pressure (mm Hg):
400 @ 39.5C (104F)
Evaporation Rate (BuAc=1):
ca. 7.7

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m3; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

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

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Acetone (67-64-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

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

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: ACETONE

Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 350LB

---

15. Regulatory Information

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

Ingredient	TSCA	EC	Japan	Australia
Acetone (67-64-1)	Yes	Yes	Yes	Yes

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

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Acetone (67-64-1)	Yes	Yes	No	Yes

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

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No

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

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Acetone (67-64-1)	5000	U002	No

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

Australian Hazchem Code: 2[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
****

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****

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

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

Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

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

Section 1: Material Identification

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

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

NFPA: 3 / 2 / 0 / -

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

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

Section 2: Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

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

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

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

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

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

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

Section 3: Physical Data

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

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

Section 4: Fire and Explosion Data

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

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

Section 5: Reactivity Data

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

Section 6: Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a suspected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).

Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.

Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.

Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.

Primary Entry Routes: Inhalation, skin contact.

Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, dizziness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).

Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.

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

Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7: Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).

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

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4); 112; and per RCRA, Sec. 3001]

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

Listed as SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8: Special Protection Data

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

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

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

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[107]

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

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

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

Section 9: Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.

Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."

Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)	IMO Shipping Name: Benzene
DOT Hazard Class: Flammable liquid	IMO Hazard Class: 3.2
ID No.: UN1114	ID No.: UN1114
DOT Label: Flammable liquid	IMO Label: Flammable liquid
DOT Packaging Exceptions: 173.118	IMDG Packaging Group: II
DOT Packaging Requirements: 173.119	

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

SDS Collection References: 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143

Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

CHEM SERVICE INC -- F16 CHLOROETHANE

==========

MSDS Safety Information

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FSC: 6550
MSDS Date: 08/27/1992
MSDS Num: BWJHR
LIIN: 00F037543
Product ID: F16 CHLOROETHANE
MFN: 01
Responsible Party
Cage: 84898
Name: CHEM SERVICE INC
Address: 660 TOWER LN
Box: 3108
City: WEST CHESTER PA 19381-3108
Info Phone Number: 215-692-3026/800-452-9994
Emergency Phone Number: 215-692-3026/800-452-9994
Review Ind: Y
Published: Y

==========

Preparer Co. when other than Responsible Party Co.

==========

Cage: 84898
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381

==========

Contractor Summary

==========

Cage: 84898
Name: CHEM SERVICE INC
Box: 3108
City: WEST CHESTER PA 19381
Phone: 215-692-3026
Cage: 8Y898
Name: CHEM SERVICE, INC
Address: 660 TOWER LN
Box: 599
City: WEST CHESTER PA 19301-9650
Phone: 610-692-3026

==========

Ingredients

==========

Cas: 75-00-3
RTECS #: KH7525000
Name: ETHYL CHLORIDE, CHLOROETHANE
Other REC Limits: 2600 MG/CUM
OSHA PEL: 1000 PPM
ACGIH TLV: 1000 PPM
EPA Rpt Qty: 100 LBS
DOT Rpt Qty: 100 LBS

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Health Hazards Data

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Route Of Entry Inds - Inhalation: YES
Skin: YES
Ingestion: YES
Carcinogenicity Inds - NTP: NO
IARC: NO
OSHA: NO
Effects of Exposure: SKIN: RAPIDLY ABSORBED/FATAL/ADVERSE HEALTH

EFFECTS/FROSTBITE. INHALTION: HARMFUL/FATAL/RESPSIRATORY TRACT IRRITATION/MUCOUS MEMBRANE IRRITATION/DELAYED LUNG INJURY. INGESTION: FATAL. EYES: DAMAGE. EX POSURE CAN CAUSE NERVOUS/CARDIOVASCULARSYSTEM INJURY, DELAYED ADVERSE HEALTH EFFECTS, LIVER & KIDNEY DAMAGE.
Explanation Of Carcinogenicity: NONE
Signs And Symptions Of Overexposure: IRRITATION, GI DISTURBANCES, NAUSEA, HEADACHE, DIZZINESS, DISORIENTATION.
First Aid: EYES: FLUSH W/WATER FOR 15-20 MINS. SKIN: FLUSH W/WATER FOR 15-20 MINS. IF NOT BURNED, WASH W/SOAP & WATER. INHALATION: REMOVE TO FRESH AIR. GIVE CPR/OXYGEN IF NEEDED. IF IN SHOCK, KEEP WARM & QUIET. INGESTION: DON'T GIVE LIQUIDS/INDUCE VOMITING IF UNCONSCIOUS/CONVULSIVE. IF VOMITING OCCURS, WATCH CLOSELY FOR ANY AIRWAY OBSTRUCTION. OBTAIN MEDICAL ATTENTION IN ALL CASES.

==========
Handling and Disposal
==========
Spill Release Procedures: EVACUATE AREA. WEAR APPRORPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. WASH CONTAMINATED SURFACES TO REMOVE ANY RESIDUES.
Waste Disposal Methods: BURN IN A CHEMICAL INCINERATOR EQUIPPED W/AN AFTERBURNER & SCRUBBER IAW/FEDERAL, STATE & LOCAL REGULATIONS.
Handling And Storage Precautions: STORE IN A COOL DRY PLACE ONLY W/COMPATIBLE CHEMICALS. KEEP TIGHTLY CLOSED. DON'T USE MAGNESIUM/ALUMINUM/THEIR ALLOYS AS CONTAINERS. (SEE SUPP)
Other Precautions: AVOID CONTACT W/SKIN, EYES & CLOTHING. DON'T BREATH VAPORS. CONTACT LENSES SHOULDN'T BE WORN IN THE LABORATORY. FOR LABORATORY USE ONLY. ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS. AVOID DIRECT PHYS ICAL CONTACT.

==========
Fire and Explosion Hazard Information
==========
Flash Point Text: -58F
Lower Limits: 3.8
Upper Limits: 15.4
Extinguishing Media: CO2, DRY CHEMICAL POWDER. DON'T USE WATER.
Unusual Fire/Explosion Hazard: FLAMMABLE CHEMICAL.

==========
Control Measures
==========
Respiratory Protection: WEAR APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT.
Ventilation: CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD.
Eye Protection: EYE SHIELDS
Work Hygienic Practices: REMOVE/LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.
Supplemental Safety and Health: STORAGE & HANDLING CONT'D: DARK COLORS DON'T AFFECT PURITY.

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Physical/Chemical Properties
==========
B.P. Text: 54.14F
M.P/F.P Text: -217.66F
Vapor Pres: 1000
Vapor Density: 2.23
Solubility in Water: SLIGHT
Appearance and Odor: COLORLESS CONDENSED GAS W/ETHER LIKE ODOR.

==========
Reactivity Data
==========
Stability Indicator: YES
Stability Condition To Avoid: SENSITIVE TO HEAT & LIGHT.
Materials To Avoid: ACTIVE METALS, SODIUM, POWDERED METALS, MAGNESIUM, ALUMINUM, STRONG OXIDIZING AGENTS.
Hazardous Decomposition Products: TOXIC FUMES. DECOMPOSITION PRODUCTS ARE CORROSIVE.
Hazardous Polymerization Indicator: NO

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Toxicological Information
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Ecological Information
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MSDS Transport Information
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Regulatory Information
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Other Information
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HAZCOM Label
==========
Product ID: F16 CHLOROETHANE
Cage: 84898
Company Name: CHEM SERVICE INC
PO Box: 3108
City: WEST CHESTER PA
Zipcode: 19381
Health Emergency Phone: 215-692-3026/800-452-9994
Label Required IND: Y
Date Of Label Review: 12/16/1998
Status Code: C
Label Date: 12/16/1998
Origination Code: G
Hazard And Precautions: SKIN: RAPIDLY ABSORBED/FATAL/ADVERSE HEALTH EFFECTS/FROSTBITE. INHALTION: HARMFUL/FATAL/RESPSIRATORY TRACT IRRITATION/MUCOUS MEMBRANE IRRITATION/DELAYED LUNG INJURY. INGESTION: FATAL. EYES: DAMAGE. EX POSURE CAN CAUSE NERVOUS/CARDIOVASCULARSYSTEM INJURY, DELAYED ADVERSE HEALTH EFFECTS, LIVER & KIDNEY DAMAGE. IRRITATION, GI DISTURBANCES, NAUSEA, HEADACHE, DIZZINESS, DISORIENTATION.
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CORNELL

Material Safety Data Sheets

Division of Facilities Services

DOD Hazardous Material Information (ANSI Format)
For Cornell University Convenience Only

F13 1,1-DICHLOROETHANE

Section 1 - Product and Company Identification	Section 9 - Physical & Chemical Properties
Section 2 - Compositon/Information on Ingredients	Section 10 - Stability & Reactivity Data
Section 3 - Hazards Identification Including Emergency Overview	Section 11 - Toxicological Information
Section 4 - First Aid Measures	Section 12 - Ecological Information
Section 5 - Fire Fighting Measures	Section 13 - Disposal Considerations
Section 6 - Accidental Release Measures	Section 14 - MSDS Transport Information
Section 7 - Handling and Storage	Section 15 - Regulatory Information
Section 8 - Exposure Controls & Personal Protection	Section 16 - Other Information

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Cornell University does not in any way warrant or imply the applicability, viability or use of this information to any person or for use in any situation.

Section 1 - Product and Company Identification
F13 1,1-DICHLOROETHANE

Product Identification: F13 1,1-DICHLOROETHANE
Date of MSDS: 06/01/1989 **Technical Review Date:** 12/30/1994
FSC: 6550 **NIIN:** **LIIN:** 00F037545
Submitter: F BT
Status Code: C
MFN: 01
Article: N
Kit Part: N

Manufacturer's Information

Manufacturer's Name: CHEM SERVICE INC
Post Office Box: 3108
Manufacturer's Address1: 660 TOWER LN
Manufacturer's Address2: WEST CHESTER, PA 19381-3108
Manufacturer's Country: US
General Information Telephone: 215-692-3026/800-452-9994
Emergency Telephone: 215-692-3026/800-452-9994
Emergency Telephone: 215-692-3026/800-452-9994
MSDS Preparer's Name: N/P
Proprietary: N
Reviewed: Y
Published: Y
CAGE: 84898
Special Project Code: N

Preparer Information

Preparer's Name: CHEM SERVICE INC
Post Office Box: 3108
Preparer's Address1: N/K
Preparer's Address2: WEST CHESTER, PA 19381
Preparer's CAGE: 84898
Assigned Individual: N

Contractor Information

Contractor's Name: CHEM SERVICE INC
Post Office Box: 3108
Contractor's Address1: N/K
Contractor's Address2: WEST CHESTER, PA 19381
Contractor's Telephone: 215-692-3026
Contractor's CAGE: 84898

Contractor Information

Contractor's Name: CHEM SERVICE, INC
Post Office Box: 599
Contractor's Address1: 660 TOWER LN
Contractor's Address2: WEST CHESTER, PA 19301-9650
Contractor's Telephone: 610-692-3026
Contractor's CAGE: 8Y898

Section 2 - Compositon/Information on Ingredients
F13 1,1-DICHLOROETHANE

Ingredient Name: 1,1-DICHLOROETHANE (ETHYLIDINE CHLORIDE)
Ingredient CAS Number: 75-34-3 **Ingredient CAS Code:** M
RTECS Number: KI0175000 **RTECS Code:** M
=WT: =WT Code:
=Volume: =Volume Code:

>WT: >WT Code:
>Volume: >Volume Code:
<WT: <WT Code:
<Volume: <Volume Code:
% Low WT: % Low WT Code:
% High WT: % High WT Code:
% Low Volume: % Low Volume Code:
% High Volume: % High Volume Code:
% Text: N/K
% Enviromental Weight:
Other REC Limits: 200 PPM
OSHA PEL: 100 PPM **OSHA PEL Code:** M
OSHA STEL: OSHA STEL Code:
ACGIH TLV: 200 PPM **ACGIH TLV Code:** M
ACGIH STEL: N/P **ACGIH STEL Code:**
EPA Reporting Quantity: 1000 LBS
DOT Reporting Quantity: 1000 LBS
Ozone Depleting Chemical: N

Section 3 - Hazards Identification, Including Emergency Overview
F13 1,1-DICHLOROETHANE

Health Hazards Acute & Chronic: SKIN: RAPIDLY ABSORBED/HARMFUL/IRRITATION/ALLERGIC REACTION/SENSITIZATION. INHALATION: HARMFUL/RESPIRATORY TRACT IRRITATION/MUCOUS MEMBRANE IRRITATION. INGESTION: HARMFUL. EYES: IRRITATION. EXPOSURE C AN CAUSE LIVER/KIDNEY/NERVOUS SYSTEM INJURY, DELAYED ADVERSE HEALTH AFFECTS. NARCOTIC AT HIGH CONCENTRATIONS.

Signs & Symptoms of Overexposure:
IRRITATION, DISORIENTATION.

Medical Conditions Aggravated by Exposure:
N/K

LD50 LC50 Mixture: ORAL LD50 (RAT/MOUSE): 725 MG/KG

Route of Entry Indicators:
Inhalation: YES
Skin: YES
Ingestion: YES

Carcenogenicity Indicators
NTP: NO
IARC: NO
OSHA: NO

Carcinogenicity Explanation: NONE

Section 4 - First Aid Measures
F13 1,1-DICHLOROETHANE

First Aid:
EYES: FLUSH W/WATER FOR 15-20 MINS. SKIN: FLUSH W/WATER FOR 15-20 MINS. IF NOT BURNED, WASH W/SOAP & WATER. INHALATION: REMOVE TO FRESH AIR. GIVE CPR/OXYGEN IF NEEDED. KEEP WARM & QUIET. INGESTION: DO N'T INDUCE VOMITING/GIVE LIQUIDS IF UNCONSCIOUS/CONVULSIVE. IF VOMITING, WATCH CLOSELY FOR ANY AIRWAY OBSTRUCTION. OBTAIN MEDICAL ATTENTION IN ALL CASES.

Section 5 - Fire Fighting Measures
F13 1,1-DICHLOROETHANE

Fire Fighting Procedures:
N/K
Unusual Fire or Explosion Hazard:
FLAMMABLE CHEMICAL.
Extinguishing Media:
CO2, DRY CHEMICAL POWDER. DON'T USE WATER.
Flash Point: Flash Point Text: 23F

Autoignition Temperature:
Autoignition Temperature Text: N/A
Lower Limit(s): 6
Upper Limit(s): 16

Section 6 - Accidental Release Measures
F13 1,1-DICHLOROETHANE

Spill Release Procedures:
EVACUATE AREA. WEAR APPRORPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. ABSORB ON VERMICULITE/SIMILAR MATERIAL. SWEEP UP & PLACE IN APPROPRIATE CONTAINER/HOLD FOR DISPOSAL. WASH CONTAMINATED SURFAC ES TO REMOVE ANY RESIDUES.

Section 7 - Handling and Storage
F13 1,1-DICHLOROETHANE

Handling and Storage Precautions:

Other Precautions:

Section 8 - Exposure Controls & Personal Protection
F13 1,1-DICHLOROETHANE

Repiratory Protection:
WEAR APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT.
Ventilation:
CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD.
Protective Gloves:
N/K
Eye Protection: EYE SHIELDS
Other Protective Equipment: N/K
Work Hygenic Practices: REMOVE/LAUNDER CONTAMINATED CLOTHING BEFORE REUSE. READILY ABSORBED & RETAINED ON CLOTHING &/SHOES.
Supplemental Health & Safety Information: N/K

Section 9 - Physical & Chemical Properties
F13 1,1-DICHLOROETHANE

HCC:
NRC/State License Number:
Net Property Weight for Ammo:
Boiling Point: Boiling Point Text: 135.14F
Melting/Freezing Point: Melting/Freezing Text: -142.6F
Decomposition Point: Decomposition Text: N/K
Vapor Pressure: 182 **Vapor Density:** 3.4
Percent Volatile Organic Content:
Specific Gravity: N/K
Volatile Organic Content Pounds per Gallon:
pH: N/K
Volatile Organic Content Grams per Liter:
Viscosity: N/P
Evaporation Weight and Reference: N/K
Solubility in Water: SLIGHT
Appearance and Odor: COLORLESS LIQUID W/FRUITY/PLEASANT ODOR.
Percent Volatiles by Volume: N/K
Corrosion Rate: N/K

Section 10 - Stability & Reactivity Data
F13 1,1-DICHLOROETHANE

Stability Indicator: YES
Materials to Avoid:
STRONG OXIDIZING AGENTS/BASES, CAUSTICS.
Stability Condition to Avoid:
SENSITIVE TO HEAT.
Hazardous Decomposition Products:
TOXIC FUMES.
Hazardous Polymerization Indicator: NO
Conditions to Avoid Polymerization:
N/K

Section 11 - Toxicological Information
F13 1,1-DICHLOROETHANE

Toxicological Information:
N/P

Section 12 - Ecological Information
F13 1,1-DICHLOROETHANE

Ecological Information:
N/P

Section 13 - Disposal Considerations
F13 1,1-DICHLOROETHANE

Waste Disposal Methods:
BURN IN A CHEMICAL INCINERATOR EQUIPPED W/AN AFTERBURNER & SCRUBBER IAW/FEDERAL, STATE & LOCAL REGULATIONS.

Section 14 - MSDS Transport Information
F13 1,1-DICHLOROETHANE

Transport Information:

N/P

Section 15 - Regulatory Information
F13 1,1-DICHLOROETHANE

SARA Title III Information:
N/P
Federal Regulatory Information:
N/P
State Regulatory Information:
N/P

Section 16 - Other Information
F13 1,1-DICHLOROETHANE

Other Information:
N/P

HAZCOM Label Information

Product Identification: F13 1,1-DICHLOROETHANE
CAGE: 84898
Assigned Individual: N
Company Name: CHEM SERVICE INC
Company PO Box: 3108
Company Street Address1: N/K
Company Street Address2: WEST CHESTER, PA 19381 US
Health Emergency Telephone: 215-692-3026/800-452-9994
Label Required Indicator: Y
Date Label Reviewed: 12/16/1998
Status Code: C
Manufacturer's Label Number:
Date of Label: 12/16/1998
Year Procured: N/K
Organization Code: G
Chronic Hazard Indicator: N/P
Eye Protection Indicator: N/P
Skin Protection Indicator: N/P
Respiratory Protection Indicator: N/P
Signal Word: N/P
Health Hazard:
Contact Hazard:
Fire Hazard:
Reactivity Hazard:

8/8/2002 4:23:21 PM

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 385

ETHYL BENZENE
(Revision A)
Issued: August 1978
Revised: November 1988

SECTION 1: MATERIAL IDENTIFICATION

Material Name: ETHYL BENZENE

Description (Origin/Uses): Used as a solvent and as an intermediate in the production of styrene monomer.

Other Designations: Phenylethane; Ethylbenzol; $C_2H_5C_6H_5$; CAS No. 0100-41-4

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



NFPA

HMIS	
H 2	R 1
F 3	I 3
R 0	S 2
PPG*	K 4

*See sect. 8

SECTION 2: INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Ethyl Benzene, CAS No. 0100-41-4	Ca 100	OSHA PELs 8-Hr TWA: 100 ppm, 435 mg/m³ 15-Min STEL: 125 ppm, 545 mg/m³ ACGIH TLVs, 1988-89 TLV-TWA: 100 ppm, 435 mg/m³ TLV-STEL: 125 ppm, 545 mg/m³ Toxicity Data* Human, Inhalation, TC_{Lo}: 100 ppm (8 Hrs) Rat, Oral, LD_{50}: 3500 mg/kg

*See NIOSH, *RTECS* (DA0700000), for additional data with references to reproductive, irritative, and mutagenic effects.

SECTION 3: PHYSICAL DATA

Boiling Point: 277°F (136°C)
Melting Point: -139°F (-95°C)
Vapor Pressure: 7.1 Torrs at 68°F (20°C)
Vapor Density (Air = 1): 3.7
% Volatile by Volume: Ca 100

Molecular Weight: 106 Grams/Mole
Solubility in Water (%): Slight
Specific Gravity (H_2O = 1): 0.86258 at 77°F (25°C)

Appearance and Odor: A clear, colorless, flammable liquid; characteristic aromatic hydrocarbon odor.

SECTION 4: FIRE AND EXPLOSION DATA

Flash Point and Method: 64°F (18°C) CC	Autoignition Temperature: 810°F (432.22°C)	LEL: 1% v/v	UEL: 6.7% v/v

Extinguishing Media: Use foam, dry chemical, or carbon dioxide to put out ethyl benzene fires. A water spray may be ineffective in extinguishing the fire, because it can scatter and spread the burning liquid. Use water spray to cool fire-exposed containers of ethyl benzene, to disperse ethyl benzene vapor, and to protect personnel attempting to stop an ethyl benzene leak. Unusual Fire or Explosion Hazards: This liquid can readily form explosive vapor-air mixtures, especially when heated. Ethyl benzene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back to its origin. Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Ethyl benzene is stable in closed containers during routine operations. Hazardous polymerization cannot occur. Chemical Incompatibilities: Hazardous chemical reactions can occur between ethyl benzene and strong oxidizing agents, acids, ammonia, and bases. Conditions to Avoid: Avoid any exposure to sources of ignition such as heat, sparks, open flame, and lighted tobacco products, etc., and to incompatible chemicals. Use caution when entering confined spaces, particularly low-lying areas where explosive concentrations of ethyl benzene vapor may be present. Provide good ventilation to such areas to prevent the concentration of this vapor. Hazardous Products of Decomposition: Thermal-oxidative degradation can include toxic gases such as carbon monoxide and/or aromatic hydrocarbon gases.

SECTION 6: HEALTH HAZARD INFORMATION

Carcinogenicity: Ethyl benzene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Ethyl benzene vapor is severely irritating to the eyes and to the mucous membranes of the respiratory system. Sustained inhalation of excessive levels can cause depression of the central nervous system (CNS) characterized by dizziness, headache, narcosis, and coma. Skin contact with liquid ethyl benzene causes irritation; dermatitis and defatting can also develop. The acute oral toxicity of ethyl benzene is low; however, ingestion of it presents a serious aspiration hazard. Aspirating even a small amount into the lungs can result in extensive edema (lungs filled with fluid) and hemorrhaging of the lung tissue. No systemic effects are expected at the levels that produce pronounced, unignorable, disagreeable skin and eye irritation. The TLVs cited in section 2 are set to prevent this intolerable irritation. Medical Conditions Aggravated by Long-Term Exposure: None reported. Target Organs: Skin, eyes, respiratory system, and CNS. Primary Entry: Inhalation, skin contact. Acute Effects: Irritation of the skin, eyes, and respiratory system. Also, cardiac rhythm dis-

SECTION 6: HEALTH HAZARD INFORMATION, cont.

flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. Skin. Rinse the affected area with plenty of water, then wash it with soap and water. Inhalation. Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Ingestion. Unlikely. Should this type of exposure occur, the aspiration hazard must be considered. Do not induce vomiting unless directed to do so by a physician. To prevent aspiration by spontaneous vomiting, keep the victim's head low (between his or her knees). Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid. Note to Physician: Professional judgment is required as to whether or not to induce vomiting because of the possibility of aspiration. A gastric lavage may be administered, followed by saline catharsis, if this procedure is appropriate to the specific incident. Monitor cardiac and pulmonary functions.

SECTION 7: SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation. Cleanup personnel need protection against skin or eye contact with this liquid as well as inhalation of its vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways. Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), §§ 311 (b) (4) and 307 (a).

SECTION 8: SPECIAL PROTECTION INFORMATION

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

SECTION 9: SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store ethyl benzene in closed containers in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage. Special Handling/Storage: Outside, isolated, detached, or remote storage is recommended for large quantities of ethyl benzene. Isolate bulk storage areas from acute fire hazards. Engineering Controls: Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. To prevent static sparks, electrically ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations. Other: Use safety cans for transferring small amounts of ethyl benzene.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Ethyl Benzene
DOT Hazard Class: Flammable Liquid
ID No. UN1175
DOT Label: Flammable Liquid
DOT Packaging Exceptions: 49 CFR 173.118
DOT Packaging Requirements: 49 CFR 173.119

IMO Shipping Name: Ethylbenzene
IMO Hazard Class: 3.2
IMO Label: Flammable Liquid
IMDG Packaging Group: II

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

Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corp.

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

MSDS Number: **M4420** * * * * * *Effective Date: 07/22/02* * * * * *Supercedes: 05/17/01*

MSDS Material Safety Data Sheet

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

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

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

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

METHYLENE CHLORIDE

1. Product Identification

Synonyms: MC; Dichloromethane (DCM); Methylene dichloride; Methylene bichloride; Methane dichloride
CAS No.: 75-09-2
Molecular Weight: 84.93
Chemical Formula: CH2Cl2
Product Codes: 9235, 9264, 9266, 9295, 9315, 9324, 9329, 9330, 9341, 9348, 9350, 9965, Q480

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methylene Chloride	75-09-2	> 99%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO

SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

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

-

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

-

Potential Health Effects

Inhalation:
Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes formation of carbon monoxide in blood which affects cardiovascular system and central nervous system. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and even death. Exposure may make the symptoms of angina (chest pains) worse.

Ingestion:
May cause irritation of the gastrointestinal tract with vomiting. If vomiting results in aspiration, chemical pneumonia could follow. Absorption through gastrointestinal tract may produce symptoms of central nervous system depression ranging from light headedness to unconsciousness.

Skin Contact:
Causes irritation, redness and pain. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

Eye Contact:
Vapors can cause eye irritation. Contact can produce pain, inflammation and temporal eye damage.

Chronic Exposure:
Can cause headache, mental confusion, depression, liver effects, kidney effects, bronchitis, loss of appetite, nausea, lack of balance, and visual disturbances. Can cause dermatitis upon prolonged skin contact. Methylene chloride may cause cancer in humans.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye problems, impaired liver, kidney, respiratory or cardiovascular function may be more susceptible to the effects of this substance.

4. First Aid Measures

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

5. Fire Fighting Measures

Fire:
Autoignition temperature: 556C (1033F)
Flammable limits in air % by volume:
lel: 12; uel: 23
Forms flammable vapor-air mixtures above 100C (212F).
Explosion:
Concentrated can be ignited by a high intensity ignition source. Vapor may form flammable mixture in atmosphere that contains a high percentage of oxygen. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US

Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Outside or detached storage is recommended. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. To minimize decomposition, all storage containers should be galvanized or lined with a phenolic coating. This material may corrode plastic and rubber. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Odor Threshold: 205 - 307 ppm. The odor threshold only serves as a warning of exposure; not smelling it does not mean you are not being exposed.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Methylene Chloride (Dichloromethane):
- OSHA Permissible Exposure Limit (PEL) -
25 ppm (TWA), 125 ppm (STEL), 12.5 ppm (8-hour TWA - Action Level)
- ACGIH Threshold Limit Value (TLV) -
50 ppm (TWA), A3 - suspected human carcinogen.

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

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. The cartridges recommended for this material have a predicted service of less than 30 minutes at concentrations of ten times (10x) the exposure limits. Actual service life will vary considerbly, depending on concentration levels, temperature, humidity, and work rate. This substance has poor warning properties.

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

for personal protective equipment. Natural rubber and polyvinyl chloride ARE NOT recommended materials for personal protective equipment.

Eye Protection:

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

Other Control Measures:

Do not use closed circuit rebreathing system employing soda lime or other carbon dioxide absorber because of formation of toxic compounds capable of producing cranial nerve paralysis. See OSHA Standard for medical surveillance, record keeping, and reporting requirements for methylene chloride (29 CFR 1910.1052).

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Chloroform-like odor.
Solubility:
1.32 gm/100 gm water @ 20C.
Specific Gravity:
1.318 @ 25C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
39.8C (104F)
Melting Point:
-97C (-143F)
Vapor Density (Air=1):
2.9
Vapor Pressure (mm Hg):
350 @ 20C (68F)
Evaporation Rate (BuAc=1):
27.5

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Emits highly toxic fumes of phosgene when heated to decomposition. Decomposes in a flame or hot surface to form toxic gas phosgene and corrosive mists of hydrochloric acid. Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.

Incompatibilities:
Strong oxidizers, strong caustics, plastics, rubber, nitric acid, water + heat, and chemically active metals, such as aluminum and magnesium powder, sodium, potassium, and lithium. Avoid contact with open flames and electrical arcs. Liquid methylene chloride will attack some forms of plastics, rubber, and coatings.
Conditions to Avoid:
Moisture, heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Dichloromethane: Oral rat LD50: 1600 mg/kg; inhalation rat LC50: 52 gm/m3; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Dichloromethane has been linked to spontaneous abortions in humans.

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

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methylene Chloride (75-09-2)	No	Yes	2B

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of greater than 30 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

13. Disposal Considerations

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

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

International (Water, I.M.O.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

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

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

15. Regulatory Information

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

Ingredient	TSCA	EC	Japan	Australia
Methylene Chloride (75-09-2)	Yes	Yes	Yes	Yes

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

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methylene Chloride (75-09-2)	Yes	Yes	No	Yes

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

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methylene Chloride (75-09-2)	No	No	Yes	No

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

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methylene Chloride (75-09-2)	1000	U080	No

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

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2Z
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.
Do not get in eyes, on skin, or on clothing.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 9.
Disclaimer:
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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This

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

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

MSDS Number: **T3913** * * * * * *Effective Date: 11/02/01* * * * * *Supercedes: 11/17/99*

MSDS Material Safety Data Sheet

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

Mallinckrodt CHEMICALS J.T.Baker

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

National Response In Canada
CANUTEC: 613-996-6666

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

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

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

TOLUENE

1. Product Identification

Synonyms: Methylbenzene; Toluol; Phenylmethane
CAS No.: 108-88-3
Molecular Weight: 92.14
Chemical Formula: C6H5-CH3
Product Codes:
J.T. Baker: 5375, 5584, 5809, 5812, 9336, 9351, 9364, 9456, 9457, 9459, 9460, 9462, 9466, 9472, 9476
Mallinckrodt: 4483, 8091, 8092, 8604, 8608, 8610, 8611, V560

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Toluene	108-88-3	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL.

FLAMMABLE LIQUID AND VAPOR. MAY AFFECT LIVER, KIDNEYS, BLOOD SYSTEM, OR CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

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

-

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

-

Potential Health Effects

Inhalation:
Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Very high concentrations may cause unconsciousness and death.
Ingestion:
Swallowing may cause abdominal spasms and other symptoms that parallel over-exposure from inhalation. Aspiration of material into the lungs can cause chemical pneumonitis, which may be fatal.
Skin Contact:
Causes irritation. May be absorbed through skin.
Eye Contact:
Causes severe eye irritation with redness and pain.
Chronic Exposure:
Reports of chronic poisoning describe anemia, decreased blood cell count and bone marrow hypoplasia. Liver and kidney damage may occur. Repeated or prolonged contact has a defatting action, causing drying, redness, dermatitis. Exposure to toluene may affect the developing fetus.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or impaired liver or kidney function may be more susceptible to the effects of this substance. Alcoholic beverage consumption can enhance the toxic effects of this substance.

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4. First Aid Measures

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. CALL A PHYSICIAN IMMEDIATELY.

Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately. If vomiting occurs, keep head below hips to prevent aspiration into lungs.
Skin Contact:
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 7C (45F) CC
Autoignition temperature: 422C (792F)
Flammable limits in air % by volume:
lel: 3.3; uel: 19
Flammable liquid and vapor!
Dangerous fire hazard when exposed to heat or flame. Vapors can flow along surfaces to distant ignition source and flash back.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response

Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Toluene:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA); 300 ppm (acceptable ceiling conc.); 500 ppm (maximum conc.).
- ACGIH Threshold Limit Value (TLV):
50 ppm (TWA) skin, A4 - Not Classifiable as a Human Carcinogen.

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

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

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

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

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Aromatic benzene-like.
Solubility:
0.05 gm/100gm water @ 20C (68F).
Specific Gravity:
0.86 @ 20C / 4 C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
111C (232F)
Melting Point:
-95C (-139F)
Vapor Density (Air=1):
3.14
Vapor Pressure (mm Hg):
22 @ 20C (68F)
Evaporation Rate (BuAc=1):
2.24

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Heat, flame, strong oxidizers, nitric and sulfuric acids, chlorine, nitrogen tetraoxide; will attack some forms of plastics, rubber, coatings.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Oral rat LD50: 636 mg/kg; skin rabbit LD50: 14100 uL/kg; inhalation rat LC50: 49

gm/m3/4H; Irritation data: skin rabbit, 500 mg, Moderate; eye rabbit, 2 mg/24H, Severe. Investigated as a tumorigen, mutagen, reproductive effector.

Reproductive Toxicity:

Has shown some evidence of reproductive effects in laboratory animals.

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

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Toluene (108-88-3)	No	No	3

12. Ecological Information

Environmental Fate:

When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released into water, this material may evaporate to a moderate extent. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day. This material is not expected to significantly bioaccumulate. This material has a log octanol-water partition coefficient of less than 3.0. Bioconcentration factor = 13.2 (eels).

Environmental Toxicity:

This material is expected to be toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

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

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: TOLUENE
Hazard Class: 3
UN/NA: UN1294
Packing Group: II
Information reported for product/size: 390LB

International (Water, I.M.O.)

Proper Shipping Name: TOLUENE
Hazard Class: 3
UN/NA: UN1294
Packing Group: II
Information reported for product/size: 390LB

15. Regulatory Information

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

Ingredient	TSCA	EC	Japan	Australia
Toluene (108-88-3)	Yes	Yes	Yes	Yes

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

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Toluene (108-88-3)	Yes	Yes	No	Yes

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

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Toluene (108-88-3)	No	No	Yes	No

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

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Toluene (108-88-3)	1000	U220	No

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

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

Australian Hazchem Code: 3[Y]E
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL. FLAMMABLE LIQUID AND VAPOR. MAY AFFECT LIVER, KIDNEYS, BLOOD SYSTEM, OR CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If vomiting occurs, keep head below hips to prevent aspiration into lungs. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

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

MSDS Number: **T4914** * * * * * *Effective Date: 09/14/00* * * * * *Supercedes: 07/15/99*

MSDS Material Safety Data Sheet

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

J.T.Baker®

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response In Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

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

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

1,1,1-TRICHLOROETHANE

1. Product Identification

Synonyms: Methyl chloroform; trichloroethane; chloroetene
CAS No.: 71-55-6
Molecular Weight: 133.40
Chemical Formula: CH3CCl3
Product Codes: 5381, 9435, 9437, W509, W510

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Chloroform	71-55-6	96 - 100%	Yes
Dioxane	123-91-1	< 3%	Yes
1,2-Epoxybutane	106-88-7	< 0.5%	Yes
Actual concentrations proprietary			

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, AND CARDIOVASCULAR SYSTEM. CAUSES IRRITATION TO

SKIN, EYES AND RESPIRATORY TRACT. POSSIBLE CANCER HAZARD. CONTAINS DIOXANE WHICH MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.

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

-

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

-

Potential Health Effects

Inhalation:
Inhalation of vapors will irritate the respiratory tract. Affects the central nervous system. Symptoms include headache, dizziness, weakness, nausea. Higher levels of exposure (> 5000 ppm) can cause irregular heart beat, kidney and liver damage, fall in blood pressure, unconsciousness and even death.
Ingestion:
Harmful if swallowed. Symptoms similar to inhalation will occur along with nausea, vomiting. Aspiration of material into the lungs can cause chemical pneumonitis which can be fatal. If aspirated, may be rapidly absorbed through the lungs and result in injury to other body systems.
Skin Contact:
Causes mild irritation and redness, especially on prolonged contact. Repeated contact may cause drying or flaking of the skin.
Eye Contact:
Liquids and vapors cause irritation. Symptoms include tearing, redness, stinging, swelling.
Chronic Exposure:
Prolonged or repeated skin contact may cause dermatitis. Chronic exposure may affect the kidneys and liver. Dioxane is a suspected human carcinogen based on animal data.
Aggravation of Pre-existing Conditions:
Personnel with CNS, kidney, liver or heart disease may be more susceptible to the effects of this substance. Use of alcoholic beverages may aggravate symptoms.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Autoignition temperature: 500C (932F)
Flammable limits in air % by volume:
lel: 7.0; uel: 16.0
Vapors in containers can explode if subjected to high energy source.
Dioxane has a flash point below 16C (60F).
Explosion:
Can react with strong caustic, such as potash to form a flammable or explosive material. Air/vapor mixtures may explode when heated. Vapors can flow along surfaces to distant ignition source and flash back. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! Do not use aluminum, magnesium or zinc metal for storage container. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do not use aluminum equipment or storage containers. Contact with aluminum parts in a pressurized fluid system may cause violent reactions.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
350 ppm (TWA) for trichloroethane
100 ppm (TWA) skin for dioxane
-ACGIH Threshold Limit Value (TLV):
350 ppm (TWA), 450 ppm (STEL) for trichloroethane
20 ppm (TWA) skin, A3 - Animal Carcinogen for dioxane
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has questionable warning properties. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Viton is a recommended material for personal protective equipment.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:

Clear, colorless liquid.
Odor:
Mild chloroform-like odor.
Solubility:
4,400 ppm in water @ 20C (68F)
Specific Gravity:
1.34 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
74C (165F)
Melting Point:
-32C (-26F)
Vapor Density (Air=1):
4.63
Vapor Pressure (mm Hg):
100 @ 20C (68F)
Evaporation Rate (BuAc=1):
12.8

10. Stability and Reactivity

Stability:
Requires inhibitor content to prevent corrosion of metals. Slowly hydrolyzes in water to form hydrochloric and acetic acid.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition. Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Hazardous polymerization can occur in contact with aluminum trichloride.
Incompatibilities:
Open flames, welding arcs, nitrogen tetroxide, oxygen, liquid oxygen, sodium, sodium hydroxide, and sodium-potassium alloy, strong alkalis, oxidizers, aluminum and other reactive metals.
Conditions to Avoid:
Insufficient inhibitor, incompatibles, heat, flame and ignition sources

11. Toxicological Information

Oral rat LD50: 9600 mg/kg; inhalation rat LC50: 18000 ppm/4H; investigated as a mutagen, tumorigen, reproductive effector; irritation eye rabbit, Standard Draize, 2mg/24H severe.

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

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methyl Chloroform (71-55-6)	No	No	3
Dioxane (123-91-1)	No	Yes	2B
1,2-Epoxybutane (106-88-7)	No	No	2B

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released to water, this material is expected to quickly evaporate. This material is not expected to significantly bioaccumulate. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released to the atmosphere, this material has an average global half-life of 6.0 - 6.9 years. When released into the air, this material may adversely affect the ozone layer.
Environmental Toxicity:
This material is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

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

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: 1,1,1-TRICHLOROETHANE
Hazard Class: 6.1
UN/NA: UN2831
Packing Group: III
Information reported for product/size: 20L

15. Regulatory Information

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

Ingredient	TSCA	EC	Japan	Australia
Methyl Chloroform (71-55-6)	Yes	Yes	Yes	Yes
Dioxane (123-91-1)	Yes	Yes	Yes	Yes
1,2-Epoxybutane (106-88-7)	Yes	Yes	Yes	Yes

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

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Methyl Chloroform (71-55-6)	Yes	Yes	No	Yes
Dioxane (123-91-1)	Yes	Yes	No	Yes
1,2-Epoxybutane (106-88-7)	Yes	Yes	No	Yes

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

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Methyl Chloroform (71-55-6)	No	No	Yes	No
Dioxane (123-91-1)	No	No	Yes	No
1,2-Epoxybutane (106-88-7)	No	No	Yes	No

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

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Methyl Chloroform (71-55-6)	1000	U226	No
Dioxane (123-91-1)	100	U108	No
1,2-Epoxybutane (106-88-7)	100	No	No

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

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2[Z]
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, AND CARDIOVASCULAR SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND

RESPIRATORY TRACT. POSSIBLE CANCER HAZARD. CONTAINS DIOXANE WHICH MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.

Label Precautions:

Avoid breathing vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8, 11.

Disclaimer:

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Material Safety Data Sheets Collection:

Sheet No. 318
Xylene *(Mixed Isomers)*

Issued: 11/80 Revision: E, 9/92 Errata: 12/94

Section 1. Material Identification

Xylene (Mixed Isomers) (C_8H_{10}) Description: The commercial product is a blend of the three isomers [*ortho*-(*o*-), *meta*-(*m*-), *para*-(*p*-)] with the largest proportion being *m*- xylene. Xylene is obtained from coal tar, toluene by transalkylation, and pseudocumene. Used in the manufacture of dyes, resins, paints, varnishes, and other organics; as a general solvent for adhesives, a cleaning agent in microscope technique; as a solvent for Canada balsam microscopy; as a fuel component; in aviation gasoline, protective coatings, sterilizing catgut, hydrogen peroxide, perfumes, insect repellants, pharmaceuticals, and the leather industry; in the production of phthalic anhydride, isophthalic, and terephthalic acids and their dimethyl esters - which are used in the manufacture of polyester fibers; and as an indirect food additive as a component of adhesives. Around the home, xylene is found as vehicles in paints, paint removers, degreasing cleaners, lacquers, glues and cements and as solvent/vehicles for pesticides.

Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

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

Cautions: Xylene is an eye, skin, and mucous membrane irritant and may be narcotic in high concentrations. It is a dangerous fire hazard.

NFPA: R 1, I 2, S 2, K 3

HMIS: H 2†, F 3, R 0, PPE ‡

† Chronic Effects

‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Xylene (mixed isomers): the commercial product generally contains ~ 40% *m*-xylene; 20% each of *o*-xylene, *p*-xylene, and ethylbenzene; and small quantities of toluene. Unpurified xylene may contain pseudocumene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m³)
15-min STEL: 150 ppm (655 mg/m³)

1990 IDLH Level
1000 ppm

1990 NIOSH RELs
TWA: 100 ppm (435 mg/m³)
STEL: 150 ppm (655 mg/m³)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m³)
STEL: 150 ppm (651 mg/m³)
BEI (Biological Exposure Index): Methylhippuric acids in urine at end of shift: 1.5 g/g creatinine

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m³)
Category II: Substances with systemic effects
Half-life: < 2 hr
Peak Exposure: 200 ppm, 30 min; average value, 4 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 200 ppm produced olfaction effects, conjunctiva irritation, and other changes involving the lungs, thorax, or respiration.
Man, inhalation; LC_{Lo}: 10000 ppm/6 hr; toxic effects not yet reviewed.
Human, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted.
Rat, oral, LD_{50}: 4300 mg/kg; toxic effect not yet reviewed.
Rat, inhalation, LC_{50}: 5000 ppm/4 hr; toxic effects not yet reviewed.

* See NIOSH, *RTECS* (XE2100000), for additional toxicity data.

Section 3. Physical Data

Boiling Point Range: 279 to 284 °F (137 to 140 °C)*
Boiling Point: *ortho:* 291 °F (144 °C); *meta:* 281.8 °F (138.8 °C); *para:* 281.3 °F (138.5 °C)
Freezing Point/Melting Point: *ortho:* -13 °F (-25 °C); *meta:* -53.3 °F (- 47.4 °C); *para:* 55 to 57 °F (13 to 14 °C)
Vapor Pressure: 6.72 mm Hg at 70 °F (21 °C)
Saturated Vapor Density (Air = 1.2 kg/m³): 1.23 kg/m³, 0.077 lbs/ft³

Appearance and Odor: Clear, sweet-smelling liquid.

* Materials with wider and narrower boiling ranges are commercially available.

Molecular Weight: 106.16
Specific Gravity: 0.864 at 20 °C/4 °C
Water Solubility: Practically insoluble
Other Solubilities: Miscible with absolute alcohol, ether, and many other organic liquids.
Octanol/Water Partition Coefficient: logKow = 3.12-3.20
Odor Threshold: 1 ppm
Viscosity: <32.6 SUS

Section 4. Fire and Explosion Data

Flash Point: 63 to 77 °F (17 to 25 °C) CC	Autoignition Temperature: 982 °F (527 °C) (*m*-)	LEL: 1.1 (*m*-, *p*-); 0.9 (*o*-)	UEL: 7.0 (*m*-, *p*-); 6.7 (*o*-)

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2), water spray or regular foam. For large fires, use water spray, fog or regular foam. Water may be ineffective. Use water spray to cool fire-exposed containers. **Unusual Fire or Explosion Hazards:** Xylene vapors or liquid (which floats on water) may travel to an ignition source and flash back. The heat of fire may cause containers to explode and/or produce irritating or poisonous decomposition products. Xylene may present a vapor explosion hazard indoors, outdoors, or in sewers. Accumulated static electricity may occur from vapor or liquid flow sufficient to cause ignition. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after fire is extinguished. Stay clear of tank ends. Use unmanned hose holder or monitor nozzles for massive cargo fires. If impossible, withdraw from area and let fire burn. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Xylene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Xylene is easily chlorinated, sulfonated, or nitrated. **Chemical Incompatibilities:** Incompatibilities include strong acids and oxidizers and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin). Xylene attacks some forms of plastics, rubber, and coatings. **Conditions to Avoid:** Avoid heat and ignition sources and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of xylene can produce carbon dioxide, carbon monoxide, and various hydrocarbon products.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list xylene as a carcinogen. **Summary of Risks:** Xylene is an eye, mucous membrane, and respiratory tract irritant. Irritation starts at 200 ppm; severe breathing difficulties which may be delayed in onset can occur at high concentrations. It is a central nervous system (CNS) depressant and at high concentrations can cause coma. Kidney and liver damage can occur with xylene exposure. With prolonged or repeated cutaneous exposure, xylene produces a defatting dermatitis. Chronic toxicity is not well defined, but it is less toxic than benzene. Prior to the 1950s, benzene was often found as a contaminant of xylene and the effects attributed to xylene such as blood dyscrasias are questionable. Since the late 1950s, xylenes have been virtually benzene-free and blood dyscrasias have not been associated with xylenes. Chronic exposure to high concentrations of xylene in animal studies have demonstrated mild reversible decrease in red and white cell counts as well as increases in platelet counts.

Section 6. Health Hazard Data, *continued*

Menstrual irregularity was reported in association with workplace exposure to xylene perhaps due to effects on liver metabolism. Xylene crosses the human placenta, but does not appear to be teratogenic under conditions tested to date. **Medical Conditions Aggravated by Long-Term Exposure:** CNS, respiratory, eye, skin, gastrointestinal (GI), liver and kidney disorders. **Target Organs:** CNS, eyes, GI tract, liver, kidneys, and skin. **Primary Entry Routes:** Inhalation, skin absorption (slight), eye contact, ingestion. **Acute Effects:** Inhalation of high xylene concentrations may cause dizziness; nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid in lung); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensation in the oropharynx and stomach and transient CNS depression. **Chronic Effects:** Repeated or prolonged skin contact may cause drying and defatting of the skin leading to dermatitis. Repeated eye exposure to high vapor concentrations may cause reversible eye damage, peripheral and central neuropathy, and liver damage. Other symptoms of chronic exposure include headache, fatigue, irritability, chronic bronchitis, and GI disturbances such as nausea, loss of appetite, and gas.

FIRST AID *Emergency personnel should protect against exposure.* **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, *do not induce vomiting!* If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). *Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage.* **Note to Physicians:** Hippuric acid or the ether glucuronide of *ortho*-toluic acid may be useful in diagnosis of *meta*-, *para*- and *ortho*-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate spill area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without undue risk, stop leak. Use appropriate foam to blanket release and suppress vapors. Water spray may reduce vapor, but does not prevent ignition in closed spaces. For small spills, absorb on paper and evaporate in appropriate exhaust hood or absorb with sand or some non-combustible absorbent and place in containers for later disposal. For large spills dike far ahead of liquid to contain. Do not allow xylene to enter a confined space such as sewers or drains. On land, dike to contain or divert to impermeable holding area. Apply water spray to control flammable vapor and remove material with pumps or vacuum equipment. On water, contain material with natural barriers, booms, or weirs; apply universal gelling agent; and use suction hoses to remove spilled material. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** Little bioconcentration is expected. Biological oxygen demand 5 (after 5 days at 20 °C): 0.64 (no stated isomer). Ecotoxicity values: LD_{50} Goldfish, 13 mg/L/24 hr, conditions of bioassay not specified, no specific isomer. **Environmental Degradation:** In the atmosphere, xylenes degrade by reacting with photochemically produced hydroxyl radicals with a half-life ranging from 1-1.7 hr. in the summer to 10-18 hr in winter or a typical loss of 67-86% per day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, will volatilize and leach into groundwater. **Disposal:** As a hydrocarbon, xylene is a good candidate for controlled incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U239, F003 (spent solvent)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4); per RCRA, Sec. 3001]

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; any supplied-air respirator; or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in clearly labelled, tightly closed, containers in a cool, well-ventilated place, away from strong oxidizing materials and heat and ignition sources. During transferring operations, electrically ground and bond metal containers. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Use hermetically sealed equipment, transfer xylene in enclosed systems, avoid processes associated with open evaporating surfaces, and provide sources of gas release with enclosures and local exhaust ventilation. Use Class I, Group D electrical equipment. **Administrative Controls:** Establish air and biological monitoring programs and evaluate regularly. Consider preplacement and periodic medical examinations including a complete blood count, a routine urinalysis, and liver function tests. Consider hematologic studies if there is any significant contamination of the solvent with benzene. If feasible, consider the replacement of xylene by less toxic solvents such as petrol (motor fuel) or white spirit. Before carrying out maintenance and repair work, steam and flush all equipment to remove any xylene residues.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Xylenes
DOT Hazard Class: 3
ID No.: UN1307
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Nonbulk Packaging : 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: –

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.
Prepared by: MJ Wurth, BS; Industrial Hygiene Review: PA Roy, MPH, CIH; Medical Review: W Silverman, MD

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Appendix B

Site Monitoring Well Logs

IT CORPORATION
A Member of The IT Group

Drilling Log

Monitoring Well

Project GROUNDWATER INVESTIGATION Owner SOVEREIGN SPECIALTY CHEMICALS
Location 710 OHIO ST. BUFFALO Project No. 768912 Date drilled 5/10/99
Surface Elev. ____ Total Hole Depth ~14.5' Diameter ~7"
Top of Casing ____ Water Level Initial ____ Static 4.33' BTOC (2")
Screen: Dia 2" Length 7.5' Type/Size 20 SLOT SCH 40 PVC
Casing: Dia 2" Length ____ Type SCH 40 PVC
Filter Pack Material 2095 SAND Rig/Core Type CME 75
Drilling Company MAXIM Method 4¼" HSAs w/ 2" SSPs Permit # ____
Driller PHIL BANCE Log By KEVIN CRONIN
Checked By ____ License No. ____

See Site Map For Boring Location MW-1

COMMENTS:
~15.1' NE OF NE CORNER OF BLDG. 29

Depth (ft.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2						
0						ASPHALT
CONCRETE		140	S-1 8-3 6-4	REC 1.7'		DRY, LOOSE, BLACK, BROWN, CINDERS, WOOD, ASH CERAMIC PIECES, BECOMING WET BELOW ~3.5',
BENTONITE 2		>280	S-2 2-3 2-2	REC 1.3'		(NOTE: SOLVENT ODOR IN 2'-4' SAMPLE.) (FILL) W/ SAND, GRAVEL, SILT, SLAG.
3.5 4		80	S-3 2-2 2-2	REC 1.0'		WET (FILL) AS ABOVE
6		170	S-4 2-2 4-5	REC 1.5'		0.3' (FILL) OVER MOIST, FIRM GRAY W/ RUST MOTTLING SiC-CSi, NO ODOR, OUTSIDE STAINING FROM ABOVE
8		17				
		14	S-5 2-3 2-2	REC 1.9'		SiC-CSi AA, NO STAIN OR ODOR
10						
11		1.0	S-6 2-2 4-4	REC 2.0		AS ABOVE
12		0.4	S-7 2-4 4-3	REC 2.0		4" SiC CSi AS ABOVE, MOIST, FIRM GRADES TO LOOSE BROWNISH GRAY, MOIST TO WET SSi-SiS W/ SOME CLAY. NO STAIN OR ODOR
BENTONITE 14						END BORING @ ~14.5' BGL
						20 SLOT SCREEN 2095 SAND
16						
18						
20						
22						
24						

IT CORPORATION
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Drilling Log

Monitoring Well

Project GROUNDWATER INVESTIGATION Owner SOVEREIGN SPECIALTY CHEMICALS
Location 710 OHIO ST. BUFFALO Project No. 768912 Date drilled 5/11/99
Surface Elev. ____ Total Hole Depth ____ Diameter ____
Top of Casing ____ Water Level Initial ____ Static ____
Screen: Dia 2" Length 7.5' Type/Size 0.020" SLOT / SCH. 40 PVC
Casing: Dia 2" Length ____ Type SCH 40 PVC
Filter Pack Material 20/30 SAND Rig/Core Type CME 75
Drilling Company MAXIM Method 9¼" HSAs w/ 2" SSP Permit # ____
Driller PHIL BENCE Log By KEVIN CRONIN
Checked By ____ License No. ____

See Site Map For Boring Location MW-2

COMMENTS:
COLLECT SOIL SAMPLE (COMPOSITE FILL) FROM 0'-8'.

Depth (ft.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2						
0						GRAVEL / SOIL
0 CONCRETE / BENTONITE 2	RISER	0.4	S-1 13-6 4-4	S-1 REC, 1.1'		DRY, LOOSE, SAND, GRAVEL, SILT, ASH (FILL) NO ODOR NOTED
4		0.2	S-2 2-1 1-3	REC 1.0'		AS ABOVE BECOMING MOIST TOWARDS BOTTOM.
6		0.2	S-3 4-1 1-2	REC 0.1'		POOR RECOVERY - WET LOOSE COARSE SLAG AND FINE GRAVEL (NO ODOR NOTED (FILL)
8	20 SLOT SCREEN	ND	S-4 4-3 3-1	REC 6.8'		SATURATED, LOOSE GRAVEL, SAND, CERAMIC CHIPS, SLAG (FILL) - 2" OVER SiC-CSi w/ RUST MOTTLING. MOIST OLIVE BROWN FIRM
10		ND	S-5 4-5 5-9	REC 1.5'		GRAY TO OLIVE BROWN, MOIST FIRM TO STIFF SiC-CSi w/ RUST MOTTLING NO STAIN OR ODOR
12		NT	S-6 5-6 7-7	REC 0.1'		COARSE GRAVEL IN SHOE - VERY POOR RECOVERY. HAD LITTLE BROWN CSi-SiC w/ GRAY MOTTLING NO STAIN OR ODOR
14						
16						
18						
20						
22						
24						

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Drilling Log

Monitoring Well

Project GROUNDWATER INVESTIGATION Owner SOVEREIGN SPECIALTY CHEMICALS
Location 710 OHIO ST. BUFFALO Project No. 768912 Date drilled 5/11/99
Surface Elev. _____ Total Hole Depth _____ Diameter _____
Top of Casing _____ Water Level Initial _____ Static _____
Screen: Dia 2" Length 7.5' Type/Size 0.020" SLOT SCH 40 PVC
Casing: Dia 2" Length _____ Type SCH 40 PVC
Filter Pack Material 20/5 Rig/Core Type CME 75
Drilling Company MAXIM Method 4¼" HSAs w/ 2" SSP Permit # _____
Driller PHIL BOUCE Log By KEVIN CRONIN
Checked By _____ License No. _____

See Site Map For Boring Location MW-3

COMMENTS: WELL IS ~ 66' WEST OF CHAIN LINK FE 30.5' EAST OF EDGE OF OHIO ST. ~4' SOUTH OF ASSUMED PROPERTY LINE. COLLECTED COMPOSITE FILL SAMPLE FROM 0-10'

Depth (ft.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2						
0	CONCRETE					ASPHALT PARKING LOT
	BENTONITE	ND	S-1 3-4 6-5	REC 1.2'		DRY, HARD OLD ASPHALT OVER DRY TO DAMP COMPACT BROWN TO BLACK SAND, GRAVEL, SILT, SLAG (FILL) NO STAIN OR ODOR
2		ND	S-2 5-3 3-2	REC 0.3		POOR RECOVERY - SLAG IN SHOE (FILL) AS ABOVE W/ BRICK FRAGMENTS. NO STAIN OR ODOR
4		ND	S-3 6-3 2-2	REC 0.4'		POOR RECOVERY, WET, LOOSE, DK GRAY GRAVEL, SAND, SILT, SLAG (FILL) NO STAIN OR ODOR
6		ND	S-4 2-4 3-3	REC 0.6'		SATURATED, LOOSE DK GRAY, SAND, GRAVEL, SILT (FILL) NO STAIN OR ODOR.
8		ND	S-5 3-6 10-11	REC 1.8'		3" OF FILL, WET AS ABOVE, OVER MOIST, STIFF BROWNISH GRAY MOTTLED SiC-CSi. NO STAIN OR ODOR
10	BENTONITE	ND	S-6 1-3 3-4	REC 1.7'		4" OF SiC-CSi AS ABOVE GRADES TO MOIST TO WET, SOFT SiC W/ LITTLE TO SOME SAND, BROWNISH GRAY.
12						END BORING @ ~12' BGL, PLUG HOLE BACK TO 10' W/ BENTONITE
14						
16						
18						
20						
22						
24						

2" SLOT SCREEN
20/5 SAND

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Drilling Log

Monitoring Well

Project GROUNDWATER INVESTIGATION Owner SOVEREIGN SPECIALTY CHEMICALS
Location 710 OHIO ST. BUFFALO Project No. 768912 Date drilled 5/12/99
Surface Elev. _____ Total Hole Depth _____ Diameter ~7"
Top of Casing _____ Water Level Initial _____ Static _____
Screen: Dia 2" Length 7.5' Type/Size 0.020" SLOT SCH 40 PVC
Casing: Dia 2" Length _____ Type SCH 40 PVC
Filter Pack Material 2095 SAND Rig/Core Type CME 75
Drilling Company MAXIM Method 4¼" HSAs w/ 2"SSP Permit # _____
Driller PHIL BENCE Log By KEVIN CROWN
Checked By _____ License No. _____

See Site Map For Boring Location MW-4

COMMENTS:
COMPOSITE FILL SAMPLE FROM 0-8' FOR ANALYSIS

Depth (ft.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2						
0						NORTHWEST CORNER OF AST BERM BY NORTH FENCE
GROUT		ND	S-1 1-2 3-4	REC 0.9'		4" OF BROWN SiC TOPSOIL OVER DAMP, LOOSE, BRN TO BLK SAND, GRAVEL, SILT (FILL), ASH, BRICK FRAGS. NO ODOR
BENTONITE 2	SCH 40 RISER	ND	S-2 6-7 3-2	REC 1.0'		MOIST, LOOSE, BROWN TO BLACK FILL AS ABOVE
4		ND	S-3 4-4 6-7	REC 1.0'		FILL AS ABOVE, BECOMING WET, NO ODOR
6		ND	S-4 5-10 8-4	REC 1.2'		WET, COMPACT (FILL) AS ABOVE NO ODOR
8	2095 SAND	ND	S-5 4-3 4-6	REC 1.8'		~3" FILL AS ABOVE OVER FIRM BROWNISH GRAY, MOIST SiC-CSi w/ RUST MOTTLING, NO ODOR
10	20 SLOT SCREEN	ND	S-6 4-7 8-7	REC 2.0'		MOIST, STIFF GRAYISH BRN SiC-CSi w/ RUST MOTTLING
BENTONITE 12						END BORING @ ~12' BGL, PLUG BACK w/ BENTONITE TO ~10'.
14						
16						
18						
20						
22						
24						

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Drilling Log

Monitoring Well

Project GROUNDWATER INVESTIGATION Owner SOVEREIGN SPECIALTY CHEMICALS
Location 710 OHIO ST. BUFFALO Project No. 768912 Date drilled 5/11/99
Surface Elev. ____ Total Hole Depth 14 Diameter ____
Top of Casing ____ Water Level Initial ____ Static ____
Screen: Dia 2" Length 7.5' Type/Size 0.020" SLOT PVC
Casing: Dia 2" Length 4.5 Type SCH 40 PVC
Filter Pack Material 2095 SAND Rig/Core Type CME 75
Drilling Company MAXIM Method 4¼" HSAs w/2" SSP Permit # ____
Driller ____ Log By KEVIN CRONIN
Checked By ____ License No. ____

See Site Map For Boring Location MW-5

COMMENTS:
COLLECTED SOIL SAMPLE FROM 6'-8'

Depth (ft.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2						
0						EASTERN AST TANK BERM
CONCRETE		ND	S-1 10-9 4-3	REC 1.4'		DRY TO MOIST COMPACT BLACK TO BROWN SAND GRAVEL, SILT, SLAG, CERAMIC CHIPS (FILL) TRACE ROOTS, NO ODOR
BENTONITE 2		ND	S-2 5-15 9-6	REC 0.2		POOR RECOVERY, MOIST, VERY STIFF BROWN SiC W/ SOME FINE GRAVEL, LITTLE SAND (FILL), NO ODOR
4		12	S-3 5-3 2-4	REC 1.2'		MOIST, LOOSE, BLACK, BROWN Si, SAND, GRAVEL COAL, ASH, WHITISH GRAY SILT/CLAY (FILL), NO ODOR
6		22	S-4 2-3 1-1	REC 0.8'		MOIST, BECOMING WET, LOOSE BLACK SILT, CLAY GRAVEL, SAND, SLAG (FILL) NO ODOR
8	20 SLOT SCREEN / 2095 SAND	2.0	S-5 3-2 3-4	REC 1.2		~4" WET FILL AS ABOVE OVER GRAY FIRM MOIST, SiC-CSi NO ODOR (NATIVE)
10		1.0	S-6 1-2 4-5	REC 1.6		MOIST, SOFT, GRAY W/ RUST MOTTLING SiC-CSi NO STAIN OR ODOR
BENTONITE 12		0.8	S-7 5-7 7-6	REC 2.0'		AS ABOVE
14						END BORING @ ~14' BGL (HSAs ADVANCED TO ~10') PLUG BACK TO 10' W/ BENTONITE
16						
18						
20						
22						
24						

Appendix C

Vendor Contacts

VENDOR CONTACTS
SOVEREIGN SPECIALTY CHEMICALS, INC.
BUFFALO, NEW YORK

Company	National Vacuum Corporation
Address	408 47th Street
	Niagara Falls, New York 14304
Phone	716.773.1167
Fax	716.282.1315
Contact	Charlie Litten
Role on Project	Clean out clogged sewer line

Company	CME Associates, Inc.
Address	P.O. Box 676
	Buffalo, New York 14217
Phone	716.877.9577
Fax	716.877.9629
Contact	Ernest W. Kihl
Role on Project	Density testing (Compaction testing of backfill)

Company	H2K Technologies
Address	9851 13th Avenue, North
	Plymouth, Minnesota 55441
Phone	763.746.9900
Fax	763.746.9903
Contact	Rick Kolbow
Role on Project	Design and build HVE treatment unit

Company	Gernatt Asphalt Products, Inc.
Address	Taylor Hollow Rd, P.O. Box 400
	Collins, New York 14034
Phone	716.532.3371
Fax	n.a.
Contact	David Gier
Role on Project	Provided clay backfill and select granular fill

Company	Gordon and Zoerb Electrical Contractors, Inc.
Address	420 South Harris Hill Road
	Buffalo, New York 14221
Phone	716.633.1166
Fax	716.633.1075
Contact	Tom Wawrzyniak
Role on Project	Electricial connections for treatment system installation

Company	Pinto Construction Services, Inc.
Address	1 Babcock Street
	Buffalo, New York 14210
Phone	716.825.6666
Fax	716.825.6773
Contact	Jim Lyke
Role on Project	Sewer trench excavation

Company	Marcor Remediation, Inc.
Address	460 Buffalo Rd, Suite 5
	Rochester, New York 14611
Phone	585.247.6955
Fax	585.247.6852
Contact	Doug Stamp
Role on Project	Remediation contractor for above ground work

Company	Woodard Engineering
Address	85 Ruskin Road
	East Aurora, New York 14052
Phone	716.655.1032
Fax	716.655.1032
Contact	Ralph A. Woodard
Role on Project	Electrical Engineer, reviewed H2K design

Company	John W. Danforth Service Company
Address	P.O. Box 10833
	Albany, New York 12201
Phone	716.832.2386
Fax	716.832.7758
Contact	Jack Betz, VP
Role on Project	Mechanical contractors, fixed blowers

Company	J. A. Brundage / The Drain Doctor
Address	1400 College Avenue
	Niagara Falls, New York 14305
Phone	716.825.6383
Fax	716.285.6347
Contact	John Brundage
Role on Project	Clean out clogged sewer line

Company	Waste Stream Technology, Inc.
Address	302 Grote Street
	Buffalo, NY 14207
Phone	716.876.5290
Fax	716.876.2412
Contact	Brian Schepart, Laboratory Director
Role on Project	Laboratory analysis

Company	Severn Trent Laboratories (STL)
Address	10 Hazlewood Drive, Suite 106
	Amherst, NY 14228-2298
Phone	716.691.2600
Fax	716.691.7991
Contact	Paul Morrow
Role on Project	Laboratory analysis

Appendix D

Inspection Forms and Checklists

	Sovereign Specialty Chemicals	Data:	Daily	Readings				
		Init						
		Day						
		Date						
#	Instrument	Time						
	Building Thermometer	^{0}F						
	GW Suppression	**Units**						
1	PI-200, Transfer pump discharge	psi						
2	PI-300, BF-300 Inlet	psi						
3	PI-301, BF-300 Outlet	psi						
4	PI-302, BF-301 Inlet	psi						
5	PI-303, BF-302 Outlet	psi						
6	PI- , T-400 Inlet	psi						-
7	PI-400, T-400 Outlet	psi						-
8	PI- , T-401 Inlet	psi						-
9	PI-401, T-401 Outlet	psi						-
10	**FE-400**	**gal**						
	HVE							
11	PI-100, Well 1 Inlet (A-N)	inHg						
12	PI-101, Well 2 Inlet (A-S)	inHg						
13	PI-102, Well 3 Inlet (Area C)	inHg						
14	FE-100, Well 3 Flow	cfm						-
15	FE-101, Well 2 Flow	cfm						-
16	FE-102, Well 1 Flow	cfm						-
17	VI-103, KO Pot Inlet	inHg						
18	DPI-100, KO Pot Inlet delta P	inWC						
19	PI-103, Transfer pump discharge	psi						-
20	**FE-104, KO pot transfer volume**	**gal**						
21	FE-103, SVE vapor flow rate	cfm						
22	PI-100, Blower discharge	inHg						-
23	TI-100, Blower discharge temp	F						
24	PI-101, T-101 discharge pressure	inWC						
25	PI-102, T-102 discharge pressure	inWC						-
26	**Vac Blower Hour meter**	**Hrs**						
27	MS Transfer Pump Hour Meter	Hrs						-
28	HT Transfer Pump Hour Meter	Hrs						-
29	External Tank #1 Vapor Conc.	ppm						
30	Exterior Tank #2 Vapor Conc.	ppm						
	NOTES							

URS

Daily Field Report

Owner _____ **Report No.** _____

Project _____ **Page** _____ **1 of**

Project No. _____ **Day** _____

Contractor(s) _____ **Date** _____

Contractor Super(s) _____ **Weather: A.M. / P.M.** _____

Project Manager _____ **Temp (F): High / Low** _____

H&S Officer _____ **Rain /Snow** _____ **Winds** _____

Number and Function of Contractors' Personnel, Hours Worked (Identify Subcontractors Separately)

Contractor	Function	Hours

Major Constr. Equip. Description	Size/Capacity	No.	Location

Visitors **Representing**

_____ _____

_____ _____

Daily Notes:

Copies to:

Signature: _____

URS

Daily Field Report

Report No. _____

Page _____

Day _____

Date _____

Signature: _____

Appendix E

Manufacturer's O&M Manual for HVE System

OPERATIONS & MAINTENANCE MANUAL

Operation & Maintenance Manual

Project:
Marcor
URS – Buffalo, NY Project

Supplied By:
H2K Technologies Inc.
9851 13th Avenue North
Plymouth, MN 55441
mkeilen@H2Ktech.com

Project Manager: Mike Keilen
Project: **1288**

April 7, 2004

TABLE OF CONTENTS

1. Equipment Description

2. Mechanical Drawings

3. Control Panel Schematics and Description

4. Installation/Start-up/Shut down Procedures

5. Maintenance Schedule

6. Trouble Shooting Guide

APPENDICES

A) Manufacturers' O&M Manuals

1. Equipment Description

SVE System

(1) H2K model RLV 6015 soil vapor extraction system
- Blower, Roots URAI model 615
- Flexible couplings for vibration isolation on blower inlet and outlet
- Marathon Motor model U957
- 25 HP, 230/460 VAC, 3Ø, EXP motor
- Motor mounted on adjustable sliding base
- V belt drive with OSHA belt guard
- Vacuum relief valve, Kunkle model 215V, 3" Set to 7" Hg
- Vacuum gage on inlet, 0-30" HG liquid filled, Wika
- Temperature gage on blower discharge, Wika, 50-300 deg F
- Sample port on blower discharge
- Discharge silencer/stand, reactive silencer, Solberg model BBF-600F
- Discharge absorbtive silencer, Universal Model SU5-6
- Vacuum switch on blower inlet, Dwyer model 1950P-25
- Air flow meter on blower inlet, Dwyer DS-300 pitot tube with magnehelic gage, scfm
- (1) Moisture separator tank, H2K model VLS-200
  - Tangential inlet for 95%+ moisture removal
  - 30" Diameter
  - 75 gallon holding capacity
  - 6" flanged inlet & outlet, 1" Drain ball valve
  - PVC site glass with stainless steel high/high-high-low pump out level switches
  - Inlet filter with 10 micron replaceable element, integral with moisture separator, Solberg model FT-275P-600
  - Vacuum gage on separator inlet
  - 3" Air bleed valve with silencer on separator inlet
  - Sample port on separator inlet
- (1) Condensate pump, Meyers model CT-07
  - 20 gpm at 72' TDH
  - 1 hp, 230/460 VAC, 3Ø, EXP motor
  - Cast iron bronze fitted pump construction
  - Check valve and isolation valve on pump inlet
  - Throttle valve and pressure gage on pump discharge

(1) SVE inlet Manifold
- 6" header with (3) 4" takeoffs, schedule 80 PVC piping & fittings
- (3) Vacuum gages
- (3) 4" PVC butterfly valves
- (3) Air flow meter, Dwyer DS-300 pitot tube with magnehelic gage, scfm
- (3) Sample ports

(2) H2K model VPC 013 vapor phase carbon vessels with carbon
- 1,500 lbs 4x10 mesh reactivated vapor phase carbon in each vessel
- Carbon steel construction with epoxy/urethane finish inside and out
- Air plenum on inlet to balance airflow across carbon bed
- Steel carbon support grate with stainless steel screen
- 22" dia bolt on top manway for easy access
- 120-1200 cfm max flow range
- 8" nozzle inlet and outlet connections

(3) Pressure gages, 3 ½" ,0-60" wc

Groundwater Treatment System

(1) Water flow meter, Hersey MVR 50, total water flow

(1) Water holding tank
- 1000 gallon HDPE vertical tank
- High/high, high and low pump out level controls
- Inlet and outlet threaded bungs
- 64" diameter x 79" tall

(1) Transfer pump, Meyers model CT-07
- 20 gpm at 72' TDH
- 1 hp, 230/460 VAC, 3Ø, EXP motor
- Cast iron bronze fitted pump construction
- Check valve and isolation valve on pump inlet
- Throttle valve and pressure gage on pump discharge

(2) Krystil Klear model 88-30 bag filters piped in series
- 2" schedule 80 PVC interconnecting piping & fittings
- Carbon steel housing, 100 psi maximum design pressure
- (25) 25 micron filter bags (4.4 sq. ft. surface area)
- 2" side inlet and bottom outlet connections
- Pressure gage and sample port on inlet and outlet of each filter housing
- (2) 2" PVC ball valves for isolation

(2) H2K Tech model LC05 liquid Phase carbon vessels
- Carbon steel construction, 75 psi design pressure
- Epoxy resin lining, epoxy/urethane exterior finish
- Forkliftable skid, lifting lugs
- 500lbs 8x30 mesh reactivated carbon in each vessel
- 2" influent and effluent 150# flange connections
- PVC hub and lateral internals
- 3/4" Air bleed valve with galvanized piping
- (2) 12"x16" manways
- 1" drain valve with galvanized piping
- 2-35 gpm flow range
- 2" Camlock fittings on inlet and outlet of each vessel

Pressure gage on discharge of each vessel
Sample port on inlet and outlet of each vessel
(3) 2" Dia. x 10' long Buna-N hoses with camlock fittings on each end

(1) Water flow meter, Hersey MVR 50, total water flow

(2) BJM model J-400 submersible sump pumps
25 gpm @ 30' TDH
Cast iron volute and impeller, 304 ss motor casing
1/2 HP, 230VAC, 1Ø, sealed motor

Controls

(1) Control System

For operation on 480 volt, 3Ø, 4 wire incoming electrical service. To control 25HP SVE blower, (2) 1hp pumps. Furnished mounted on the outside of building. To include:

QTY	DESCRIPTION
1	Enclosure, NEMA 4, 36"h, 30"w, 12"d with inner door for switches and indicators
1	Power distribution terminal block (65-335A) 3 pole; L1, L2, L3
1	Power distribution terminal block, 1 pole; Neutral
1	Lightning arrestor; 230 volt, 3 wire with bracket
3	Motor starter: Contactor 23A FLA/Overload relay 1.6-5.0A, 3Ø; pumps
1	Motor starter: Contactor 72A FLA/Overload relay 55-72A, 3Ø; SVE
1	Circuit breaker 230V 1P10A 10K; control power
6	Circuit breaker 230V 1P15A 10K; vent fan, lighting
1	Circuit breaker 230V 1P20A 10K; receptacle(s)
2	Circuit breaker 480V 3P15A 10K; pumps
1	Circuit breaker 480V 3P40A 10K; SVE
4	Switch; three position; Hand-Off-Auto with integral Run (green/LED) indication
3	Light (red/LED); alarms
1	Pushbutton (red/NO); alarm Reset
3	Run time meters for motors
	Engraved laminated legends for all door mounted devices
	Relay logic controls
	Terminal blocks for external connections and fusing as required
	Color-coded wiring with wire markers at all terminations
	Fully documented, assembled, wired, programmed and pre-shipment test
1	UL 698A serialized label
1	Panel heater, 120VAC, 250Watt with thermostat
1	GFIC 20A outlet with and weatherproof cover; mounted adjacent to control panel
1	480/110 V transformer

Enclosure

(1) H2K enclosure system, 8' wide x 27' long x 8' high

Includes equipment installation and wiring

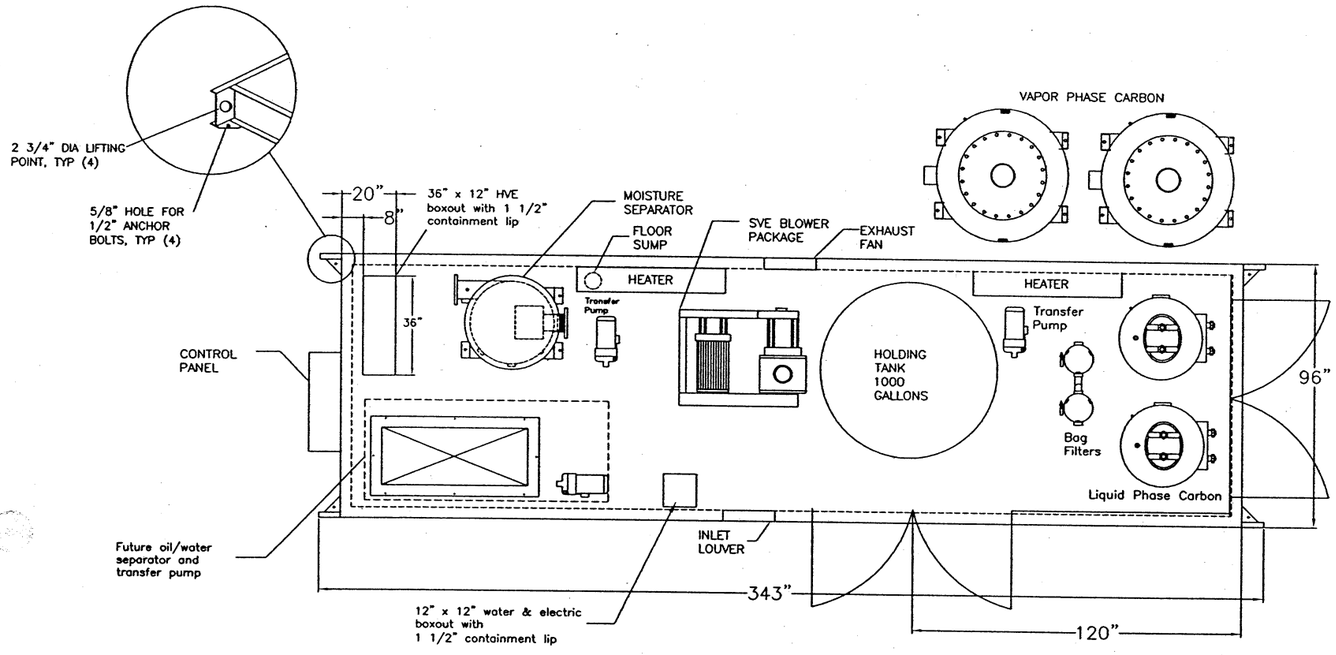
Steel skid, Wood construction building
2"x4" wood wall construction, 16" on center
T 1-11 wood siding with exterior latex finish
(4) layer 5/8" fire rated sheetrock walls (1) Layer ceiling
Fiberglass insulation, minimum R11 insulation value walls and ceiling
Vapor barrier under sheetrock
Gable roof, 4/12 pitch, aluminum drip edge
7/16" OSB roof sheathing, 15# felt on roof
Owens Corning asphalt rolled roofing
Steel skid with industrial enamel coated, 3/16" sheet steel floor
6" structural I-beam floor supports 24" on center, to allow large loading
6" structural I-beam skid framing members, Anchor lugs and lifting eyes
2" high internal floor spill containment
Floor box for incoming and outgoing lines as needed
Anchor lugs and lifting eyes
Floor sump with high level switch
(2) Explosion proof electric convection heater w/ thermostat, 7600 W each
(1) Explosion vent fan with inlet and outlet louvers and thermostat
(3) Explosion proof incandescent light with wall switch
(2) 36" x 6' 8" double access doors, insulated steel
Additional (2) 36" x 6' 8" double access doors, insulated steel
En mounted with structural support

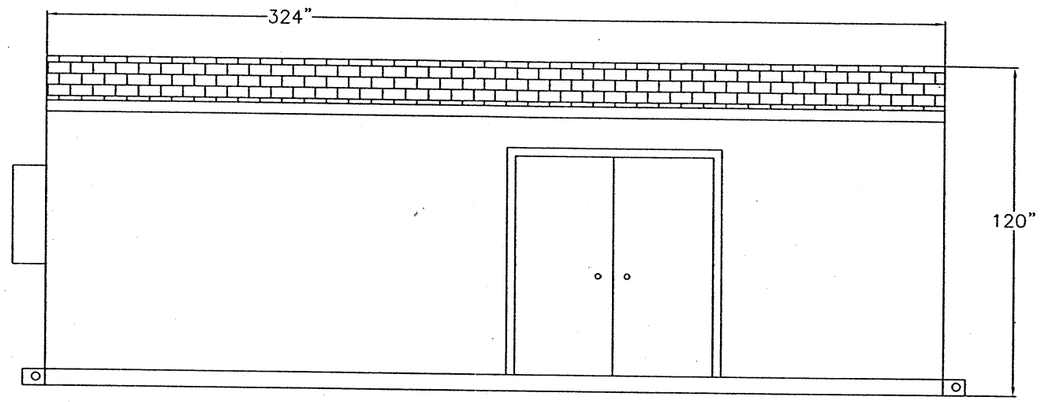
SVE & GWTS will be installed, piped and wired in building, control panel will be mounted and wired on outside of building. Piping will PVC schedule 80 for SVE and groundwater treatment. Wiring will be per NEC for Class I, Div II Group D hazardous environment inside of building. The rest of the building will be wired per NEC for a non-classified area.

2. Mechanical Drawings

A) P&ID Drawing

B) Plot Drawing





REVISIONS		
DESCRIPTION	DATE	DWN
AS BUILT	4/04	MK

UNLESS SPECIFIED OTHERWISE
* DIMENSIONS ARE IN INCHES
* DO NOT SCALE DRAWING

DRAWN BY:	GH
DESIGNED BY:	GH
PROJECT MGR.:	GH
DATE:	11/21/03
PROJECT NO.:	1288

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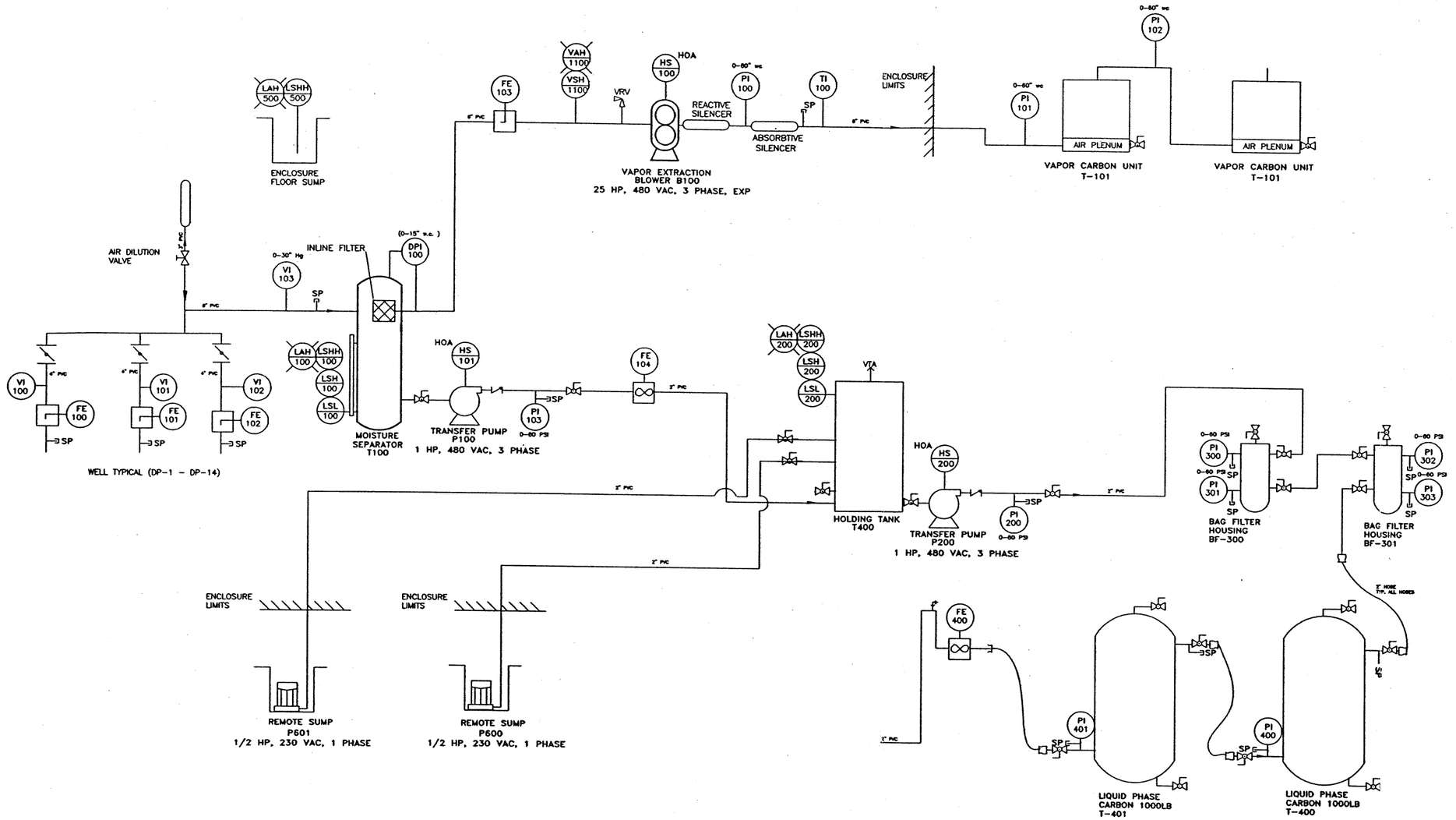
H2K Technologies, Inc.
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PROJECT TITLE:
MARCOR ENV. - URS - GWTS ENCL. BUFFALO, NY

DRAWING TITLE:
GWTS Enclosure Elevation/Layout Drawing

SHEET 1 OF 1

DRAWING NO.:
1288-02



REVISIONS		
DESCRIPTION	DATE	DWN
AS BUILT	4/04	MK

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DRAWN BY:	MK
DESIGNED BY:	GH
PROJECT MGR.:	MK
DATE:	11/21/03
PROJECT NO.:	1288

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PROJECT TITLE:
MARCOR ENV. - URS - GWTS ENCL.
BUFFALO, NY

DRAWING TITLE:
GWTS P&ID Drawing

SHEET 1 OF 1

DRAWING NO.:
1288-03

3. Control Panel Schematics and Description

Scope

The controls were provided by H2K Technologies, Inc. for the Marcor Environmental-URS, GWTS, Buffalo, NY site. This section on controls is provided as a descriptive summary of the P & ID. This section can be used to determine the conditions which must be met for each item to operate.

General

- Any switch in the "HAND" position will operate the corresponding circuit under any alarm condition, except for a motor temperature fault or a circuit overload. The "HAND" position is for diagnostics or to clear alarms. The system should never be left unattended while any switch is in the "HAND" position.
- To reset an alarm, switch all switches to the "OFF" position. Clear the cause of the alarm condition. Then the press the "RESET" button. If the panel will not reset, then an alarm condition still exists.
- Upon powering the panel, alarm lights may be lit. The panel may require to be reset every time power is disconnected.

In the "AUTO" position

Item	Required conditions
Vacuum Extraction Blower B-100	Vacuum Extraction Blower VAH-100 must NOT exist. Moisture Sep LAH-100 must NOT exist. Building Sump LAH-500 must NOT exist. The corresponding circuit breaker or overload must NOT be tripped.
Moist Sep Transfer Pump P-100	Moisture Sep pump down latch must exist. Moisture Sep LAH-100 must NOT exist. Holding Tank LAH-200 must NOT exist. Building Sump LAH-500 must NOT exist. The corresponding circuit breaker or overload must NOT be tripped.
Holidng Tank Transfer Pump P-200	Holding Tank pump down latch must exist. Holding Tank LAH-200 must NOT exist. Building Sump LAH-500 must NOT exist. The corresponding circuit breaker or overload must NOT be tripped.
Remote Sump Pump P-600	Integral Sump Float must be made. Holding Tank LAH-200 must NOT exist. Building Sump LAH-500 must NOT exist. The corresponding circuit breaker or overload must NOT be tripped.
Remote Sump Pump P-601	Integral Sump Float must be made. Holding Tank LAH-200 must NOT exist. Building Sump LAH-500 must NOT exist. The corresponding circuit breaker or overload must NOT be tripped.

Alarm Description

Control Device	**Resultant Condition**	**Control Panel Indication**
Moisture Sep LSHH-100	Shuts down Vacuum Extract Blower B-100 Shuts down Moist Sep Transfer Pump P-100	Moist Sep LAH-100 pilot light illuminates
Vacuum Extraction Blower VSH-100	Shuts down Vacuum Extract Blower B-100	Vacuum Extraction Blower VAH-100 pilot light illuminates
Holding Tank LSHH-200	Shuts down Moist Sep Transfer Pump P-100 Shuts down Holding Tank Pump P-200 Shuts down Remote Sump Pump P-600 Shuts down Remote Sump Pump P-601	Holding Tank LAH-200 pilot light illuminates
Building Sump LSH-500	Shuts down all motors	Building Sump LAH-500 pilot light illuminates

COMING POWER SUPPLY

BuvAC, 3PHASE, 3WIRE = SYSTEM FLA = 74 AMPS
ER NEC CODE, THIS CONTROL PANEL
EQUIRES 100AMP FUSES OR CIRCUIT BREAKER
T TO PANEL DISCONNECT

L1,L2,L3 GND — GROUND BLOCK

100AMP NON-FUSED PANEL DISCONNECT
INTERLOCKED TO CONTROL PANEL INNER DOOR
(NOT SERVICE ENTRANCE RATED)

(BLK-4AWG)

POWER DISTRIBUTION BLOCK
PDB1

CB3 40AMP (BLK-10AWG) — MS1 — 25 HP — VAPOR EXTRACTION BLOWER B-100 — 31 FLA

CB5 15AMP (BLK-12AWG) — MS2 — 1 HP — MOIST SEP TRANSFER PUMP P-100 — 1.6 FLA

CB7 15AMP (BLK-12AWG) — MS3 — 1 HP — HOLDING TANK TRANSFER PUMP P-200 — 1.6 FLA

CB9 20AMP (BLK-12AWG) — CK58 — XP BUILDING HEATER #1 7600W, 15.8AMP

CB11 20AMP (BLK-12AWG) — CK59 — XP BUILDING HEATER #2 7600W, 15.8AMP

LA19 — LIGHTNING ARRESTOR

L1,L2,L3

L1,L2,L3 — FUL1-20, FUL2-20 — 15AMP (ATQR) (BLK-12AWG)

480VAC — H1 H2 H3 H4 — 5KVA — X1 X4 — TRANSFORMER MOUNTED NEXT TO CONTROL PANEL

CB23 30AMP (BLK-10AWG) — N

CB25 10AMP

CB26 15AMP (BLK-14AWG) — MS4 — 1/2 HP — REMOTE SUMP PUMP P-600 — 3.5 FLA

CB28 15AMP (BLK-14AWG) — MS5 — 1/2 HP — REMOTE SUMP PUMP P-601 — 3.5 FLA

CB30 20AMP — N — BUILDING GFCI RECEPTACLE 6 AMPS

CB31 15AMP — BUILDING EXHAUST FAN 1/3HP, 6.8AMPS

CB32 15AMP — BUILDING LIGHTING 600 WATTS

L1,L2,L3

COLUMN 1

120 VAC

N

INSTALL JUMPER IF EXTERNAL SYSTEM SHUTDOWN IS UNAVAILABLE

HS24 (HAND OFF AUTO) — MOTOR OVERTEMP SWITCH — 24 — 24A O/L — 24B MS1 — XOO

21 — 25 CR72 — 25A CR63 — 25B — TDR 66 — 25C — 24 — XOO

MS1 25D AUX — G — VACUUM EXTRACTION BLOWER B-100 RUNNING

RTM — VACUUM EXTRACTION BLOWER B-100 ELAPSED RUN TIME

VACUUM EXTRACTION BLOWER B-100 (25)

HS28 (HAND OFF AUTO) — MOTOR OVERTEMP SWITCH — 28 — 28A O/L — 28B MS2 — XOO

CR69 — 29 WLC112 — 29A — 28 — XOO

MS2 29B AUX — G — MOISTURE SEP TRANSFER PUMP P-100 RUNNING

RTM — MOISTURE SEP TRANSFER PUMP P-100 ELAPSED RUN TIME

MOISTURE SEP TRANSFER PUMP P-100 (29)

HS32 (HAND OFF AUTO) — MOTOR OVERTEMP SWITCH — 32 — 32A O/L — 32B MS3 — XOO

25A CR69 — 33 WLC121 — 33A — 32 — XOO

MS3 33B AUX — G — HOLDING TANK TRANSFER PUMP P-200 RUNNING

RTM — HOLDING TANK TRANSFER PUMP P-200 ELAPSED RUN TIME

HOLDING TANK TRANSFER PUMP P-200 (33)

HS36 (HAND OFF AUTO) — 36 — 36A O/L — MS4 — XOO

33 ISB101 — 37 — 36 — XOO

MS4 37A AUX — G — REMOTE SUMP PUMP P-600 RUNNING

REMOTE SUMP PUMP P-600 (37)

21 — 33 — N

WIRING COLORING & NOTES:

1) 120VAC POWER - RED (16AWG)
2) 120NEUTRAL - WHITE (16AWG)
3) 24VDC POSITIVE - BLUE (16AWG)
4) 24VDC COMMON - WHITE W/ BLUE STRIPE (16AWG)
5) GROUND - GREEN (16AWG)
6) ALL OTHER WIRING AS INDICATED

REVISIONS

DESCRIPTION	DATE	DWN
RELEASE FOR SUBMITTAL	12/15/03	RC
RELEASE FOR RESUBMITTAL	01/20/04	RC
RELEASE FOR PRODUCTION	01/28/04	RC
AS BUILT	03/31/04	RC

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DRAWN BY: RC
DESIGNED BY: RC
PROJECT MANAGER: MK
DATE: 12/12/03
PROJECT NO.: 1288

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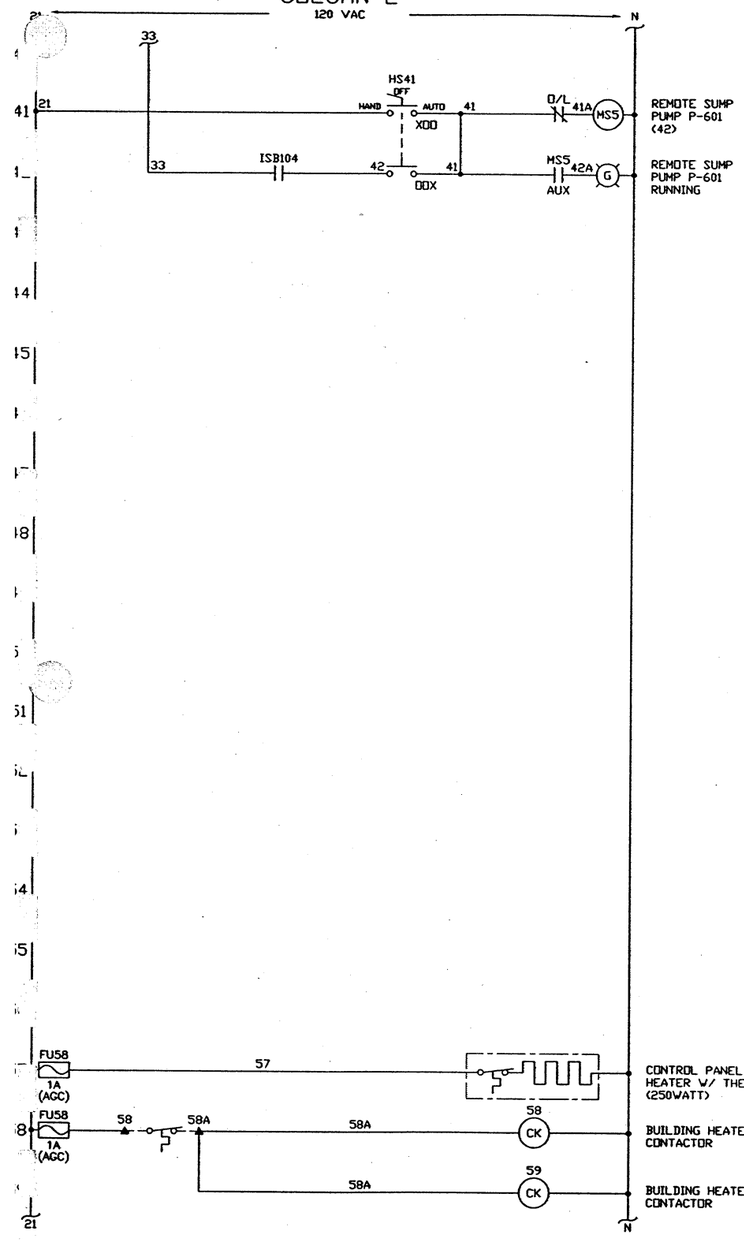
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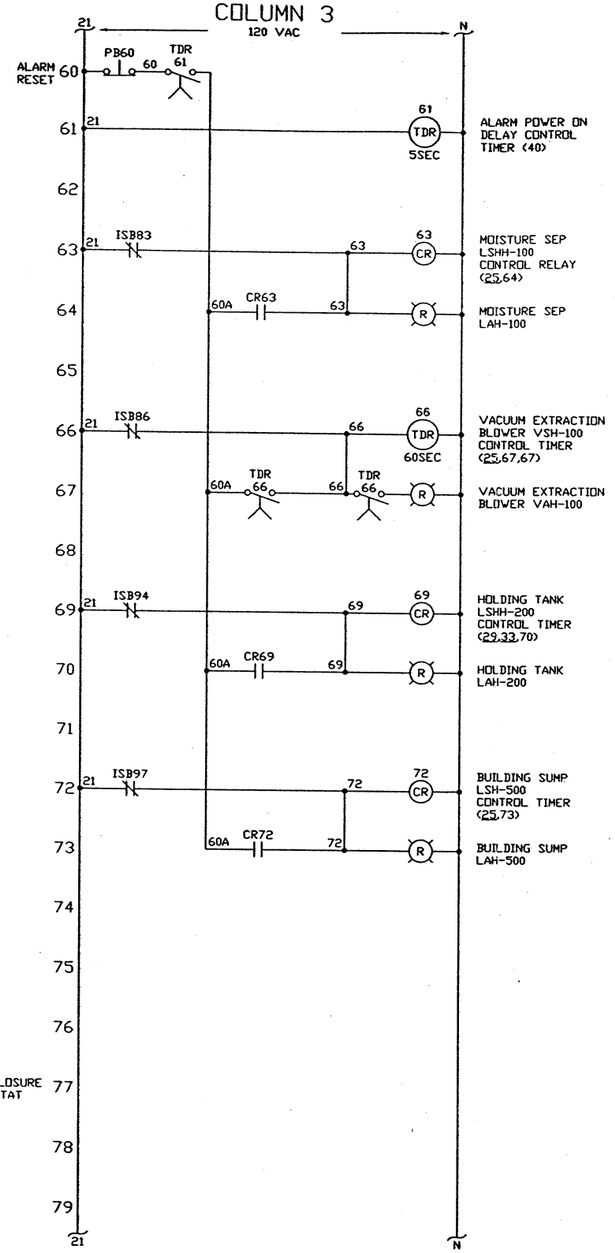
PROJECT TITLE:
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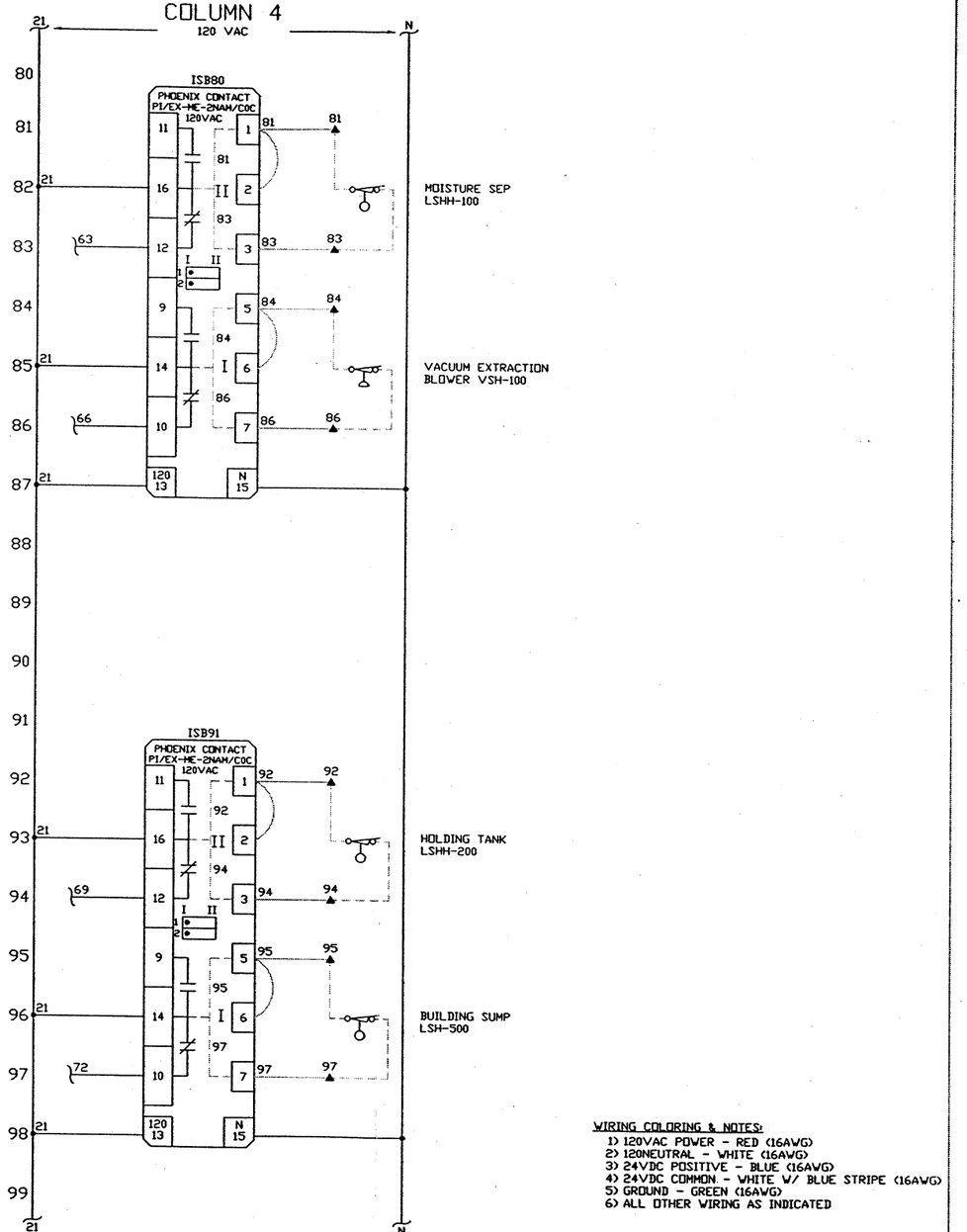
DRAWING TITLE:
SCHEMATIC CONTROL PANEL

SHEET 1 OF 4

DRAWING NO.:
1288-21







WIRING COLORING & NOTES:
1) 120VAC POWER - RED (16AWG)
2) 120NEUTRAL - WHITE (16AWG)
3) 24VDC POSITIVE - BLUE (16AWG)
4) 24VDC COMMON - WHITE W/ BLUE STRIPE (16AWG)
5) GROUND - GREEN (16AWG)
6) ALL OTHER WIRING AS INDICATED

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RELEASE FOR RESUBMITTAL	01/20/04	RC	DESIGNED BY: RC
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AS BUILT	03/31/04	RC	DATE: 12/12/03
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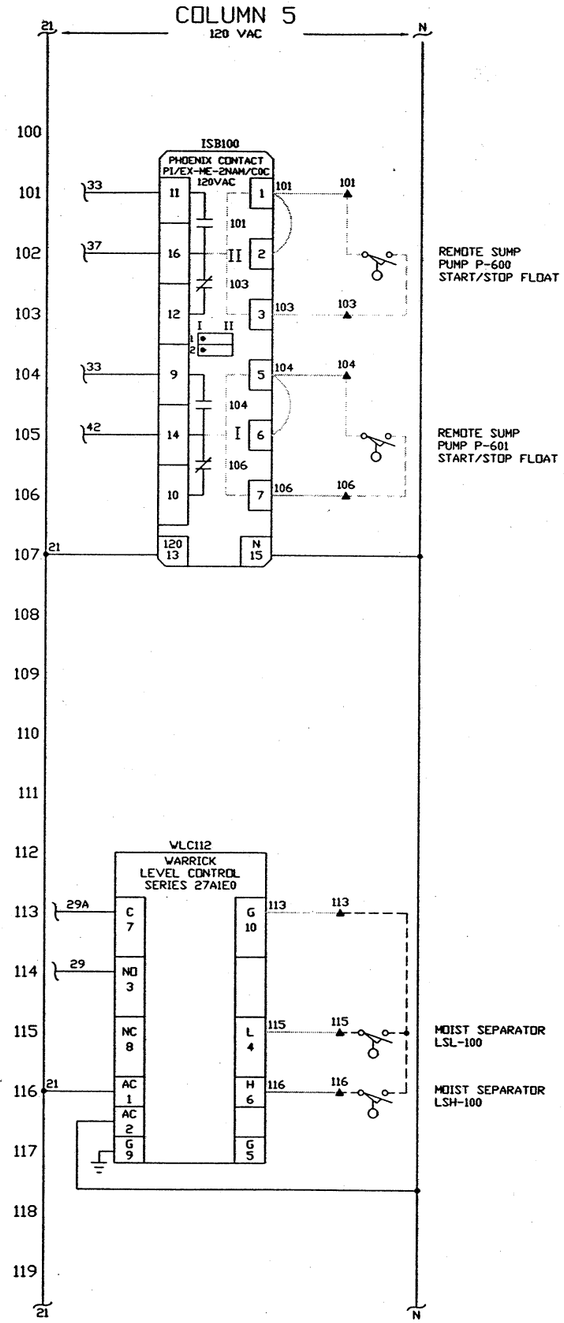
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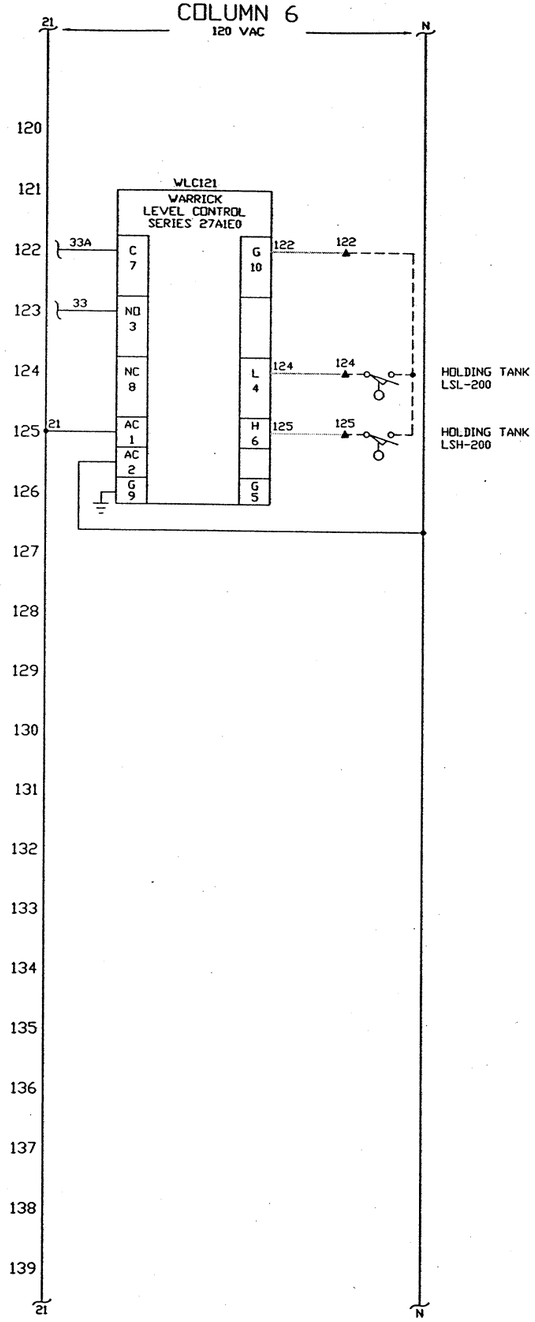
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MARCOR ENV
-URS-GWTS ENCL
BUFFALO, NY

DRAWING TITLE:
SCHEMATIC CONTROL PANEL

SHEET 2 OF 4

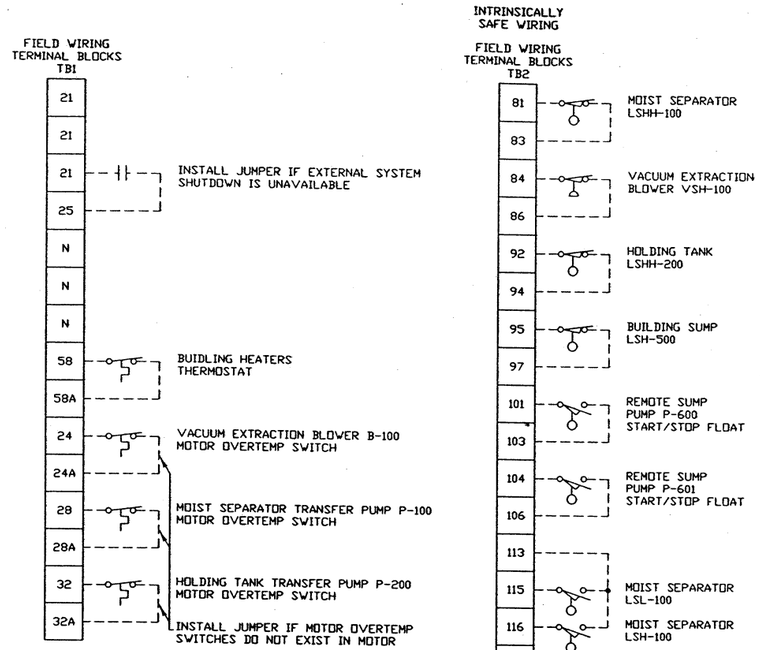
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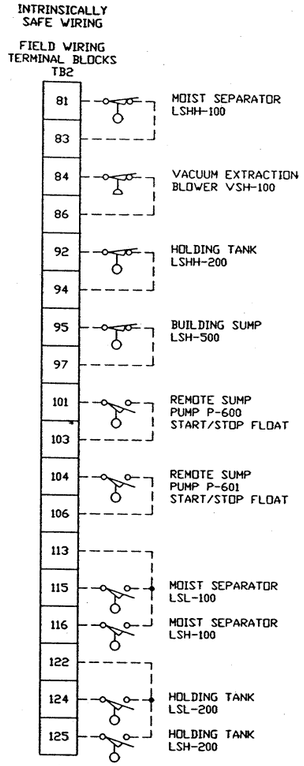




INSTALL IN ACCORDANCE WITH ARTICLE 504 OF THE NEC CODES

CLASSIFIED AREA IS CLASS 1 DIV 2 GROUP D HAZARDOUS LOCATION





WIRING COLORING & NOTES:
1) 120VAC POWER - RED (16AWG)
2) 120NEUTRAL - WHITE (16AWG)
3) 24VDC POSITIVE - BLUE (16AWG)
4) 24VDC COMMON - WHITE W/ BLUE STRIPE (16AWG)
5) GROUND - GREEN (16AWG)
6) ALL OTHER WIRING AS INDICATED

REVISIONS		
DESCRIPTION	DATE	DWN
RELEASE FOR SUBMITTAL	12/15/03	RC
RELEASE FOR RESUBMITTAL	01/20/04	RC
RELEASE FOR PRODUCTION	01/28/04	RC
AS BUILT	03/31/04	RC

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DATE: 12/12/03
PROJECT NO.: 1288

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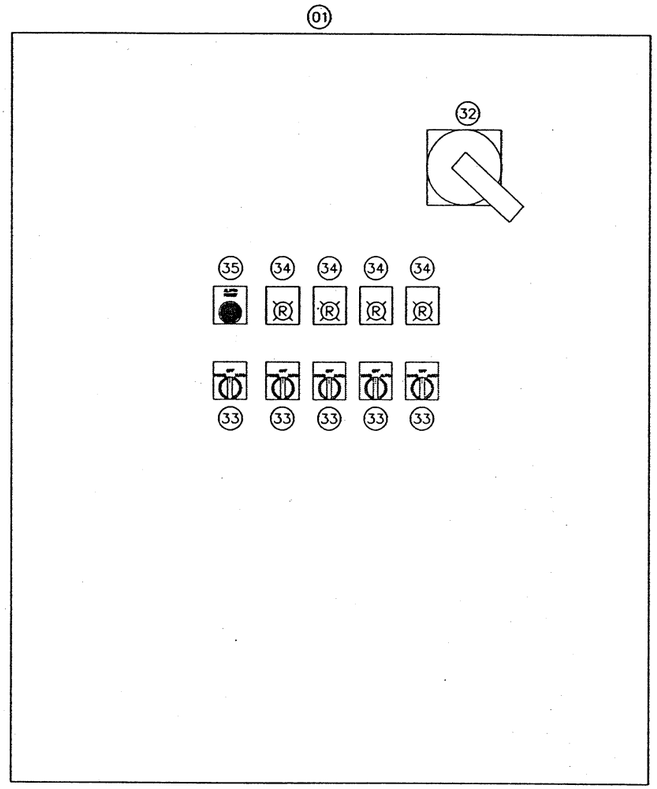
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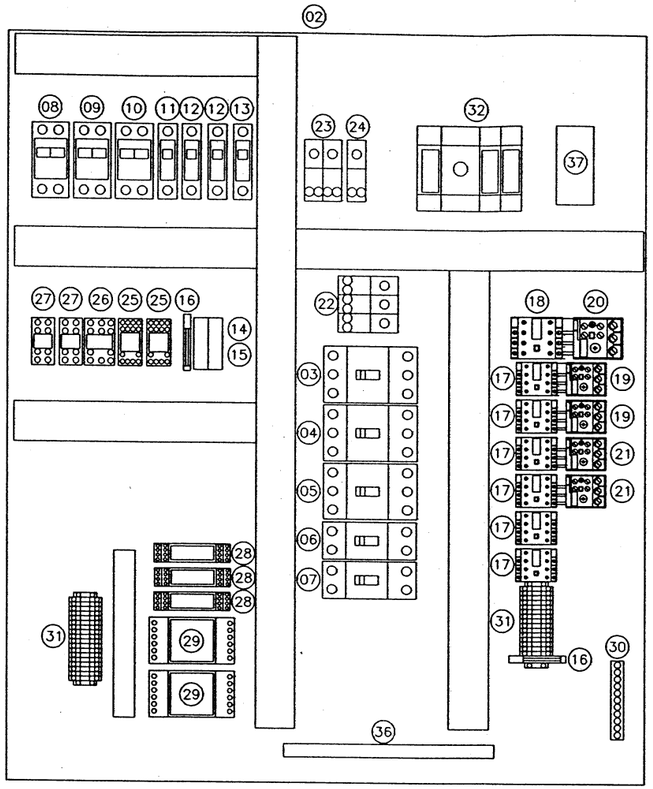
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MARCOR ENV
-URS-GWTS ENCL
BUFFALO, NY

DRAWING TITLE:
SCHEMATIC CONTROL PANEL

SHEET 3 OF 4

DRAWING NO.:
1288-23





37		LIGHTNING ARRESTOR
36		CONTROL PANEL CONDENSATION HEATER
35		PUSHBUTTON
34		RED PILOT LIGHT
33		HAND-OFF-AUTO SELECTOR
32		NON-FUSED DISCONNECT, 480VAC, 100 AMP
31		FIELD WIRING TERMINAL BLOCKS
30		GROUNDING BLOCK
29		INTRINSICALLY SAFE LEVEL CONTROLLER
28		INTRINSICALLY SAFE BARRIER
27		RELAY WITH BASE, 2 POLE
26		RELAY WITH BASE, 3 POLE
25		TIMER, ON DELAY WITH BASE
24		BLOCK, POWER DISTRIBUTION, 1-POLE
23		BLOCK, POWER DISTRIBUTION, 2-POLE
22		BLOCK, POWER DISTRIBUTION, 3-POLE
21		OVERLOAD, 2.0 THRU 7.0 AMP, 1 PHASE
20		OVERLOAD, 12 THRU 37 AMP, 3 PHASE
19		OVERLOAD, 1.0 THRU 2.9 AMP, 3 PHASE
18		CONTACTOR, 37 AMP
17		CONTACTOR, 23 AMP
16		FUSE HOLDER W/ FUSE, 1 AMP
15		FUSE HOLDER W/ FUSE, 15 AMP
14		FUSE HOLDER W/ FUSE, 15 AMP
13		CIRCUIT BREAKER, 1 POLE, 120VAC, 10 AMP
12		CIRCUIT BREAKER, 1 POLE, 120VAC, 15 AMP
11		CIRCUIT BREAKER, 1 POLE, 120VAC, 20 AMP
10		CIRCUIT BREAKER, 2 POLE, 240VAC, 15 AMP
09		CIRCUIT BREAKER, 2 POLE, 240VAC, 15 AMP
08		CIRCUIT BREAKER, 2 POLE, 240VAC, 30 AMP
07		CIRCUIT BREAKER, 2 POLE, 480VAC, 20 AMP
06		CIRCUIT BREAKER, 2 POLE, 480VAC, 20 AMP
05		CIRCUIT BREAKER, 3 POLE, 480VAC, 15 AMP
04		CIRCUIT BREAKER, 3 POLE, 480VAC, 15 AMP
03		CIRCUIT BREAKER, 3 POLE, 480VAC, 40 AMP
02		SUBPANEL, 42x36
01		INNER DOOR, 42x36

REVISIONS

DESCRIPTION	DATE	DWN
RELEASE FOR SUBMITTAL	12/15/03	RC
RELEASE FOR RESUBMITTAL	01/20/04	RC
RELEASE FOR PRODUCTION	01/28/04	RC
AS BUILT	03/31/04	RC

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PROJECT MANAGER: MK
DATE: 12/03/03
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PROJECT TITLE:
MARCOR ENV
-URS-GWTS ENCL
BUFFALO, NY

DRAWING TITLE:
SCHEMATIC CONTROL PANEL

SHEET 4 OF 4

DRAWING NO.:
1288-24

4. Installation / Start-Up/ Shut Down Procedures

Note: Always read the individual manufacturers' manuals prior to beginning for more detailed information for a better understanding of the system.

Installation

- Set the system in place using the properly sized lifting equipment. Anchor the system in place per the site specifications.
- Connect the influent and effluent piping to the system.
    - The piping connected to the system should be self-supporting.
- The SVE inlet to the system are the (3) 4" PVC pipes at the boxout of the enclosure.
- The sump pump influent piping is the (2) 2" PVC pipes located at the small boxout of the enclosure.
- The SVE discharge is the 6" PVC pipe located through the wall. Connect the vapor phase carbon to the SVE discharge.
- Connect power to the control panel. A service entrance disconnect will need to be installed prior to the control panel.

Start-Up Procedure

- Verify the system is properly secure.
- Verify that all influent and effluent connection have been made, and open all valves to ensure that there are no restrictions on the blower.
- Turn on power to the control panel. If any lights come on press the reset button and the alarms should clear. If not, check the switches and controls to determine the problem.
- Verify the power leads are properly wired to the motor. **Incorrect voltage or improper wiring will ruin the motor.**

Vacuum Blower:

Start-Up Procedure

- Verify the system is properly secured to the floor.
- Verify that all influent and effluent connection have been made, and open all valves to ensure that there are no restrictions on the blower.
- Verify there is oil in the gear box of the blower.
- Verify the power leads are properly wired to the blower motor. **Incorrect voltage or improper wiring will ruin the motor.**
- Bump the blower to verify rotation. Verify proper rotation. There should be suction on the inlet and pressure on the discharge line. If rotation is backwards, have an electrician correct rotation. **Be sure to lock out and tag the main incoming power. Verify that there is not power at the motor with a multimeter.**
- The SVE system can now be run in normal operation. Start the blower in the auto mode and adjust valving according to the desired site conditions.
- It is best to record the initial readings of the system for trouble shooting purposes later.

Pressure at blower discharge_____ Vacuum at the well _____

Motor amp draw _____ Voltage _____

Pressure drop across the filter _____ System Inlet Temp _____

System exhaust temperature _____ System flow rate _____

Location of flow meter _____ Vacuum at the blower _____

Bag Filter

- Put a bag in the housing and tighten down the top cover.
- Begin normal flow through the vessel.
- Slowly open the vent valve. Release any air that is still in the vessel. When water begins coming out the valve, close the valve. Periodically bleed the air out of the vessel.
- Check initial readings of the pressure gauges at the flow rate of operation.

Liquid Phase Carbon Filter

- Fill carbon vessel with carbon
- Leave the vent port open.
- Isolate the vessel and fill with clean water so the carbon bed is covered with water.
- Allow the carbon vessel to remain vented and filled with clean water for 24 hours prior to system startup. This will release the air that will develop from the carbon initially getting wet. Check for any water leaks.
- After 24 hours, close the venting port. Check again for any leaks that might have developed.
- If possible, it is recommended to backwash the vessel at initial start-up to remove the carbon fines (see "Backwash Procedures" section below). If the vessels are not backwashed, the carbon fines can create added backpressure to the system.
- After backwashing the system, orientate the valves for normal system flow operation.
- Begin normal flow through the carbon vessel.
- Slowly open the vent valve. Release any air that is still in the vessel. When water begins coming out the valve, close the valve. Periodically bleed the air out of the vessel.
- Check initial readings of the pressure gauges at the flow rate of operation.

Vapor Phase Carbon Filter

- Verify the system is properly secured to the floor.
- If the vessel is not filled with carbon, see the "carbon filling/removal procedures" section.
- Verify that all influent and effluent connections have been made, and open all valves to ensure that there are no restrictions on the air flow through the system.
- Begin air flow through the vessel filled with carbon.
- It is best to record the initial readings of the system for trouble shooting purposes later.

Inlet Pressure _____ Discharge Pressure _____

Inlet Temperature _____ Discharge Temperature _____

Inlet Air Sample _____ Discharge Air Sample _____

System flow rate _____ Location of flow meter _____

Transfer Pump(centrifugal):

- Bump the motor to verify rotation. Verify proper rotation. If rotation is backwards, have an electrician exchange two of the power leads. **Be sure to lock out and tag the main incoming power. Verify that there is not power at the motor with a multimeter.**
- Position the discharge valve fully open. As water rises in the r tank and the two lower floats are raised the pump will turn on.
- While the pump is running, adjust the valving to minimize the pressure on the pump and to also get a slow pump down of the tank. This will take some adjusting of the two valves.
- The pump will turn off automatically when the lower float drops down. Never let the pump run dry.

Shut Down Procedure

Vacuum Blower

- Turn off the blower
- Close all valves to the wells and open the air bleed valve.
- Allow the blower to run for 5 minutes "open" to atmosphere.
- If an extended period of down time is anticipated, mist the lobes of the blower with WD-40 to help prevent the lobes from rusting.

Bag Filter

- Turn off water flow to the vessel.
- Close the inlet & outlet valves
- Open the air bleed line to relieve any pressure in the vessel.
- Open the drain valve and drain the water from the vessel (note: the water does not need to be drained if the vessel is not shut down for extended periods.
- If the vessel is to be shut down for a long period of time and the bag is fouled, the bag should be removed and replaced with a new bag.

Liquid Phase Carbon Filter

- Turn off water flow to the vessels.
- Close the inlet & outlet valves
- Open the air bleed line to relieve any pressure in the vessel.
- Open the drain valve and drain the water from the vessel (note: the water does not need to be drained if the vessel is not shut down for extended periods.
- If the vessel is to be shut down for a long period of time and the carbon is spent, the carbon should be removed.

Vapor Phase Carbon Filter

- Turn off the air flow through the vessel.
- Drain any condensate that may have accumulated in the bottom of the vessel.
- If the carbon is spent, remove the carbon, see the "carbon filling/removal procedures" section. If the carbon is not spent, it is safe to leave it in the vessel while the system is shut down.

Transfer Pumps

- Turn off the power to the transfer pump.
- Drain the pumps.

5. Maintenance Schedule

****The list below is a recommend system maintenance list. The individual manufacturers' O&M manuals must be followed in addition to the list below.**

Vacuum Blower

Weekly	Clean/replace filter element	The differential pressure should not exceed 15" wc. Depending on the system operating conditions, this might have to be changed earlier or allowed to go for a longer period of time. The filter life will be site dependent.
	Record system operating conditions	A good record of operating conditions helps monitor the performance of the system and helps to trouble shoot when a problem occurs.
	First week	Change oil after first 100 hours, use the proper weight of oil based on the manufacturer's suggestion.
	Check Oil	Oil should be up to the bottom of the side plug.
	Grease bearings on blower	Based on time of operation (See Table 4 in the manufacturer's O&M)
	Listen for any unusual noises	
Monthly	Check any controls, switches or interlocks with the SVE system	Finding a faulty instrument can prevent problems if detected.
	Clean moisture separator	As needed, depending on water quality. Recommend initial inspection after first month.
	Change oil	Every 1000 hours.
Yearly	Grease motor with NLGI #2	

Bag Filter

As Needed	Bag change out	When differential pressure across the vessel exceeds 15-20 psi. 1. Shut off water flow to the vessel. 2. Isolate the inlet and outlet of the vessel . 3. Slowly open the air bleed valve to release the pressure. 4. Open the drain valve and drain the vessel. 5. Open the lid and pull out the dirty filter. 6. Put in a new filter and make sure it is seated properly. 7. Reinstall cover. 8. Close drain. 9. Open isolation valves. 10. Begin water flow. 11. Bleed air out of the vessel and close bleed air valve.

Liquid Phase Carbon Filter

As Needed	Backwash	When differential pressure across the vessel exceeds 15-20 psi.
	Exchange Carbon	When Carbon becomes spent or cannot be effectively backwashed.

Vapor Phase Carbon Filter

Weekly or as needed	Drain condensate	Condensate can develop any time the temperature in the vessel decreases below the temperature of the air source (SVE ground temperature, air stripper discharge temperature, etc…).
	Record system operating conditions	A good record of operating conditions helps monitor the performance of the system and helps to trouble shoot when a problem occurs.
As needed	Sample air stream	
	Replace carbon	Prior to or when breakthrough is reached.
	Inspect inside of vessel	When the carbon is exchanged. Check for signs of corrosion or damage.

Transfer Pump

6 months/Yearly	Disassemble, inspect, and clean impeller housing, and rotor	May require service more often based on the site operating conditions
	Grease motor with NLGI #2, if applicable.	Yearly

6. Trouble Shooting Guide

SVE Blower

Problem	Cause	Task
Blower will not run when the operator turns the switch on "hand" or "auto"	Circuit protection is tripped	Reset overload protection. Try restarting the blower. Since the overload tripped, there might still be a problem in the system. Try to determine what caused the overload to trip.
	Motor temperature switch is open	The motor might have an internal motor temperature switch. Check to see that it was wired. If not, it needs to be wired into the logic of the controls. If it was wired, the motor might have gotten too hot. Try restarting the blower and monitor it to see if it opens again. If it does, there is either a problem with the motor or the system causing the motor to overheat.
Blower will run in with the selector switch in "hand", but not "auto"	Alarm condition occurs, or a system enable is not active.	Verify what alarm is active or what system enable is not active. Even if the panel doesn't show there is an alarm, there might be a light bulb burnt out which would normally display the alarm condition.
Blower does not run at the desired air flow capacity	Filter is plugging	Clean or replace the filter element.
	Too much vacuum on the inlet	Verify the vacuum level is acceptable with the blower curve. A higher vacuum will decrease the blower air flow.
	Too much back pressure on the discharge	Decrease the backpressure. Verify nothing is obstructing the flow on the discharge. A higher back pressure on the blower will decrease the blower air flow.
	Vacuum relief valve is opening	Verify that the vacuum relief valve is set properly.
Blower seems to have vacuum on the pressure side.	Incorrect blower rotation	Verify and change rotation

Bag Filter

Problem	Cause	Task
High differential pressure	Bag fouled	Replace bag
	Solids or organics fouling top of bed	Replace bag
	Air pocket	Bleed air from top of vessel
Solids in the effluent	Bag torn	Replace bag
	Too large of micron bag	Use smaller micron bag

Liquid Phase Carbon Filter

Problem	Cause	Task
High differential pressure	Fines were not backwashed out at startup	Backwash vessel
	Solids or organics fouling top of bed	Backwash vessel
	Air pocket	Bleed air from top of vessel
High differential pressure even after backwash	Solids or organics fouling top of bed	Remove the top layer or affected area of the carbon bed
Carbon in the effluent	Lateral broken	Empty carbon bed and replace damaged lateral.

Vapor Phase Carbon Filter

Problem	Cause	Task
Contaminants detected in the discharge air	Carbon has reached break through.	Replace carbon.
Break through seems premature	Higher than expected contaminant levels on the inlet of the vessel.	Replace carbon more frequently or bleed more clean air into the air stream to dilute the air stream. This will extend the amount of time between exchanges.
Moisture in the discharge air stream	Condensation of moisture in the vapor stream	Add an inline heater or insulate the vessels so the discharge temperature of the last vessel is 20 °F warmer than the original air source. The original air source can be the ground, an air stripper discharge, etc...
Increasing backpressure through the vessel	Condensation of moisture in the vapor stream	Add an inline heater or insulate the vessels so the discharge temperature of the last vessel is 20 °F warmer than the original air source. The original air source can be the ground, an air stripper discharge, etc...
Backpressure is higher than expected in the vessel	Too much carbon added to the vessel	Remove some of the carbon.
	Too high of air flow through the vessel	Adjust the air flow to the proper air flow for the vessel.

Transfer Pump

Pump will run with the selector switch in "hand", but not "auto"	Alarm condition is active	Clear any alarm condition and reset the control panel.
	Pump down latch not active	Allow sump to fill until the high level switch activates the pump.
Pump will not run when the operator turns the switch on	Circuit protection is tripped	Reset overload protection. Try restarting the blower. Since the overload tripped, there might still be a problem in the system. Try to determine what caused the overload to trip.

"hand" or "auto"	Motor temperature switch is Open	The motor might have an internal motor temperature switch. Check to see that it was wired. If not, it needs to be wired into the logic of the controls. If it was wired, the motor might have gotten too hot. Try restarting the blower and monitor it to see if it opens again. If it does, there is either a problem with the motor or the system causing the motor to overheat.
	Alarm condition occurs, or a system enable is not active.	Verify what alarm is active or what system enable is not active. Even if the panel doesn't show there is an alarm, there might be a light bulb burnt out which would normally display the alarm condition. There needs to be a jumper from terminal 21 to terminal 25 if an upstream enable is not present.
Pump operating at reduced performance	Incorrect pump rotation	Verify and change rotation
	Pump restricted	Inspect and clean all influent lines, pump head and effluent lines.
	Rotor is worn	Replace the rotor
Pump leaking	Shaft seal worn, cracked housing	Replace shaft seal, inspect housing and fittings

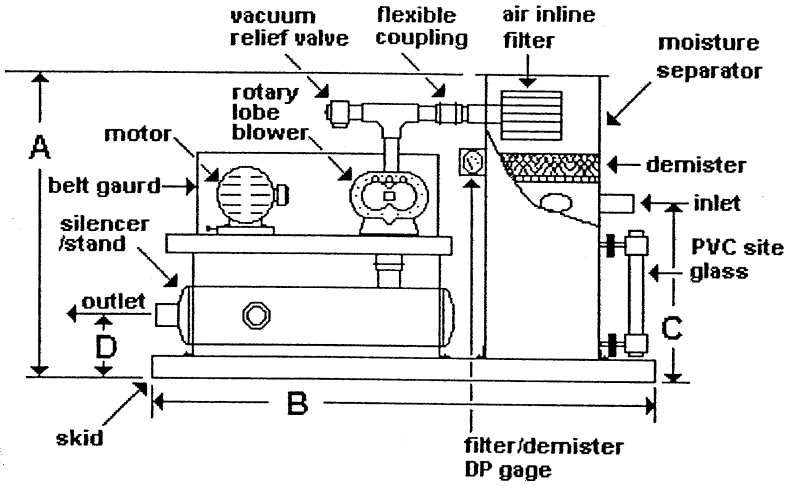
RLV Series Rotary Lobe Vacuum System Operation & Maintenance Manual

H2K Technologies, Inc.

Receiving

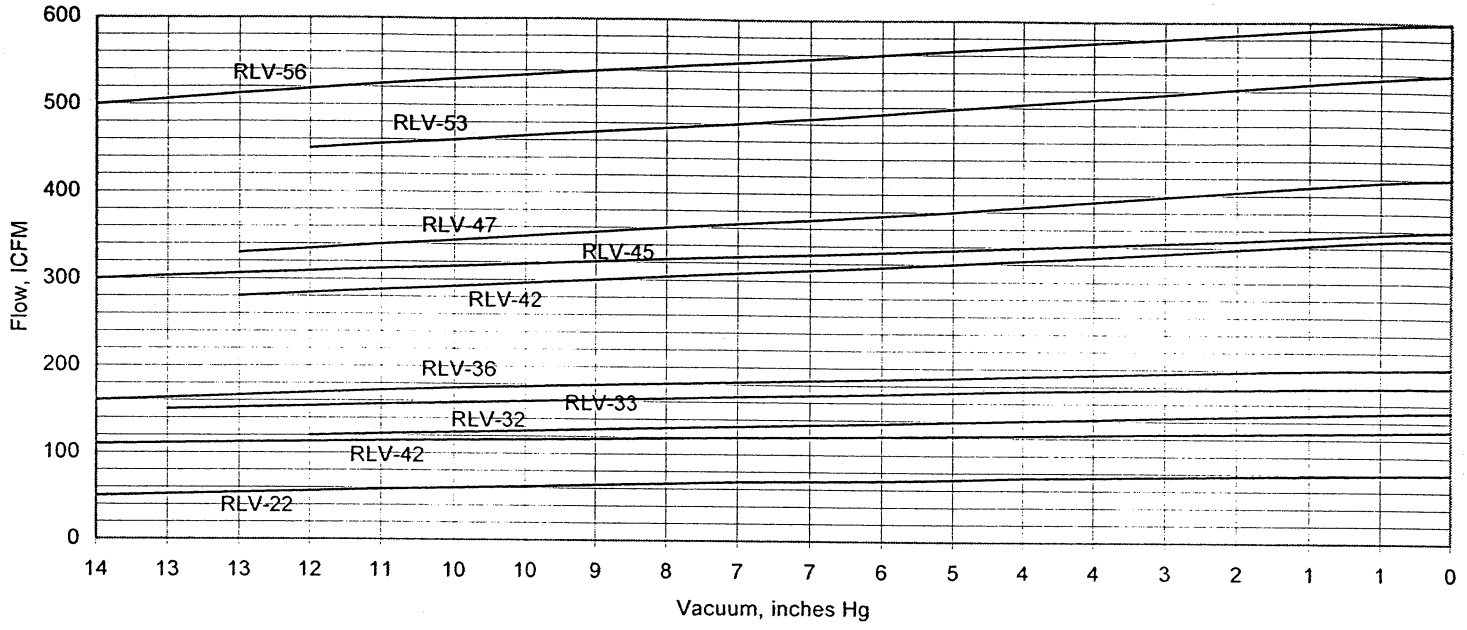
- Always use a properly sized piece of lifting equipment to offload the unit from the delivery truck. Take care not to damage the system during the offloading and setting into place.
- Carefully inspect system for damage that might have occurred during shipping. Note any damage on the bill of lading before the delivery truck leaves the site.

Features & Specifications

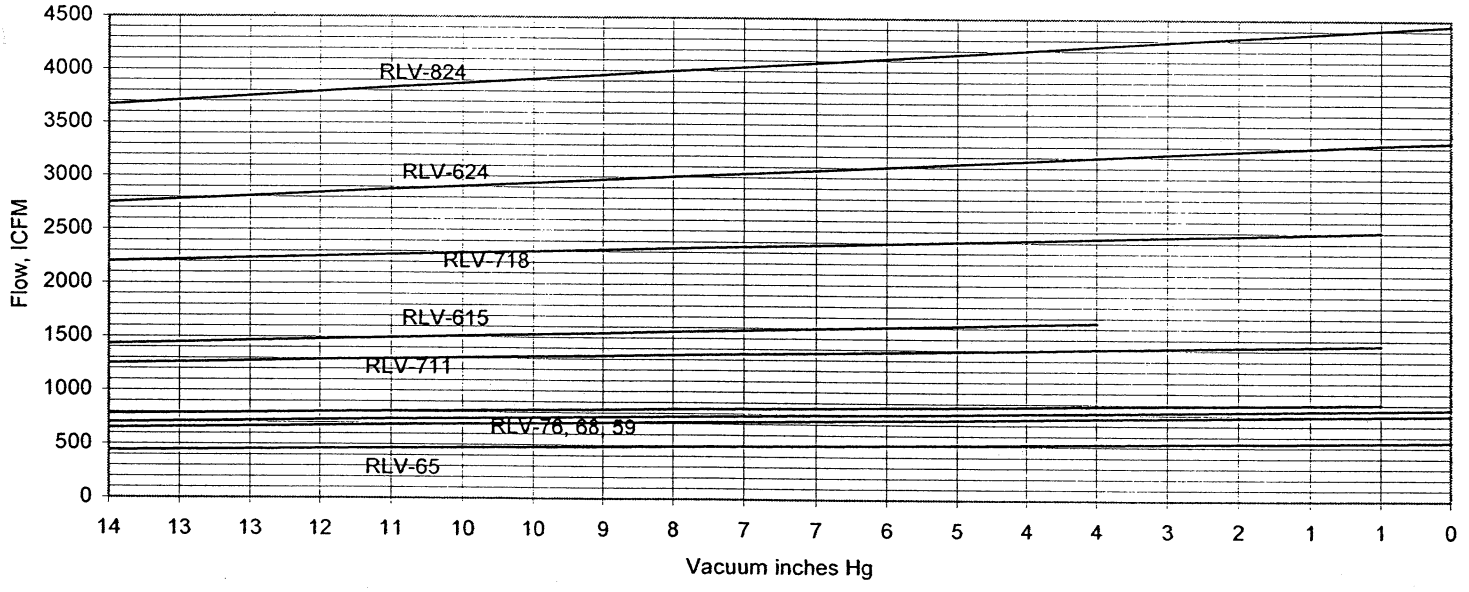


Model Number	Dim A In.	Dim B In.	Dim C In.	Dim D In.	Dim Width In.	Blower Inlet/Outlet connection In	Max. Motor HP	Available Voltage	Separator Holding Capacity gallons	Shipping Weight Lbs.	Max. Noise Level At 3 feet
RLV-22	54"	76"	38"	9"	24"	1" FPT	3	230 VAC 1 phase (5hp max) 230/460 VAC 3phase	40	720	88 dBA
RLV-24	54"	76"	38"	9"	24"	2" FPT	5	230 VAC 1 phase (5hp max) 230/460 VAC 3phase	40	740	87 dBA
RLV-32	54"	76"	38"	9"	24"	1.25" FPT	7.5	230 VAC 1 phase (5hp max) 230/460 VAC 3phase	40	840	91 dBA
RLV-33	54"	76"	38"	9"	24"	2" FPT	10	230 VAC 1 phase (5hp max) 230/460 VAC 3phase	40	870	90 dBA
RLV-36	54"	76"	38"	10"	30"	2.5" FPT	15	230/460 VAC 3phase	40	1,150	90 dBA
RLV-42	54"	76"	38"	9"	24"	1.5" FPT	10	230/460 VAC 3phase	40	900	93 dBA
RLV-45	54"	76"	38"	10"	30"	2.5" FPT	15	230/460 VAC 3phase	40	1,140	93 dBA
RLV-47	54"	100"	38"	11"	30"	3" FPT	20	230/460 VAC 3phase	40	1,400	92 dBA
RLV-53	54"	76"	38"	10"	30"	2.5" FPT	15	230/460 VAC 3phase	40	1,180	93 dBA
RLV-56	54"	100"	38"	12"	36"	4" FPT	25	230/460 VAC 3phase	40	1,660	93 dBA
RLV-59	54"	100"	38"	12"	36"	4" FPT	30	230/460 VAC 3phase	40	1,770	92 dBA
RLV-65	54"	100"	38"	11"	30"	3" FPT	25	230/460 VAC 3phase	40	1,610	92 dBA
RLV-68	54"	114"	38"	14"	36"	5" FPT	40	230/460 VAC 3phase	40	2,310	93 dBA
RLV-615	78"	134"	42"	16"	36"	6" 150 lb flange	50	230/460 VAC 3phase	75	3,100	91 dBA
RLV-76	54"	100"	42"	12"	36"	4" FPT	30	230/460 VAC 3phase	40	2,000	95 dBA
RLV-711	78"	134"	42"	16"	36"	6" 150 lb flange	60	230/460 VAC 3phase	75	3,320	95 dBA
RLV-718	78"	126"	42"	13"	40"	8" 150 lb flange	75	460 VAC 3phase	75	4,000	93 dBA
RLV-624	78"	142"	42"	16"	40"	10" 150 lb flange	125	460 VAC 3phase	110	4,300	93 dBA
RLV-824	78"	142"	42"	18"	40"	12" 150 lb flange	200	460 VAC 3phase	110	5,800	93 dBA

Blower Performance Curves at Maximum Performance Point
Vacuum at moisture separator inlet at 1000' elevation typical performance
with 12" wc backpressure



Blower Performance Curves at Maximum Performance Point
Vacuum at moisture separator inlet at 1000' elevation typical performance
with 12" wc backpressure



Installation

- Set the system in place using the properly sized lifting equipment. Anchor the system in place per the site specifications.
- Connect the influent and effluent piping to the system.
    - It is recommended to use a flex connector on both the influent and effluent piping connections. The piping connected to the system should be self-supporting.
    - The discharge piping of the blower will be hot. It is recommended to use steel piping on the discharge for a long enough run to allow the air to cool down.
    - A pressure relief valve can also be installed on the effluent piping to prevent the system from over-amping the motor.
- Connect the motor and controls to the control panel.

Start-Up Procedure

- Verify the system is properly secured to the floor.
- Verify that all influent and effluent connection have been made, and open all valves to ensure that there are no restrictions on the blower.

  Verify there is oil in the gear box of the blower.
- Verify the power leads are properly wired to the blower motor. **Incorrect voltage or improper wiring will ruin the motor.**
- Bump the blower to verify rotation. Verify proper rotation. There should be suction on the inlet and pressure on the discharge line. If rotation is backwards, have an electrician correct rotation. **Be sure to lock out and tag the main incoming power. Verify that there is not power at the motor with a multimeter.**
- The SVE system can now be run in normal operation. Start the blower in the auto mode and adjust valving according to the desired site conditions.
- It is best to record the initial readings of the system for trouble shooting purposes later.

Pressure at blower discharge_____ Vacuum at the well _____

Motor amp draw _____ Voltage _____

Pressure drop across the filter _____ System Inlet Temp _____

System exhaust temperature _____ System flow rate _____

Location of flow meter _____ Vacuum at the blower _____

Shut Down Procedure

- Turn off the blower
- Close all valves to the wells and open the air bleed valve.
- Allow the blower to run for 5 minutes "open" to atmosphere.
- If an extended period of down time is anticipated, mist the lobes of the blower with WD-40 to help prevent the lobes from rusting.

Maintenance Procedure

****The list below is a recommend system maintenance list. The individual manufacturers' O&M manuals must be followed in addition to the list below.**

Weekly	Clean/replace filter element	The differential pressure should not exceed 15" wc. Depending on the system operating conditions, this might have to be changed earlier or allowed to go for a longer period of time. The filter life will be site dependent.
	Record system operating conditions	A good record of operating conditions helps monitor the performance of the system and helps to trouble shoot when a problem occurs.
	First week	Change oil after first 100 hours, use the proper weight of oil based on the manufacturer's suggestion.
	Check Oil	Oil should be up to the bottom of the side plug.
	Grease bearings on blower	Based on time of operation (See Table 4 in the manufacturer's O&M)
	Listen for any unusual noises	
Monthly	Check any controls, switches or interlocks with the SVE system	Finding a faulty instrument can prevent problems if detected.
	Clean moisture separator	As needed, depending on water quality. Recommend initial inspection after first month.
	Change oil	Every 1000 hours.
Yearly	Grease motor with NLGI #2	

Trouble Shooting Procedure

Also see manufacturer's trouble shooting guide for more information.

Problem	Cause	Task
Blower will not run when the operator turns the switch on "hand" or "auto"	Circuit protection is tripped	Reset overload protection. Try restarting the blower. Since the overload tripped, there might still be a problem in the system. Try to determine what caused the overload to trip.
	Motor temperature switch is open	The motor might have an internal motor temperature switch. Check to see that it was wired. If not, it needs to be wired into the logic of the controls. If it was wired, the motor might have gotten too hot. Try restarting the blower and monitor it to see if it opens again. If it does, there is either a problem with the motor or the system causing the motor to overheat.
Blower will run in with the selector switch in "hand", but not "auto"	Alarm condition occurs, or a system enable is not active.	Verify what alarm is active or what system enable is not active. Even if the panel doesn't show there is an alarm, there might be a light bulb burnt out which would normally display the alarm condition.
Blower does not run at the desired air flow capacity	Filter is plugging	Clean or replace the filter element.
	Too much vacuum on the inlet	Verify the vacuum level is acceptable with the blower curve. A higher vacuum will decrease the blower air flow.
	Too much back pressure on the discharge	Decrease the backpressure. Verify nothing is obstructing the flow on the discharge. A higher back pressure on the blower will decrease the blower air flow.
	Vacuum relief valve is opening	Verify that the vacuum relief valve is set properly.
Blower seems to have vacuum on the pressure side.	Incorrect blower rotation	Verify and change rotation

Options

- Pressure relief valve
- Air bleed valve with filter/silencer
- Sound enclosure with urethane sound insulation to reduce sound level 10-15 dBA at 3'
- Centrifugal pump to pump off condensate
- Air cooled after cooler to cool exhaust for vapor GAC treatment
- Moisture separator heat trace or immersion heater for classified or non-classified electrical areas for freeze protection
- Moisture separator R-5 insulation with jacket, (steel or aluminum jacket)
- Pressure relief valve on blower discharge
- Clean out ports on moisture separator
- Flow, pressure, level & temperature gages or transmitters
- Custom control panel to control blower, pump and other equipment if required

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INSTALLATION OPERATION MAINTENANCE

BLOWERS EXHAUSTERS COMPRESSORS

ROOTS™

US $3.00, Canada $4.50

UNIVERSAL RAI® & RAM™ SERIES

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PARTS LIST 31

DO THESE THINGS TO GET THE MOST FROM YOUR ROOTS™ BLOWER

- ❑ Check shipment for damage. If found, file claim with carrier and notify ROOTS.
- ❑ Unpack shipment carefully, and check contents against Packing List. Notify ROOTS if a shortage appears.
- ❑ Store in a clean, dry location until ready for installation. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.
- ❑ Read OPERATING LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.
- ❑ Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.
- ❑ Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.
- ❑ Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.
- ❑ Read starting check points under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.
- ❑ In event of trouble during installation or operation, do not attempt repairs of ROOTS furnished equipment. Notify ROOTS, giving all nameplate information plus an outline of operating conditions and a description of the trouble. Unauthorized attempts at equipment repair may void ROOTS warranty.
- ❑ Units out of warranty may be repaired or adjusted by the owner. It is recommended that such work be limited to the operations described in this manual, using ROOTS™ parts. Good inspection and maintenance practices should reduce the need for repairs.

NOTE: Information in this manual is correct as of the date of publication. ROOTS reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

For your nearest ROOTS Office, dial our Customer Service Hot Line toll free; 1 877 363 ROOT(S) (7668) or direct 281-966-4700.

DRESSER

Roots

IRB-180-102

ROOTS™ products are sold subject to the current General terms of Sale, GTS-5001 and Warranty Policy WP-5020. Copies are available upon request.
Contact your local ROOTS Office or ROOTS Customer Service Hot Line 1.877.363.ROOT(S) (7668).

Safety Precautions

It is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should be particularly noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Protect external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream. **CAUTION: Never cover the blower inlet with your hand or other part of body.**
- Stay clear of open inlet piping (suction area) of pressure blowers, and the open discharge blast from vacuum blowers.
- Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- Casing pressure must not exceed 25 PSI (1725 mbar) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents without first consulting ROOTS.
- Do not use air blowers on explosive or hazardous gases.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be trained to exercise adequate general safety precautions.

Operating Limitations

A ROOTS™ blower or exhauster must be operated within certain approved limiting conditions to enable continued satisfactory performance. Warranty is contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in TABLE 1 for various models & sizes of blowers & exhausters. These limits apply to all units of normal construction, when operated under standard atmospheric conditions. Be sure to arrange connections or taps for thermometers and pressure or vacuum gauges at or near the inlet and discharge connections of the unit. These, along with a good tachometer, will enable periodic checks of operating conditions.

PRESSURE – The pressure rise, between inlet and discharge, must not exceed the figure listed for the specific unit frame size concerned. Also, in any system where the unit inlet is at a positive pressure above atmosphere a maximum case rating of 25 PSI gauge (1725 mbar) should not be exceeded without first consulting the ROOTS. Never should the maximum allowable differential pressure be exceeded.

On vacuum service, with the discharge to atmospheric pressure, the inlet suction or vacuum must not be greater than values listed for the specific frame size.

TEMPERATURE – Blower & exhauster frame sizes are approved only for installations where the following temperature limitations can be maintained in service:

- Measured temperature rise must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the unit. This is not outdoor temperature unless the unit is installed outdoors.
- If inlet temperature is higher than ambient, the listed allowable temperature rise values must be **reduced** by 2/3 of the difference between the actual measured inlet temperature and the ambient temperature.
- The average of the inlet and discharge temperature must not exceed 250°F. (121°C).

SPEED – These blowers & exhausters may be operated at speeds up to the maximum listed for the various frame sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be a limiting factor.

Special Note: The listed maximum allowable temperature rise for any particular blower & exhauster may occur well before its maximum pressure or vacuum rating is reached. This may occur at high altitude, low vacuum or at very low speed. The units' operating limit is always determined by the maximum rating reached first. It can be any one of the three: Pressure, Temperature or Speed.

INSTALLATION

ROOTS™ blowers & exhausters are treated after factory assembly to protect against normal atmospheric corrosion. The maximum period of internal protection is considered to be one year under average conditions, if shipping plugs & seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the unit until ready to start installation, as corrosion protection will be quickly lost due to evaporation.

If there is to be an extended period between installation and start up, the following steps should be taken to ensure corrosion protection.

- ❑ Coat internals of cylinder, gearbox and drive end bearing reservoir with Nox-Rust VCI-10 or equivalent. Repeat once a year or as conditions may require. Nox-Rust VCI-10 is petroleum soluble and does not have to be removed before lubricating. It may be obtained from Daubert Chemical Co., 2000 Spring Rd., Oak Brook, Ill. 60521.
- ❑ Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-110 or equivalent.
- ❑ Seal inlet, discharge, and vent openings. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Nox-Rust VCI-10 vapor will escape and lose its effectiveness.
- ❑ Protect units from excessive vibration during storage.
- ❑ Rotate shaft three or four revolutions every two weeks.
- ❑ Prior to start up, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and drive end bearing cover and inspect gear teeth and bearings for rust.

Because of the completely enclosed unit design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is preferred. However, an outdoor location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected operating temperatures, and that the unit be located so that routine checking and servicing can be performed conveniently. Proper care in locating driver and accessory equipment must also be considered.

Supervision of the installation by a ROOTS Service Engineer is not usually required for these units. Workmen with experience in installing light to medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance with safe practices. Unit mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

Bare-shaft Units: Two methods are used to handle a unit without base. One is to use lifting lugs bolted into the top of the unit headplates. Test them first for tightness and fractures by tapping with a hammer. In lifting, keep the direction of cable pull on these bolts as nearly vertical as possible. If lifting lugs are not available, lifting slings may be passed under the cylinder adjacent to the headplates. Either method prevents strain on the extended drive shaft.

Packaged Units: When the unit is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the unit casing or mounting feet, or on any mounted accessory equipment. **DO NOT** use the lifting lugs in the top of the unit headplates.

Before starting the installation, remove plugs, covers or seals from unit inlet and discharge connections and inspect the interior completely for foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with a petroleum solvent. Turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the connection flanges and drive shaft extension may also be removed at this time with the same solvent. Cover the flanges until ready to connect piping.

Mounting

Care will pay dividends when arranging the unit mounting. This is especially true when the unit is a "bare-shaft" unit furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces the least satisfactory results. It definitely causes the most problems in leveling and alignment and may result in a "Soft Foot" condition. Correct soft foot before operation to avoid unnecessary loading on the casing and bearings. Direct use of building structural framing members is not recommended.

For blowers without a base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided. The plate should be at

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least 1 inch (25 mm) thick, with its top surface machined flat, and large enough to provide leveling areas at one side and one end after the unit is mounted. It should have properly sized studs or tapped holes located to match the unit foot drilling. Proper use of a high quality machinist's level is necessary for adequate installation.

With the mounting plate in place and leveled, set the unit on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop rocking. Place half of this under each of the diagonally-opposite short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers turn freely. If the unit is to be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the unit shaft. Best unit arrangement is directly bolted to the mounting plate while the driver is on shims of at least 1/8 inch (3mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thickness.

Aligning

When unit and driver are factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. Satisfactory installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and partly inside the leveled and shimmed base is recommended.

It is possible for a base-mounted assembly to become twisted during shipment, thus disturbing the original alignment. For this reason, make the following checks after the base has been leveled and bolted down. Disconnect the drive and rotate the unit shaft by hand. It should turn freely at all points. Loosen the unit foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if unit is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections.

In planning the installation, and before setting the unit, consider how piping arrangements are dictated by the unit design and assembly. Drive shaft rotation must be established accordingly and is indicated by an arrow near the shaft.

Typical arrangement on vertical units has the drive shaft at the top with counterclockwise rotation and discharge to the left. Horizontal units are typically arranged with the drive shaft at the left with counterclockwise rotation and discharge down. See Figure 3 and 4 for other various unit arrangements and possible conversions.

When a unit is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the unit. Refer to Table 1 for allowable speeds of various unit sizes. A flexible type coupling should always be used to connect the driver and unit shafts.

Coupling halves must be accurately aligned, and a sufficient gap between shaft ends provided so that side strains and end thrust on either shaft are avoided or minimized. This will require considerable care in the mounting of the driver. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end-play exists.

The following requirements of a good installation are recommended. Coupling halves must be fitted to the two shafts with a line to line thru .001" interference fit. Coupling halves must be warmed up, so that only light tapping is required to install them. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around the coupling.

When a unit is BELT DRIVEN, the proper selection of sheave diameters will result in the required unit speed. This flexibility can lead to operating temperature problems caused by unit speed being too low. Make sure the drive speed selected is within the allowable range for the specific unit size, as specified under Table 1.

Belt drive arrangements usually employ two or more V-belts running in grooved sheaves. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the unit shaft. **The driver should be mounted on the inlet side of a vertical unit (horizontal piping) and on the side nearest to the shaft on a horizontal unit.** The driver must also be mounted on an adjustable base to permit installing, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

Install the unit sheave so that its inner hub face is not more than 1/8 inch (3mm) from the drive end cover. See page 18 for minimum sheave diameter and maximum sheave width. The shaft fit should be such that the sheave can be worked into place by hand or by very light tapping. A tight or driving fit can damage a bearing, and may cause internal unit damage by forcing the impeller out of its normal operating position. A loose fit or wobbly sheave will cause vibration, and may result in shaft breakage.

CAUTION: Couplings as well as sheave bushings must have a slight slide fit with the unit shaft such that they can be installed in place by hand. Any force used to install them could change unit end clearance resulting in unit damage. If interference fit is desired for the coupling, the coupling hub should be heated and shrunk on the shaft. For engine drives, use "locktite" between the coupling hubs and the shafts and on the threads of the coupling set screws.

The driver sheave should also be mounted as close to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that 2/3 of the total movement is available in the direction away from the unit, and mount the assembly so that the face of the sheave is accurately in line with the unit sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the unit is operating under load. Excessive tightening can lead to early bearing failures or shaft breakage.

Before operating the drive under power to check initial belt tension, first remove covers from the unit connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a coarse screen over the inlet connection to prevent anything being drawn into the unit while it is operating, and avoid standing in line with the discharge opening. Put oil in the sumps per instructions under **LUBRICATION.**

Piping

Before connecting piping, remove any remaining anti-rust compound from Unit connections. Clean pipe should be no smaller than unit connections. In addition, make sure it is free of scale, cuttings, weld beads, or foreign material of any kind. To further guard against damage to the unit, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours of operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the unit may cause serious damage.

Pipe flanges or male threads must meet the unit connections accurately and squarely. DO NOT attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the unit casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the unit to eliminate dead weight strains. Also, if pipe expansion is likely to occur from temperature change, installation of flexible connectors or expansion joints is advisable.

Figure 2 represents an installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or other restrictions. When a shut-off valve can not be avoided, make sure a full size vacuum relief is installed nearest the unit inlet. This will protect against unit overload caused by accidental closing of the shut-off valve.

Need for an inlet silencer will depend on unit speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is recommended, especially in dusty or sandy locations. A discharge silencer is also normally suggested, even though Whispair units operate at generally lower noise levels than conventional rotary blowers. Specific recommendations on silencing can be obtained from ROOTS.

Discharge piping requires a pressure relief valve, and should include a manual unloading valve to permit starting the unit under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are recommended to allow making the important checks on unit operating conditions. The back-pressure regulator shown in Figure 2 is useful mainly when volume demands vary while the unit operates at constant output. If demand is constant, but somewhat lower than the unit output, excess may be blown off through the manual unloading valve.

In multiple unit installations where two or more units operate with a common header, use of check valves is mandatory. These should be of a direct acting or free swinging type, with one valve located in each line between the unit and header. Properly installed, they will protect against damage from reverse rotation caused by air and material back-flow through an idle unit.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment.

DO NOT operate the unit at this time unless it has been lubricated per instructions.

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LUBRICATION

LUBRICATION: For Units with a Grease Lubricated Drive End

A simple but very effective lubrication system is employed on the drive shaft end bearings. Hydraulic pressure relief fittings are provided to vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure but permit venting excess lubricant under steadily rising pressures.

When servicing drive end bearings, use a NLGI #2 premium grade grease with 300°F (149°C) service temperature and moisture resistance and good mechanical stability. Using a pressure gun, slowly force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting.

After a long shutdown, it is recommended that the grease fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled. Grease should be added using a hand operated grease gun to the drive end bearings at varying time intervals depending on duty cycle and RPM. Table 4 has been prepared as a general greasing schedule guide based on average operating conditions. More frequent intervals may be necessary depending on the grease operating temperature and unusual circumstances. ROOTS™ synthetic grease (ROOTS P/N T20019-) is highly recommended.

LUBRICATION: For Units with Splash Lubrication on Both Ends

Bearings and oil seals are lubricated by the action of the timing gears or oil slingers which dip into the main oil sumps causing oil to splash directly on gears and into bearings and seals. A drain port is provided below each bearing to prevent an excessive amount of oil in the bearings. Seals located inboard of the bearings in each headplate effectively retain oil within the sumps. Any small leakage that may occur should the seals wear passes into a cavity in each vented headplate and is drained downward.

Oil sumps on each end of the blower are filled by removing top vent plugs, Item (21), and filling until oil reaches the middle of the oil level sight gauge, Item (37), or the overflow plug.

Initial filling of the sumps should be accomplished with the blower not operating, in order to obtain the correct oil level. Approximate oil quantities required for blowers of the various models and configurations are listed in Table 3. Use a good grade of industrial type non-detergent, rust inhibiting, anti-foaming oil and of correct viscosity per Table 2. ROOTS™ synthetic oil (ROOTS P/N 813-106-) is highly recommended.

The oil level should not fall below the middle of the site gauge when the blower is idle. It may rise on the gauge during operation, to an extent depending somewhat on oil temperature and blower speed.

Proper lubrication is usually the most important single consideration in obtaining maximum service life and satisfactory operation from the unit. Unless operating conditions are quite severe, a weekly check of oil level and necessary addition of lubricant should be sufficient. During the first week of operation, check the oil levels in the oil sumps about once a day, and watch for leaks. Replenish as necessary. Thereafter, an occasional check should be sufficient. It is recommended that the oil be changed after initial 100 hours of operation. Frequent oil changing is not necessary unless the blower is operated in a very dusty location. Normal life expectancy of petroleum based oils is about 2000 hours with an oil temperature of about 200°F (93°C). As the oil temperature increases by increments of 15-18°F (8°C - 10°C), the life is reduced by half. Example: Oil temperatures of 230-236°F (110°C - 113°C) will produce life expectancy of 1/4 or 500 hours. Therefore, it is considered normal to have oil change periods of 500 hours with petroleum based oils.

OPERATION

Before operating a blower under power for the first time, recheck the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure check list as a guide, but consider any other special conditions in the installation.

- ❑ Be certain that no bolts, tools, rags, or debris have been left in the blower air chamber or piping.
- ❑ If an outdoor intake without filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen as described under INSTALLATION is strongly recommended.
- ❑ Recheck blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
- ❑ Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- ❑ Make sure oil levels in the main oil sumps are correct.
- ❑ Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
- ❑ Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, be sure it is open.
- ❑ Bump blower a few revolutions with driver to check that direction of rotation agrees with arrow near blower shaft, and that both coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under "no-load" conditions. The following procedure is suggested to cover this initial operation test period.

a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.

b. Repeat above, but let blower run 2 or 3 minutes. Check for noises, such as knocking sounds.

c. Operate blower for about 10 minutes unloaded. Check oil levels. Observe cylinder and headplate surfaces for development of hot spots such as burned paint, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is restarted, gradually close the discharge unloading valve to apply working pressure. At this point it is recommended that a good pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in this manual, shut down and investigate conditions in the piping system. Refer to the **TROUBLESHOOTING CHECKLIST** for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full load. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under **INSTALLATION**. At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a small excess may be blown off continuously through the manual unloading or vent valve. Never rely on the pressure relief valve as an automatic vent. Such use may cause the discharge pressure to become excessive, and can also result in failure of the valve itself. If blower capacity appears to be too low, refer to the **TROUBLESHOOTING CHECKLIST**.

Vibration Assessment Criteria

With measurements taken at the bearing locations on the housings, see chart below for an appropriate assessment guide for rotary lobe blowers rigidly mounted on stiff foundations.

In general, blower vibration levels should be monitored on a regular basis and the vibration trend observed for progressive or sudden change in level. If such a change occurs, the cause should be determined through spectral analysis.

As shown on the chart below, the level of all pass vibration will determine the need to measure discrete frequency vibration levels and the action required.

All Pass Vibration (in/sec)	Discrete Frequency Vibration (in/sec)	Action
0.45 or less	N/R	Approved
Greater than 0.45 but 1.0 or less	0.45 or less @ any frequency	Approved
	Greater than 0.45 @ any frequency	ROOTS™ Approval Required
Greater than 1.0	Less than 1.0	ROOTS™ Approval Required
	Greater than 1.0	ROOTS™ Approval Required

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OPERATING CHARACTERISTICS

ROOTS™ rotary blowers and exhausters, as covered in this manual, are available in basic frame sizes ranging from 2 inch to 7 inch gear diameter. Various models, within this gear diameter range, are available with different case lengths to produce reasonable steps in flow capacity. The shorter case lengths have lower volumetric capacities, but are capable of operating against higher pressures. All models are available for air service and there are specifically designed models for gas service.

The basic ROOTS™ rotary lobe blower is a positive displacement type unit. Flow capacity is determined by frame size, operating speed and pressure conditions. It employs two impellers mounted on parallel shafts rotating in opposite directions within a cylinder closed at the ends by head-plates. As the impellers rotate, gas is drawn into one side of the cylinder and forced out the opposite side. The pressure or vacuum developed depends on the resistance of the piping and process system.

The unit is a precision engineered product with very fine clearances between the rotating impellers and stationary case. Since there is no actual contact between these surfaces, internal lubrication is not required. Clearances are maintained by a pair of accurately machined timing gears, mounted on the two shafts extended outside the blower casing.

Operation of the familiar basic rotary lobe blower is illustrated in FIGURE 1, where air flow is left to right from inlet to discharge with the top impeller rotating clockwise. In Position 1 it is delivering a known volume (B) to the discharge, while space (A) between the lower impeller and cylinder wall is being filled. Counterclockwise rotation of this impeller then traps equal volume (A) in Position 2, and further rotation delivers it to the discharge in Position 3.

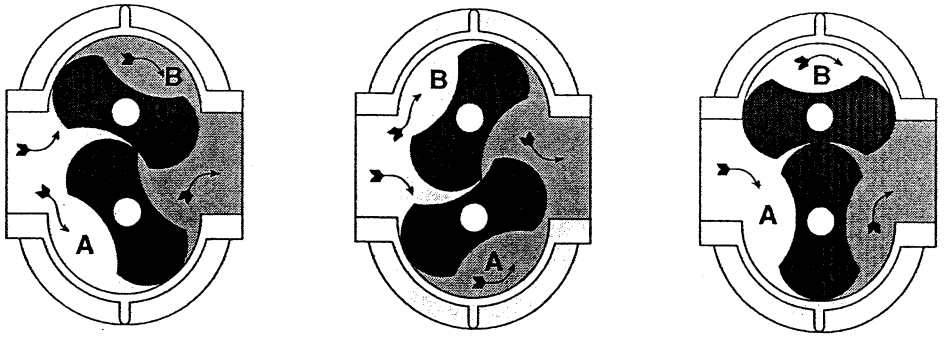
One complete revolution of the driving shaft alternately traps four fixed and equal volumes of air (two by each impeller) and pushes them through to the discharge. The volume capacity of a lobe blower operating at a constant speed therefore remains relatively independent of reasonable inlet of discharge pressure variations. To change capacity, it is necessary either to change speed of rotation or blow off some of the discharge air.

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This will not only increase the power load on the driver, but can also overload and seriously damage the blower. If a possibility does exist that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is required for protection against cut-off or blocking in this line. Refer to FIGURE 3 for a complete piping schematic.

When a belt drive is installed, blower speed can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves. In a direct coupled arrangement a variable speed motor or transmission is required, or excess air may be blown off through a manually controlled unloading valve and silencer. If returned to the blower inlet, the air must be cooled to 100°F (38°C) through a by-pass arrangement to maintain acceptable blower temperatures.

Before making any change in blower capacity, or operating conditions, contact ROOTS for specific information applying to your particular blower. In all cases, operating conditions must be maintained within the approved range of pressures, temperatures and speeds as stated under **LIMITATIONS.** The air blower must not be used to handle liquids or solids as serious damage to the rotating parts may result.

FIGURE 1 – FLOW THROUGH A BASIC ROTARY LOBE BLOWER



POSITION 1 **POSITION 2** **POSITION 3**

TROUBLESHOOTING

Trouble	Item	Possible Cause	Remedy
No flow	1	Speed too low	Check by tachometer and compare with published performance
	2	Wrong rotation	Compare actual rotation with Figure 1 or 2 Change driver if wrong
	3	Obstruction in piping	Check piping, valves, silencer to assure open flow path
Low capacity	4	Speed too low	See item 1, If belt drive, check for slippage and readjust tension
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure and compare with Published performance
	6	Obstruction in piping	See item 3
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances
Excessive power	8	Speed too high	Check speed and compare with published performance
	9	Excessive pressure rise	See Item 5
	10	Impeller rubbing	Inspect outside of cylinder for high temperature areas, then check for impeller contact at these points. Correct blower mounting, drive alignment
	11	Scale, sludge, rust or product build up	Clean blower appropriately
Overheating of bearing or gears	12	Inadequate lubrication	Check oil sump levels in gear and drive end headplates
	13	Excessive lubrication	Check oil levels. If correct, drain and refill with clean oil of recommended grade
	14	Excessive pressure rise	See Item 5
	15	Coupling misalignment	Check carefully. Realign if questionable
	16	Excessive belt tension	Readjust for correct tension
Vibration	17	Misalignment	See Item 15
	18	Impellers rubbing	See Item 10
	19	Worn bearings/gears	Check gear backlash and condition of bearings, and replace as indicated
	20	Unbalanced or rubbing impeller	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance
	21	Driver or blower loose	Tighten mounting bolts securely
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping
	23	Scale/sludge build-ups	Clean out interior of impeller lobes to restore dynamic balance
	24	Casing strain	re-work piping alignment to remove excess strain
Driver stops, or will not start	25	Impeller stuck	Check for excessive hot spot on headplate or cylinder. See item 10. Look for defective shaft bearing and/or gear teeth
	26	Scale, sludge, rust or product build-up	Clean blower appropriately
Excessive breather	27	Broken seal	Replace seals
Blow-by or excessive oil leakage to vent area	28	Defective O-ring	Replace seals and O-ring

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MAINTENANCE & REPLACEMENTS: UNIVERSAL RAI® SERIES BLOWERS

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention thereafter may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION**.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected to surprising degree by shaft finish under the seal lip. Because of these normal variables, minor seal leakage should not be considered as indicating seal replacement.

Timing gear wear, when correct lubrication is maintained, should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance , backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interference or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely Foreign materials in the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to ROOTS.

Warranty failures should not be repaired at all, unless specific approval has been obtained through ROOTS before starting work. Unauthorized disassembly within the warranty period will void the warranty.

It is recommended that major repairs be performed at an authorized ROOTS facility. However, it is recognized that this may not always be practical. If a blower is out of warranty, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that ROOTS™ parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give item numbers and their word descriptions from the appropriate sectional drawings. Also specify quantities required and the blower model and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care, patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that high percentages of bearing failures are caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following repair procedures, numbers shown in brackets ( ) correspond to the item numbers used in sectional drawings. It is recommended that the procedures be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

Requirements for special tools will depend on the work to be done. If impeller clearances and float are to be checked or re-set, a dial indicator and a set of long feeler gauges will be needed. Work involving removal of the timing gears cannot be accomplished without a suitable puller.

Design of ROOTS™ blower is simple, and most repair operations are straightforward. For this reason, the following procedures are intended mainly to indicate a preferred work order and to call out points to be observed. Where special operations are required, detailed coverage is given.

A – Replacing Timing Gears

1. Drain all oil from the gearhouse by removing drain plug (21) in the bottom. Remove gearhouse by taking out all cap screws (23) in its flange. It may be necessary to bump the sides with a wood block or mallet to break the flange joint.
2. Reach through one of the blower pipe connections and place a chalk mark on the strip of one impeller and the mating waist of the other, so that they may easily be returned to their original relative positions.
3. **GEAR REMOVAL:** CAUTION: Do not remove gear nuts (17) completely before the gears are unseated from the taper fits or damage/injury may result. For this operation, the impellers should be wedged, as shown in Table 5. Back off gear clamping nuts (17) about 1/4". Use a suitable puller or wedge. As the puller set screw is torqued, the puller will have a tendency to turn and contact teeth of the other gear. To prevent this contact, hold the puller corner nut with a wrench while torquing the set screw. Once the gear is unseated, remove the puller. Remove gear nuts (17) and the gear.
4. **GEAR INSTALLATION:** Place impellers in correct position as previously marked. Be sure shafts and gear bores are clean, oil free and free of scratches. Clean the shaft tapered fits. Place hardwood wedges as shown in Table 5. Install drive gear (4) and gear nut (17). Tighten the drive gear nut to the torque given below. Blower assembly must be fastened down for torquing operation.
5. Installing driven gear (4) – Insert a long, metal feeler gauge between the impellers' lobes at the fronts or backs as shown below. Feeler gauge thickness to be a middle value from Table 5 for fronts and backs. Install nut (17). Tighten lightly with a small wrench, then check front and back clearances against Table 5 for each 45° position. Both fronts and backs should be about the same and within the specified range in Table 5. Adjust gear position, if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified in below. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts. **CAUTION!** *Keep fingers away from impellers and gears.*

UNIVERAL RAI® SERIES BLOWER GEAR NUT TORQUE

Frame Size	Torque	
	lb.-ft.	(kg-m)
22, 24,	60	(8.3)
32, 33, 36	110	(15.2)
42, 45, 47	190	(26.3)
53, 56, 59	250	(34.6)
65, 68, 615	400	(55.3)
76, 711, 718	550	(76.1)

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6. Check the end clearances between impellers and headplates. Adjust clearances per B-15 below.
7. When clearances are correct, clean and re-install the gearhouse. Check condition of flange gasket (7) and replace if questionable. Fill gearhouse to correct level with proper grade oil.

B – Replacing Shaft Bearings and Impellers

Remove coupling or sheave from the drive shaft. Drain and remove gearhouse, and pull the timing gears. If gears are to be re-used, mark them so they may be returned to the same shafts.

1. Break corners and deburr the keyway. Remove bearing end cover at the drive end. Remove bearing clamp plates (34).
2. Make single and double identifying punch marks on the mating edges of headplate and cylinder flanges at the two ends of the blower.
3. At the drive end, drive out the two dowel pins and remove all capscrews holding headplate to cylinder. By inserting jacking screws into the two threaded flange holed, and turning them in evenly, the headplate will be separated from the cylinder. As the headplate comes off the shafts it will bring bearings with it. 2-1/2" and 3-1/2" gear diameter units do not have tapped holes for jack screws in the drive end headplates. Remove dowel pins and all capscrews holding headplate to cylinder and foot on the drive end. Support unit under gear end cylinder flange with the shafts vertical. Using soft metal block against gear end shafts, push them out of gear end headplate.
4. For 2-1/2" and 3-1/2" gear diameter units, support the drive end headplate on the underside, and using soft metal block against drive end shafts, push them out of drive end headplate.

   For 4", 6" & 7" gear diameter units, from the gear end, using a wood or soft metal block against the ends of the shafts, drive them out of the head plate. If they are to be reused, protect them from damage in this operation.
5. If blower interior surfaces need cleaning, it may be advisable to separate the gear end headplate from the cylinder. Use the same general procedure as employed at the drive end.
6. Working from the back (flat) face of each head plate, push or tap out the bearings and seals. Use a round bar or tube that will pass through the shaft clearance holes in the headplates. All lip seals will be damaged during removal and must be replaced.
7. Clean bearing and seal pockets in headplates and remove burrs or rough edges. (Apply a thin coating of sealant on seal O.D.) Press new seals (27) into gear end headplate using a round tube or bar with recessed end that will bear on the outer metal edge of seal enclosure. Seal lip should point toward the driving tool. Seals to be flush without board bore face. Apply a light coat of oil or grease to the seal lips. In a similar fashion, install lip seals into the drive end headplate.
8. Place cylinder on a flat surface. Assemble gear end headplate to cylinder after checking flange punch marks. Drive in the two locating dowel pins before tightening flange screws. Also install gear end foot using the same longer cap screws (32) and washers (41). (On 6" & 7" UNIVERSAL RAI® blower install both gear end feet.)
9. Place the assembly horizontally on steel blocks with gear end headplate on bottom. The height of the blocks should be sufficient to clear gear end shaft extensions. Assemble impellers into the cylinder with the drive shaft (longer shaft) in same location as in original assembly. Before starting the shafts through the headplate holes, make sure shaft ends have no sharp or rough edges to damage seal lips. Position impellers at 90° to each other in the cylinder, using lobe-and-waist match marks if original impellers are being re-installed. Install drive end headplate and feet in same manner as gear end.
10. It is recommended that new bearings be used for rebuild. Apply thin film of machine oil on the shaft bearing fit, bearing I.D., and headplate bearing bore. Install drive end bearings into headplate. Use a tube with flanged end that will contact both bearing faces simultaneously. Refer to Assembly Drawing for proper bearing depths.
    NOTE: *Cylindrical drive bearing should be installed with inner race large shoulder facing outboard.*
11. Place blower on its feet on a flat surface. Loosen feet capscrews (32) and square up unit. Re-tighten capscrews (32). Clamp unit down to a solid base for further assembly.
12. Oil the gear end bearing fits as described previously. Install 2-1/2" thru 5" blower gear end bearings flush with the headplate bearing shoulders using proper drivers. On 6" & 7" gear diameter units, install thrust washer (29) in bearing bores then install gear end bearings so they protrude 1/16" (1.6mm) above headplate surface.
13. Install bearing clamp plates (34). On 6" & 7" gear diameter units, blower impeller end clearances are also to be set during this step. Install clamp plates (34) with capscrews (31) making sure that the gap between the clamp plates and the headplate is even all around. At the same time, set end clearances per Table 5.
14. Install gears and time impellers as in (A).

15. For setting end clearances on 2-1/2" thru 5" gear diameter units, special tools, thrust adjuster fork and thrust adjuster saddle are required. Refer to Table 5 for installation of tools. The flat side of the saddle rests against the bearing inner race and the flat side of the fork rests against the back side of the gear. Install a shim, with thickness equal to gear end clearance (Table 5), between the impeller and the gear end headplates. Tap on top of the fork until the shim becomes snug. Remove the shim and check end clearances. To increase gear end clearance, tap on the end of the gear end shaft with a soft metal mallet. Set end clearances for 6" & 7" by turning capscrews (31) evenly in or out.

16. Install drive end cover (5) after packing bearing cavities with suitable grease. Replace drive shaft seal. Lip must point toward (33) the bearing. Exercise care not to damage the lip as it passes over shaft keyway.

17. Install gasket item (7). Install the gear house after cleaning out the inside. Tighten gear box cap screws (23) evenly. Fill with correct grade of oil until oil flows out through oil level hole. Grease drive and bearings. (See Lubrication.)

18. Reinstall coupling or belt sheave making sure that they have a slight slide fit with the shaft and could be installed by hand.

TECHNICAL SUPPLEMENT

for 32, 33, 36, 42, 45, 47, 53, 56, 59, 65, 68, 615 UNIVERAL RAI®-G BLOWERS

ROOTS™ Universal RAI™-G rotary positive gas blowers are a design extension of the basic Universal RAI™ blower model. URAI™-G blower uses (4) mechanical seals in place of the standard in board lip seals to minimize gas leakage into the atmosphere. The seal vent chambers are plugged. These units are intended for gases which are compatible with cast iron case material, steel shafts, 300/400 series stainless steel and carbon seal components, viton o-rings and the oil/grease lubricants. If there are any questions regarding application or operation of this gas blower, please contact factory.

Precaution: ***URAI™-G blowers: Care must be used when opening the head plate seal vent chamber plugs (43) as some gas will escape–if it is a pressure system, or the atmospheric air will leak in-if the system is under vacuum. There is a possibility of some gas leakage through the mechanical seals. This leakage on the gear end will escape through the gear box vent, and on the drive end, through the grease release fittings. If the gas leakage is undesirable, each seal chamber must be purged with an inert gas through one purge gas hole (43) per seal . There are two plugged purge gas holes(1/8 NPT) provided per seal. The purge gas pressure must be maintained one psi above the discharge gas pressure. Also, there exists a possibility of gear end oil and drive end grease leakage into the gas stream.***

The lubricants selected must be compatible with the gas. Mechanical Seal Replacement: Disassemble the blower. During disassembly, damage to mechanical seals is very likely. During rebuild, always use new mechanical seals. Prior to any assembly, make sure that all parts are completely clean and free from nicks and scratches.

(1) Place head plate on an assembly table with seal bores pointing up. Coat the OD of the stationary seal element and install it with carbon facing up in the seal bore with a seal driver that is guided by the bearing bore. Drive the seal flush with front face of the seal bore. Repeat this procedure for all four seals. Apply a light coating of lubricating oil on the sealing surface. Protect sealing faces during assembly from any damage.

(2) Apply teflon based sealant on the cylinder flanges before installing head plates. Continue the assembly procedure as outlined up to bearing installation. Before installation of the bearings, the seal mating rings need to be installed. Apply light film of lubricating oil on mating ring o-rings and sealing faces. Slide mating rings on the shaft and up to carbon faces making sure that no damage to the o-rings occur during installation (break sharp shaft corners to avoid damage to the o-rings during initial preparation). Install bearings all the way against the back bearing bore shoulders.

(3) Complete the rest of the assembly.Make sure all plugged holes are sealed with teflon thread liquid sealant.

Note: On 6" gear diameter units, shims (44) are used between the bearing clamp plates and the head plate on the gear end.

Also, on size 32 and 42, washers with embedded o-rings are used on the center head plate to cylinder bolts.

After the assembly is completed, plug the blower inlet and discharge connections and run static soap bubble. Leak test to assure leak free assembly.

For satisfactory operation of mechanical seals, synthetic lubricants are recommended (Check suitability to gases before using.)

Oils:

(1) ROOTS™ GT Synthetic Lubricant ROOTS P/N 13-106-001 (1) one quart ISO-220

(2) Mobil SHC 600 Series Lubricating Oils

Grease:

ROOTS™ Synthetic Grease – NLGI # 2
ROOTS P/N T20-019-001 (1) one 14 oz tube

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MAINTENANCE & REPLACEMENTS: RAM™ SERIES BLOWERS

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention thereafter may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION**.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration and wear, and may require replacement at varying periods.

Piston ring seals (28) are designed to operate without rubbing contact, once temperature and thermal growth have stabilized. The stationary rings will rub the rotating sleeve (38) briefly as a result of temperature cycles that occur during the startup and shutdown of the unit. The sleeves are hardened and the rings are coated with dry lubricant that provides for temporary break in wear. Replace piston ring seals if they become excessively worn or inspection shows more than .010" (.25mm) axial clearance between ring and groove.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected to surprising degree by shaft finish under the seal lip. Because of these normal variables, minor seal leakage should not be considered as indicating seal replacement.

Timing gear wear, when correct lubrication is maintained, should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance , backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interferences or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely Foreign materials sucked into the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to ROOTS.

Warranty failures should not be repaired at all, unless specific approval has been obtained through a Sales Office or the factory before starting work. Unauthorized disassembly within the warranty period will void the warranty.

It is recommended that major repairs be performed at an authorized ROOTS facility. However, it is recognized that this may not always be practical. If a blower is out of warranty, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that ROOTS™ parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give Item numbers and their word descriptions from sectional drawings and parts lists. Also specify quantities wanted and the blower size and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care, patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that high percentages of bearing failures are caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following repair procedures, numbers shown in brackets ( ) correspond to the Item numbers used in assembly drawings, and parts lists. It is recommended that the procedures be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

Requirements for special tools will depend on the work to be done. If impeller clearances and float are to be checked or re-set, a dial indicator and a set of long feeler gauges will be needed. Work involving removal of the timing gears cannot be accomplished without a puller suitable. Heat must be used during bearing and sleeve installation.

Design of ROOTS™ blower is simple, and most repair operations are straightforward. For this reason, the following procedures are intended mainly to indicate a preferred work order and to call out points to be observed. Where special operations are required, detailed coverage is given.

DISASSEMBLY OF DRIVE END

1. Remove the sheave or coupling and key from the drive shaft. File off any burrs or sharp edges along the keyway.
2. Drain oil by removing drain plug (22).
3. Remove the flange screws (75). Tap the drive end cover to loosen it, then slide it along the shaft care fully to avoid damaging the lip seal (33) on the drive shaft keyway. Remove the gasket (7). Remove oil slinger (40) and cap screw (60).
4. Remove bearing clamp plates (34) by unscrewing capscrews (32) and removing lock washers (35). Keep shim halves (10) together exactly as removed by tagging them with each clamping plate.
5. Remove the headplate – remove all capscrews (23) holding headplate to the cylinder. Insert jacking screws into the four threaded flange holes and turn them in evenly. The headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.
6. Remove the bearing inner race and sleeve (38) from the shaft with aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.

DISASSEMBLY OF GEAR END

1. Drain oil completely from the gearbox sump by removing plugs (22) in bottom of the headplate (1).
2. Loosen all flange screws (75) in the gearbox and remove all but two upper screws. Bump the gear box to break the joint if it cannot be pulled free by hand, then remove the last two screws and lift off the gearbox. Remove gasket (7).
3. Removing gears: CAUTION: Do not remove gear nuts (31) completely before the gears are unseated from the taper fits or damage/injury may result. Be sure that each gear is marked for return to the same shaft in the same angular position and that the gears have match marks for the teeth. For this operation, the impellers should be wedged as shown in Figure 8. Back off nuts (31) and slinger (46). The timing gears (4) have two 1/2" – 13 holes for pulling purposes. Use a suitable puller.
4. Remove bearing clamp plates (54) by unscrewing capscrews (32) and removing lock washers. Group the shims (10), the wavy spring washers (29) with each clamp plate and tag for ease of reassembly.
5. Remove the headplate – remove all capscrews 23) holding the headplate to the cylinder. Insert jacking screws into the four (4) threaded flange holes and turn them in evenly. They headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.

   For RAM™-J WHISPAIR™ gas pump units:
   The gear end headplate which is removed next requires a different approach from the drive end. On this end, the shafts are forced from the bearing bore by using a bar across the end of the shaft with threaded rods to the headplate. Once the headplates are removed from the assembly, the seal housings can be pressed or driven from

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the headplate bores. Generally, new seals will be required prior to reassembly.

6. Remove the bearing inner race and sleeve (38) from the shaft with the aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.

ASSEMBLY

Prior to any assembly operation, it is essential that all parts are completely clean and free from nicks and scratches.

Prior to assembly, lightly coat the groove in the sleave with slip plate. ROOTS P/N813-314-000.

1. Assembly of Piston ring seals (28) – To avoid scratching the lip seal surface, install the Piston ring seals (28) in the sleeves (38) from the end nearest the groove before assembling the sleeve on the shaft.

   Unhook the gap joint and expand the ring while sliding it to the groove, then compress it so one end of the hook joint slides over the other. Move the ring in the groove to be sure it is free.

   NOTE: *Care must be taken not to scratch or dent the sleeve surface since it is the sealing surface for the lip seal.*

2. Installation of sleeves (38) – heat the sleeve to 300° F. (149°C) then quickly slide it on the shaft tightly against the impeller. If the sleeve hangs up during assembly, it can be pressed into place using a tubular pressing tool with square, clean ends.

3. Assembly of seals (27) in headplate (1) – Place headplate flat with seal bores up. Be sure the pressing tool face is clean and square and there is a smooth, clean entering bevel in the headplate. Lubricate the seal lips. Place seal over the bore with lip facing up, then press the seal evenly until it is flush with bore face.

   For Gas Sealed Units: Assemble mechanical seals (27) in headplate – (**CAUTION:** *Care must be used to avoid damaging the carbon face. Before proceeding with this step, you should have a piloted seal driver which is designed to clear the carbon face.*) with headplate positioned horizontally with seal bores up. Be sure the pressing tool face is clean and square and there is a smooth, clean entering bevel in the headplate. Place the seal over the bore with carbon facing up. Then press the seal evenly on its steel shell using the piloted seal driver until the driver seats against the stop.

4. Assembly of impellers (12 and 13) to headplate (1) – Place gear end headplate flat on 3 in. (76 mm) blocks with the smallest bores facing up. Inspect entering bevels to be sure they are smooth and clean. Locate the drive impeller correctly (top for vertical units and toward the driver for horizontal units). Place the seal ring gaps toward the inlet for pressure applications and towards dis charge for vacuum applications. Insert the impeller shafts in the headplate so the impellers rest on the headplate. Use care to avoid damaging the lip seals.

5. Assembly of cylinder (11) to gear end headplate (1) – Install dowel pins (16) and secure cylinder to headplate with capscrews (23). Torque to 35 ft.-lbs (4.5 Kg-m). Then, install drive end headplate (1) and dowel pins (16) and secure with capscrews (23). Install feet (76) & 77) to both headplates and secure with capscrews (66). Torque to 35 ft.-lbs. (4.5 kg-m).

   For Gas Sealed Units: Use a Teflon sealant between headplate and cylinder joint. Assemble rotating seal – apply a light coating of oil to the O-ring and seal face. Then with flute side out install the rotating seat tight to the shaft sleeve. Check and record seal compression – With the seal body in place and the impeller against the opposite headplate, check that seal compression is adequate. This can be checked using a depth gauge or dial indicator from the face of the head plate to the face of the mating ring. First, measure this distance while the carbon is out at its full length. Then, push the mating ring back against its stop and measure it again. The difference between these measurements is the compression. This can be done easily with finger pressure as the spring force is only 10 lbs. The correct travel is given below (record actual compression on clearance sheets).

SEAL COMPRESSION

Frame	Minimum	Maximum
400	.047"	.097"
600	.108"	.151"

* Prior to to assembly, lightly coat the groove in the sleave(38) with slip plate. ROOTS™ P/N 813-314-000

6. Installation of bearings (14) – Heat bearing inner race to 300°F (149°C) in an oven or hot oil; then slide it onto the shaft so the bearing shoulder is snugly against the sleeve. Note: Be sure to install the shaft shim (70) behind the shaft sleeve before installing the drive end drive bearing inner race. This is required to compensate for the oil leader for shimming. Insert the bearing outer race and rollers in each bore and tap lightly in place. Spray bearings with lubricant.

7. Measure and record the end clearances between the impellers and drive headplate using long feeler gauges. Then, subtract the allowed average drive end clearance. See Table 6. The result is the space required between clamping plates (34) and bearing outer race. Place shims (10) as required to get this clearance. Then, fasten the clamping

plates to the headplate with capscrews (32) and lock washers (35).

8. Installation of gear end bearings (14) – Turn the blower so that the gear end headplates is up. Heat bearing inner race to 300°F (149°C) in an oven or hot oil; then slide it onto the shaft so that the bearing shoulder is snugly against the sleeve. Insert the bearing outer race and rollers in each bore and tap lightly into place.

9. Measure and record the end clearance between the impellers and gear end headplate, then subtract the allowed average gear end clearance. See Table 6. The result is the space required between clamping plate (54) and bearing outer race. Place shims (10) as required to get this clearance. Then fasten the clamping plates (54) to the headplate using capscrews (32) and lock washers (35). Do not install wavy-spring washers (29) at this time, as a final check of clearances is required first.

10. Final check of end clearances and float – Using long feeler gauges, check the clearance between the impellers and drive end headplate. See Table 6. Place the blower assembly on its feet and correct shimming as required. Then, force the impellers as close to the gear end headplate as possible, and check the clearance between impellers and gear end headplate for agreement with Table 6. Adjust shimming on the gear end as required. With unit securely fastened down, use a dial indicator to measure the impeller float. Again push the impeller to one end of the cylinder. With indicator firmly mounted, place contact point on the end of the shaft just pushed and set dial on zero. Force the impeller to the opposite end (toward indicator). Indicator reading will be a measurement of the impeller float. Repeat process on second impeller and compare float to Table 6. Adjust shimming at bearing clamp plates to obtain both float and end clearances specified in Table 6.

    Finally, after clearances and float have been corrected and checked, remove the gear end clamping places (54) and install wavy-spring washers (29) and reinstall shims (10) and clamping plates (54). Be sure oil feed grooves are up and toward bearings.

11. Installing drive gear (4) – Be sure shafts and gear bores are clean and free of scratches. Oil gear nut threads lightly. Place hardwood wedges as shown in Figure 8. Install gear (4) and nut (31) so match mark at the tooth is at the line of engagement. Tighten the drive gear to the torque given below. Blower assembly must be fastened down for torquing operation.

12. **Left side discharge machine**
    Installing driven gear (14) – Insert a long metal feeler gauge between the impellers' lobes at the fronts as shown in Table 6. Feeler gauge thickness to be a middle value from Table 6 for fronts.

13. **Right side discharge machine**
    Installing driven gear (4) – Insert a long metal feeler gauge between the impellers' lobes at the backs. Feeler gauge thickness to be minimum value from Table 6 for backs.

RAM™ SERIES BLOWER GEAR NUT TORQUE

Frame Size	Torque	
	lb.-ft.	(kg-m)
404, 406, 409, 412, 418	400	(56)
616, 624	630	(88)

RAM™ SERIES BLOWER OIL SLINGER SCREW TORQUE

Frame Size	Torque	
	lb.-ft.	(kg-m)
404, 406, 409, 412, 418	75	(10)
616, 624	140	(19)

Align the gear so the tooth match marks agree with the drive gear, then install slinger (46) and nuts (31). Tighten lightly with a small wrench, then check front and back clearances against Table 6 for each 45° position. Both fronts should be about the same and backs should about equal and be within the specified range in Table 6. Adjust gear position if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified above. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts. **CAUTION: Keep fingers away from impeller end gears.**

Install gearbox (3) with gasket (7) and tighten the capscrews (75) evenly to 10 ft.-lbs. (1.3 kg-m).

Install drive end oil slinger (40) and capscrew (60), apply Locktite to threads and torque to value specified above.

Install drive end cover (5) and gasket (7) with drive lock pins (17) in place, being careful not to dent or scratch drive shaft lip seal surface. Tighten capscrews (75) evenly. Check seal bore for concentricity with shaft using an indicator; reposition drive lock pins, if necessary. Install seal (33) with lip facing inward, using care to avoid tearing or scratching seal on shaft keyway. Use a pressing tool with clean, square ends to insure correct positioning of the seal. For hydrodynamic style seals, the shaft rotation is critical for correct installation and proper sealing. Match the directional arrow shown on the seal faces with the required shaft rotation. An installation protective sleeve is required to protect seal lip during installation.

Install vent plug (21) in each headplate.

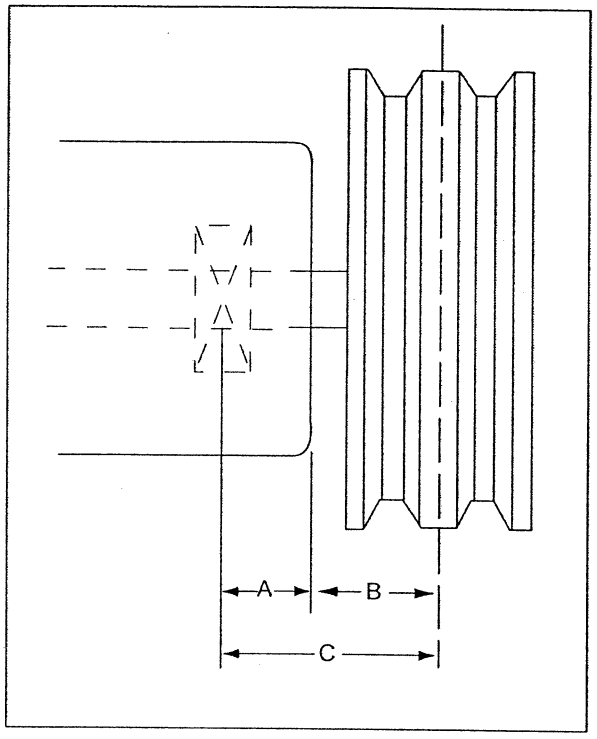
Replace oil drain plugs (22) and refill drive end and gear sumps with proper grade of oil as discussed under **LUBRICATION**.

Install drive sheave or coupling half and install blower, refer to **INSTALLATION instructions**.

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FIGURE 2

ALLOWABLE OVERHUNG LOADS FOR V-BELT DRIVES UNIVERSAL RAI®/URAI™-J UNITS



$$\text{Belt Pull lbs} = \frac{252100 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

C = Distance between drive bearing center line and sheave center line (A+B)

$$B = (1/8" + \frac{\text{Sheave Width}}{2})$$

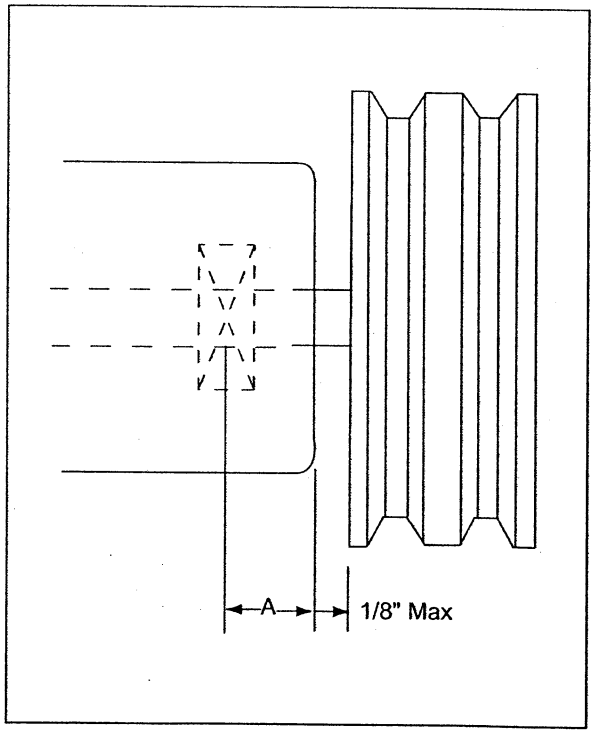
Shaft Load (lb.in) = Belt Pull • C

Frame Size	Dimension "A"	Max Allowable Shaft Load (lb-in.)
22, 24	0.61	80
32, 33, 36	0.80	300
42, 45, 47	1.02	640
53, 56, 59	1.13	1,110
65, 68, 615	1.36	1,550
76, 711, 718	1.16	2,300

NOTE: Arc of sheave belt contact on the smaller sheave not to be less than 170°

Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.

ALLOWABLE OVERHUNG LOADS FOR V-BELT DRIVES 400 - 600 RAM™ UNITS



$$\text{Belt Pull lbs} = \frac{27500 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

$$\text{Shaft Load (lb.in)} = \text{Belt Pull} \cdot (A + 1/8" + \frac{\text{Sheve Width}}{2})$$

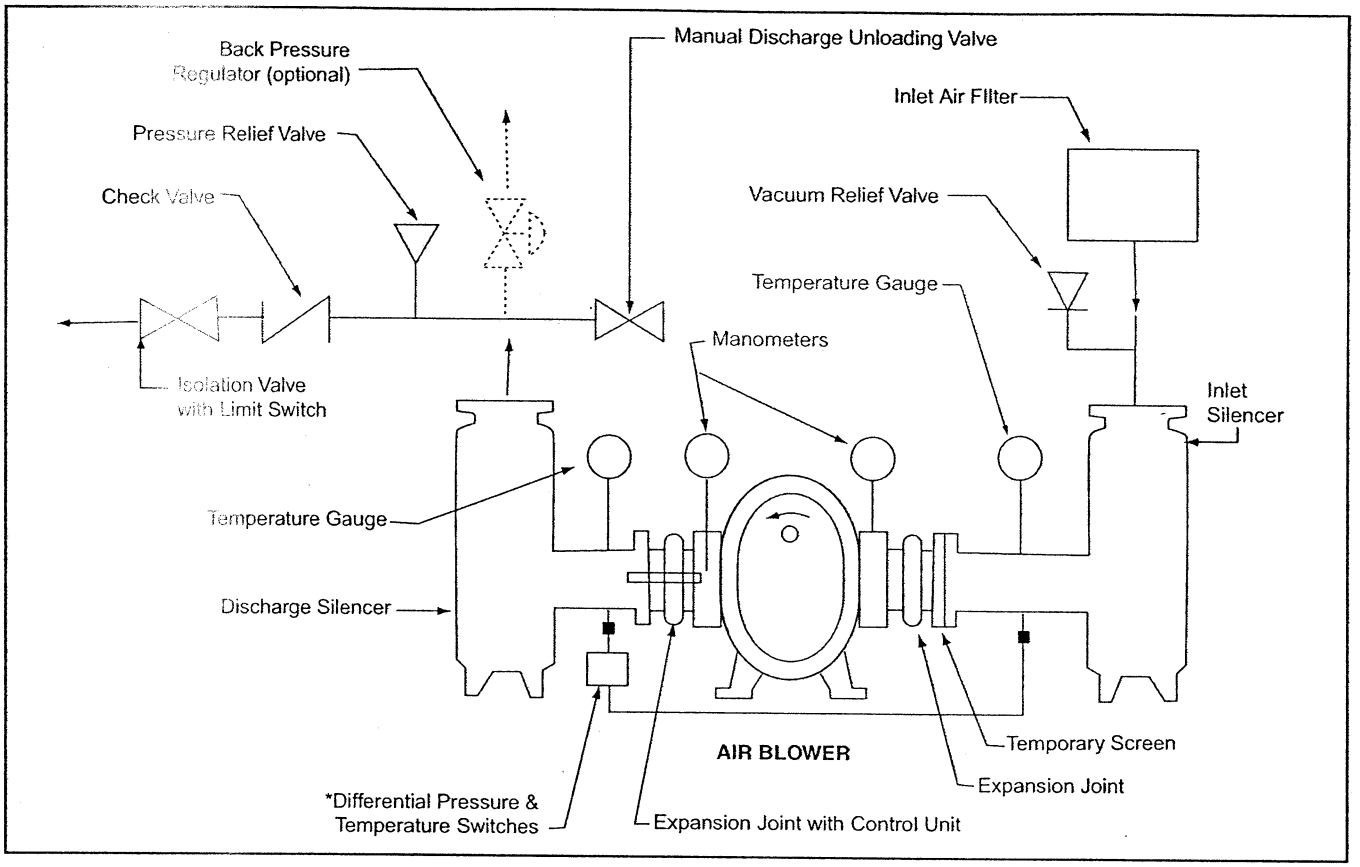
	Dimension "A"		
Frame Size	Standard Unit	Bottom Drive or Double Shaft Seal	Max Allowable Shaft Load (lb-in.)
404, 406	1.90	2.11	3,200
409, 412, 418	1.90	2.11	3,200
616, 624	2.11	2.67	7,975

NOTE: Arc of sheave belt contact on the smaller sheave not to be less than 170°

Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.

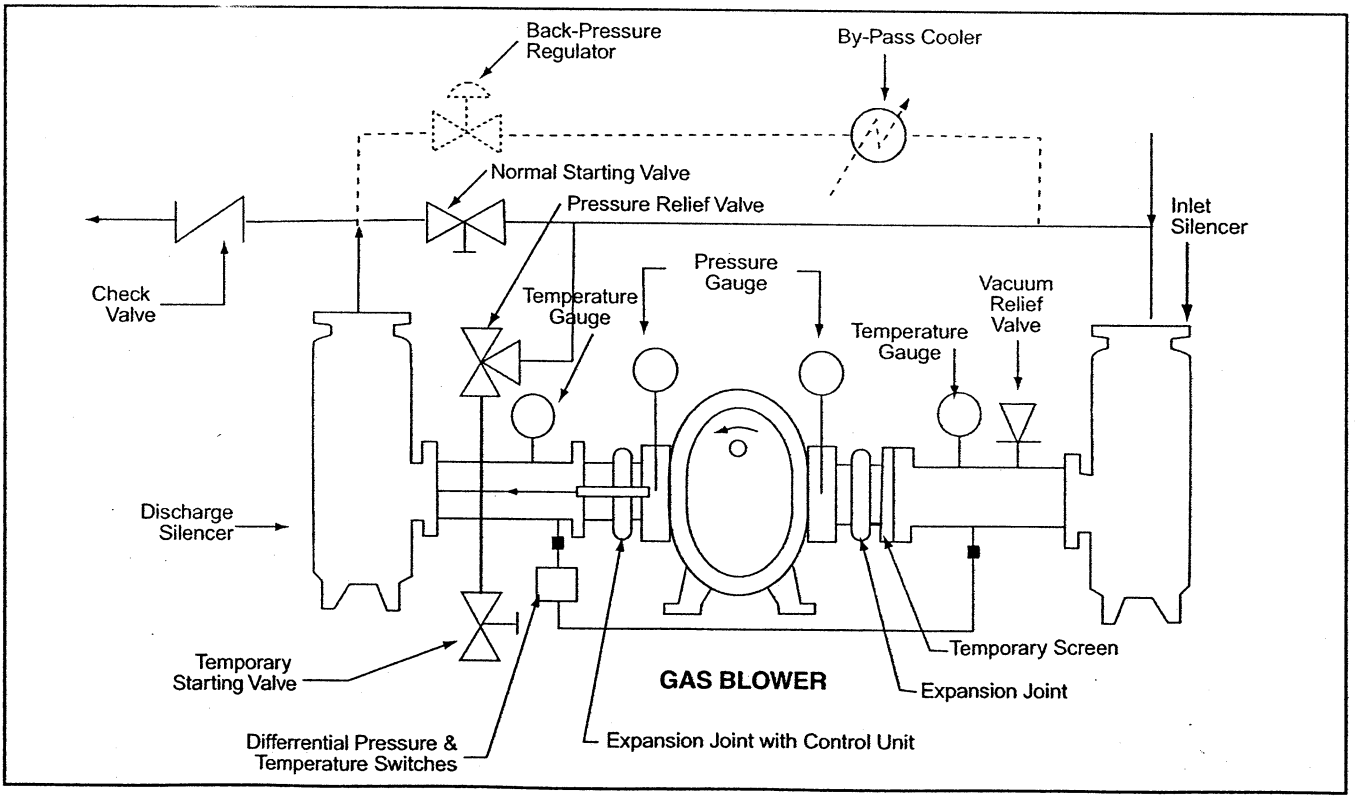
FIGURE 3

AIR BLOWER INSTALLATION WITH ACCESSORIES



Above are suggested locations for available accessories.

GAS BLOWER INSTALLATION WITH ACCESSORIES



Above are suggested locations for available accessories.

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FIGURE 4

BLOWER ORIENTATION CONVERSION

Model	Reversible Rotation	Whispair Design
Universal RAI	yes	no
URAI-J	no	yes
URAI-G	yes	no
RAM	yes	no
RAM-J	no	yes
RAM-GJ	no	yes

Special Note: WHISPAIR™ models are designed to operate with only one shaft rotation direction to take full advantage of the Whispair feature. Therefore, a WHISPAIR™ blower should be operated in the following combinations only.

- **CCW Rotation:** Bottom Shaft; Right side discharge or a Left Shaft; Bottom discharge
- **CCW Rotation:** Top Shaft; Left side discharge or a Right Shaft; Top discharge
- **CW Rotation:** Bottom Shaft; Left side discharge or a Right Shaft Bottom discharge
- **CW Rotation:** Top Shaft; Right side discharge or a Left Shaft Top discharge

BLOWER ORIENTATION AND LUBRICATION POINTS: UNIVERSAL RAI® & URAI™-G GAS BLOWERS

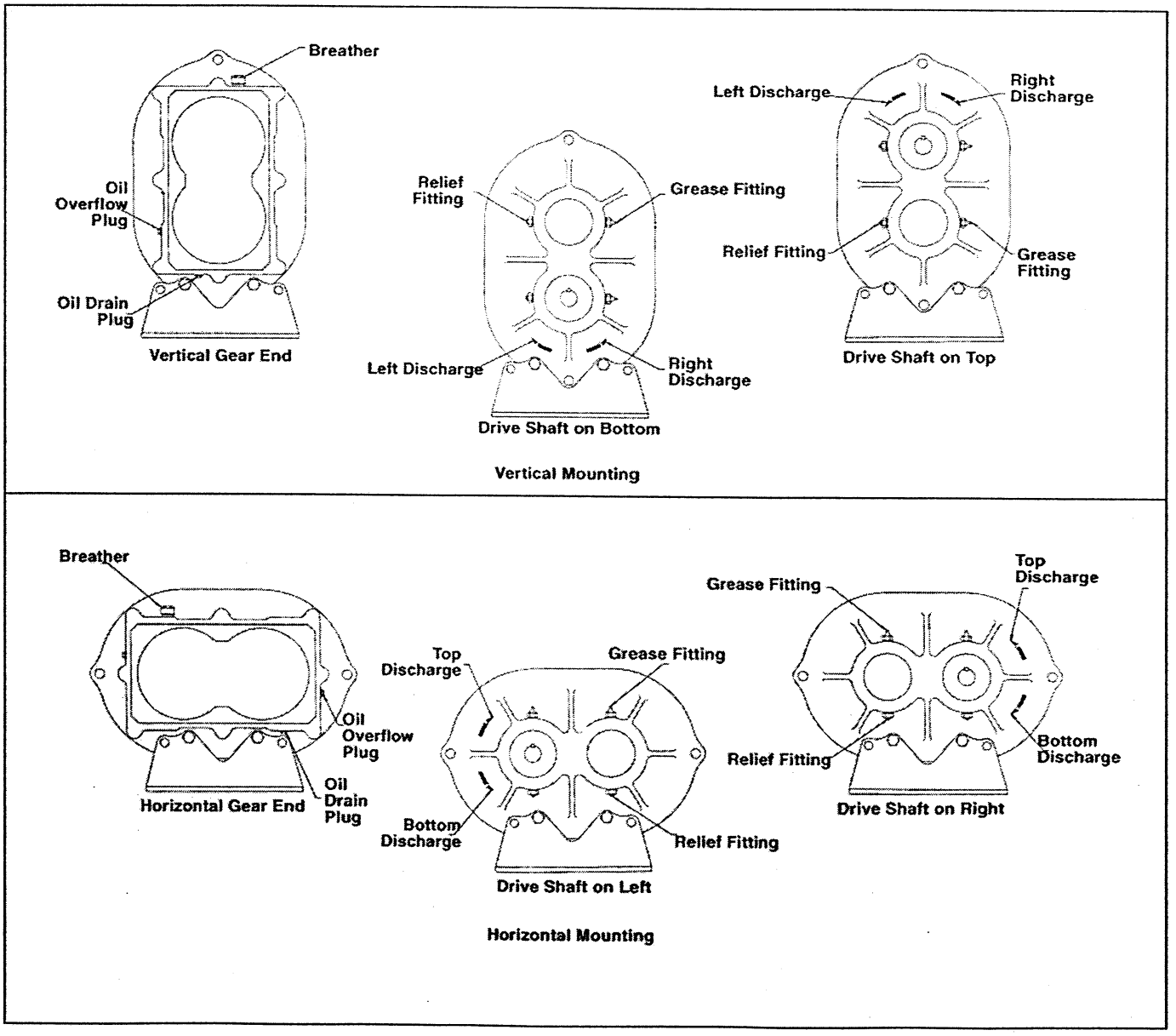
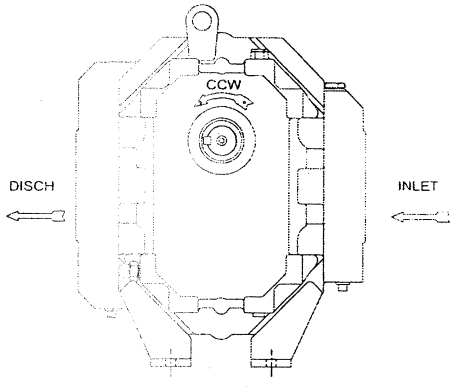


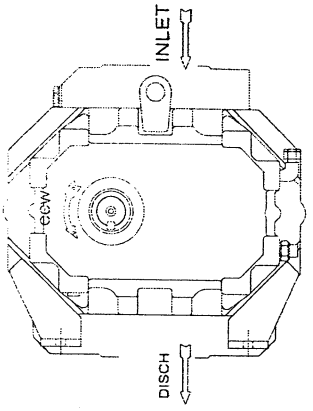
FIGURE 5

BLOWER ORIENTATION CONVERSION - WHISPAIR™ UNITS

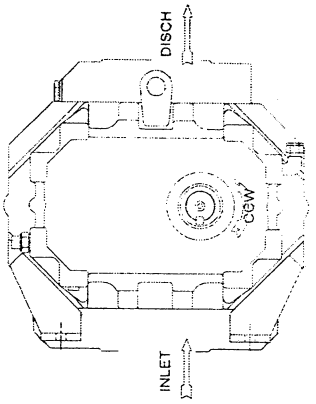
1. STANDARD ARRANGEMENT (3-WAY UNIVERSAL)
   EXTERNAL SIGHT GLASSES (37) & BREATHERS (21) MUST BE RELOCATED AS SHOWN.
   FEET (76&77) & LIFTING LUGS (63) MUST BE RELOCATED AS SHOWN.



TOP DRV, L.S. DISCH

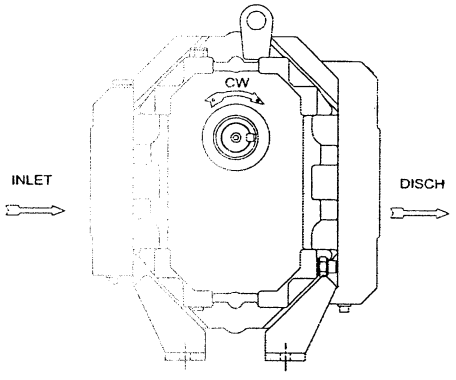


L.H. DRV, BTM DISCH

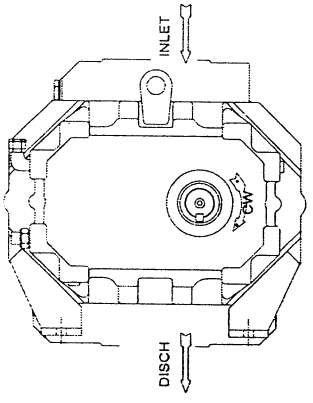


R.H. DRV, TOP DISCH

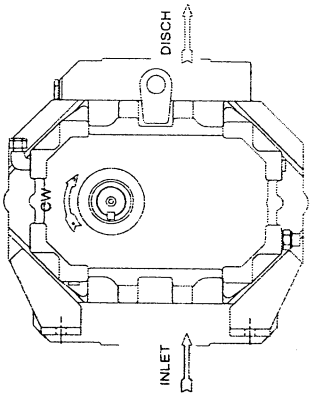
2. NON-STANDARD ARRANGEMENT (3-WAY UNIVERSAL)
   CYLINDER (11) MUST BE UNBOLTED FROM HEADPLATES (1) AND DISCHARGE RELOCATED AS SHOWN. **MUST HAVE AUTHORIZATION FOR CONVERSION SO NOT TO VOID WARRANTY.**
   EXTERNAL SIGHT GLASSES (37) & BREATHERS (21) MUST BE RELOCATED ALSO.
   FEET (76&77) & LIFTING LUGS (63) MUST BE RELOCATED AS SHOWN



TOP DRV, R.S. DISCH

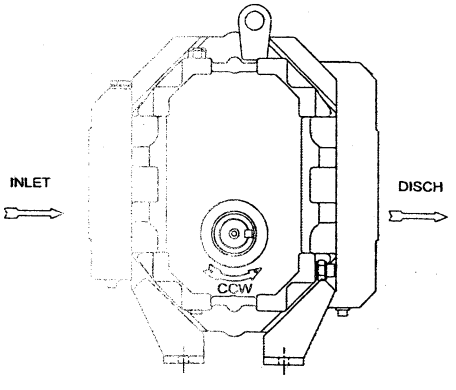


R.H. DRV, BTM DISCH

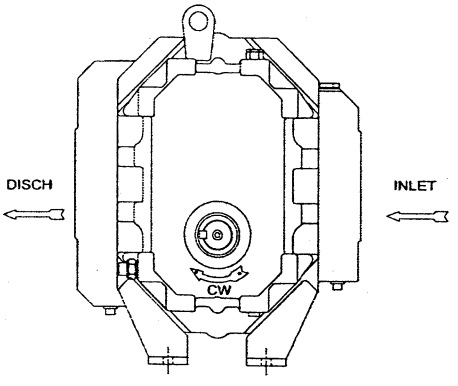


L.H. DRV, TOP DISCH

3. BOTTOM DRIVE SHAFT ARRANGEMENT "SPECIAL ORDER" (3-WAY UNIVERSAL)
   SPECIAL OGE OIL SLINGER REQUIRED FOR ASSEMBLY.
   MAY BE CONVERTED TO HORIZONTAL CONFIGURATION AS PREVIOUSLY SHOWN.



BTM DRV, R.S. DISCH



BTM DRV, L.S. DISCH

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TABLE 1 -

URAI™-J WHISPAIR™ & URAI™-G GAS BLOWER, MAXIMUM ALLOWABLE OPERATING CONDITIONS

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise F° (C°)	Delta Pressure PSI (mbar)	Inlet Vacuum INHG (mbar)
22	2.5	5275	225 (125)	12 (227)	15 (500)
24	2.5	5275	210 (117)	7 (483)	15 (500)
32	3.5	3600	240 (133)	15 1034	16 (539)
33	3.5	3600	225 (125)	12 (827)	15 (500)
36	3.5	3600	225 (125)	7 (483)	15 (500)
42	4.0	3600	240 (133)	15 (1034)	16 (539)
45	4.0	3600	225 (125)	10 (690)	16 (539)
47	4.0	3600	225 (125)	7 (483)	15 (500)
53	5.0	2850	225 (125)	15 (1034)	16 (539)
56	5.0	2850	225 (125)	13 (896)	16 (539)
59	5.0	2850	225 (125)	7 (483)	15 (500)
65	6.0	2350	250 (130)	15 (1034)	16 (539)
68	6.0	2350	240 (133)	14 (965)	16 (539)
615	6.0	2350	130 (72)	7 (483)	12 (405)
76	7.0	2050	250 (139)	15 (1034)	16 (539)
711	7.0	2050	225 (125)	10 (690)	16 (539)
718	7.0	2050	130 (72)	6 (414)	12 (405)

RAM™, RAM™-J WHISPAIR™ BLOWER, RAM™-GJ GAS BLOWER
MAXIMUM ALLOWABLE OPERATING CONDITIONS

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise F° (C°)	Delta Pressure PSI (mbar)	Inlet Vacuum INHG (mbar)
404	4.5	4000	240 (133)	18 (1241)	16 (539)
406	4.5	4000	240 (133)	18 (1241)	16 (539)
409	4.5	4000	240 (133)	18 (1241)	16 (539)
412	4.5	4000	240 (133)	15 (1034)	16 (539)
418	4.5	4000	240 (133)	10 (690)	16 (539)
616	6.0	3000	230 (128)	15 (1034)	16 (539)
624	6.0	3000	230 (128)	10 (690)	16 (539)

TABLE 3

RECOMMENDED OIL GRADES

Ambient Temperature °F (°C)	Viscosity Range SSU at 100°F	ISO No.	Approximate SAE No.
Above 90° (32°)	1000-1200	320	60
32° to 90° (0° to 32°)	700-1000	220	50
0° to 32° (-18° to 0°)	500-700	150	40
Below 0° (-18°)	300-500	100	30

UNIVERSAL RAI®, URAI™-J, URAI™-G OIL SUMP CAPACITIES

Frame Size	Capacity Fl. Oz. (Liters)	
	Vertical	Horizontal
22	3.4 (.1)	6.1 (.18)
24	3.4 (.1)	6.1 (.18)
32	8.5 (.25)	16.0 (.47)
33	8.5 (.25)	16.0 (.47)
36	8.5 (.25)	16.0 (.47)
42	12.7 (.37)	22.8 (.67)
45	12.7 (.37)	22.8 (.67)
47	12.7 (.37)	22.8 (.67)
53	16.0 (.47)	27.6 (.82)
56	16.0 (.47)	27.6 (.82)
59	16.0 (.47)	27.6 (.82)
65	28.3 (.84)	52.1 (1.54)
68	28.3 (.84)	52.1 (1.54)
615	28.3 (.84)	52.1 (1.54)
76	32.3 (.96)	59.5 (1.76)
711	32.3 (.96)	59.5 (1.76)
718	32.3 (.96)	59.5 (1.76)

RAM™, RAM™-J & RAM™-GJ OIL SUMP CAPACITIES

Orientation	Gearbox		Drive End	
	Fl. Oz.	(Liters)	Fl. Oz.	(Liters)
400 (Horizontal)	36	1.06	19	.56
400 (Vertical)	18	.52	9	.27
600 (Horizontal)	95	2.81	50	1.48
600 (Vertical)	55	1.63	28	0.83

TABLE 4

SUGGESTED BEARING GREASING INTERVALS

Speed In RPM	Operating Hours Per Day		
	8	16	24
	Greasing Intervals in Weeks		
750-1000	7	4	2
1000-1500	5	2	1
1500-2000	4	2	1
2000-2500	3	1	1
2500-3000	2	1	1
3000 and up	1	1	1

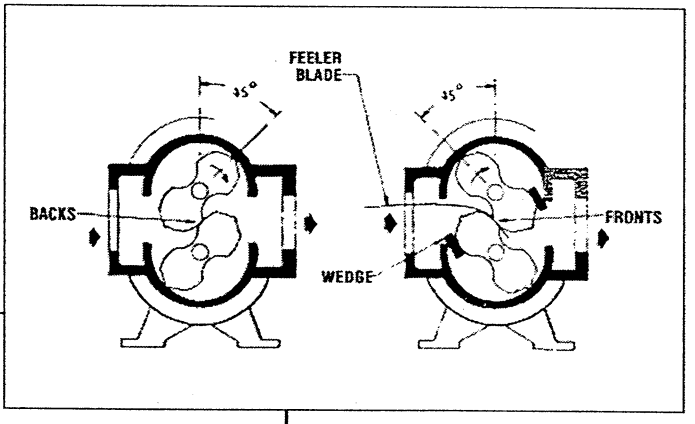
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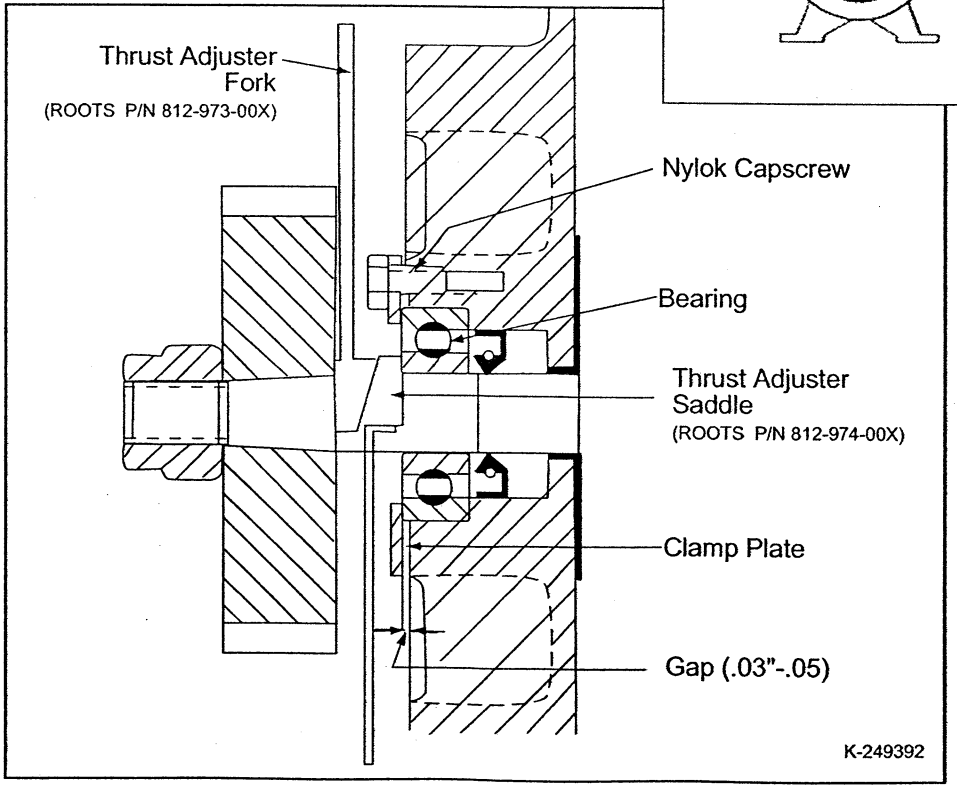
TABLE 5

NORMAL CLEARANCES FOR UNIVERSAL RAI® AND URAI™-J, URAI™-G BLOWERS - INCHES (MM)

Frame Size	Impeller Ends			Cylinder		Impeller
	Total	Drive End Minimum	Gear End Minimum	Inlet & Discharge	Center Center	* Fronts/Backs
22	.006/.010 (.15-.25)	.003 (.08)	.003 (.08)	.004/.005 (.10-.13)	.002/.003 (.05-.08)	.007/.01 (.18-.25)
24	.006/.010 (.15-.25)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.007/.01 (.18-.25)
32	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
33	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
36	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
42	.008/.011 (.20-.28)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.009/.012 (.23-.30)
45	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.012/.015 (.30-.38)
47	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.012/.015 (.30-.38)
53	.008/.011 (.20-.28)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.011/.013 (.28-.33)
56	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.015/.017 (.38-.43)
59	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.015/.017 (.38-.43)
65	.012/.016 (.30-.40)	.008 (.20)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
68	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
615	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
76	.012/.016 (.30-.40)	.008 (.13)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)
711	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)
718	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)

* IMPELLER TIMING FOR STANDARD ROTATION VIEWED FROM GEAR END





THRUST SETTING, 2-1/2" THRU 5" UNIVERSAL RAI® BLOWERS

TABLE 6

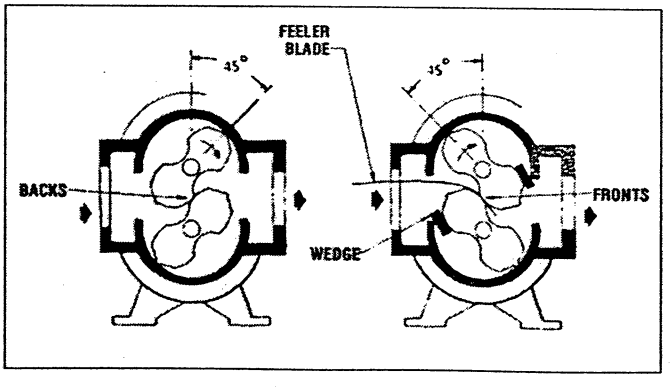
NORMAL CLEARANCES FOR RAM™-J & RAM™-GJ WHISPAIR™ BLOWERS - INCHES (MM)

Blower Frame Size	* Impeller Lobes at 45°		End Clearance			Impeller Tips to Cylinders		
	Fronts	Backs	Each End Without Wavy Spring	Gear End Without Spring Installed	Required End Float	Inlet	Center	Discharge
	Min-Max	Min-Max	Min-Max	Min-Max	Minimum	Min-Max	Min-Max	Min-Max
404	.012-.014	.006-.009	.003-.005	.003-.008	.003	.004-.006	.002-.004	.002-.004
	(.31-.36)	(.15-.23)	(.08-.13)	(.10-.15)	(.08-.20)	(.08)	(.05-.10)	(.05-.10)
406	.012-.014	.006-.009	.003-.005	.007-.012	.006	.005-.007	.003-.005	.002-.004
	(.31-.36)	(.15-.23)	(.08-.13)	(.15-.30)	(.13)	(.13-.18)	(.08-.13)	(.05-.10)
409	.013-.015	.006-.009	.003-.005	.013-.018	.008	.005-.007	.003-.005	.002-.004
	(.33-.38)	(.15-.23)	(.08-.13)	(.31-.43)	(.17)	(.13-.18)	(.08-.13)	(.05-.10)
412	.013-.015	.006-.009	.003-.005	.016-.021	.011	.006-.008	.004-.006	.004-.006
	(.33-.38)	(.15-.23)	(.08-.13)	(.36-.48)	(.28)	(.15-.20)	(.10-.15)	(.10-.15)
418	.013-.015	.006-.009	.003-.005	.022-.027	.017	.008-.010	.004-.006	.004-.006
	(.33-.38)	(.15-.23)	(.08-.13)	(.51-.64)	(.38)	(.20-.25)	(.10-.15)	(.10-.15)
616	.012-.014	.006-.008	.004-.006	.017-.022	.011	.009-.011	.004-.006	.002-.005
	(.31-.36)	(.15-.20)	(.10-.15)	(.38-.51)	(.28)	(.23-.28)	(.10-.15)	(.05-.13)
624	.012-.015	.006-.009	.004-.006	.024-.029	.018	.013-.015	.005-.007	.002-.005
	(.31-.36)	(.15-.23)	(.10-.15)	(.61-.74)	(.46)	(.33-.38)	(.13-.18)	(.05-.13)

NORMAL CLEARANCES FOR RAM™ BLOWERS - INCHES (MM)

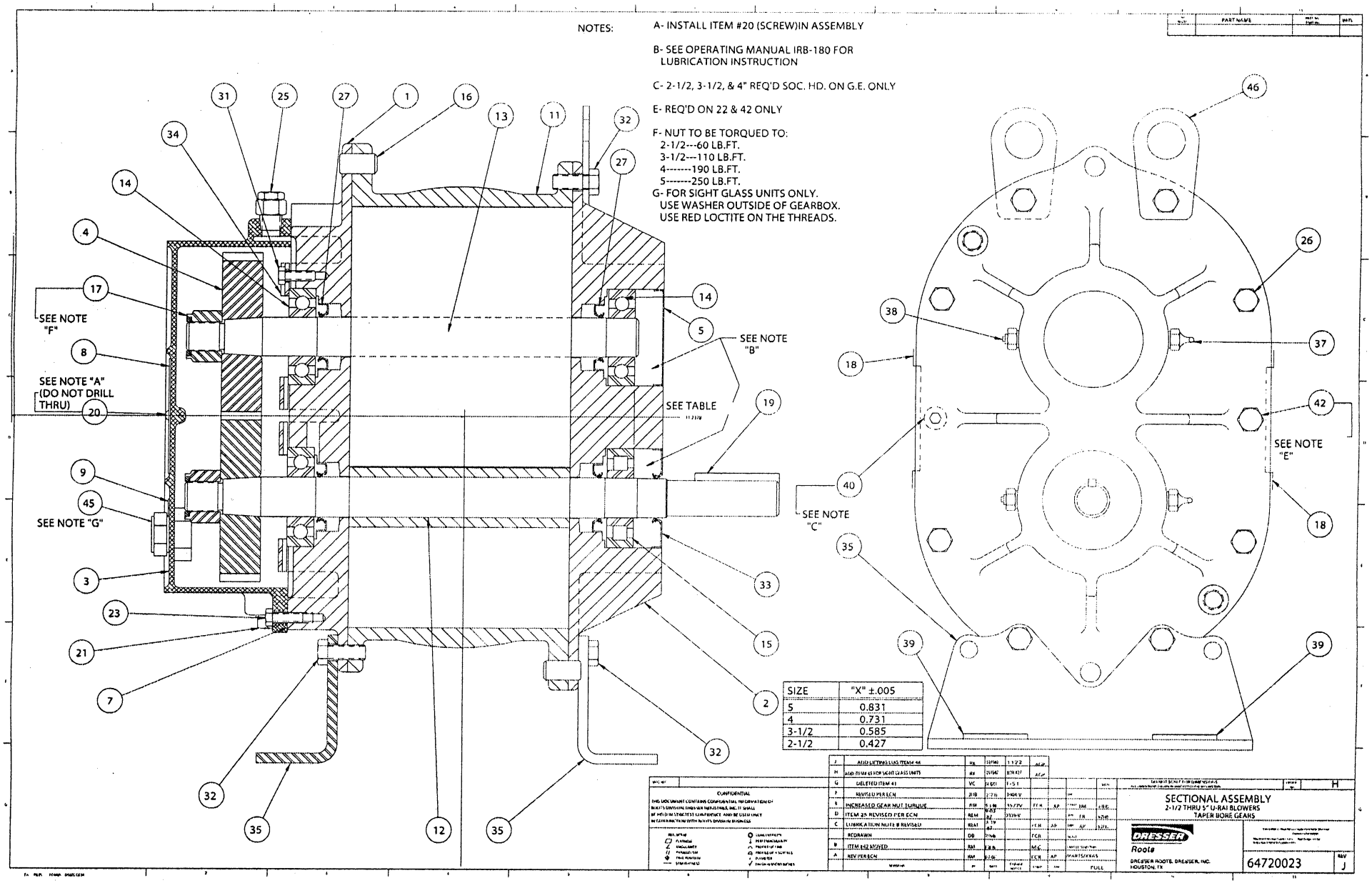
Blower Frame Size	* Impeller Lobes at 45°		End Clearance			Impeller Tips to Cylinders		
	Fronts	Backs	Each End Without Wavy Spring	Gear End Without Spring Installed	Required End Float	Inlet	Center	Discharge
	Min-Max	Min-Max	Min-Max	Min-Max	Minimum	Min-Max	Min-Max	Min-Max
404	.009-.013	.009-.013	.003-.005	.003-.008	.003	.004-.006	.002-.004	.004-.006
	(.23-.33)	(.23-.33)	(.08-.13)	(.08-.20)	(.08)	(.10-.15)	(.05-.10)	(.10-.15)
406	.009-.013	.000-.013	.003-.005	.007-.012	.006	.005-.007	.003-.005	.005-.007
	(.23-.33)	(.23-.33)	(.08-.13)	(.15-.30)	(.13)	(.13-.18)	(.08-.13)	(.13-.18)
409	.010-.014	.010-.014	.003-.005	.013-.018	.008	.005-.007	.003-.005	.005-.007
	(.25-.36)	(.25-.36)	(.08-.13)	(.31-.43)	(.17)	(.13-.18)	(.08-.13)	(.13-.18)
412	.010-.014	.010-.014	.003-.005	.016-.021	.011	.006-.008	.004-.006	.006-.008
	(.25-.36)	(.25-.36)	(.08-.13)	(.36-.48)	(.28)	(.15-.20)	(.10-.15)	(.15-.20)
418	.010-.014	.010-.014	.003-.005	.022-.027	.017	.008-.010	.004-.006	.008-.010
	(.25-.36)	(.25-.36)	(.08-.13)	(.51-.64)	(.38)	(.20-.25)	(.10-.15)	(.20-.25)
616	.011-.013	.011-.013	.004-.006	.017-.022	.011	.009-.011	.004-.006	.009-.011
	(.28-.33)	(.28-.33)	(.10-.15)	(.38-.51)	(.28)	(.23-.28)	(.10-.15)	(.23-.28)
624	.011-.013	.011-.013	.004-.006	.024-.029	.018	.013-.015	.005-.007	.013-.015
	(.28-.33)	(.28-.33)	(.10-.15)	(.61-.74)	(.46)	(.33-.38)	(.13-.18)	(.33-.38)

* IMPELLER TIMING FOR STANDARD ROTATION VIEWED FROM GEAR END

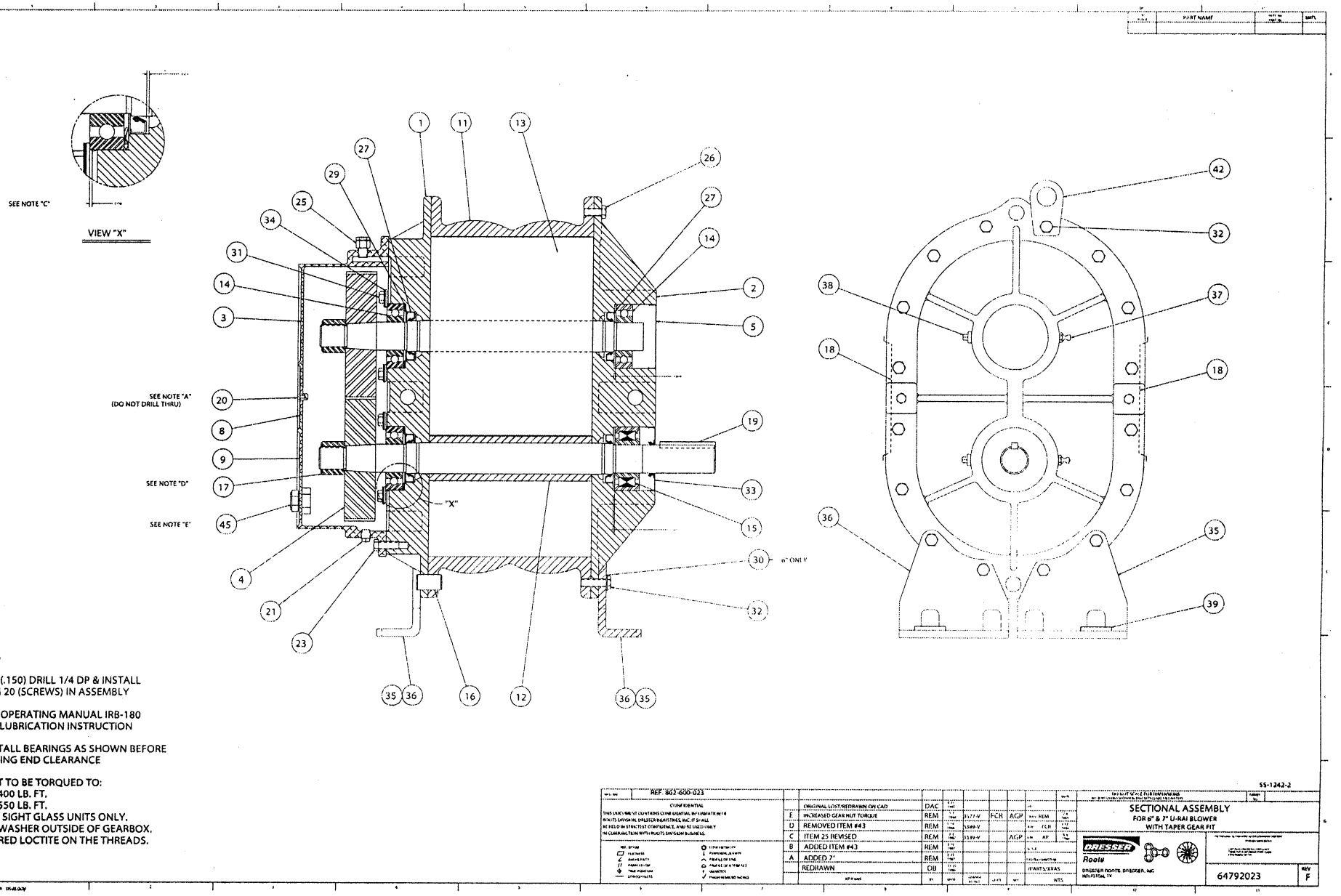


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ASSEMBLY OF UNIVERSAL RAI® SERIES, AIR BLOWERS, 2-1/2" THRU 5" GEAR DIAMETER



NOTES

A #25(.150) DRILL 1/4 DP & INSTALL ITEM 20 (SCREWS) IN ASSEMBLY

B SEE OPERATING MANUAL IRB-180 FOR LUBRICATION INSTRUCTION

C INSTALL BEARINGS AS SHOWN BEFORE SETTING END CLEARANCE

D NUT TO BE TORQUED TO:
6"---400 LB. FT.
7"---550 LB. FT.

E FOR SIGHT GLASS UNITS ONLY. USE WASHER OUTSIDE OF GEARBOX. USE RED LOCTITE ON THE THREADS.

E	INCREASED GEAR NUT TORQUE	REM	3577-V	FCR	AGP	REM	
D	REMOVED ITEM #43	REM	5388-V			FCR	
C	ITEM 25 REVISED	REM	5339-V		AGP	AP	
B	ADDED ITEM #43	REM					
A	ADDED 7"	REM					
	REDRAWN	DB				PARTS,TEXAS	
	ORIGINAL LOST/REDRAWN ON CAD	DAC					

REF: 863-600-023

CONFIDENTIAL

SS-1242-2

SECTIONAL ASSEMBLY
FOR 6" & 7" U-RAI BLOWER
WITH TAPER GEAR FIT

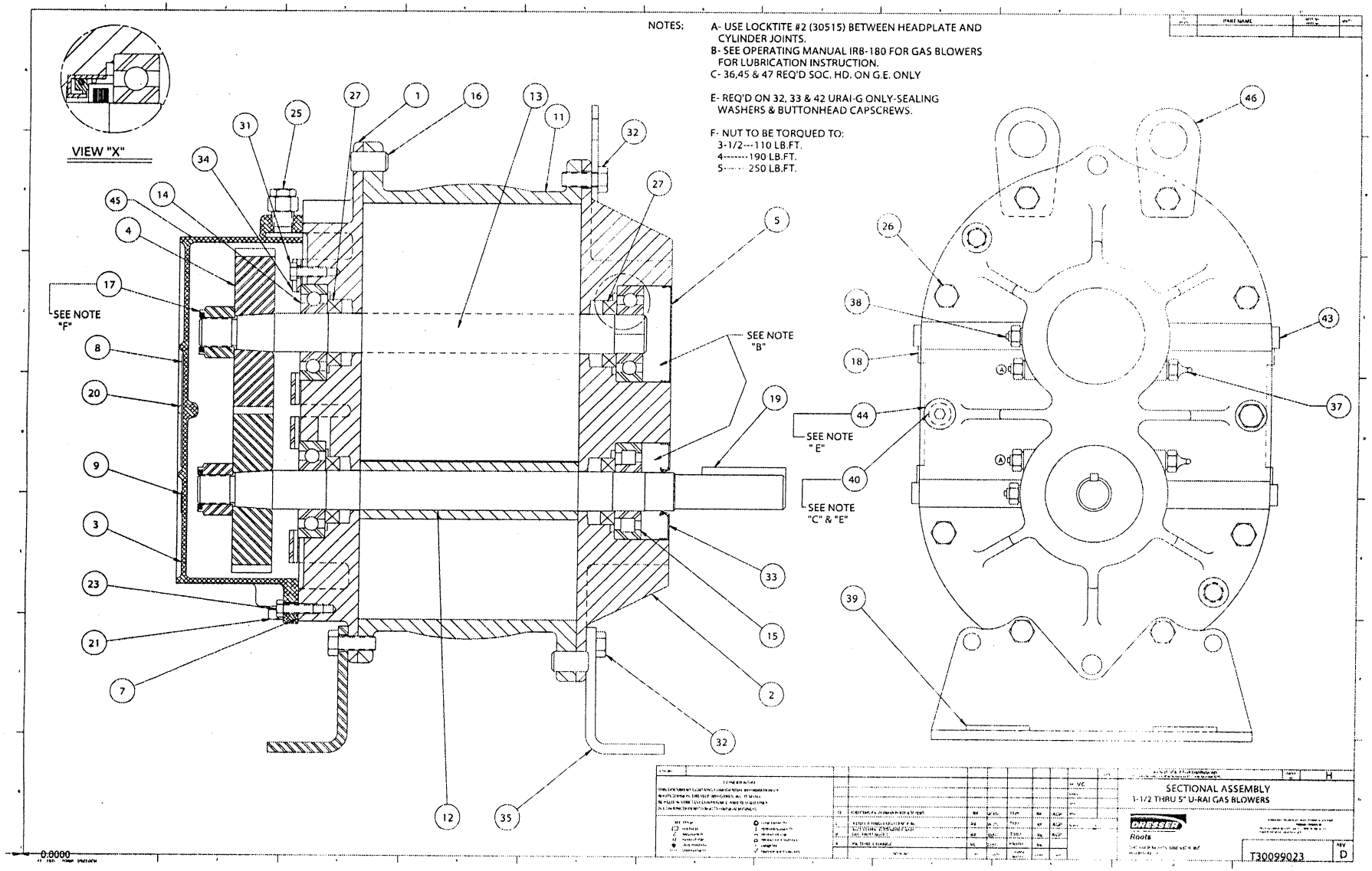
DRESSER Roots
DRESSER ROOTS, DRESSER, INC
HOUSTON, TX

64792023 REV F

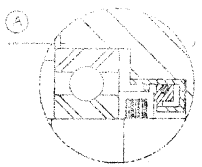
ASSEMBLY OF UNIVERSAL RAI® BLOWERS, 6" AND 7" DIAMETER

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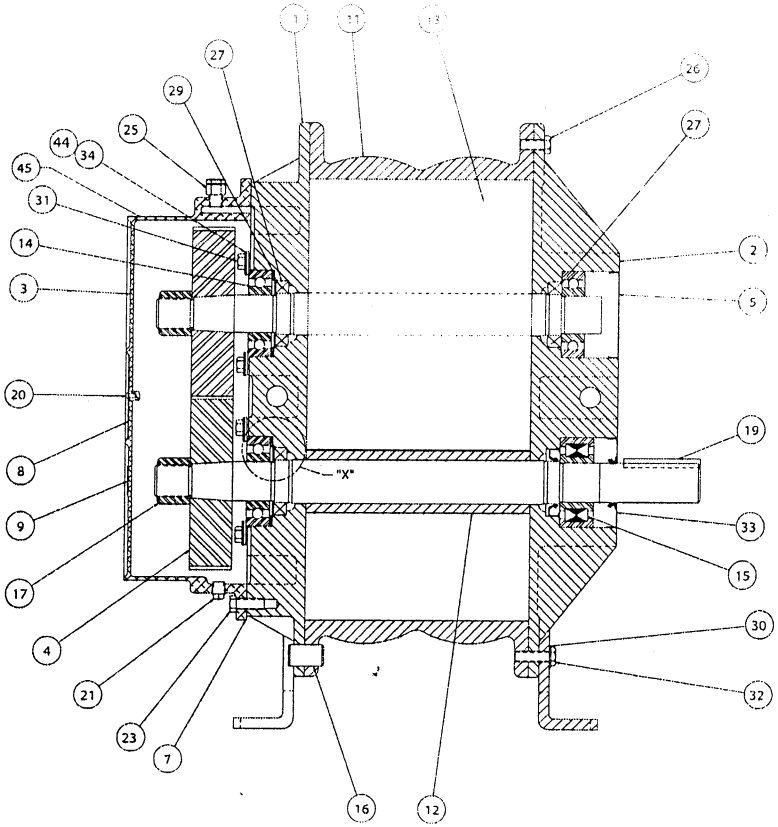
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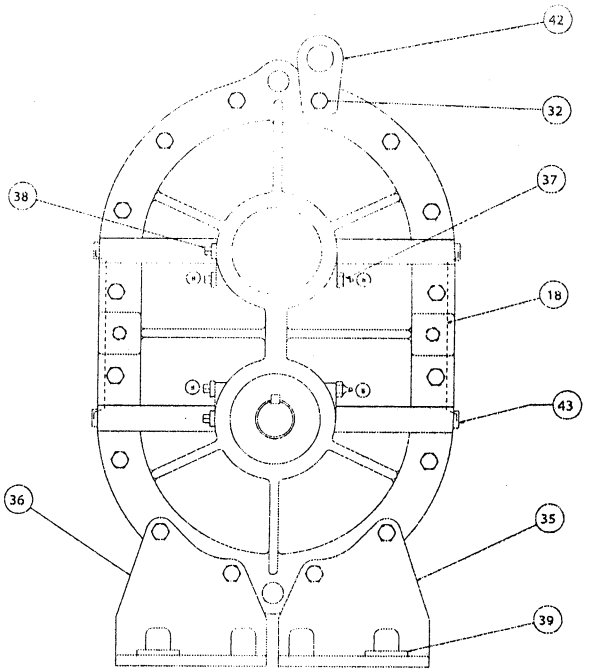
ASSEMBLY OF UNIVERSAL RAI™-G SERIES GAS BLOWERS, 3-1/2"THRU 5" GEAR DIAMETER



VIEW "X"



SEE NOTE "C"



NOTES

A USE LOCKTITE #2 (30515) BETWEEN HEADPLATE AND CYLINDER JOINTS.

B SEE OPERATING MANUAL IRB-180 FOR LUBRICATION INSTRUCTION

C NUT TO BE TORQUED TO: 6"---400 LB. FT.

PART NAME

REF: 04792022

CONFIDENTIAL

C		RK	
B	PICTURE CHANGE	VC	
A	ADDED DIMENSION .066	VC	

SECTIONAL ASSEMBLY
FOR 6" U-RAI GAS BLOWERS

DRESSER Roots

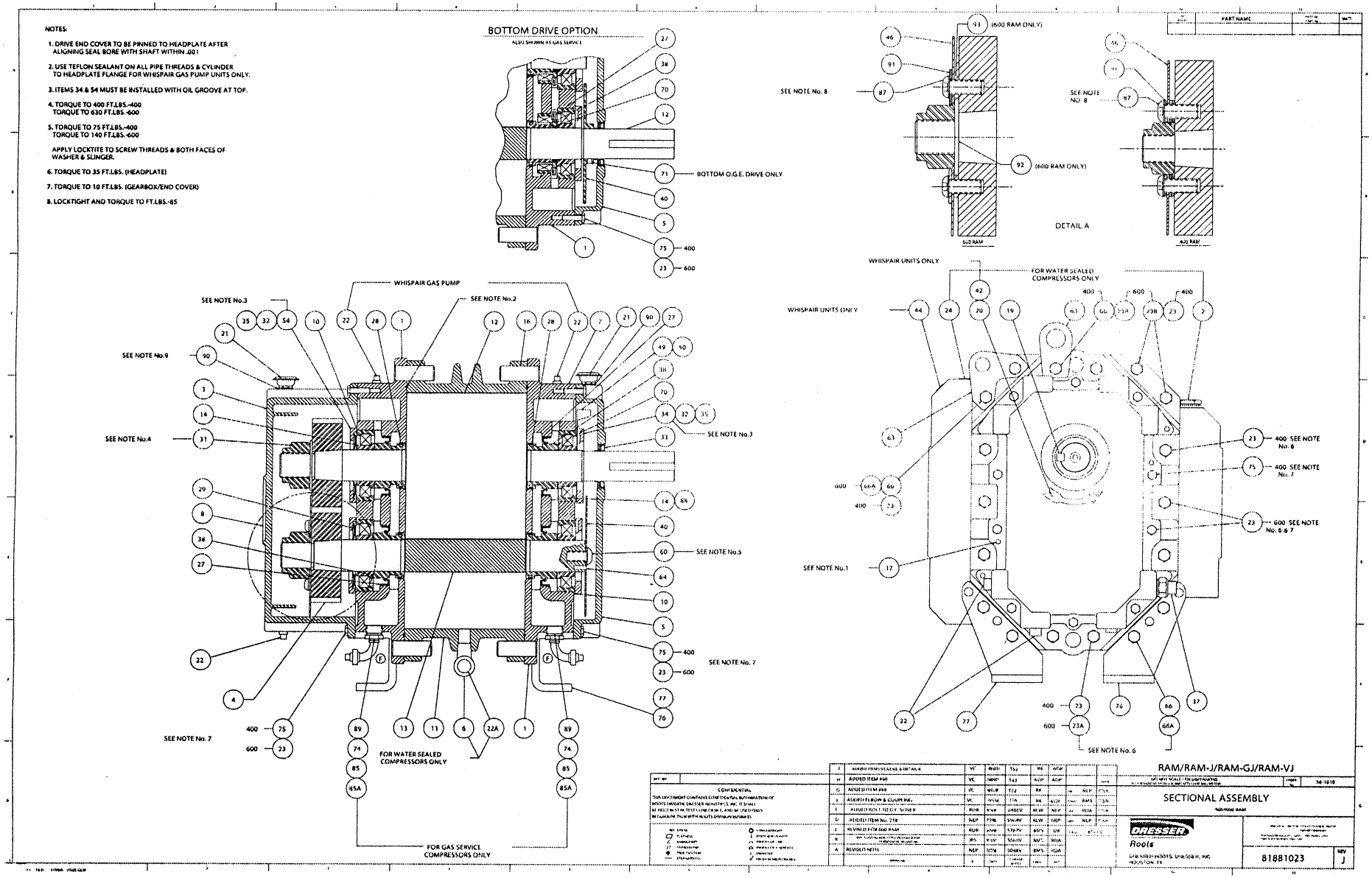
DRESSER ROOTS, DRESSER, INC
ROTISSION, TX

T30110023 REV B

ASSEMBLY OF UNIVERSAL RAI® SERIES GAS BLOWERS, 6" GEAR DIAMETER

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ASSEMBLY OF RAM™ SERIES AIR & GAS BLOWERS

UNIVERSAL RAI® SERIES BLOWERS PARTS LIST

Item No.	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Gears	1
5	Cover-Blind (Plug Opening)	1
7	Gasket	1
9	Nameplate Lube	1
14	Bearing G.E., - Driven	3
15	Bearing Drive D.E., - Drive	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
20	Screw, Self Tap	1
21	Plug, Pipe	3
23	Screw Hex	6
25	Breather (Plug Vent)	1
26	Screw, Hex	14
27	Seal	4
29	Washer - wavy Spring	2
30	Washer	8
31	Screw, Hex	4
32	Screw, Hex	4
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
36	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Flat	4
40	Screw Socket	2
40*	Screw, Button Hd.	4
42	Screw Hex	2
43	Plug	8
44*	Washer	4

*For 32 and 42 URAI-G only.

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RAM™ SERIES PARTS LIST

Item No.	Part Name	Qty.
01	Headplate	2
03	Gearbox	1
04	Gear, Assembly	1
05	End Cover	1
07	Gasket – Gearbox/Cover	2
09	Installation Tag	2
10	Shims-(.010)	Lot
14	Bearing Roller	4
16	Pin, Dowel (Pull Out)	4
17	Pin, Dowel	2
19	Key Square	1
20	Screw, Drive - Rd. Hd.	4
21	Breather	2
22	Plug, Pipe	12
23	Screw, Cap Hex Hd.	24
27	Seal, (Viton)	4
28	Piston, Ring-Seal	4
29	Washer, Wavy Spring	2
31	Nut, Hex ESNA	2
32	Scr, Cap Hex Hd.	16
33	Seal, Lip	1
34	Brg. Clamp Plate - D. E.	2
35	Lock Washer - Spring	16
37	Sight Plug - Oil Level	2
38	Sleeve - GE & DE	4
38	Sleeve - Piston Ring	4
40	Slinger - D.E. (Top Drive)	1
40	Slinger - D. E. (Bottom Drive)	1
42	Rotation Arrow	1
44	Label	1
46	Slinger - G.E.	1
49	Oil Leader L/S	1
50	Oil, Leader-R/S	1
54	Brg Clamp Plate - G. E.	2
60	Screw, Cap Butt. HD.	1
63	Lifting Lug	2
64	Pin, Spring	1
66	Screw, Cap Hex HD.	12
66.1	Whispair, Spring Lock 3/8M	12
70	Shims D.E. Brg.	1
75	Screw, Cap - Hex HD.	20
76	Blower Foot - RH	2
77	Blower Foot - LH	2
85	Elb, Pipe-Black	2
85.1	Plug, Pipe	2
87	Scr, Cap BH	2
88	Ball Spherical	4
90	BSHG-RDCG	2
91	Washer, Plain Flat	2
92	Washer, Plain Flat	2
93	Washer	2

NOTES

CONTACT LIST

CUSTOMER SERVICE

Dresser ROOTS
2135 Hwy 6 South
Houston, TX 77077
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Toll Free Fax: 1-877-357-7238
Local Fax: 281-966-4309

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11611B Tanner RD
Houston, TX 77041
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Local Phone: 713-896-4810
Local Fax: 713-896-4927

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Toll Free: 1-800-866-6182
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Local Fax: 713-896-4927

Dresser, Inc.

DRESSER
Roots

Dresser ROOTS 2135 Hwy 6 South Houston, TX 77077 PH: 281-966-4700 FX: 281-966-4309 Toll Free: 1-877-363-ROOT(S)	Dresser ROOTS - Connersville 900 West Mount Street Connersville, IN 47331 PH: 765-827-9200 FX: 765-827-9266	Dresser ROOTS - Holmes Operation PO Box B7 Off St. Andrews Rd Turnbridge, Huddersfield England HD1 6RB PH: +44-1484-422222 FX: +44-1484-422668

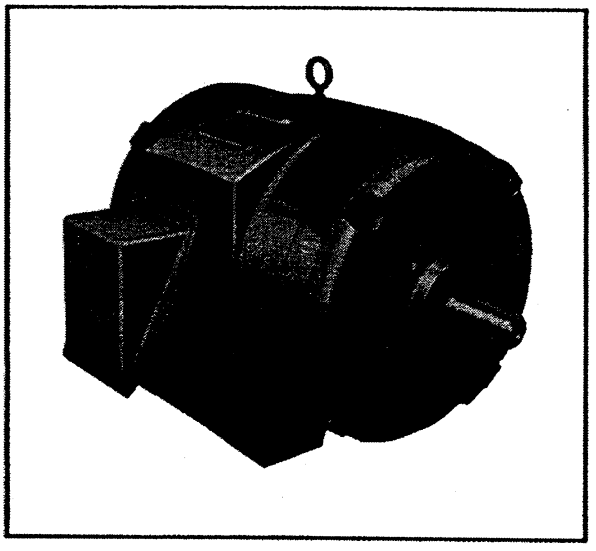
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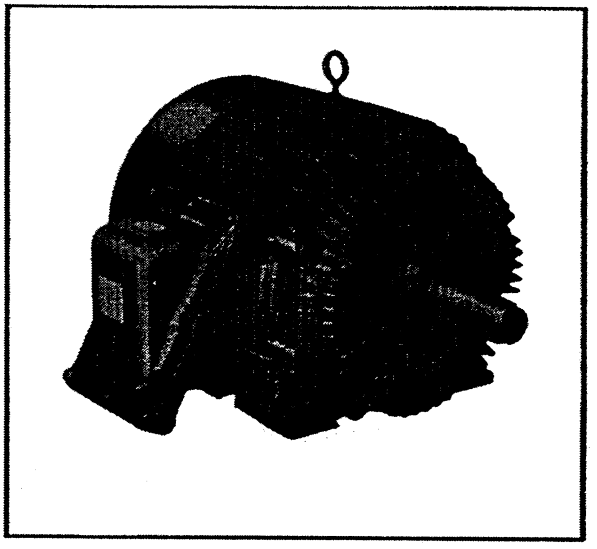
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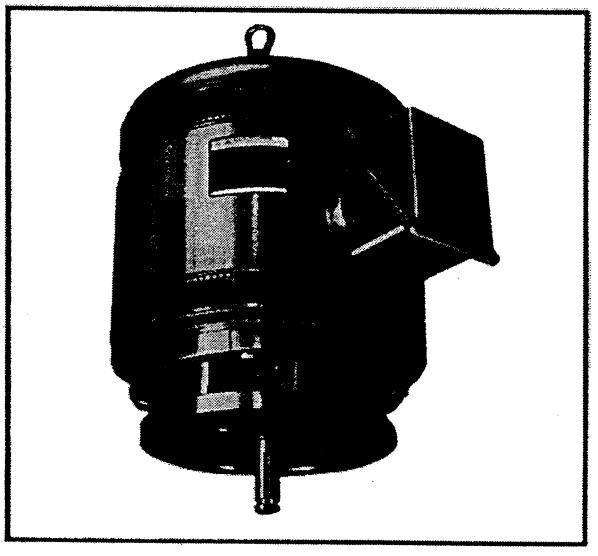
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MARATHON® ELECTRIC

Standard Induction Motors

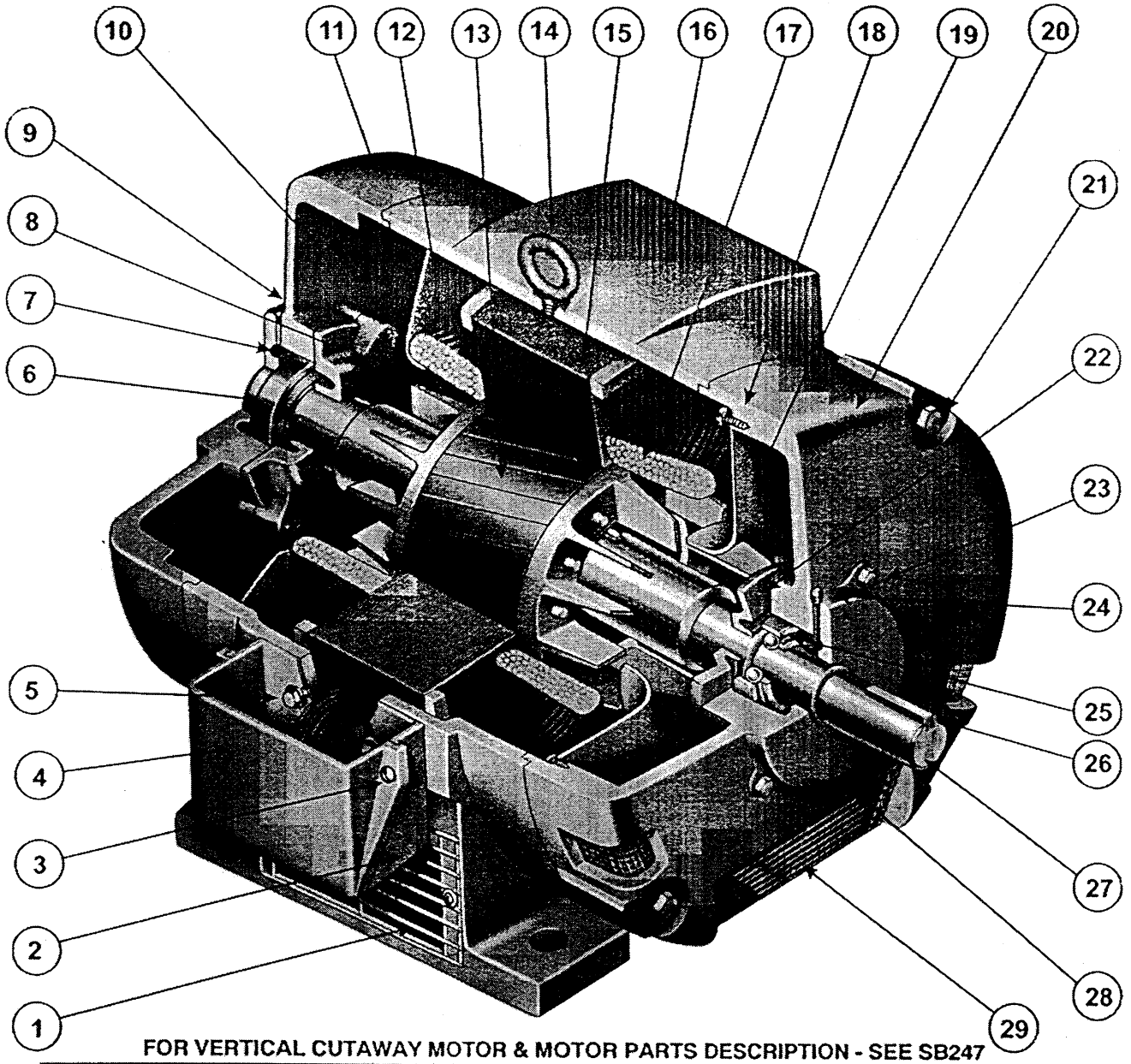






Installation, Operation, & Maintenance Instructions

TYPICAL CUTAWAY VIEW OF A MARATHON DESIGNED, DRIPPROOF, HORIZONTAL INTEGRAL HORSEPOWER MOTOR & PARTS DESCRIPTION 364 THRU 445 FRAME SIZE



FOR VERTICAL CUTAWAY MOTOR & MOTOR PARTS DESCRIPTION - SEE SB247

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	** Frame Vent Screen	11.	Bracket O.P.E.	21.	Bracket Holding Bolt
2.	Conduit Box Bottom	12.	Baffle Plate O.P.E.	22.	Inner Bearing Cap P.E.
3.	Conduit Box Top-Holding Screw	13.	Rotor Core	23.	Inner Bearing Cap Bolt
4.	Conduit Box Top	14.	Lifting Eye Bolt	24.	Grease Plug
5.	Conduit Box Bottom-Holding Bolt	15.	Stator Core	25.	*Ball Bearing P.E.
6.	*Ball Bearing O.P.E.	16.	Frame	26.	Shaft Extention Key
7.	Pre-loading Spring	17.	Stator Winding	27.	Shaft
8.	Inner Bearing Cap O.P.E.	18.	Baffel Plate Holding Screw	28.	Drain Plug (grease)
9.	Grease Plug	19.	Baffle Plate P.E.	29.	** Bracket Screen
10.	Inner Bearing Cap Bolt	20.	Bracket P.E.		

P.E. = Pulley End

O.P.E. = Opposite Pulley End

* = Bearing Numbers are shown on motor nameplate when requesting information or parts always give complete motor description, model and serial numbers.

** = Bracket and frame screens are optional.

WARNING

These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of all persons who install, operate or maintain this equipment.

GENERAL INFORMATION

Marathon Electric motors are all fully factory tested and inspected before shipping. Damage during shipment and storage can occur. Motors not correctly matched to the power supply and/or the load will not operate properly. These instructions are intended as a guide to identify and eliminate these problems before they are overlooked or cause further damage.

ACCEPTANCE

Check carefully for any damage that may have occurred in transit. If any damage or shortage is discovered, do not accept until an appropriate notation on the freight bill is made. Any damage discovered after receipt of equipment should be immediately reported to the carrier.

STORAGE

A. Keep motors clean
   1. Store indoors
   2. Keep covered to eliminate airborne dust and dirt.
   3. Cover openings for ventilation, conduit connections, etc. to prevent entry of rodents, snakes, birds, and insects, etc.

B. Keep motors dry
   1. Store in a dry area indoors
   2. Temperature swings should be minimal to prevent condensation.
   3. Space heaters are recommended to prevent condensation.
   4. Treat unpainted flanges, shafts, and fittings with a rust inhibitor.
   5. Check insulation resistance before putting motor into service. (Consult manufacturer for guidelines).

C. Keep Bearings Lubricated
   1. Once per month, rotate shaft several turns to distribute grease in bearings.
   2. If unit has been stored more than one year, add grease before start-up. (Refer to lubrication procedure).

INSTALLATION

UNCRATING AND INSPECTION

After uncrating, check for any damage which may have been incurred in handling. The motor shaft should turn freely by hand. Repair or replace any loose or broken parts before attempting to use the motor.

Check to be sure that motor has not been exposed to dirt, grit, or excessive moisture in shipment or storage before installation.

Measure insulation resistance (see operation). Clean and dry the windings as required.

Never start a motor which has been wet without having it thoroughly dried.

SAFETY

Motors should be installed, protected and fused in accordance with latest issue of National Electrical Code, NEMA Standard Publication No. MG 2 and local codes.

Eyebolts or lifting lugs are intended for lifting the motor only. These lifting provisions should never be used when lifting or handling the motor with other equipment (i.e. pumps, gear boxes, fans or other driven equipment) as a single unit. Be sure the eyebolt is fully threaded and tight in its mounting hole.

Eyebolt lifting capacity ratings is based on a lifting alignment coincident with the eyebolt centerline. Eyebolt capacity reduces as deviation from this alignment increases. See NEMA MG 2.

Frames and accessories of motors should be grounded in accordance with National Electrical Code (NEC) Article 430. For general information of grounding refer to NEC Article 250.

Rotating parts such as pulleys, couplings, external fans, and shaft extensions should be permanently guarded.

LOCATION

In selecting a location for the motor, consideration should be given to environment and ventilation. A motor with the proper enclosure for the expected operating condition should be selected.

The ambient temperature of the air surrounding the motor should not exceed 40°C (104°F) unless the motor has been especially designed for high ambient temperature applications. The free flow of air around the motor should not be obstructed.

The motor should never be placed in a room with a hazardous process, or where flammable gases or combustible material may be present, unless it it specifically designed for this type of service.

1. Dripproof (open) motors are intended for use indoors where atmosphere is relatively clean, dry and non-corrosive.
2. Dripproof (open) fire pump motors are to be installed in a Type 2 dripproof environment as defined in NEMA 250.
3. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations.
4. Explosion proof motors are built for use in hazardous locations as indicated by Underwriters' label on motor. Consult UL, NEC, and local codes for guidance.

Refer to Marathon Electric for application assistance.

FLOOR MOUNTING

Motors should be provided with a firm, rigid foundation, with the plane of four mounting pads flat within .010" for 56 to 210 frame; .015" from 250 through 500 frame. This may be accomplished by shims under the motor feet. For special isolation mounting, contact Marathon Electric for assistance.

V-BELT DRIVE

1. Select proper type and number of belts and sheaves. Excessive belt load will damage bearings. Sheaves should be in accordance to NEMA Spec. MG-1 or as approved by the manufacturer for a specific application.
2. Align sheaves carefully to avoid axial thrust on motor bearing. The drive sheave on the motor should be positioned toward the motor so it is as close as possible to the bearing.

3. When adjusting belt tension, make sure the motor is secured by all mounting bolts before tightening belts.
4. Adjust belt tension to belt manufacturers recommendations. Excessive tension will decrease bearing life.
5. For more information see Marathon Electric Publication SB588.

DIRECT CONNECTED DRIVE

Flexible or solid shaft couplings must be properly aligned for satisfactory operation. On flexible couplings, the clearance between the ends of the shafts should be in accordance with the coupling manufacturer's recommendations or NEMA standards for end play and limited travel in coupling.

MISALIGNMENT and RUN-OUT between direct connected shafts will cause increased bearing loads and vibration even when the connection is made by means of a flexible coupling. Excessive misalignment will decrease bearing life. Proper alignment, per the specifications of the coupling being used, is critical.

Some large motors are furnished with roller bearings. Roller bearings should **not** be used for direct drive.

ELECTRICAL CONNECTIONS

CAUTION

Install and ground per local and national codes. Consult qualified personnel with questions or if repairs are required.

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

1. All wiring, fusing, and grounding must comply with National Electrical Codes and local codes.
2. To determine proper wiring, rotation and voltage connections, refer to the information and diagram on the nameplate, separate connection plate or decal. If the plate or decal has been removed, contact Marathon Electric for assistance.
3. Use the proper size of line current protection and motor controls as required by the National Electrical Code and local codes. Recommended use is 125% of full load amps as shown on the nameplate for motors with 40°C ambient and a service factor over 1.0. Recommended use is 115% of full load amps as shown on the nameplate for all other motors. Do not use protection with larger capacities than recommended. Three phase motors must have all three phases protected.

THERMAL PROTECTOR INFORMATION

The nameplate will indicate one of the following:

1. Motor is thermally protected
2. Motor is not thermally protected
3. Motor is provided with overheat protective device

For examples, refer to paragraphs below:

1. Motors equipped with built-in thermal protection have "THERMALLY PROTECTED" stamped on the nameplate. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded.
   The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, press the red button to reset.
2. Motors without thermal protection have nothing stamped on nameplate about thermal protection.
3. Motors that are provided with overheat protective device that does not open the motor circuit directly will indicate "WITH OVERHEAT PROTECTIVE DEVICE".
   A. Motors with this type of "Overheat Protective Device" have protector leads brought out in the motor conduit box marked "P1" and "P2". These leads are intended for connection in series with the stop button of the 3-wire pilot circuit for the magnetic starter which controls the motor. See Figure 1.
   B. The circuit controlled by the above "Overheat Protective Device" must be limited to a maximum of 600 volts and 360 volt-amps.

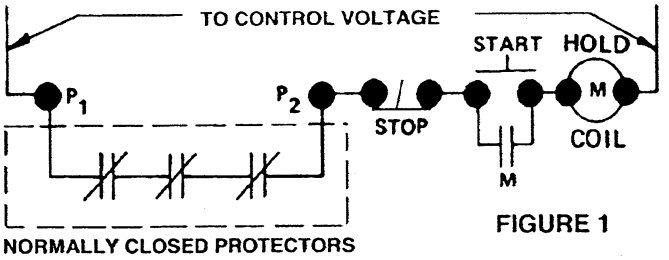
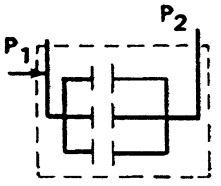


FIGURE 1



Normally Open (N/O) Motor Thermostats may be used in conjunction with controls installed by Original Equipment Manufacturers.

FIGURE 1A

CHANGING ROTATION

1. Keep hands and clothing away from rotating parts.
2. Before the motor is coupled to the load, determine proper rotation.
3. Check rotation by jogging or bumping. Apply power to the motor leads for a short period of time, enough to just get motor shaft to rotate a slight amount to observe shaft rotating direction.
4. Three phase - interchange any two (2) of the three (3) line leads. Single phase - reconnect per the connection diagram on the motor.

REDUCED VOLTAGE STARTING

Motors used on reduced voltage starting, should be carefully selected based upon power supply limitations and driven load requirements. The motors starting torque will be reduced when using reduced voltage starting. The elapsed time on the start step should be kept as short as possible and should not exceed 5 seconds. It is recommended that this time be limited to 2 seconds. Refer to Marathon Electric for application assistance.

OPERATION

WARNING

Disconnect and lock out before working on motor or driven equipment.

BEFORE INITIAL STARTING

1. If a motor has become damp in shipment or in storage, measure the insulation resistance of the stator winding.

$$\text{Minimum Insulation Resistance In Megohms} = 1 + \frac{\text{Rated Voltage}}{1000}$$

Do not attempt to run the motor if the insulation resistance is below this value.

2. If insulation resistance is low, dry out the moisture in one of the following ways:
   a. Bake in oven at temperature not more than 90°C (194°F).
   b. Enclose motor with canvas or similar covering, leaving a hole at the top for moisture to escape, and insert heating units or lamps.
   c. Pass a current at low voltage (rotor locked) through the stator winding. Increase the current gradually until the winding temperature, measured with a thermometer, reaches 90°C (194°F). Do not exceed this temperature.
3. See that voltage and frequency stamped on motor and control nameplates correspond with that of the power line.
4. Check all connections to the motor and control with the wiring diagram.
5. Be sure rotor turns freely when disconnected from the load. Any foreign matter in the air gap should be removed.
6. Leave the motor disconnected from the load for the initial start (see following caution). Check for proper rotation. Check for correct voltage (within ± 10% of nameplate value) and that it is balanced within 1% at the motor terminals. After the machine is coupled to the load, check that the nameplate amps are not exceeded. Recheck the voltage level and balance under load per the above guidelines.

Shut down the motor if the above parameters are not met or if any other noise or vibration disturbances are present. Consult NEMA guidelines or the equipment manufacturer if any questions exist before operating equipment.

CAUTION

For motors nameplated as "belted duty only", do not run motor without belts properly installed.

COLLECTOR RINGS (Wound Rotor Motors Only)

The collector rings are sometimes treated at the factory to protect them while in stock and during shipment. The brushes have been fastened in a raised position. Before putting the motor into service, the collector rings should be cleaned to remove this treatment. Use a cleaning fluid that is made for degreasing electrical equipment. All of the brushes must be released and lowered to the collector surface. Keep the rings clean and maintain their polished surfaces. Ordinarily, the rings will require only occasional wiping with a piece of canvas or non-linting cloth. Do not let dust or dirt accumulate between the collector rings.

BRUSHES (Wound Rotor Motors Only)

See that the brushes move freely in the holders and at the same time make firm, even contact with the collector rings. The pressure should be between 2 and 3 pounds per square inch of brush surface.

When installing new brushes, fit them carefully to the collector rings. Be sure that the copper pigtail conductors are securely fastened to, and make good contact with, the brushholders.

ALLOWABLE VOLTAGE AND FREQUENCY RANGE

If voltage and frequency are within the following range, motors will operate, but with somewhat different characteristics than obtained with correct nameplate values.

1. Voltage: Within 10% above or below the value stamped on the nameplate. On three phase systems the voltage should be balanced within 1%. A small voltage unbalance will cause a significant current unbalance.
2. Frequency: Within 5% above or below the value stamped on the nameplate.
3. Voltage and Frequency together: Within 10% (providing frequency above is less than 5%) above or below values stamped on the nameplate.

CLEANLINESS

Keep both the interior and exterior of the motor free from dirt, water, oil and grease. Motors operating in dirty places should be periodically disassembled and thoroughly cleaned.

CONDENSATION DRAIN PLUGS

All explosion proof and some totally enclosed motors are equipped with automatic drain plugs, they should be free of oil, grease, paint, grit and dirt so they don't clog up. The drain system is designed for normal floor (feet down) mounting. For other mounting positions, modification of the drain system may be required, consult Marathon Electric.

SERVICE

WARNING

Disconnect power before working on motor or driven equipment. Motors with automatic thermal protectors will automatically restart when the protector cools. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

CAUTION

Overgreasing bearings can cause premature bearing and/or motor failure. The amount of grease added should be carefully controlled.

NOTE

If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction.

Marathon Electric motors are pregreased with a polyurea mineral oil NGLI grade 2 type grease unless stated otherwise on the motor nameplate. Some compatible brands of polyurea mineral base type grease are: Chevron SRI #2, Rykon Premium #2, Exxon Polyrex EM or Texaco Polystar RB.

Motors are properly lubricated at the time of manufacture. It is not necessary to lubricate at the time of installation unless the motor has been in storage for a period of 12 months or longer (refer to lubrication procedure that follows).

LUBRICATION PROCEDURES

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.
4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the Relubrication Time Intervals table for service schedule and Relubrication Amounts table for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs (see following warning).
7. Motor is ready for operation.

WARNING

If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

RELUBRICATION TIME INTERVAL

(For motors with regreasing provisions).

Service Condition	NEMA FRAME SIZE					
	140-180		210-360		400-510	
	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 month
Seasonal	See Note 2.					

NOTE

1. For motors nameplated as "belted duty only" divide the above intervals by 3.
2. Lubricate at the beginning of the season. Then follow service schedule above.

SEASONAL SERVICE: The motor remains idle for a period of 6 months or more.

STANDARD SERVICE: Up to 16 hours of operation per day, indoors, 100°F maximum ambient.

SEVERE SERVICE: Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures (100° to 150°F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

RELUBRICATION AMOUNTS

(For motors with regreasing provisions).

NEMA FRAME SIZE	VOLUME cu. in. (fluid oz.)
140	.25 (.14)
180	.50 (.28)
210	.75 (.42)
250	1.00 (.55)
280	1.25 (.69)
320	1.50 (.83)
360	1.75 (.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

TROUBLESHOOTING

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

If trouble is experienced in the operation of the motor, make sure that:

1. The bearings are in good condition and operating properly.
2. There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
3. The air gap is uniform. (Consult manufacturer for specifications).
4. All bolts and nuts are tightened securely.
5. Proper connection to drive machine or load has been made.

In checking for electrical troubles, be sure that:

1. The line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.
2. The voltage is actually available at motor terminals.
3. The fuses and other protective devices are in proper condition.
4. All connections and contacts are properly made in the circuits between the control apparatus and motor.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be desired for the purchaser's purposes, the matter should be referred to the nearest Marathon Electric Manufacturing Corp. sales office listed on the back page.

MOTOR TROUBLE SHOOTING CHART

Your motor service and any trouble shooting must be handled by qualified persons who have proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor nameplate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also see that all control contacts are closing.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication.
	Short circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload	Reduce load.
	Low voltage	See that nameplate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay, stator and pushbuttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop.	Use higher voltage on transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check load motor is supposed to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Adequate wire size.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.
Motor overheats while running under load	Overload	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventialation of motor.	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearing.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add shim.
Unbalanced line current on polyphase motors during normal operation	Unequal terminal volts	Check leads and connections.
	Single phase operation	Check for open contacts.
	Unbalanced voltage	Correct unbalanced power supply.
Scraping noise	Fan rubbing air shield	Remove interference.
	Fan striking insulation	Clear fan.
	Loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small.	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
Hot bearings ball	Insufficient grease	Maintain proper quantity of grease in bearing.
	Deterioration of grease or lubircant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly.

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SB 181 6/2001

Liquid Bag Filter Vessel

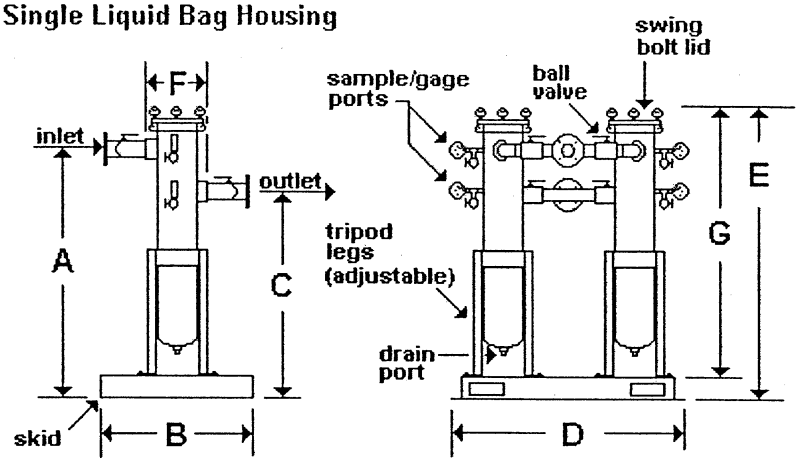
Single, duplex and multi–round welded steel size #2 bag filter housings, With Inlet and outlet isolation valves for easy filter change-out while operating

Receiving

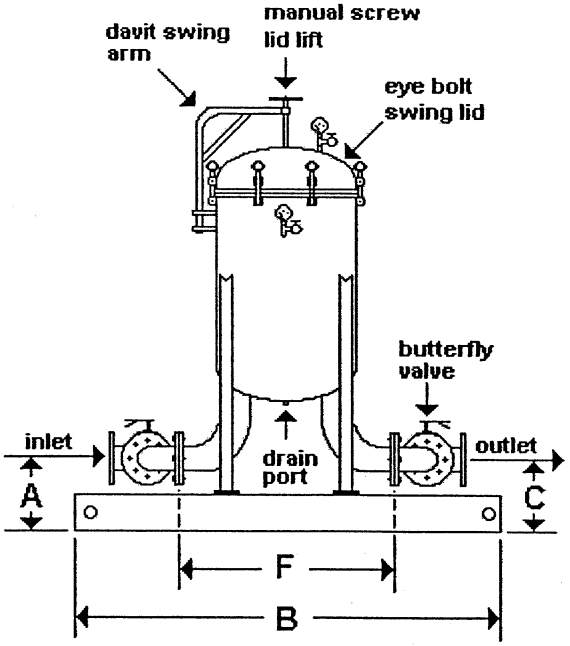
- Always use a properly sized piece of lifting equipment to offload the bag filter from the delivery truck. Take care not to damage the vessel during the offloading and setting into place.
- Anchor the bag filter to the floor.

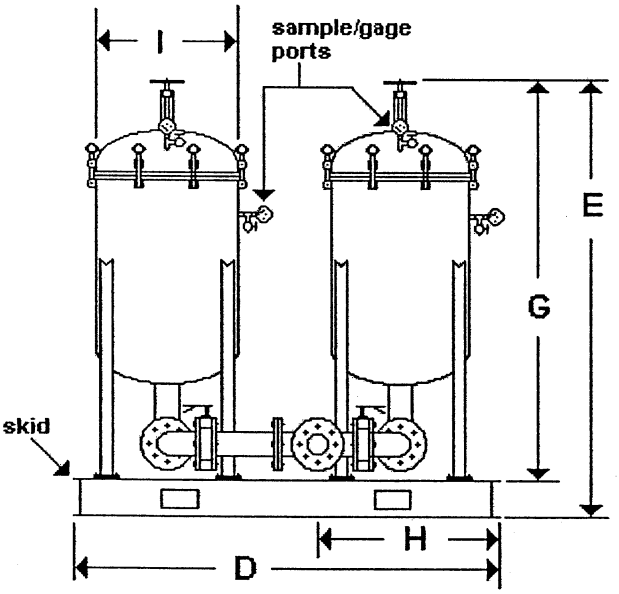
Features & Specifications

Single Liquid Bag Housing



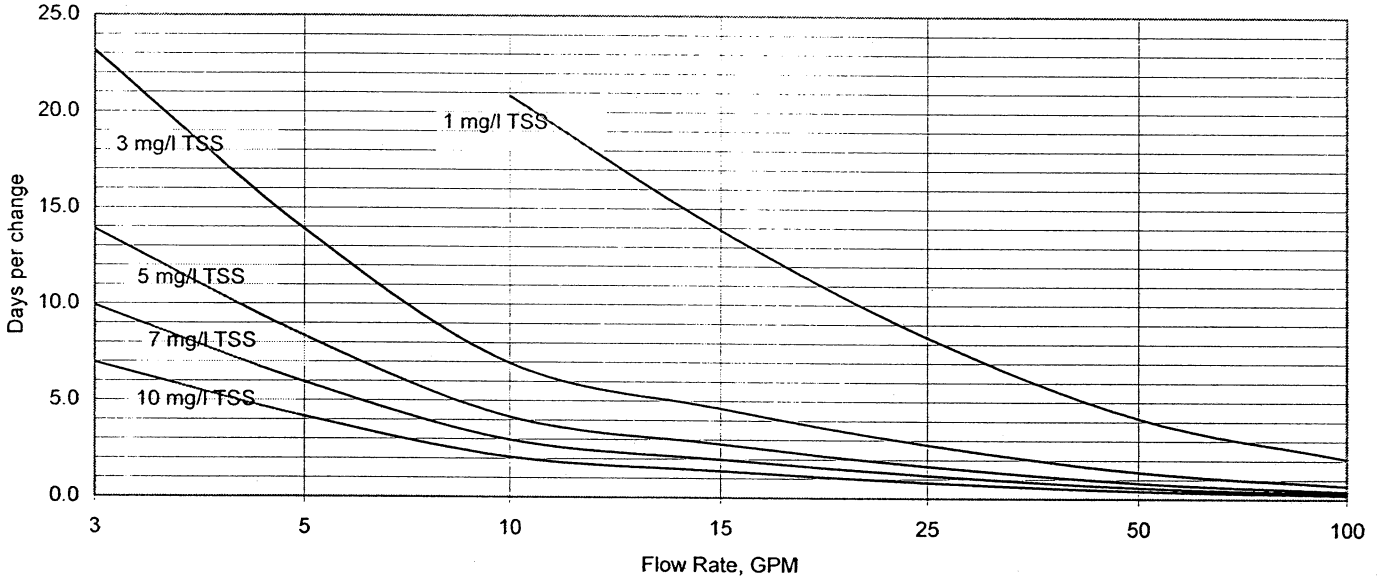
Multi-Round Liquid Bag Housing





Model Number	Number of #2 size baskets	Total Straining Filter Area Ft^2	Inlet/Outlet Connection	Dim A In.	Dim B In.	Dim C In.	Dim D In.	Dim E In	Dim F In	Dim G In	Dim H In	Dim I In	Empty weight, Single/ Duplex, lbs	Operating weight, Single/ Duplex, lbs
88-30	1	4.4	2" FPT (3", 4" opt. 2" 125lb flng standard on duplex)	46.2	30	39.2	36	53	10.6	49	NA	NA	140 / 450	210/590
1818	2	8.8	4" 150 lb flng (2",3" opt.)	11.8	48	11.8	65	65	22	59	25	18	435 / 1,720	770/3,280
2224	3	13.2	4" 150 lb flng (2",3" opt.)	12	52	12	72	74.5	25.8	68.5	28	24	555 / 1,960	1,150/3,140
2424	4	17.6	4" 150 lb flng (2",3" opt.)	12.5	55	12.5	72	76	29	70	28	24	555 / 1,960	1,150/3,200
3030	6	26.4	6" 150 lb flng (3",4" opt.)	13	65	13	82	76.4	32.8	70.4	34	30	705 / 2,560	1,650/4,400
3636	8	35.2	6" 150 lb flng (4", 8" opt)	14.3	70	14.3	84	82.5	45	76.5	37	36	1,010 / 3,120	2,400/5,900
4242	12	52.8	8" 150 lb flng (6", 10" opt)	15.5	89	15.5	96	91	52.2	85	42	42	2,070 / 5,740	4,000/9,600
4848	17	74.8	10" 150 lb flng (8", 12" opt)	15.5	104	15.5	114	95.7	59.6	89.7	49	48	2,350 / 6,600	4,800/11,400

(1) Size # 2 Filter Bag approxiamate change frequency
assumes 90% of solids are filterable 25 micron or larger using a 25 micron polyester filter bag, 4.4ft^2 of surface area



Installation

- Set the bag filter vessel in place using the properly sized lifting equipment.
- Anchor the vessel in place per the site specifications.
- Connect the influent and effluent piping to the vessel.
    - It is recommended to use a flex connector on both the influent and effluent piping connections on the vessel.
    - It is recommended to have an isolation valve on both the influent and effluent piping to isolate the vessel for filter change out.
    - It is recommended to have a pressure gauge and sample tap on the influent and effluent of the vessel as well. The pressure gauges allow the vessel differential pressure to be monitored to help detect fouling of the bag. The sample valves are recommended to monitor the performance of the bag.
    - An air bleed valve should be installed on the top of the vessel and a drain at the bottom.

Start-Up Procedure

- Put a bag in the housing and tighten down the top cover.
- Begin normal flow through the vessel.
- Slowly open the vent valve. Release any air that is still in the vessel. When water begins coming out the valve, close the valve. Periodically bleed the air out of the vessel.
- Check initial readings of the pressure gauges at the flow rate of operation.

Shutdown Procedure

- Turn off water flow to the vessel.
- Close the inlet & outlet valves
- Open the air bleed line to relieve any pressure in the vessel.
- Open the drain valve and drain the water from the vessel (note: the water does not need to be drained if the vessel is not shut down for extended periods.
- If the vessel is to be shut down for a long period of time and the bag is fouled, the bag should be removed and replaced with a new bag.

Maintenance Procedure

As Needed	Bag change out	When differential pressure across the vessel exceeds 15-20 psi. 1. Shut off water flow to the vessel. 2. Isolate the inlet and outlet of the vessel . 3. Slowly open the air bleed valve to release the pressure. 4. Open the drain valve and drain the vessel. 5. Open the lid and pull out the dirty filter. 6. Put in a new filter and make sure it is seated properly. 7. Reinstall cover. 8. Close drain. 9. Open isolation valves. 10. Begin water flow. 11. Bleed air out of the vessel and close bleed air valve.

Trouble Shooting Guide

Problem	Cause	Task
High differential pressure	Bag fouled	Replace bag
	Solids or organics fouling top of bed	Replace bag
	Air pocket	Bleed air from top of vessel
Solids in the effluent	Bag torn	Replace bag
	Too large of micron bag	Use smaller micron bag

Options

- 304 or 316 Stainless steel construction
- ASME designed & stamped
- NSF standard 61 certified coatings
- Pressure relief assemblies, PRV or rupture disk
- Polypropylene filter housing for corrosive fluids
- Heat trace or immersion heaters for classified or non-classified electrical areas for freeze protection
- R-5 insulation with jacket, (steel or aluminum jacket)
- Various piping configurations and materials
- Pressure & differential pressure switches, transmitters and gages of various types
- Flow, pressure, level & temperature gages or transmitters

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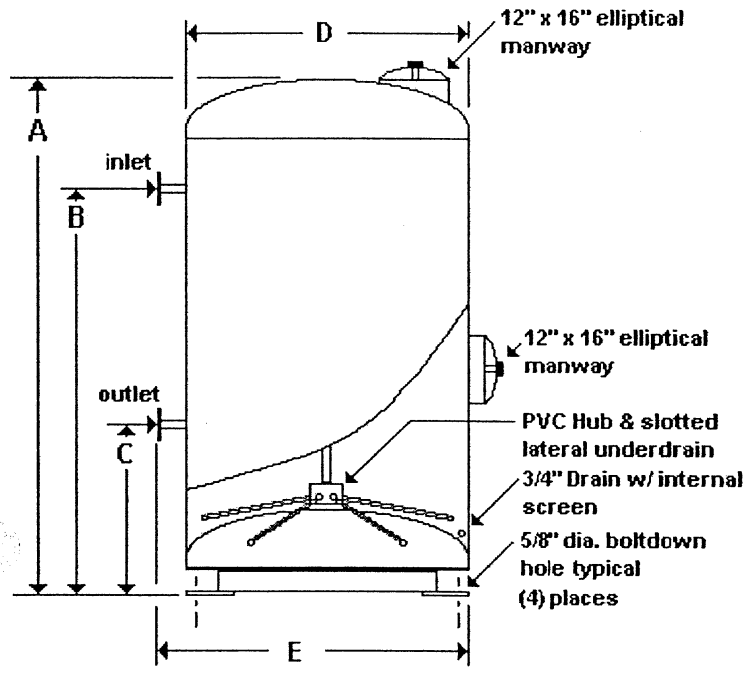
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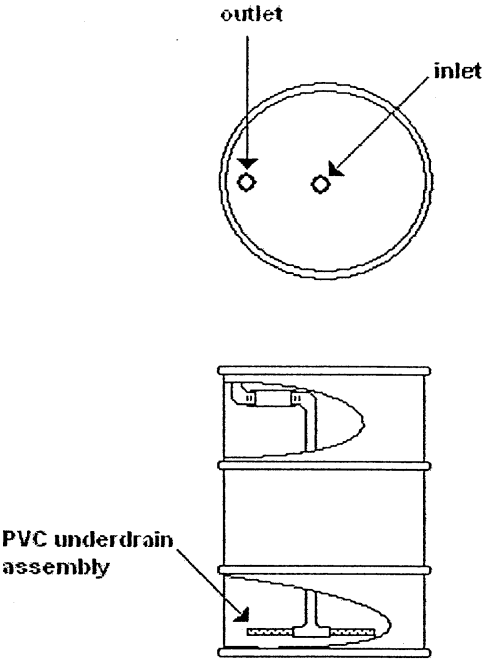
LC Series Liquid Adsorber Vessel Operation & Maintenance Manual

Receiving

- Always use a properly sized piece of lifting equipment to offload the carbon vessel from the delivery truck. Take care not to damage the vessel during the offloading and setting into place.
- Carefully inspect the interior (if the vessel is empty of carbon), and the exterior for damage that might have occurred during shipping. Note any damage on the bill of lading before the delivery truck leaves the site.

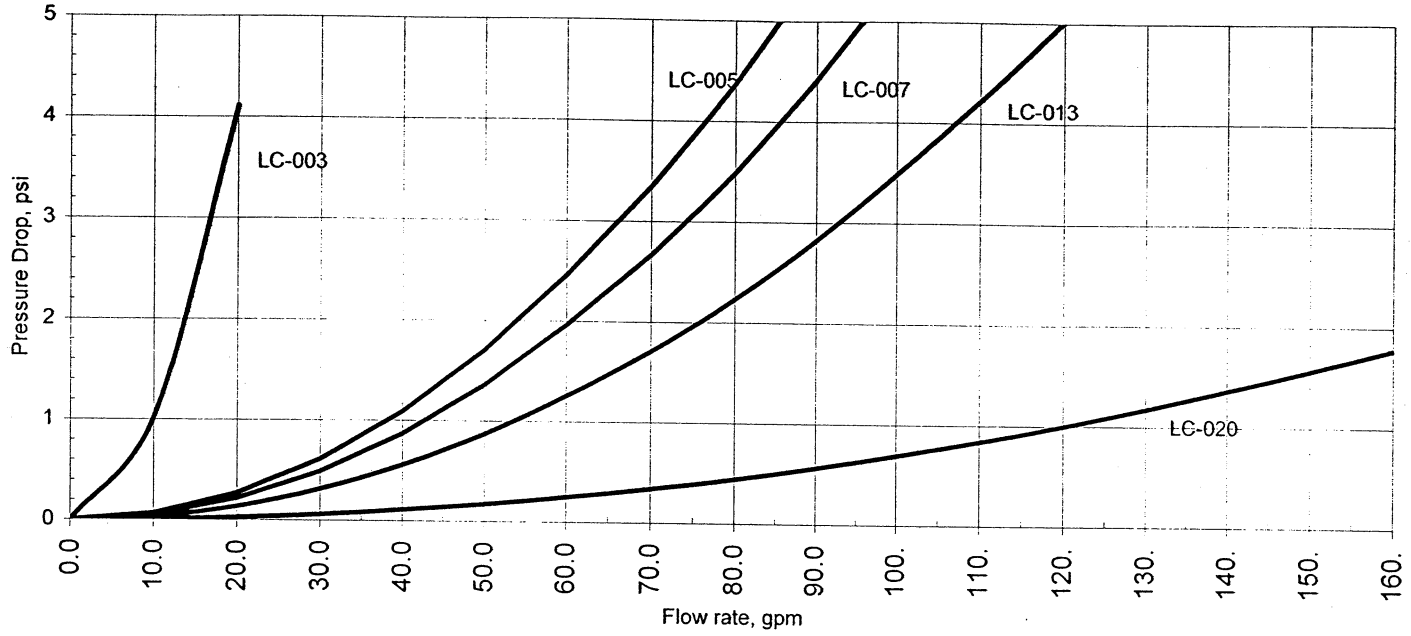
Features & Specifications



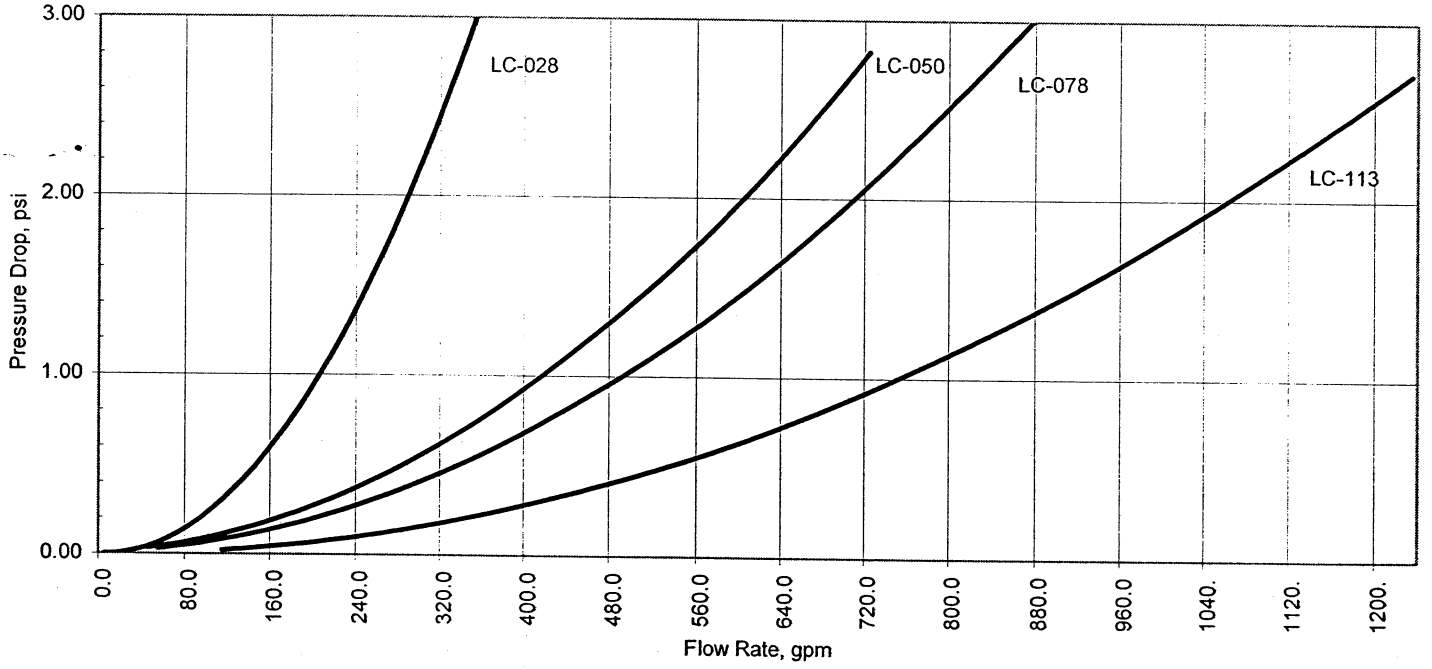


Model Number	Inlet/Outlet Connection	Dim A In.	Dim B In.	Dim C In.	Dim D In.	Dim E In	Rated Flow GPM	Backwash Flow GPM	Carbon Capacity Lbs.	Empty Weight Lbs.	Loaded Weight Lbs.	Operating Weight Lbs.	Spent & Drained Weight Lbs.	Pressure Rating, PSI
LC-003	1" FPT (top I/O)	36½	36½	24 ¼	24 ¼	24 ¼	10		200	65	205	425	355	10 psi
LC-005	2" 150 lb flng	84	70	18	30	36	40		500	680	1,200	2,380	1,380	90 psi
LC-007	2" 150 lb flng	84	70	18	36	42	57		1,000	880	1,880	3,680	2,280	90 psi
LC-013	2" 150 lb flng	84	70	20	48	54	101		1,500	1,280	2,780	6,280	3,380	90 psi
LC-020	3" 150 lb flng	86	70	26	60	66	157		2,500	1,650	4,150	9,650	5,150	75 psi
LC-028	4" 150 lb flng	126	120	48	72	78	226		5,000	4,000	9,000	24,000	14,000	75 psi
LC-050	6" 150 lb flng	148	142	60	96	102	400		10,000	8,100	18,100	36,500	28,100	75 psi
LC-078	6" 150 lb flng	190	180	65	120	126	628		20,000	10,900	30,000	67,900	50,900	75 psi
LC-113	8" 150 lb flng	216	210	84	144	150	900		30,000	16,700	44,700	101,200	72,500	75 psi

Pressure Drop for LC-003, LC-005, LC-007, LC-013 & LC-020 Liquid Phase Carbon Adsorbers
with 8x30 mesh GAC, clean bed only



Pressure Drop for LC-028, LC-050, LC-078 & LC-113



Installation

- Set the carbon vessel in place using the properly sized lifting equipment. (see carbon filling procedures below to determine if the vessel should be filled with carbon prior to setting in place if it was not shipped full of carbon)
- Anchor the vessel in place per the site specifications.
- Connect the influent and effluent piping to the carbon vessel.
    - It is recommended to use a flex connector on both the influent and effluent piping connections on the carbon vessel.
    - It is recommended to have an isolation valve on both the influent and effluent piping to isolate the carbon vessel for carbon change outs or trouble shooting of the system.
    - It is recommended to have a pressure gauge and sample tap on the influent and effluent of the carbon vessel as well. The pressure gauges allow the vessel differential pressure to be monitored to help detect fouling of the carbon vessel. The sample valves are recommended to monitor the performance of the carbon bed.
    - It is required on the effluent of the final carbon vessel to have the effluent piping rise up to the top of the carbon vessel and have an anti-siphon valve installed prior to final discharge. This will prevent the carbon vessel from draining and creating air pockets in the vessel as the water flow cycles through the vessel. If an anti-siphon valve is not installed and the final discharge is lower than the vessels, the water can siphon from the carbon vessels to the final discharge.
    - A pressure relief valve can also be installed on the vessel to prevent over pressurizaton of the vessel.

Start-Up Procedure

- Fill carbon vessel with carbon
- Leave the vent port open.
- Isolate the vessel and fill with clean water so the carbon bed is covered with water.
- Allow the carbon vessel to remain vented and filled with clean water for 24 hours prior to system startup. This will release the air that will develop from the carbon initially getting wet. Check for any water leaks.
- After 24 hours, close the venting port. Check again for any leaks that might have developed.
- If possible, it is recommended to backwash the vessel at initial start-up to remove the carbon fines (see "Backwash Procedures" section below). If the vessels are not backwashed, the carbon fines can create added backpressure to the system.
- After backwashing the system, orientate the valves for normal system flow operation.
- Begin normal flow through the carbon vessel.
- Slowly open the vent valve. Release any air that is still in the vessel. When water begins coming out the valve, close the valve. Periodically bleed the air out of the vessel.
- Check initial readings of the pressure gauges at the flow rate of operation.

Shutdown Procedure

- Turn off water flow to the vessels.
- Close the inlet & outlet valves
- Open the air bleed line to relieve any pressure in the vessel.
- Open the drain valve and drain the water from the vessel (note: the water does not need to be drained if the vessel is not shut down for extended periods.
- If the vessel is to be shut down for a long period of time and the carbon is spent, the carbon should be removed.

Maintenance Procedure

As Needed	Backwash	When differential pressure across the vessel exceeds 15-20 psi.
	Exchange Carbon	When Carbon becomes spent or cannot be effectively backwashed.

Trouble Shooting Guide

Problem	Cause	Task
High differential pressure	Fines were not backwashed out at startup	Backwash vessel
	Solids or organics fouling top of bed	Backwash vessel
	Air pocket	Bleed air from top of vessel
High differential pressure even after backwash	Solids or organics fouling top of bed	Remove the top layer or affected area of the carbon bed
Carbon in the effluent	Lateral broken	Empty carbon bed and replace damaged lateral.

Options

- Higher design pressures
- ASME designed & stamped
- Stainless steel internals, 316 or 304 ss
- Piping header for series lead/lag, parallel or standby operation of (2), (3), or more vessels
- Skid assemblies for single or multiple vessels
- Bed sampling ports
- Heat trace or immersion heaters for classified or non-classified electrical areas for freeze protection
- R-5 insulation with jacket, (steel or aluminum jacket)
- Vinyl ester interior lining for corrosive or high abrasion service
- Pressure relief assemblies, PRV or rupture disk
- FRP construction for corrosive environments
- Interior lining Holiday spark testing
- Flow, pressure, level & temperature gages or transmitters
- Flanged or NPT inlet and outlet connections or additional manways

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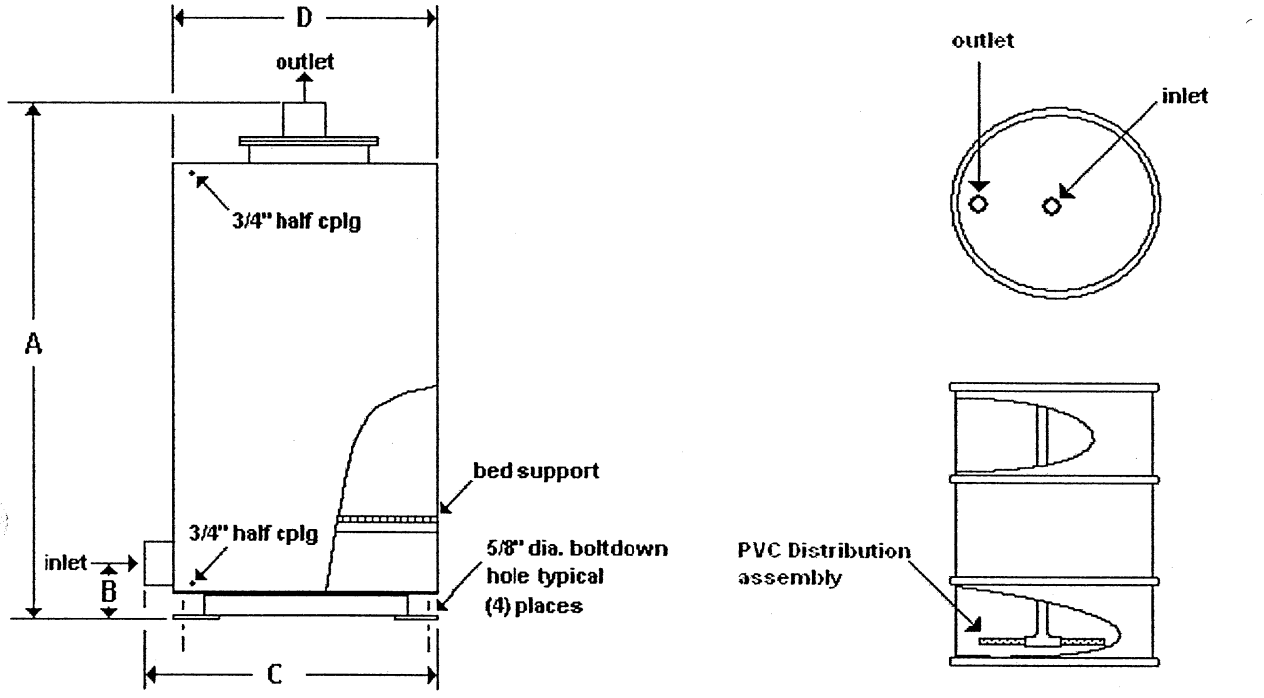
VC Series Vapor Adsorber Vessel Operation & Maintenance Manual

H2K Technologies, Inc.

Receiving

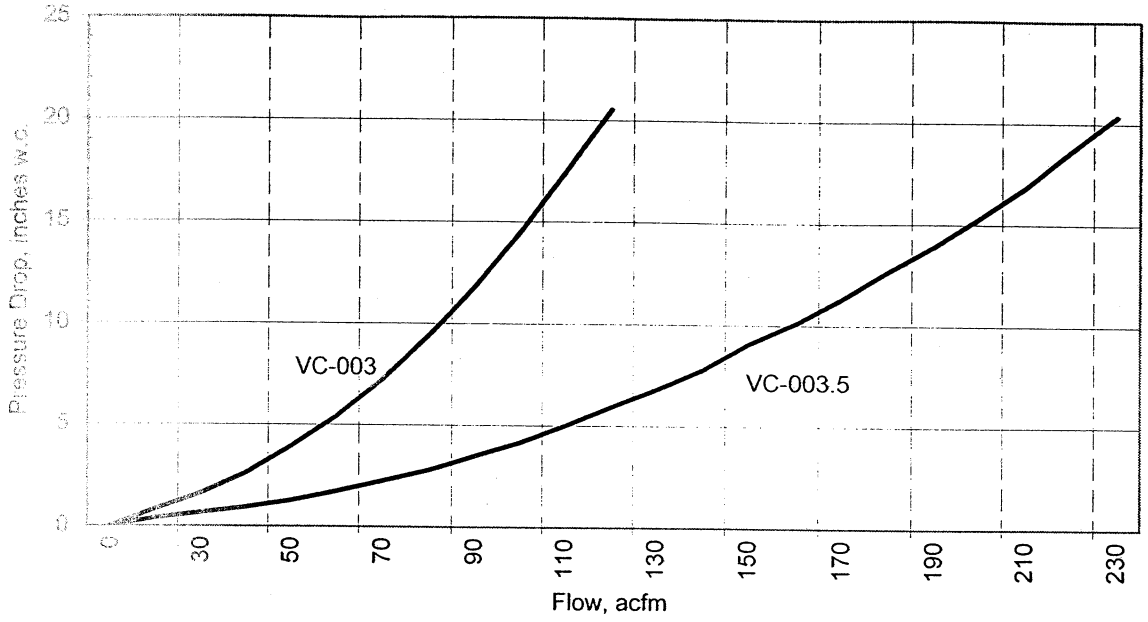
- Always use a properly sized piece of lifting equipment to offload the carbon vessel from the delivery truck. Take care not to damage the system during the offloading and setting into place.
- Carefully inspect system for damage that might have occurred during shipping. Note any damage on the bill of lading before the delivery truck leaves the site.

Features & Specifications

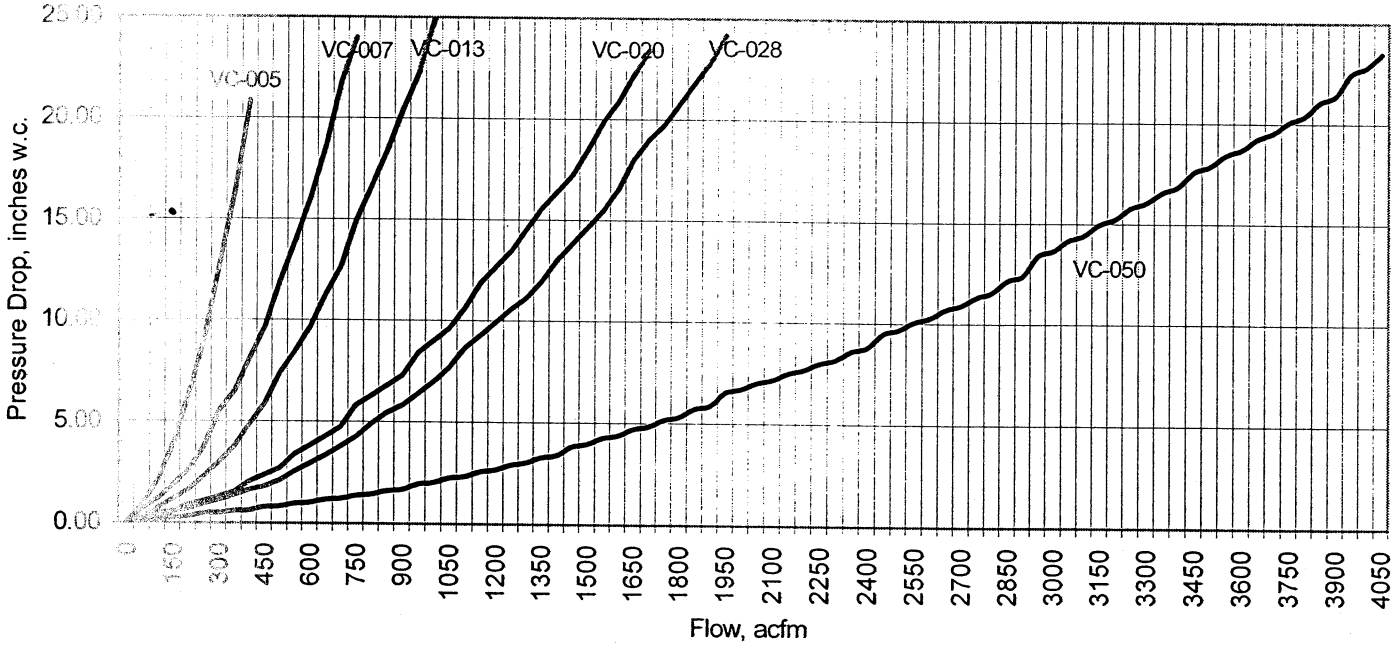


Model Number	Inlet/Outlet Connection	Dim A In.	Dim B In.	Dim C In.	Dim D In.	Rated Flow SCFM	Carbon Capacity Lbs.	Empty Weight Lbs.	Operating Weight Lbs.	Vacuum/ Pressure Rating, "Hg/PSI
VC-003	2" FPT (top in & out)	36½	36½	24 ¼	24 ¼	120	200	65	275	17"Hg/10psi
VC-003.5	4" FPT (top in & out)	38½	38½	28 ½	28 ½	250	250	100	350	17"Hg/9psi
VC-005	4" FPT	67	6	36	30	400	500	375	900	17"Hg/9psi
VC-007	6" FPT	84	7	44	38	700	1,000	700	1,800	17"Hg/9psi
VC-013	6" FPT	84	8	54	48	1,100	1,500	950	2,450	10"Hg/5psi
VC-020	8" dia.x¼" plate flange	84	8	66	60	1,600	2,000	1,200	3,200	10"Hg/5psi
VC-028	8" dia.x¼" plate flange	84	8	78	72	1,800	3,000	1,800	4,980	8"Hg/4psi
VC-050	12" dia.x¼" plate flange	84	10	102	96	3,700	5,000	2,900	8,000	8"Hg/4psi

Pressure Drop for VC Series Vapor Carbon Adsorbers with 4x10 mesh GAC



Pressure Drop for VC Series Vapor Adsorber with 4x10 mesh GAC



Installation

- Set the vessel in place using the properly sized lifting equipment. Anchor the system in place per the site specifications.
- Connect the influent and effluent piping to the system. (The inlet fitting is the top centered fitting on the drums and the lower side fitting on the larger vessels.)
    - It is recommended to use a flex connector on both the influent and effluent piping connections. The piping connected to the system should be self-supporting. Hoses are a good option whenever possible. Since the carbon will eventually need to be changed out, the piping will need to be easily removed from the top of the vessel to access the manway.
    - If the vessel is the final piece of the equipment in the treatment stream, a stack should be installed on the vessel to prevent rain or other water from entering the vessel.
    - Sample taps, flow meters, temperature gauges and pressure gauges can also be added to the piping system to monitor the performance of the vessel.
- Relative humidity and temperature are critical consideration for the carbon usage rates. The relative humidity should be approximately 50% RH. The temperature should not exceed 120 °F. A good rule of thumb is to have a 20 °F temperature rise through the carbon system from the original air source (SVE well, air stripper exhaust, etc...) to the discharge of the last vessel without exceeding 120 °F.

Start-Up Procedure

- Verify the system is properly secured to the floor.
- If the vessel is not filled with carbon, see the "carbon filling/removal procedures" section.
- Verify that all influent and effluent connections have been made, and open all valves to ensure that there are no restrictions on the air flow through the system.
- Begin air flow through the vessel filled with carbon.
- It is best to record the initial readings of the system for trouble shooting purposes later.

Inlet Pressure _____ Discharge Pressure _____

Inlet Temperature _____ Discharge Temperature _____

Inlet Air Sample _____ Discharge Air Sample _____

System flow rate _____ Location of flow meter _____

Shut Down Procedure

- Turn off the air flow through the vessel.
- Drain any condensate that may have accumulated in the bottom of the vessel.
- If the carbon is spent, remove the carbon, see the "carbon filling/removal procedures" section. If the carbon is not spent, it is safe to leave it in the vessel while the system is shut down.

Maintenance Procedure

****The list below is a recommend system maintenance list. The individual manufacturers' O&M manuals must be followed in addition to the list below.**

Weekly or as needed	Drain condensate	Condensate can develop any time the temperature in the vessel decreases below the temperature of the air source (SVE ground temperature, air stripper discharge temperature, etc...).
	Record system operating conditions	A good record of operating conditions helps monitor the performance of the system and helps to trouble shoot when a problem occurs.
As needed	Sample air stream	
	Replace carbon	Prior to or when breakthrough is reached.
	Inspect inside of vessel	When the carbon is exchanged. Check for signs of corrosion or damage.

Trouble Shooting Procedure

Problem	Cause	Task
Contaminants detected in the discharge air	Carbon has reached break through.	Replace carbon.
Break through seems premature	Higher than expected contaminant levels on the inlet of the vessel.	Replace carbon more frequently or bleed more clean air into the air stream to dilute the air stream. This will extend the amount of time between exchanges.
Moisture in the discharge air stream	Condensation of moisture in the vapor stream	Add an inline heater or insulate the vessels so the discharge temperature of the last vessel is 20 °F warmer than the original air source. The original air source can be the ground, an air stripper discharge, etc…
Increasing backpressure through the vessel	Condensation of moisture in the vapor stream	Add an inline heater or insulate the vessels so the discharge temperature of the last vessel is 20 °F warmer than the original air source. The original air source can be the ground, an air stripper discharge, etc…
Backpressure is higher than expected in the vessel	Too much carbon added to the vessel	Remove some of the carbon.
	Too high of air flow through the vessel	Adjust the air flow to the proper air flow for the vessel.

Carbon Filling/Removal Procedures

Filling

Always were proper protective equipment. Tyvek, safety glasses, and a dust mask are required as a minimum. The carbon will be very dusty. Also follow all safety procedures for climbing to the top of the vessel.

- Turn off the air flow through the vessel.
- Take off manway or access cover at the top of the vessel.
- If there is currently carbon in the vessel, it first has to be removed.
- When the vessel is empty, begin filling with new carbon.
- Carbon normally comes in 1000 lb. Bulk sacks. It can also come in smaller bags. If the carbon is in small bags, begin manually dumping the carbon into the vessel until the proper amount of carbon is added to the system. If the carbon is in 1000 lb bulk sacks, a forklift (with a high enough vertical extension to get the bags above the vessel), or a crane will be required. The bulk sack has four lifting straps on the top of the bag (one on each corner).
- Being careful not to puncture the carbon sack, lift the sack with the forklift or crane via the lifting straps at the top of the sack.
- Position the bottom center of the back directly above the opening in the top of the vessel. Leave about 1 foot of height between the vessel and the sack.
- There is a shoot tied in the bottom of the bag. Begin to untie the shoot. Be very careful and do this slowly. Be sure the shoot is over the opening before it is completely untied. The carbon will come out quickly if the shoot is completely open. The flow of carbon can be stopped by pinching off the shoot. The bag will slowly drop as the carbon comes out. Do not put your hands or arms between the bag and the vessel. If it is necessary to pinch off the shoot, have the bag raised up 2 feet above the vessel before reaching for the shoot.
- When the proper amount of carbon is added to the vessel, replace the manway or access cover and replace all piping that was removed.
- The system can immediately be put back into operation.

Removal

Always were proper protective equipment. Tyvek, safety glasses, and a dust mask are required as a minimum. The carbon will be very dusty. Also follow all safety procedures for climbing to the top of the vessel.

A vacuum system will be required to remove carbon from any vessels other than the drum style vessels. The drums can either be easily replaced with new drums, or the carbon in the drums can be dumped into other disposal containers.

For larger vessels:

- Turn off the air flow through the vessel.
- Take off manway or access cover at the top of the vessel.
- With the suction hose of the vacuum system, begin vacuuming out the carbon. Start at the top of the carbon bed allowing enough air flow to convey the carbon to the disposal container.
- Be careful at the bottom of the carbon bed not to puncture the support screen holding up the carbon. If the screen is damaged, it should be repaired prior to replacing the new carbon or the air diffusion area will be filled with carbon.
- After all the carbon has been removed, inspect the internals of the vessel. Make sure there is no signs of corrosion or damage to the carbon support system. Repair any damage prior to filling with new carbon.

Options

- Stainless steel or Fiberglass re-enforced plastic construction
- Piping header or ducting for series, parallel or standby operation of (2), (3), or more vessels
- ASME designed & stamped for vacuum or pressure
- Heat trace for classified or non-classified electrical areas for freeze protection
- R-5 insulation with jacket, (steel or aluminum jacket)
- Higher Pressure or vacuum design
- Pressure relief assemblies, PRV or rupture disk
- Flow, pressure, level & temperature gages or transmitters
- Flanged or NPT inlet and outlet connections or additional manway

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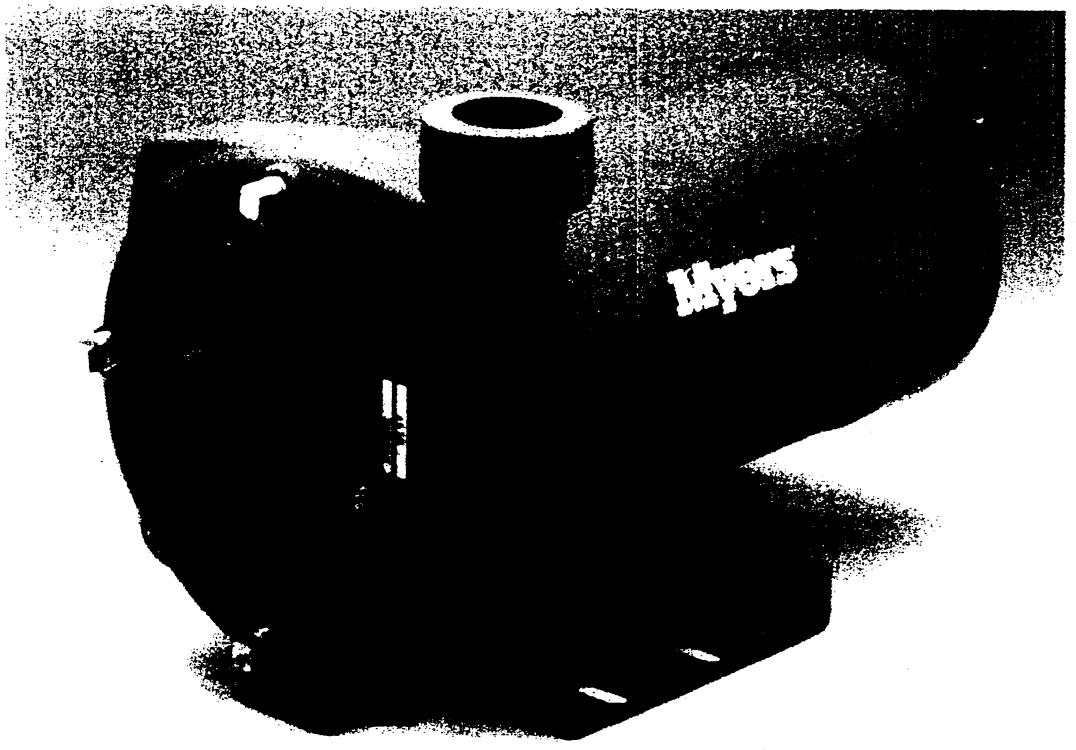
Myers®

Pentair Pump Group

Installation and Service Instructions

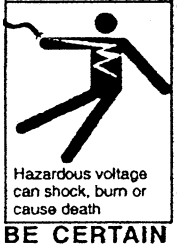
Centri-Thrift Pumps

CT Series



23833A378

WARNING! IMPORTANT SAFETY INSTRUCTIONS! READ CAREFULLY BEFORE INSTALLATION



FAILURE TO FOLLOW THESE INSTRUCTIONS AND COMPLY WITH ALL CODES MAY CAUSE SERIOUS BODILY INJURY AND/OR PROPERTY DAMAGE

⚠ 1) Before installing or servicing your pump, **BE CERTAIN THE PUMP POWER SOURCE IS TURNED OFF AND DISCONNECTED.**

⚠ 2) All installation and electrical wiring must adhere to state and local codes. Check with appropriate community agencies, or contact your local electrical and pump professionals for help.

⚠ 3) CALL AN ELECTRICIAN WHEN IN DOUBT. Pump must be connected to a separate electrical circuit directly from the entrance box. There must be an appropriately sized fuse or circuit breaker in this line. Tying into existing circuits may cause circuit overloading, blown fuses, tripped circuit breakers, or a burned up motor.

⚠ 4) Do not connect pump to a power supply until the pump is grounded. For maximum safety, a ground fault interrupter should be used. **CAUTION: FAILURE TO GROUND THIS UNIT PROPERLY MAY RESULT IN SEVERE ELECTRICAL SHOCK.**

⚠ 5) **WARNING**: Reduced risk of electric shock during operation of this pump requires the provision of acceptable grounding if the means of connection to the supply-connection box is other than grounded metal conduit, ground the motor back to the service by connecting a copper conductor, at least the size of the circuit conductors supplying the motor, to the ground screw provided within the wiring compartment of the motor.

⚠ 6) The voltage and phase of the power supply must match the voltage and phase of the pump motor.

⚠ 7) Do not use an extension cord.

⚠ 8) Do not work on this pump or switch while the power is on.

⚠ 9) Never operate a pump with a frayed or brittle power cord, and always protect it from sharp objects, hot surfaces, oil and chemicals. Avoid kinking the cord.

⚠ 10) Never service a motor or power cord with wet hands or while standing in or near water or damp ground.

⚠ 11) The three phase units must be wired by a qualified electrician, using an approved starter box and switching device.

⚠ 12) Do not use this pump in or near a swimming pool, pond, lake or river.

⚠ 13) Single phase motors are equipped with automatic resetting thermal protectors. The motor may restart unexpectedly causing the leads to energize or pump to turn. Three phase motors should be protected by proper, thermal and amperage protection. (Check local codes.)

⚠ 14) Do not pump gasoline, chemicals, corrosives, or flammable liquids; they could ignite, explode, or damage the pump, causing injury and voiding the warranty.



⚠ 15) Do not run this pump with the discharge completely closed this will create superheated water, which could damage the seal, and shorten the life of the motor. This superheated water could also cause severe burns.

⚠ 16) The following may cause severe damage to the pump and void warranty. It could also result in personal injury:

- Running the pump dry.
- Failure to protect the pump from below freezing temperatures.
- Running the pump with the discharge completely closed.
- Pumping chemicals or corrosive liquids.

⚠ 17) Never work on the pump or system without relieving the internal pressure.

⚠ 18) Do not pump water above 120° Fahrenheit.

⚠ 19) Never exceed the pressure rating of any system component.

INSTALLATION

PACKAGE CONTENTS - 1. Each pump is carefully tested and packaged at the factory.
2. The catalog lists all parts included with package. A packing list packed with pump, also lists contents.
3. Be sure all parts have been furnished and that nothing has been damaged in shipment.
4. OPEN PACKAGES AND MAKE THIS CHECK BEFORE GOING ON JOB.

PIPING - Pipes must line up and not be forced into position by unions. **Piping should be independently supported near the pump so that no strain will be placed on the pump casing**. Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as possible and use a minimum of fittings to reduce friction losses.

SUCTION PIPING - Suction pipe should be direct and as short as possible. It should be at least one size larger than suction inlet tapping and should have a minimum of elbows and fittings. The piping should be laid out so that it slopes upward to pump without dips or high points so that air pockets are eliminated. The highest point in the suction piping should be the pump inlet except where liquid flows to the pump inlet under pressure. A foot valve must be used to keep pump primed. Where liquid flows to the pump, it may be desirable to use a check valve in the suction line or discharge line to keep pump primed.

To prevent air from being drawn into suction pipe due to a suction whirlpool, the foot valve should be submerged at least three feet below the low water level. The suction pipe must be tight and free of air leaks or pump will not operate properly.

DISCHARGE PIPING - Discharge piping should never be smaller than pump tapping and should preferably be one size larger. A gate valve should always be installed in discharge line for throttling if capacity is not correct. To protect the pump from water hammer and to prevent backflow, a check valve should be installed in the discharge line between the pump and gate valve.

ELECTRICAL CONNECTIONS - Be sure motor wiring is connected for voltage being used. Unit should be connected to a separate circuit, direct from main switch. A fused disconnect switch or circuit breaker must be used in this circuit. Wire of sufficient size should be used to keep voltage drop to a maximum of 5%. All motors, unless provided with built-in overload protection, must be protected with an overload switch, either manual or magnetic. Single phase ½-2½ HP motors have built-in overload protection. **Never install a pump without proper overload protection.** When motor is mounted on a base plate or on slide rails for adjustment, flexible metallic conduit should be used to protect the motor leads.

PRIMING - The pump must be primed before starting. The pump casing and suction piping must be filled with water before starting motor. Remove vent plug in top of casing while pouring in priming water. A hand pump or ejector can be used for priming when desired. When water is poured into pump to prime, use care to remove all air before starting motor.

If pump does not start immediately, stop and reprime.

STARTING - It is good practice to close the discharge valve when starting the pump as it puts less starting load on the motor. When the pump is up to operating speed, open the discharge valve to obtain desired capacity or pressure. Do not allow the pump to run for long periods with the discharge valve tightly closed. If the pump runs for an extended period of time without liquid being discharged, the liquid in the pump case can get extremely hot.

ROTATION - The pump must run in direction of arrow on pump case. All single phase motors are single rotation and leave factory with proper rotation. Three phase motors may run either direction. If rotation is wrong when first starting motor, interchange any two line leads to change rotation.

STOPPING - Before stopping pump, close the discharge valve. This will prevent water hammer and is especially important on high head pumps.

FREEZING - Care should be taken to prevent the pump from freezing during cold weather. It may be necessary, when there is any possibility of this, to drain the pump casing when not in operation. Drain by removing the pipe plug in the bottom of the casing.

ROTARY SEAL - Centri-Thrift pumps are fitted only with a rotary seal. This seal is recommended for water free from abrasives. If liquid contains abrasives, the Centri-Thrift pump should not be used.

BEARINGS - The pump motor uses sealed ball bearings that are factory lubricated and require not further lubrication.

DISASSEMBLY INSTRUCTIONS

All pumping parts can be removed from case without disturbing the piping.

POWER SUPPLY - Open the power supply switch contacts and remove fuses. Disconnect the electrical wiring from the motor.

VOLUTE CASE

(a) Drain pump case by removing drain plug.
(b) Remove the cap screws securing volute case to pump bracket.
(c) Pry volute case from seal plate with a screwdriver.

IMPELLER

(a) Remove motor end cover.
(b) Loosen clamp holding start capacitor and swing capacitor off to one side, do not disconnect wires.
(c) Wrench flats are on the shaft just behind the centrifugal switch that is screwed into the end of the shaft. Do not remove this switch. A 7/16" open end wrench can then be used to hold the shaft from turning.
(d) Grasp the impeller and turn counterclockwise (as viewed from the pump end).

SEAL

(a) Remove the rotating part of the seal by pulling it off the shaft.
(b) The stationary seat can be pressed from the seal plate.

ASSEMBLY INSTRUCTIONS

All pump parts should be cleaned thoroughly before being reassembled.

MOTOR

(a) Assure that the rubber slinger is in place on the motor shaft.

SEAL

(a) A new pump seal should always be used when rebuilding a pump.
(b) Apply some light oil to the rubber which surrounds the ceramic stationary seat. Insert the seal seat into the seal plate using finger pressure to press firmly and squarely until it bottoms. Care must be taken to keep grease and dirt off face areas of the seal. Be sure the seal faces are not damaged during assembly (cracked, scratched, or chipped) or the seal will leak.
(c) Position the seal plate into the motor flange. use care not to chip the stationary seal seat by hitting the motor shaft.
(d) By hand, carefully press the rotating seal assembly onto the motor shaft. The smooth face of the carbon ring must contact the ceramic seat. The rubber ring must seal against the shaft.

IMPELLER

(a) Hold the motor shaft with a 7/16" open end wrench.
(b) Check that the rubber ring of the seal is positioned on the shaft.
(c) Turn the impeller clockwise onto the shaft.
(d) Replace the capacitor taking care not to pinch any wires and tighten capacitor clamp.
(e) Replace motor end cover taking care not to pinch any wires.

VOLUTE

(a) Assure that a new or good condition gasket is in place on the seal plate.
(b) Carefully position the volute in alignment over the impeller and seal plate.
(c) Assemble the components with four 3/8-16UNC cap screws. The bottom two cap screws must also pass through the bracket.

RESTARTING OPERATION

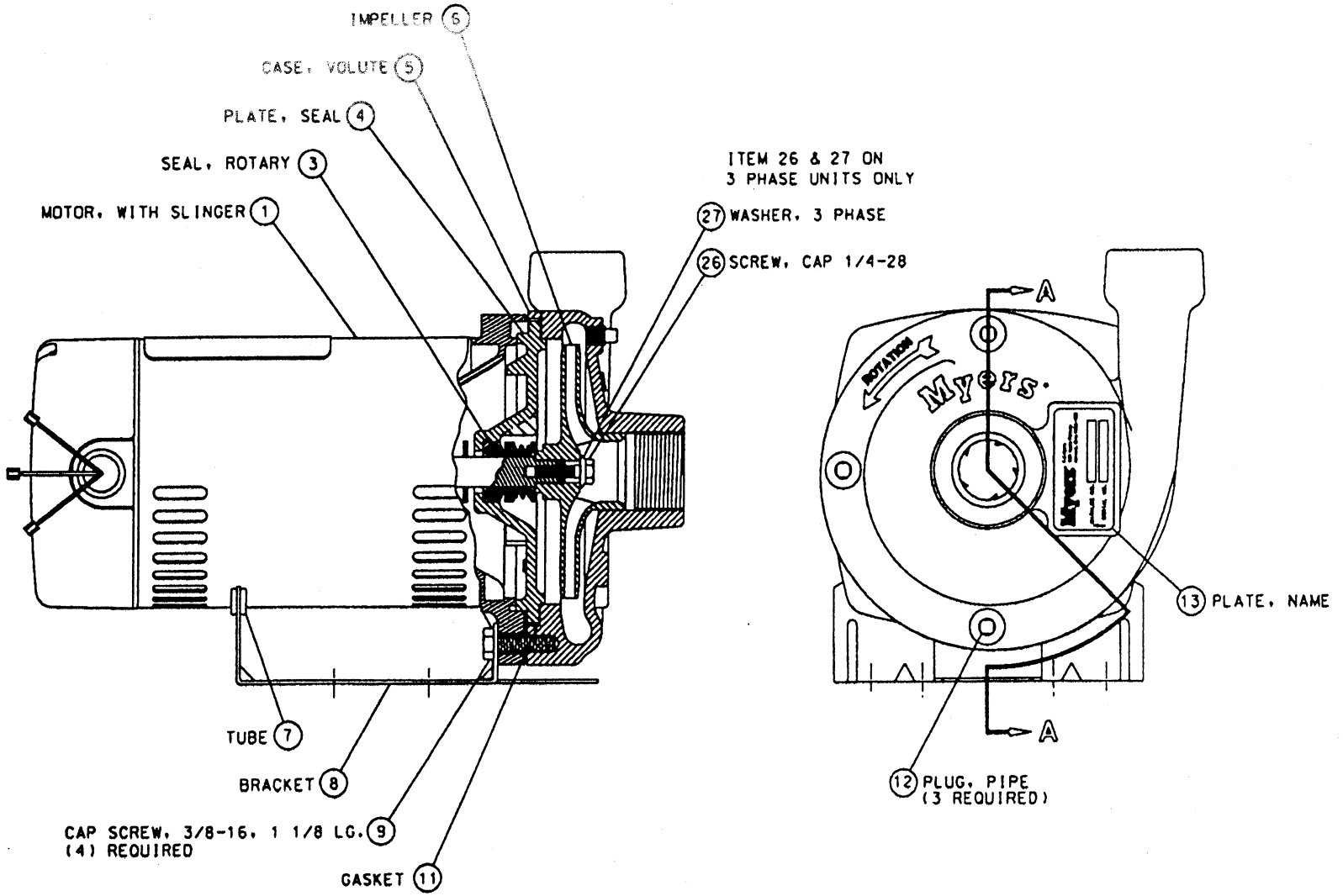
(a) The pump must be primed before starting. The pump volute and suction piping must be filled with water before starting motor. A hand pump or ejector can be used for priming when desired.
(b) Reconnect electric power.
(c) After a few minutes of operation, check that there is no leakage from the pump or piping.

PARTS LIST
CENTRI-THRIFT CT SERIES
½, ¾, 1, 1½ HP

ITEM NO.	DESCRIPTION	QUANTITY REQUIRED	PART NUMBER
1	Motor		
	1/2 HP, 115/230V, 1 Phase	1	26452A000
	1/2 HP, 208-230/460V, 3 Phase	1	26452A001
	3/4 HP, 115/230V, 1 Phase	1	26453A000
	3/4 HP, 208-230/460V, 3 Phase	1	26453A001
	1 HP, 115/230V, 1 Phase	1	26454A000
	1 HP, 208-230/460V, 3 Phase	1	26454A001
	1-1/2 HP, 115/230V, 1 Phase	1	26455A000
	1-1/2 HP, 208-230/460V, 3 Phase	1	26455A001
3	Seal, Rotary 5/8 Shaft		
	Standard Seal with Polycarbonate Impeller	1	14525A010
	Hi-Temp Seal with Brass Impeller	1	21181A021
4	Plate, Seal - Cast Iron	1	26442C000
5	Case, Volute - Cast Iron		
	BSPP Threads	1	26443D000
	NPT Threads	1	26443D001
6	Impeller		
	Polycarbonate, 1/2 HP, 1 Phase	1	26441B003
	Polycarbonate, 1/2 HP, 3 Phase	1	26441B005
	Polycarbonate, 3/4 HP, 1 Phase	1	26440B003
	Polycarbonate, 3/4 HP, 3 Phase	1	26440B005
	Polycarbonate, 1 HP, 1 Phase	1	26439B007
	Polycarbonate, 1 HP, 3 Phase	1	26439B011
	Polycarbonate, 1-1/2 HP, 1 Phase	1	26439B004
	Polycarbonate, 1-1/2 HP, 3 Phase	1	26439B010
	Bronze, 1/2 HP, 1 Phase	1	26441B000
	Bronze, 1/2 HP, 3 Phase	1	26441B004
	Bronze, 3/4 HP, 1 Phase	1	26440B000
	Bronze, 3/4 HP, 3 Phase	1	26440B004
	Bronze, 1 HP, 1 Phase	1	26439B001
	Bronze, 1 HP, 3 Phase	1	26439B009
	Bronze, 1-1/2 HP, 1 Phase	1	26439B000
	Bronze, 1-1/2 HP, 3 Phase	1	26439B008
7	Tube	1	26238A000
8	Bracket	1	25383B002
9	Cap Screw, 3/8-16 UNC x 1 1/8 Lg.	4	19101A016
11	Gasket, 6-3/8 x 5-19/32 x 1/32 Vellumoid	1	05059A446
12	Plug, 1/8 NPT - Galvanized	3	05022A021
13	Plate, Name	1	17908A000
26	Cap Screw, 1/4-28 UNF x 7/8 Lg. (3 Phase)	1	19099A032
27	Washer, 11/16 O.D. Bronze (3 Phase)	1	10186A000

PARTS LIST
CENTRI-THRIFT CT SERIES
2 and 2½ HP

ITEM NO.	DESCRIPTION	QUANTITY REQUIRED	PART NUMBER
1	Motor		
	2 HP, 115/230V, 1 Phase	1	26489A000
	2 HP, 208-230/460V, 3 Phase	1	26489A001
	2-1/2 HP, 115/230V, 1 Phase	1	26490A000
	2-1/2 HP, 208-230/460V, 3 Phase	1	26490A001
3	Seal, Rotary 5/8 Shaft		
	Standard Seal with Polycarbonate Impeller	1	14525A010
	Hi-Temp Seal with Brass Impeller	1	21181A021
4	Plate, Seal - Cast Iron	1	26485D000
5	Case, Volute - Cast Iron		
	2 HP - BSPP Threads	1	26484D001
	2 HP - NPT Threads	1	26484D003
	2-1/2 HP - BSPP Threads	1	26484D000
	2-1/2 HP - NPT Threads	1	26484D002
6	Impeller		
	Polycarbonate, 2 HP, 1 Phase	1	26487C005
	Polycarbonate, 2 HP, 3 Phase	1	26487C009
	Polycarbonate, 2-1/2 HP, 1 Phase	1	26487C004
	Polycarbonate, 2-1/2 HP, 3 Phase	1	26487C008
	Bronze, 2 HP, 1 Phase	1	26487C001
	Bronze, 2 HP, 3 Phase	1	26487C007
	Bronze, 2-1/2 HP, 1 Phase	1	26487C000
	Bronze, 2-1/2 HP, 3 Phase	1	26487C006
7	Tube	1	26238A000
8	Bracket	1	26488C000
9	Cap Screw, 3/8-16 UNC x 1-1/8 Lg.	4	19101A016
11	Gasket, 6.58 x 6.13, Vellumoid	1	05059A447
12	Plug, 1/8 NPT - Galvanized	3	05022A021
13	Plate, Name	1	17908A000
26	Cap Screw, 1/4-28 UNF x 1-1/8 Lg. (3 Phase)	1	19099A031
27	Washer, 11/16 O.D. Bronze (3 Phase)	1	10186A000


IMPELLER (6)
CASE, VOLUTE (5)
PLATE, SEAL (4)
SEAL, ROTARY (3)
MOTOR, WITH SLINGER (1)
ITEM 26 & 27 ON
3 PHASE UNITS ONLY
(27) WASHER, 3 PHASE
(26) SCREW, CAP 1/4-28
A
ROTATION
Myers.
(13) PLATE, NAME
A
TUBE (7)
BRACKET (8)
CAP SCREW, 3/8-16, 1 1/8 LG. (9)
(4) REQUIRED
GASKET (11)
(12) PLUG, PIPE
(3 REQUIRED)

SERVICE

TROUBLE SHOOTING GUIDE

A	No water delivered
B	Not enough water delivered
C	Not enough pressure
D	Pump runs for short while; then loses prime

POSSIBLE CAUSE OF PROBLEM	D	C	B	A
1. Pump not properly primed; repeat priming operation				X
2. Discharge head too high. Check total head with gauge at pump inlet and discharge. (With no water, the gauge at discharge would show shut-off pressure.)			X	X
3. Excessive volume being discharged. Throttle discharge valve.		X		
4. Suction lift too high. Check with vacuum gauge. This should not exceed 15 feet.	X		X	X
5. Air leak in suction line. Check line under pressure to find leak.	X	X	X	X
6. Air pocket in suction line. Check line for proper slope.	X			X
7. Impeller or suction line plugged.		X	X	x
8. Impeller and volute case badly worn. Disassemble pump if clearance on diameter is over .030", replace worn impeller and worn volute case.		X	X	
9. Suction strainer plugged. Clean strainer.	X			
10. Impeller diameter too small for condition required.		X	X	
11. Seal leaking - seal is worn or seal face cocked. Replace with new seal and carefully follow directions.				

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Myers
Pentair Pump Group

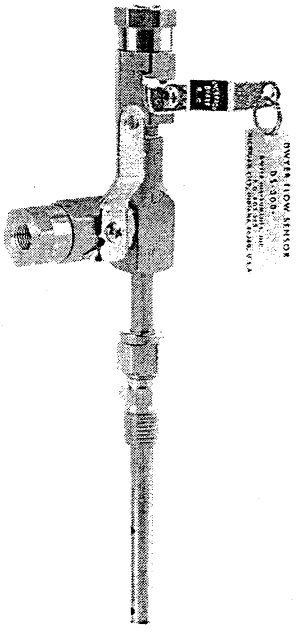
F. E. Myers, 1101 Myers Parkway, Ashland, Ohio 44805-1969
419/289-1144, FAX: 419/289-6658, TLX: 98-7443

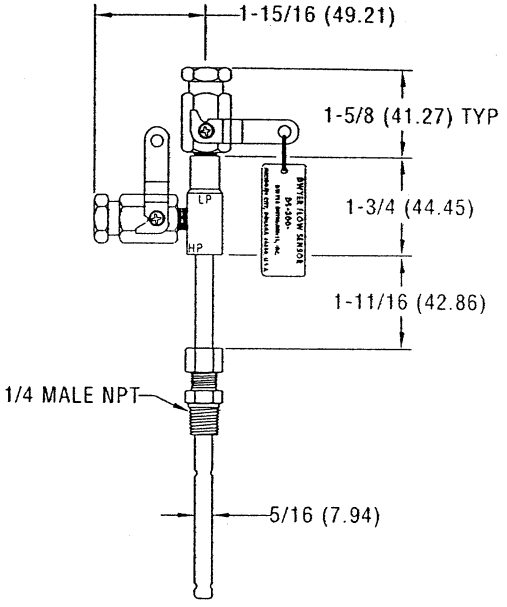
Myers (Canada), 269 Trillium Drive, Kitchener, Ontario N2G 4W5
519/748-5470, FAX: 519/748-2553

Series DS-300 Flow Sensors

Bulletin F-50

Installation and Operating Instructions Flow Calculations





Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

WYER INSTRUMENTS, INC.
O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 www.dwyer-inst.com
Fax: 219/872-9057 e-mail: info@dwyer-inst.com

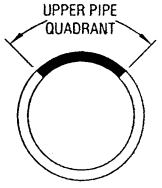
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

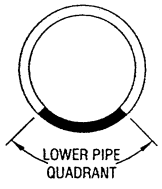
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4˝ x 3/8˝) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16˝ to allow for thermal expansion.

5. Tighten packing gland nut finger tight. Then tighten nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

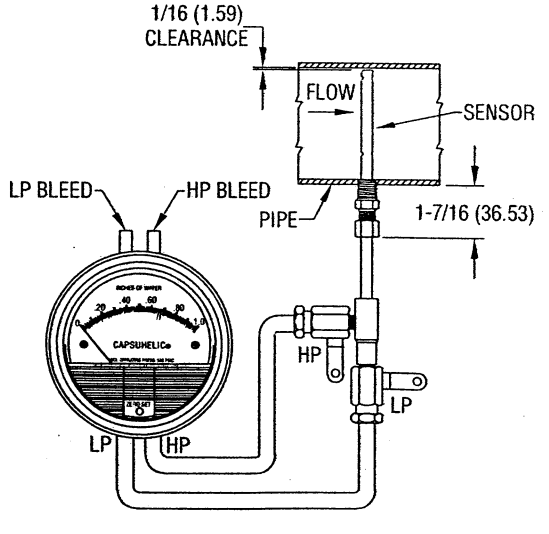
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

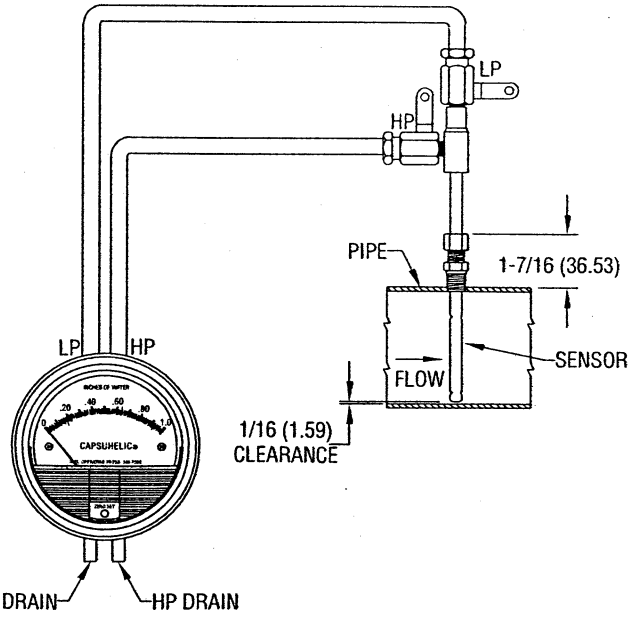
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

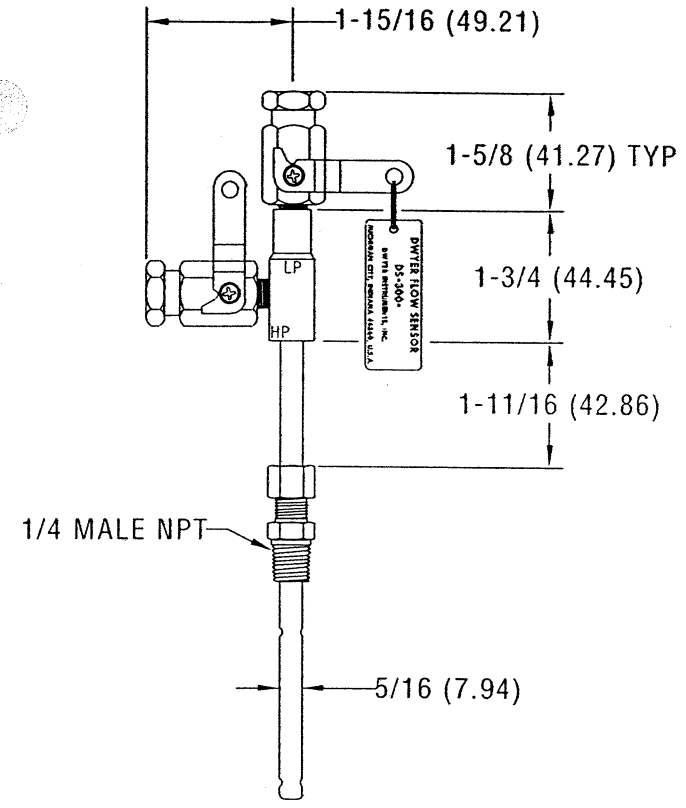
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 "Flow of Fluids Through Valves, Fittings and Pipe." It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient "K"	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

. = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

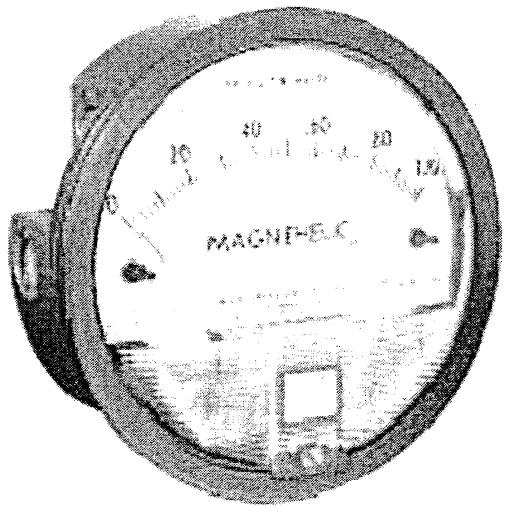
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WYER INSTRUMENTS, INC.
O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
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BULLETIN NO. **A-27**

Magnehelic® Differential Pressure Gage

OPERATING INSTRUCTIONS



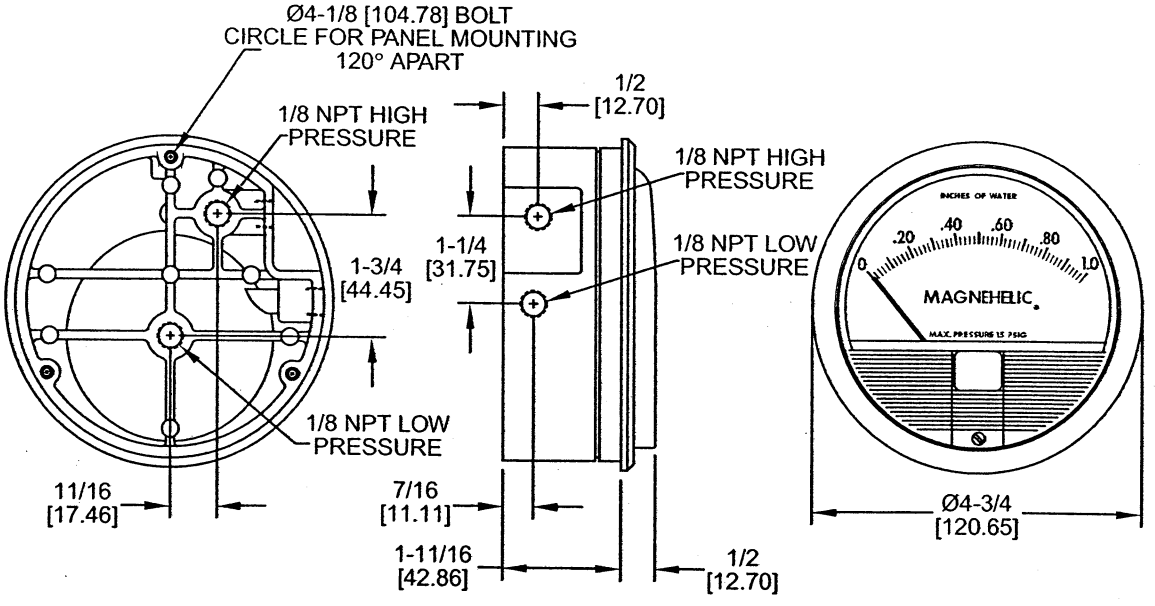
SPECIFICATIONS

Dimensions: 4-3/4" dia. x 2-3/16" deep.
Weight: 1 lb. 2 oz.
Finished: Baked dark gray enamel.
Connections: 1/8" NPT high and low pressure taps, duplicated, one pair side and one pair back.
Accuracy: Plus or minus 2% of full scale, at 70°F. (Model 2000-0, 3%; 2000-00, 4%).
Pressure Rating: 15 PSI (0,35 bar)
Ambient Temperature Range: 20° to 140°F (-7 to 60°C).
Standard gage accessories include two 1/8" NPT plugs for duplicate pressure taps, two 1/8" NPT pipe thread to rubber tubing adapters, and three flush mounting adapters with screws.

Caution: For use with air or compatible gases only.

For repeated over-ranging or high cycle rates, contact factory.

Not for use with Hydrogen gas. Dangerous reactions will occur.



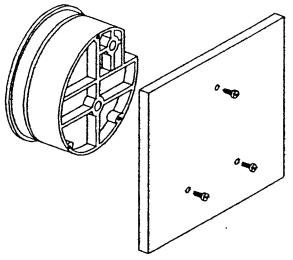
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MAGNEHELIC® INSTALLATION

1. Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F. Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines my be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.

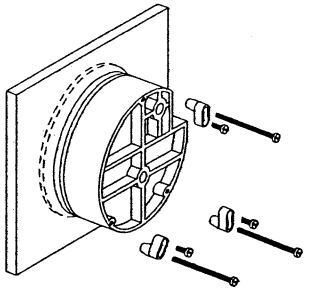
2. All standard Magnehelic gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range Model 2000-00 and metric equivalents must be used in the vertical position only.

3. Surface Mounting



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

4. Flush Mounting



Provide a 4-9/16" dia. opening in panel. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adapters, firmly secured in place. To mount gage on 1-1/4"-2" pipe, order optional A-610 pipe mounting kit.

5. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

Operation

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.

Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.

Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.

When one side of the gage is vented in dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

A. For portable use of temporary installation use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with rubber or Tygon tubing.

B. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended. See accessory bulletin S-101 for fittings.

Ordering Instructions:

When corresponding with the factory regarding Magnehelic® gage problems, be sure to include model number, pressure range, and any special options. Field repair is not recommended; contact the factory for repair service.

MAINTENANCE

Maintenance: No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves, (bulletin S-101), should be used in permanent installations.

Calibration Check: Select a second gage or manometer of known accuracy and in an appropriate range. Using short lengths of rubber or vinyl tubing, connect the high pressure side of the Magnehelic gage and the test gage to two legs of a tee. Very slowly apply pressure through the third leg. Allow a few seconds for pressure to equalize, fluid to drain, etc., and compare readings. If accuracy unacceptable, gage may be returned to factory for recalibration. To calibrate in the field, use the following procedure.

Calibration:

1. With gage case, held firmly, loosen bezel, by turning counterclockwise. To avoid damage, a canvas strap wrench or similar tool should be used.
2. Lift out plastic cover and "O" ring.
3. Remove scale screws and scale assembly. Be careful not to damage pointer.
4. The calibration is changed by moving the clamp. Loosen the clamp screw(s) and move slightly toward the helix if gage is reading high, and away if reading low. Tighten clamp screw and install scale assembly.
5. Place cover and O-ring in position. Make sure the hex shaft on inside of cover is properly engaged in zero adjust screw.
6. Secure cover in place by screwing bezel down snug. Note that the area under the cover is pressurized in operation and therefore gage will leak if not properly tightened.
7. Zero gage and compare to test instrument. Make further adjustments as necessary.

Caution: If bezel binds when installing, lubricate threads sparingly with light oil or molybdenum disulphide compound.

Warning: Attempted field repair may void your warrenty. Recalibration or repair by the user is not recommended. For best results, return gage to the factory. Ship prepaid to:

Dwyer Instruments, Inc.

Attn: Repair Dept.

102 Indiana Highway 212

Michigan City, IN 46360

Trouble Shooting Tips:

•*Gage won't indicate or is sluggish.*

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O"ring damaged, missing.
5. Pressure sensor, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F, order gage with low temperature, (LT) option.

•Pointer stuck-gage can't be zeroed.

1. Scale touching pointer.
2. Spring/magnet assembly shifted and touching helix.
3. **Metallic particles clinging to magnet and interfering with helix movement.**
4. Cover zero adjust shaft broken or not properly engaged in adjusting screw.

We generally recommend that gages needing repair be returned to the factory. Parts used in various sub-assemblies vary from one range of gage to another, and use of incorrect components may cause improper operation. After receipt and inspection, we will be happy to quote repair costs before proceeding.

Consult factory for assistance on unusual applications or conditions.

Use with air or compatible gases only.

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+GF+ SIGNET 515/3-8510-XX Rotor-X Paddlewheel Flow Sensor

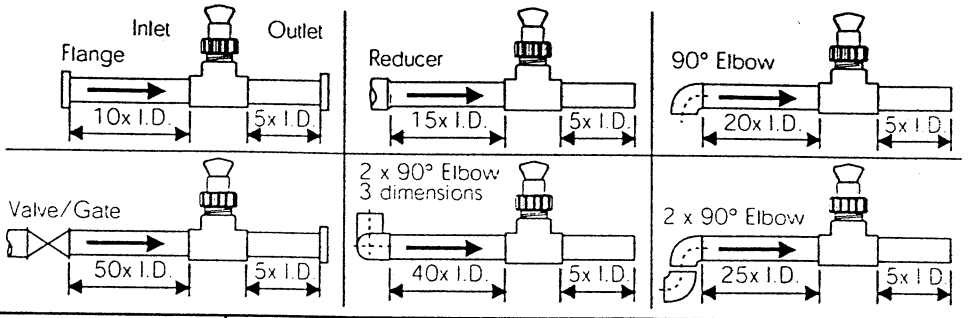
ENGLISH

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SAFETY INSTRUCTIONS
1. Do not remove from pressurized lines.
2. Do not exceed maximum temperature/pressure specifications.
3. Do not install/service without following installation instructions (see sensor manual).
4. Wear safety goggles and faceshield during installation/service.
5. Do not alter product construction.
6. Failure to follow safety instructions could result in severe personal injury!

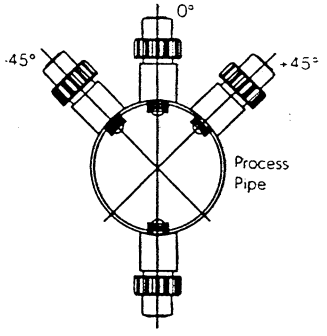
1. Location of Fitting

Recommended sensor upstream/downstream mounting requirements

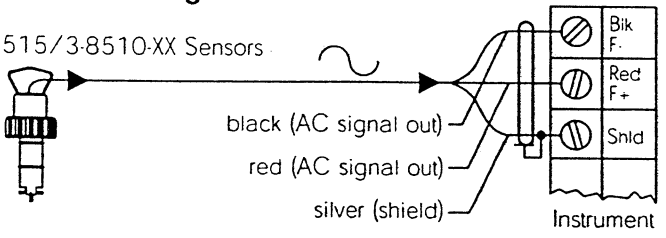


2. Sensor Mounting Position

- Horizontal pipe runs. Mount sensor in the upright (0°) position for best overall performance. Mount at a maximum of 45° when air bubbles are present. Do not mount on the bottom of the pipe when sediments are present.
- Vertical pipe runs: Sensor must be mounted in lines with UPWARD flow only.



3. Sensor Wiring



Technical Notes
- Use 2-conductor shielded cable for cable extensions up to 60 m (200 ft)
- Cable shield must be maintained through cable splice.
- Refer to your instrument manual for specific wiring details.

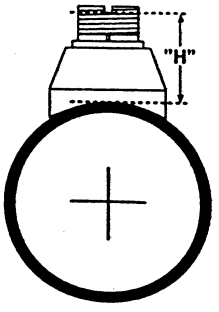
4. +GF+ SIGNET Fittings

Type	Description
Plastic tees	• 0.5 to 4 in. versions • PVC or CPVC • Mounts via glue-on fittings
PVC glue-on saddles (O-ring not required)	• 2 to 4 in., cut 1-7/16 in. hole in pipe • 6 to 8 in., cut 2-1/4 in. hole in pipe • Align wedge arrows with saddle arrows during assembly. • Pipes over 8 in., use iron saddle
Iron strap-on saddles	• 2 to 4 in., cut 1-7/16 in. hole in pipe • Over 4 in., cut 2-1/4 in. hole in pipe • Special order over 12 in.
Carbon steel weld-on weldolets	• 2 to 4 in., cut 1-7/16 in. hole in pipe • Over 4 in., cut 2-1/4 in. hole in pipe • Remove insert before welding • Installed by certified welder only • Special order over 12 in.
Carbon steel threaded tees	• 0.5 to 2 in. versions • Mounts on threaded pipe ends

Type	Description
	Metric plastic saddle • For pipes DN 65 to 200 mm • Requires a 30 mm diam. hole in the pipe • Wedge and saddle arrows must match
	Metric wafer fitting • For pipes DN 65 to 200 mm • Follow the recommended installation guidelines
	Metric union fitting • For pipes from DN 15 to 50 mm • PP or PVDF • Follow the recommended installation guidelines

5. H-Dimensions

The plastic sensor insert in the Weldolet fitting MUST be removed during the welding process. When reinstalled, it is important that the insert be threaded to the proper height ("H" dimension).



Weldolet part number	"H" dimension inches	mm	Weldolet part number	"H" dimension inches	mm
CS4W020	2.38	60.45	CS4W240	4.16	105.66
CS4W025	2.33	59.18	CS4W360	4.10	104.14
CS4W030	2.32	58.92			
CS4W040	2.30	58.42	CR4W020	2.38	60.45
CS4W050	3.09	78.48	CR4W025	2.33	59.18
CS4W060	2.96	75.18	CR4W030	2.32	58.92
CS4W080	2.73	69.34	CR4W040	2.30	58.42
CS4W100	5.48	139.19	CR4W050	3.09	78.48
CS4W120	5.25	133.35	CR4W060	2.96	75.18
CS4W140	5.10	129.54	CS4W080	2.73	69.34
CS4W160	4.85	123.19	CR4W100	5.48	139.19
CS4W180	4.60	116.84	CR4W120	5.25	133.35
CS4W200	4.38	111.25			

Standard Sensor Installation

. Lubricate the sensor O-rings with a silicone lubricant (e.g. GE silicone compound #G632 or quivalent). Do not use any petroleum based lubricant that will attack the O-rings.

. Using an alternating/twisting motion, lower the sensor into the fitting, making sure the installation rrows on the black cap are pointing in the direction of flow, **see Figure A.**

. age one thread of the sensor cap then turn the sensor until the alignment tab is seated in the ti notch. **Hand tighten the sensor cap. DO NOT** use any tools on the sensor cap or the cap rds and/or fitting flange threads will be damaged, **see Figure B.**

Figure A

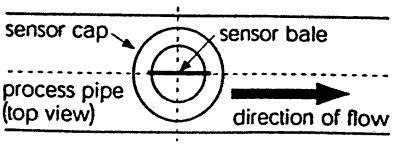
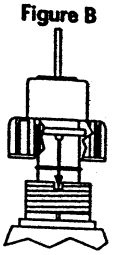


Figure B



. Wet-Tap Installation

ıe +GF+ SIGNET 319 Wet-Tap Assembly attaches directly onto any +GF+ Signet fitting to enable sensor r val without system shutdown. It consists of a flange and support plate which thread onto the pipe ti insert, and a PVC ball valve through which an extended length 515 sensor is inserted into the pipe.

rocedure

. Remove six hex nuts and bolts from the Wet-Tap flange. Separate the support plate from the main s nbly. Be sure that the Viton O-ring is properly seated in the support plate groove.

. Apply sealant to the pipe fitting insert threads to prevent leaks.

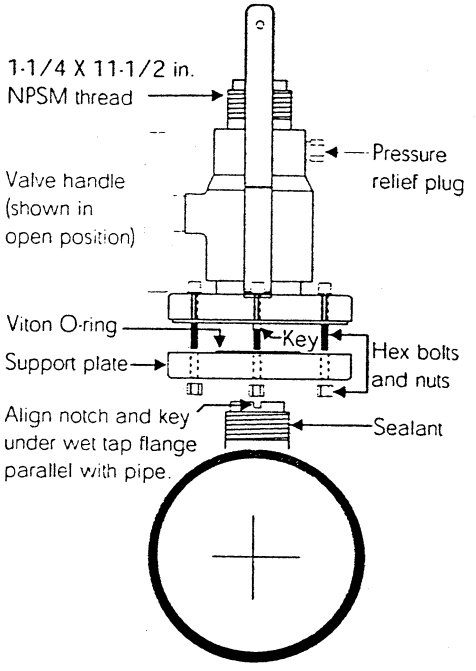
. Screw support plate onto pipe fitting insert. It must be threaded completely down until the notches at s op of the pipe fitting insert are exposed.

. Mount the main Wet-Tap Assembly on the support plate. Make certain the alignment keys on the e mate with the notches on the pipe fitting insert.

. Replace the six hex nuts and bolts to secure the Wet-Tap Assembly in place. Adjust the support plate osition as necessary to align screws.

. Check the pressure relief plug on Wet-Tap Assembly. It must closed be finger tight to prevent leaks.

. Close ball valve by turning the orange handle to the fully closed position (parallel with pipe).



. Wet-Tap Sensor Installation

The 319 Wet-Tap Assembly allows installation into pressurized pipes without system shutdown. **+GF+ Signet recommends reducing flow system pressure to 25 psi or less during sensor installation in a pressurized pipe.**

Pressurized Installation

pen the orange ball valve handle to the full open position. Follow the steps 1-3 outlined in section 6 ach the cable clamps and safety cables to the cable brackets. Verify the relief valve is closed before s n operation, **see Figure C.**

essurized Installation

. Lubricate the sensor O-rings with a silicone lubricant (e.g. GE silicone compound #G632 or ı alent)/ Do not use any petroleum based lubricant that will attack the O-rings.

. Being careful not to bump the sensor rotor against the closed ball valve orifice, gently insert the tended 515 sensor into the 319 Assembly until the first two O-rings seat inside the bore, **see ; e D.**

. ttach the cable clamps on each of the sensor's safety cables to the 319 assembly cable brackets and tighten only), **see Figure D.**

. ull the flow sensor upward to remove slack in the safety cables, **see Figure E**

. Reduce system pressure to 25 psi or less.

. **Wearing safety face protection**, slowly open the ball valve to the full open position (perpendicular to)

. Using an alternating/twisting motion, push the extended sensor into the 319 assembly, making nsor's installation decal is pointing in the direction of flow and the alignment tab seats into e ing notch, **see Figure F.**. Align the tab under the red sensor cap in the notches on the fitting ert. Hand tighten the red sensor cap, **see Figure G.** DO NOT use any tools on the red sensor cap the cap threads and/or fitting flange threads will be damaged.

CAUTION: Maximum 319 Wet-Tap operating pressure: 7 bar (100 psi) @ 20 °C (68 °F)
Maximum 515 sensor installation/removal pressure: 1.7 bar (25 psi) @ 22 °C (72 °F)

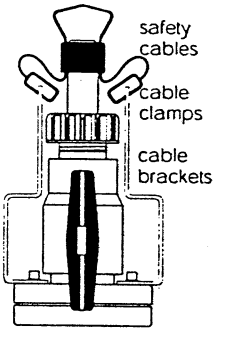


Figure C

Figure D

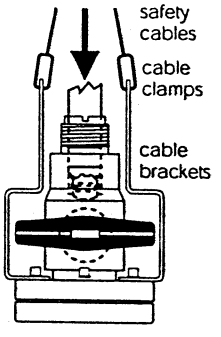
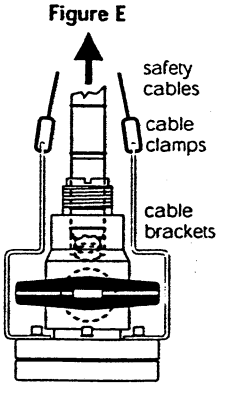


Figure E



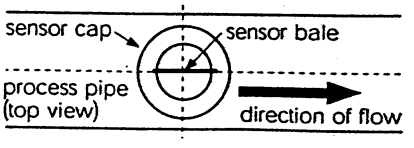


Figure F

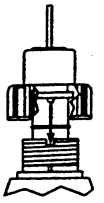


Figure G

9. K-Factors

The **K-Factor** is the number of pulses the sensor will generate for each engineering unit of fluid which passes. They are listed in U.S. gallons and in liters. For example, in a 1 inch PVC pipe, the paddlewheel generates 176.670 pulses per gallon of fluid passing the rotor. K-factors are listed for pipes up to 12 inch. For pipes over 12 inch, consult your +GF+ Signet distributor.

PIPE SIZE	+GF+ SIGNET FITTING TYPE	----K-FACTOR---- U.S. GAL	LITERS
SCH 80 PVC TEES FOR SCH 80 PVC PIPE			
1/2 IN.	PV8T005	480.190	126.867
3/4 IN.	PV8T007	257.720	68.090
1 IN.	PV8T010	174.670	46.148
1 1/4 IN	PV8T012	83.390	22.032
1 1/2 IN	PV8T015	58.580	15.477
2 IN	PV8T020	32.480	8.581
2 1/2 IN	PV8T025	21.833	5.768
3 IN	PV8T030	13.541	3.578
4 IN	PV8T040	7.626	2.015
SCH 80 CPVC TEES FOR SCH 80 CPVC PIPE			
1/2 IN	CPV8T005	480.190	126.867
3/4 IN	CPV8T007	257.720	68.090
1 IN	CPV8T010	174.670	46.148
1 1/4 IN	CPV8T012	83.390	22.032
1 1/2 IN	CPV8T015	58.580	15.477
SCH 80 PVC SADDLES FOR SCH 80 PVC PIPE			
2 IN	PV8S020	32.480	8.581
2 1/2 IN	PV8S025	21.833	5.768
3 IN	PV8S030	13.541	3.578
4 IN	PV8S040	7.626	2.015
6 IN	PV8S060	4.162	1.100
8 IN	PV8S080	2.370	0.626
SCH 80 PVC SADDLE ON SCH 40 PVC PIPE			
2 IN	PV8S020	27.350	7.226
2 1/2 IN	PV8S025	18.874	4.987
3 IN	PV8S030	12.638	3.339
4 IN	PV8S040	6.728	1.778
6 IN	PV8S060	3.730	0.985
8 IN	PV8S080	2.153	0.569
CARBON STEEL TEES ON SCH 40 PIPE			
1/2 IN	CS4T005	370.202	97.808
3/4 IN	CS4T007	212.063	56.027
1 IN	CS4T010	141.138	37.289
1 1/4 IN	CS4T012	60.655	16.025
1 1/2 IN	CS4T015	45.350	11.982
2 IN	CS4T020	26.767	7.072
STAINLESS STEEL TEES ON SCH 40 PIPE			
1/2 IN	CR4T005	358.960	94.838
3/4 IN	CR4T007	202.610	53.530
1 IN	CR4T010	127.140	33.590
1 1/4 IN	CR4T012	61.910	16.357
1 1/2 IN	CR4T015	40.410	10.676
2 IN	CR4T020	22.300	5.892

PIPE SIZE	+GF+ SIGNET FITTING TYPE	----K-FACTOR---- U.S. GAL	LITERS
GALVANIZED IRON TEES ON SCH 40 PIPE			
1 IN.	IR4T010	104.538	27.619
1 1/4 IN.	IR4T012	62.979	16.639
1 1/2 IN.	IR4T015	46.688	12.335
2 IN.	IR4T020	29.459	7.783
BRONZE TEES ON SCH 40 PIPE			
1 IN	BR4T010	104.538	27.619
1 1/4 IN	BR4T012	62.979	16.639
1 1/2 IN	BR4T015	46.688	12.335
2 IN	BR4T020	29.459	7.783
COPPER TEE FITTINGS ON COPPER PIPE PIPE			
1/2 IN SOLDER	CUKT005	443.206	117.095
1/2 IN SOLDER		414.413	109.488
3/4 IN SOLDER	CUKT007	212.156	56.052
3/4 IN SOLDER		191.086	50.495
1 IN SOLDER	CUKT010	127.176	33.600
1 IN SOLDER		119.940	31.682
1 1/4 IN SOLDER	CUKT012	88.218	23.307
1 1/4 IN SOLDER		85.451	22.576
1 1/2 IN SOLDER	CUKT015	56.962	15.049
1 1/2 IN SOLDER		55.160	14.573
2 IN SOLDER	CUKT020	29.370	7.759
2 IN SOLDER		28.605	7.558
STAINLESS STEEL WELDOLETS ON SCH 40 PIPE			
2 1/2 IN	CR4WW025	18.800	4.967
3 IN	CR4WW030	12.170	3.215
4 IN	CR4WW040	6.960	1.839
5 IN	CR4WW050	5.260	1.390
6 IN	CR4WW060	3.690	0.975
8 IN	CR4WW080	2.130	0.563
10 IN	CR4WW100	1.350	0.357
12 IN	CR4WW120	0.960	0.254
CARBON STEEL WELDOLETS ON SCH 40 PIPE			
2 1/2 IN	CS4WW025	18.800	4.967
3 IN	CS4WW030	12.170	3.215
4 IN	CS4WW040	6.960	1.839
5 IN	CS4WW050	5.260	1.390
6 IN	CS4WW060	3.690	0.975
8 IN	CS4WW080	2.130	0.563
10 IN	CS4WW100	1.350	0.357
12 IN	CS4WW120	0.960	0.254

PIPE SIZE	+GF+ SIGNET FITTING TYPE	----K-FACTOR---- U.S. GAL	LITERS
COPPER/BRONZE BRAZOLETS ON SCH 40 PIPE			
2 1/2 IN.	BR4B025	18.800	4.967
3 IN.	BR4B030	12.170	3.215
4 IN.	BR4B040	6.960	1.839
5 IN.	BR4B050	5.260	1.390
6 IN.	BR4B060	3.690	0.975
8 IN.	BR4B080	2.130	0.563
10 IN.	BR4B100	1.350	0.357
12 IN.	BR4B120	0.960	0.254
SCH 80 IRON SADDLES ON SCH 80 PIPE			
2 IN	IR8S020	32.360	8.550
2 1/2 IN	IR8S025	22.220	5.871
3 IN	IR8S030	13.420	3.546
4 IN	IR8S040	7.660	2.024
5 IN	IR8S050	5.860	1.548
6 IN	IR8S060	4.090	1.081
8 IN	IR8S080	2.330	0.616
10 IN	IR8S100	1.530	0.404
12 IN	IR8S120	1.060	0.280
SCH 80 IRON SADDLE ON SCH 40 PIPE			
2 IN	IR8S020	26.820	7.085
2 1/2 IN	IR8S025	18.800	4.967
3 IN	IR8S030	11.990	3.168
4 IN	IR8S040	6.850	1.810
5 IN	IR8S050	5.330	1.408
6 IN	IR8S060	3.760	0.993
8 IN	IR8S080	2.130	0.563
10 IN	IR8S100	1.350	0.357
12 IN	IR8S120	0.960	0.254

Conversion Formulas

1 U.S. gallon = 0.003785 cubic meters
0.000003069 Acre feet
8.3454 pounds of water

K-Factors DIN Pipes

PIPE SIZE	+GF+ SIGNET FITTING TYPE	----K-FACTOR---- U.S. GAL	LITERS	CODE
POLYPROPYLENE FITTINGS (DIN/ISO AND BS AND ANSI)				
DN 15	PPMT005	481.553	127.227	198.150.522
DN 20	PPMT007	277.089	73.207	198.150.523
DN 25	PPMT010	141.181	37.300	198.150.524
DN 32	PPMT012	83.540	22.071	198.150.525
DN 40	PPMT015	51.265	13.544	198.150.526
DN 50	PPMT020	29.596	7.819	198.150.527
DN 65	PPMT025	20.658	5.458	198.150.560
DN 80	PPMT030	13.330	3.522	198.150.561
DN 100	PPMT040	8.708	2.301	198.150.562
DN 125	PPMT050	5.067	1.339	198.150.563
DN 150	PPMT060	3.689	0.975	198.150.564
DN 200	PPMT080	2.040	0.539	198.150.565
PVDF FITTINGS (DIN/ISO AND BS AND ANSI)				
DN 15	SFMT005	420.868	111.194	198.150.529
DN 20	SFMT007	228.149	60.277	198.150.530
DN 25	SFMT010	136.697	36.116	198.150.531
DN 32	SFMT012	79.294	20.950	198.150.532
DN 40	SFMT015	43.490	11.490	198.150.533
50	SFMT020	25.908	6.845	198.150.534
65	SFMT025	18.067	4.773	198.150.571
DN 80	SFMT030	12.357	3.265	198.150.572
DN 100	SFMT040	8.060	2.129	198.150.573
DN 125	SFMT050	4.431	1.171	198.150.574
DN 150	SFMT060	3.227	0.853	198.150.575
DN 200	SFMT080	2.036	0.538	198.150.576

PIPE SIZE	+GF+ SIGNET FITTING TYPE	----K-FACTOR---- U.S. GAL	LITERS	CODE
PVC FITTINGS (DIN/ISO) - EUROPE ONLY				
DN 15	PVMT005	486.183	128.450	198.150.480
DN 20	PVMT007	242.846	64.160	198.150.481
DN 25	PVMT010	148.637	39.270	198.150.482
DN 32	PVMT012	85.125	22.490	198.150.483
DN 40	PVMT015	51.855	13.700	198.150.484
DN 50	PVMT020	29.750	7.860	198.150.485
DN 65	PVMT025	17.487	4.620	198.150.538
DN 80	PVMT030	12.491	3.300	198.150.539
DN 100	PVMT040	8.138	2.150	198.150.540
DN 150	PVMT060	4.088	1.080	198.150.543
DN 200	PVMT080	2.044	0.540	198.150.545

) Order Information

ıdard 515 Rotor-X Paddlewheel Flow Sensors — All O-rings are Viton®

o.	Sensor Body	Rotor Pin	Rotor	Pipe Size	Code
530-P0	Polypro.	Titanium	PVDF (black)	0.5 to 4.0 in.	198 801 620
530-P1	Polypro.	Titanium	PVDF (black)	5.0 to 8.0 in.	198 801 621
	Polypro.	Titanium	PVDF (black)	10 to 36 in.	198 801 622
	PVDF (natural)	Hastelloy C	PVDF (natural)	0.5 to 4.0 in.	198 801 623
V1	PVDF (natural)	Hastelloy C	PVDF (natural)	5.0 to 8.0 in.	198 801 624
V2	PVDF (natural)	Hastelloy C	PVDF (natural)	10 to 36 in.	198 801 625
530-T0	PVDF (natural)	PVDF (natural)	PVDF (natural)	0.5 to 4.0 in.	198 801 663
530-T1	PVDF (natural)	PVDF (natural)	PVDF (natural)	5.0 to 8.0 in.	198 801 664
530-T2	PVDF (natural)	PVDF (natural)	PVDF (natural)	10 to 36 in.	198 801 669

t-Tap Assembly Including Extended 515 Sensor — Rotor pin material is Titanium

er No	Valve	Sensor Body	Rotor	Pipe Size	Code
319/515 P3	PVC	Polypro	PVDF (black)	0.5 to 4.0 in	198 840 119
3 /515 P4	PVC	Polypro	PVDF (black)	5.0 to 8.0 in	198 840 120
3 /515 P5	PVC	Polypro	PVDF (black)	10 to 36 in	198 840 121

Wet-Tap Without 515 Sensor

er No	Material	Description
	PVC	319 Wet-Tap

515 Sensors for 319 Wet-Tap

er No	Sensor Body	Rotor Pin	Rotor	Pipe Size	Code
P3	Polypro	Titanium	PVDF (black)	0.5 to 4.0 in	198 840 310
P4	Polypro	Titanium	PVDF (black)	5.0 to 8.0 in	198 840 311
P5	Polypro	Titanium	PVDF (black)	10 to 36 in	198 840 312

515 Accessories

Order No. Rotors	Material	Code
M1538-2	PVDF (std.)	198 801 181
M1538-4	Tefzel	198 820 018
P51546	Tefzel with sleeve	198 820 017
P51550-3	PVDF (natural) + Rotor Pin	198 820 043

Order No. Rotor Pin	Material	Code
M1546-1	Titanium	198 801 182
M1546-2	Hastelloy C	198 801 183
M1546-3	Tantalum	198 820 014
M1546-4	Stainless steel	198 820 015
P51545	Ceramic	198 820 016
P51550-3	PVDF (natural) + Rotor	198 820 043

Order No. O-Rings	Material	Code
1220-0021	Viton® (std.)	198 801 186
1224-0021	EPR	198 820 006
1228-0021	Kalrez	198 820 007

Order No.	Description	Code
P31542	Sensor cap, PP	198 801 630
P31536	Plug, PP	198 840 201
P31536-2	Plug, PVDF (nat.) with std. cap	198 840 202

-GF+ SIGNET 3-8510-XX Integral Sensor Accessories

Order No.	Description
3-8011	Integral sensor mounting kit with 1-1/2 in. NPT ports
3-8011-D	Integral sensor mounting kit with PG 13.5 ports

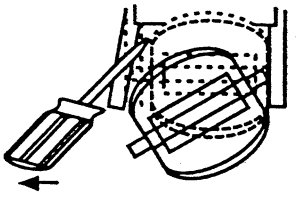
Order No.	Description	Pipe Size	Code
3-8510-P0	Integral sensor, Polypro	0.5 to 4 inch	198 864 504
3-8510-P1	Integral sensor, Polypro	5 to 8 inch	198 864 505
3-8510-V0	Integral sensor, PVDF (natural)	0.5 to 4 inch	198 864 506

Rotor Replacement Procedure

To remove the rotor, insert a small screwdriver between the rotor and the ear of the sensor.

Twist the screwdriver blade to flex the ear outward enough to remove one end of the rotor and pin. **DO NOT** flex the ear more than necessary! If it breaks, the sensor cannot be repaired.

Install the new rotor by inserting one ear into the hole, then flex the opposite ear back enough to slip rotor into place.



ecifications

al Data

ate Range:	0.3 to 6 m/s (1 to 20 ft/s)
arity:	±1% of maximum range
eatability:	±0.5% of maximum range
ze Range:	15 to 900 mm (0.5 to 36 in.)
Length:	7.6 m (25 ft) can splice up to 60 m (200 ft) without amplification
le type:	2-conductor twisted pair with shield

als

sor Assembly:	Various thermoplastics available. Refer to section 10 for details.

al

Impedance:	8 kΩ

y Standards

CE

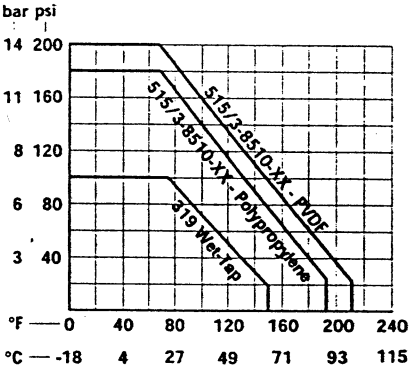
ufactured under ISO 9001

Fluid Conditions

515/3-8510-XX Sensor Pressure/Temperature Ratings:

Polypropylene Body:
- 12.5 bar (180 psi) max. @ 20 °C (68 °F)
- 1.7 bar (25 psi) max. @ 90 °C (194 °F)

PVDF Body:
- 14 bar (200 psi) max @ 20 °C (68 °F)
- 1.7 bar (25 psi) max @ 100 °C (212 °F)



319 Wet-Tap Assembly Pressure/Temperature Ratings:
- 7 bar (100 psi) max. @ 25 °C (77 °F)
- 1.4 bar (20 psi) max. @ 66 °C (150 °F)

F+ SIGNET

es Offices:

	George Fischer, Inc., 2882 Dow Avenue, Tustin, CA 92780/USA, Tel. (714) 731-8800, Fax (714) 731-6201
land	Georg Fischer Rohrleitungssysteme AG, P.O. Box 671, CH-8201 Schaffhausen/Switzerland, Tel. 052/631 1111, Fax 052/631 2830
apore	George Fischer Pte. Ltd., 15 Kaki Bukit Road 2, KB Warehouse Complex, Singapore 1441, Tel. 65/747 0611, Fax 65/747 0577
an	Kubota George Fischer, 2-47 Shikitsuhigashi, 1-Chome, Naniwa-Ku, Osaka, 556-91 Japan, Tel. 816/648 2545, Fax 816/648 2565
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tralia	George Fischer Pty. Ltd., Suite 3, 41 Stamford Road, Oakleigh, Victoria 3166, Australia, Tel. 61/3 9568 0966, Fax 61/3 9568 0988

Scientific Company, 3401 Aerojet Avenue, El Monte, CA 91731-2882 U.S.A., Tel. (626) 571-2770, Fax (626) 573-2057

GE FISCHER +GF+ Piping Systems

590-1/(I-5/97), English

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+GF+ SIGNET 8550-2 Flow Transmitter Instructions

ENGLISH

3-8550.090-2 (A-9/99) English

CAUTION!

- Remove power to unit before wiring input and output connections.
- Follow instructions carefully to avoid personal injury.

Contents

1. Installation
2. Specifications
3. Electrical Connections
4. Menu Functions



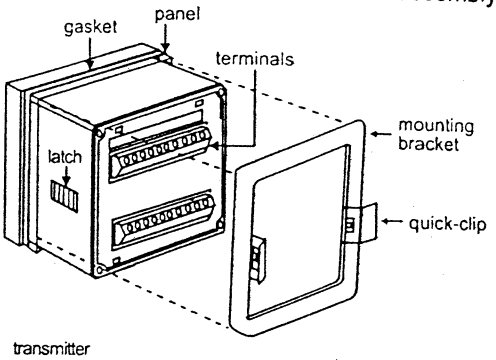
1. Installation

The transmitter is available in three versions: a panel mount version, an integral (pipe mount) version, and a universal assembly for installation near the sensor.

1.1 Panel Installation

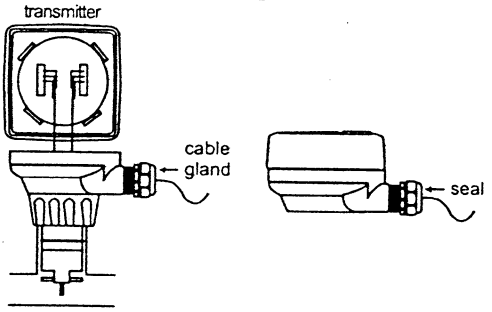
The Panel Mounting kits are supplied with the hardware to install instrumentation into panels and maintain a NEMA 4X seal.

1. Punch out panel and de-burr edges. Recommended clearance on all sides between instruments is 1 inch.
2. Place gasket on instrument, and install in panel.
3. Slide mounting bracket over back of instrument until quick-clips snap into latches on side of instrument.
4. Connect wires to terminals.
5. To remove, secure instrument temporarily with tape from front or grip from rear of instrument. DO NOT RELEASE. Press quick-clips outward and remove.



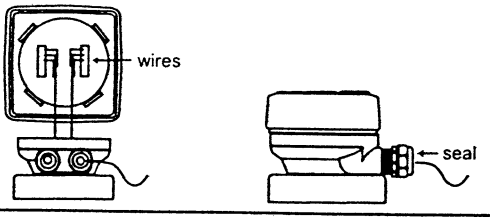
1.2 Integral Assembly (3-8051)

1. Punch out conduit ports if necessary.
2. Connect sensor to integral adapter. Push and twist-lock integral adapter to conduit base and secure with locking ring and screw.
3. Mount unit in pipe. Route cable through cable gland and connect to transmitter.
4. Close unit and secure. Seal cable entry.



1.3 Universal Assembly (3-8050)

1. Install transmitter base
2. Connect wires to transmitter.
3. Close unit and secure with push and twist lock. Seal cable entry.



2. Specifications

General

Compatibility: +GF+ SIGNET Flow Sensors (w/freq out)
Accuracy: ±0.5 Hz
Enclosure:

- Rating: NEMA 4X/IP65 front
- Case: PBT
- Window: Polyurethane coated polycarbonate
- Keypad: Sealed 4-key silicone rubber
- Weight: Approx. 325g (12 oz.)

Display:

- Alphanumeric 2 x 16 LCD
- Update rate: 1 second
- Contrast: User selected, 5 levels

Environmental

Operating temperature: -10 to 70°C (14 to 158°F)
Storage temperature: -15 to 80°C (5 to 176°F)
Relative humidity: 0 to 95%, non-condensing

Standards and Approvals

- CSA, CE, UL listed
- Manufactured under ISO 9001

Electrical

Sensor Input:

- Range: 0.5 to 1500 Hz
- Sensor power: 2-wire: 1.5 mA @ 5 VDC ± 1%
  3 or 4 wire: 20 mA @ 5 VDC ± 1%
- Optically isolated from current loop
- Short circuit protected

Current output:

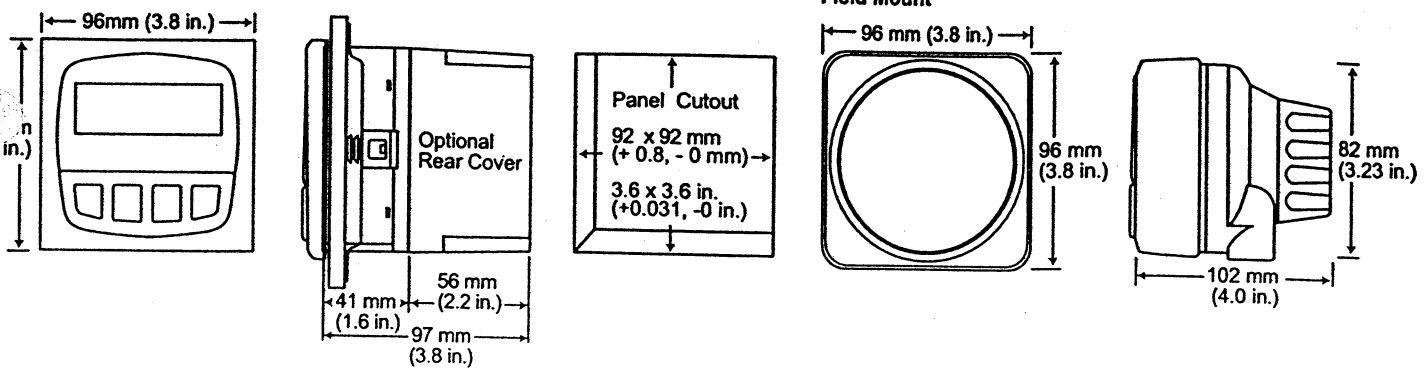
- 4 to 20 mA, isolated, fully adjustable and reversible
- Power: 12 to 24 VDC ±10%, regulated
- Max loop impedance: 50 Ω max. @ 12 V, 325 Ω max. @ 18 V, 600 Ω max. @ 24V
- Update rate: 100 ms
- Accuracy: ±0.03 mA

Relay outputs (2 sets):

- Mechanical SPDT contacts: Hi, Lo, Pulse Programmable
- Maximum voltage rating: 5 A @ 30 VDC, 5 A @ 250 VAC resistive load
- Hysteresis: User adjustable

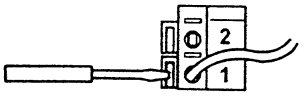
[nensions

Panel Mount



. Electrical Connections

Caution: Failure to fully open terminal jaws before removing wire may permanently damage instrument.



/ ng Procedure
Remove 0.5 - 0.625 in. (13-16 mm) of insulation from wire end.
Press the orange terminal lever downward with a small screwdriver to open terminal jaws.
Insert exposed (non-insulated) wire end in terminal hole until it bottoms out.
Release orange terminal lever to secure wire in place. Gently pull on each wire to ensure a good connection.

/iring Removal Procedure
Press the orange terminal lever downward with a small screwdriver to open terminal jaws.
When fully open, remove wire from terminal.

erminals	Description
AUX Power +	12-24 VDC
AUX Power -	

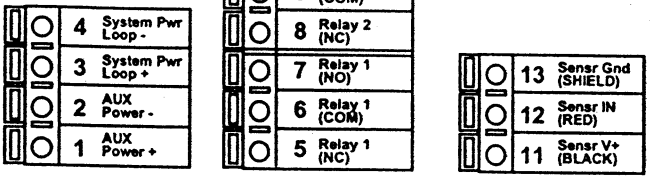
ystem Power/Loop

System Power/Loop +	12-24 VDC ±5%, system power and current loop connections.
System Power/Loop -	Max. loop impedence: 50 Ω max @12 V, 600 Ω max. @ 24 V.

elays

Relay 1 NC contact
Relay 1 COM contact
Relay 1 NO contact
Relay 2 NC contact
Relay 2 COM contact
Relay 2 NO contact

Relay 1 / 2 contact sets programmable as:
- High/Low alarm with adjustable hysteresis
- Proportional pulse output
- Disable (Off) selection



ensor Input

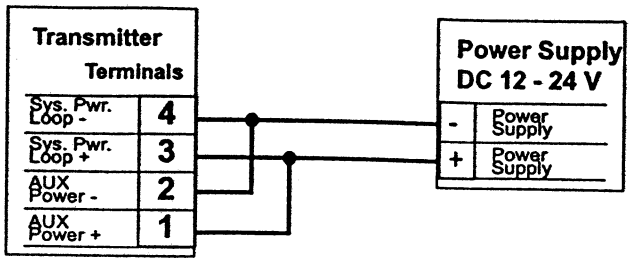
Black (Sensr V+)
Red (Sensr IN)
Silver (Sensr GND)

i ng Tips:

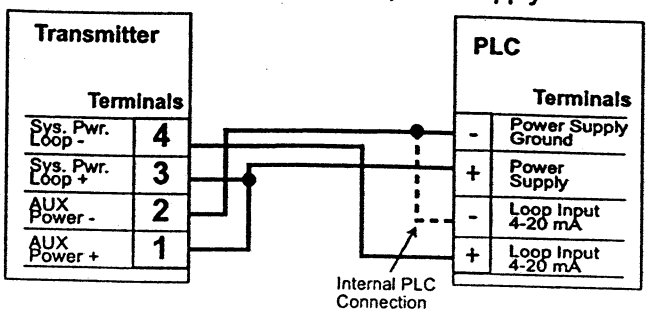
Do not route sensor cable in conduit containing AC power wiring - electrical noise may interfere with sensor signal.
Routing sensor cabling in grounded metal conduit may prevent moisture damage, electrical noise, and mechanical damage.
eal cable entry points to prevent moisture damage.
When placing two wire ends into a single terminal, solder or crimp ends together.

3.1 System Power/Loop Connections

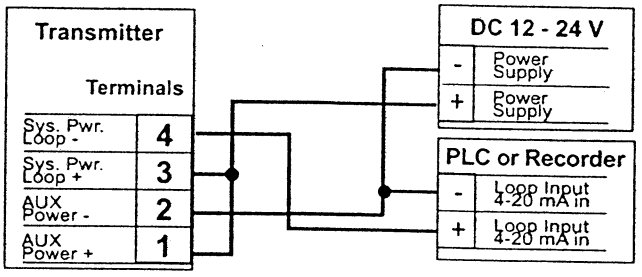
Stand-alone application, no current loop used



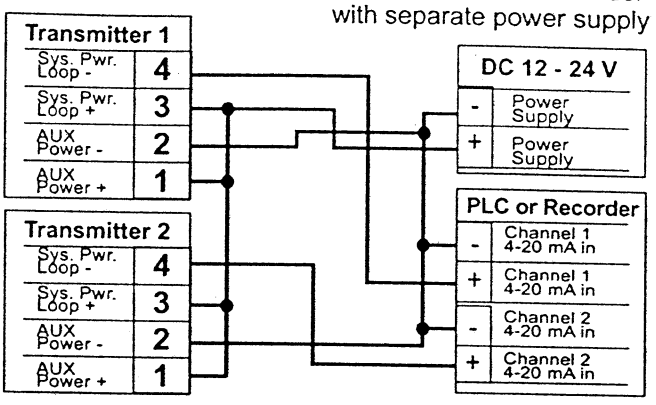
Connection to a PLC with built-in power supply



Connection to a PLC/Recorder, separate supply

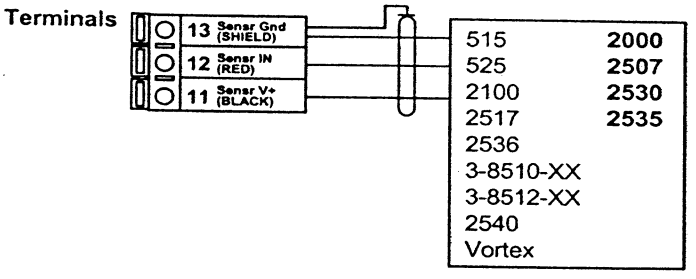


Example: Two transmitters connected to PLC/Recorder with separate power supply



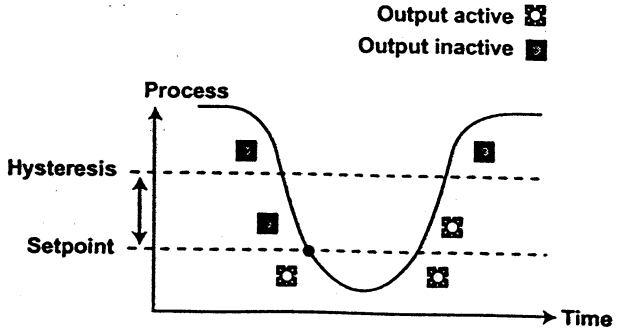
3.2 Sensor Input Connections

Wiring Tip:
Do not route sensor cable in any conduit containing AC power wiring - electrical noise may interfere with the signal.



3.3 Open Collector Functions

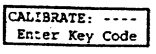
- **Low:** Output triggers when process variable is less than setpoint.
- **High:** Output triggers when process variable is higher than setpoint.
  Example: In Low Alarm Mode Operation, the output becomes active when the process drops below the setpoint, and becomes inactive when the process rises above the setpoint plus hysteresis. The opposite is true for High Alarm Mode.
- **Off:** Disables output pulse.
- **Pulse:** Outputs a pulse whenever a specified amount of volume has been totalized.
- **Frequency:** Outputs a pulse whenever the divided number of pulses are input.



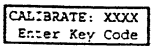
Menu Functions

EW Menu: is displayed during standard operation.
Press UP or DOWN buttons to view process parameters.
Press UP and DOWN buttons at the same time, to exit any other display and return to VIEW menu.
Display will return to VIEW menu in 10 minutes unless a key is pressed.

ALIBRATE Menu: contains display setup and output parameters. A security code feature prevents unauthorized tampering. To access CALIBRATE menu:
Press ENTER button for 2 seconds to display:

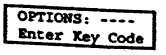


Press UP, UP, UP, DOWN buttons in sequence to display:

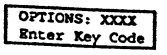


OPTIONS Menu: contains setup and display features for minor display or output adjustments. To access OPTIONS menu:

- Press ENTER button for 5 seconds to display:



- Press UP, UP, UP, DOWN buttons in sequence to display:

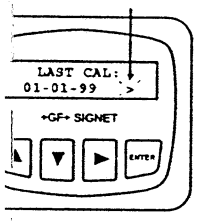


Menu Tips

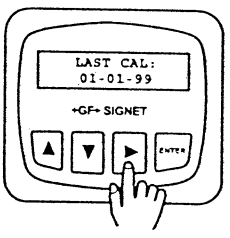
- Right button scrolls to right, from top to bottom row, and allows editing when ">" symbol is shown.
- In CALIBRATE or OPTIONS menus, the transmitter will continue to measure and control outputs. When > is pressed, the input value is held at the last measured process value.
- When sensor is not connected, unit will display CHECK SENSOR and any output controlled by sensor will be at 3.6 mA or OFF.

ample
change date, first enter CALIBRATE menu (Press ENTER button for 2 seconds; Press UP, UP, UP, DOWN buttons in sequence)
e in CALIBRATE menu, press UP button 1 time.

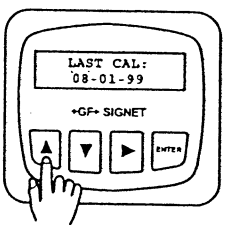
Display shows right arrow



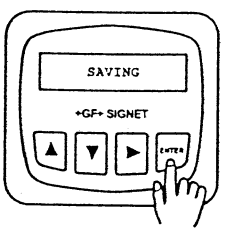
2. Press RIGHT button to display "01" blinking



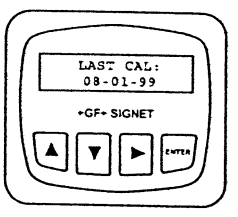
3. Press buttons to scroll through numbers.



4. Press ENTER button to save



5. Display now reads new date



ıu Functions

View Menu	Range
Flow units al: >	00000 - 99999
al Reset	Lock: OFF
Reset Total?	00000000
Total Reset	Lock: ON
Reset Total? Key Code —	▲ ▲ ▲ ▼
Perm: Total Units	00000000 - 99999999
Loop Output: mA	4-20 mA
Last Cal: Date	00-00-00 to 39-39-99

Settings repeat for Relay 2

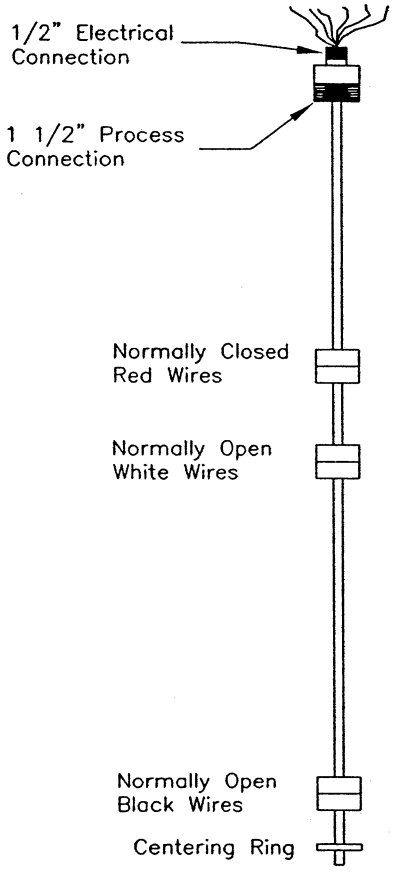
Calibrate Menu	Range	Preset
Flow Units: GPM >	a-z,A-Z,/,3, s,h,m,d s=seconds h=hours m=minutes d=days	GPM
Flow K-Factor: >	0.0000 to 99999	60.00
Total Units: Gallons >	a-z,A-Z,/,0-9 eight digit field	Gallons
Total K-Factor: 60.00 >	0.0000 to 99999	60.00
Loop Range: GPM 000.00->100.00>	0.0000 to 99999	0 to 100
Relay1 Mode: Low >	Off Low High Pulse	Low (Relay1) High (Relay2)
Low or High selected		
Relay1 Setpnt: 10.0 GPM >	0.0000 to 99999	10 (Relay1) 90 (Relay2)
Relay1 Hys: 5.0 GPM >	0.0000 to 99999	5 gpm
Pulse Selected		
Relay1 Volume: 100.00 Gallons >	0.0000 to 99999	100
Relay1 Plswdth: 0.1 Seconds >	0.1 to 999.9 seconds	0.1 seconds
Last Cal: 01-01-99 >	00-00-00 to 39-39-99	01-01-99

Options Menu	Range	Preset
Contrast: Level >	1-5	3
Flow Decimal: *** ** >	*.**** to *****.	****.*
Total Decimal: ******** >	******.** to ********.	********.
Averaging: Off >	Off Low (4secs) High(8secs)	Off
Total Reset: Lock Off >	On Off	Off
Loop Adjust: 4.00 mA >	3.8 to 5.0 mA	4.00 mA
Loop Adjust: 20.00 mA >	19.0 to 21.0 mA	20 mA
Test Loop: >	4-20 mA	N/A
Test Relay1: >	On or Off	N/A
Test Relay2: >	On or Off	N/A

Troubleshooting

Display	Problem	Solution
——	Display timebase too large	Change flow timebase (S=seconds,M=minutes,H=hours,D=days) in CALIBRATE menu to a smaller value (e.g. GPD to GPM
Check settings for Output	Pulse width value too large for frequency input or pulse volume too small	Reduce output Plswidth setting or increase Output Volume setting.
SETUP READ ERROR Press Any Key	Memory fault occurred.	Press any key to reload presets, then reprogram setpoints.

Provided by KTH Sales, Inc www.KTHSales.com



This drawing shows a typical tank pump down with high level alarm scenerio.

Note:
1. All components to be stainless steel.
2. Multiple or single float assemblies.
3. Switch to be 50 watt reed switch with 22 gage PVC insulated leads
4. Length can be specified, but is not field adjustable

SHEET 1 OF 1
DRAWING NO.:
LEVEL SUBMIT

DRAWING TITLE:
Custom Level Switches

PROJECT TITLE:
Standard Product

H2K Technologies, Inc.

THESE MATERIALS ARE PROPRIETARY AND SHALL REMAIN THE PROPERTY OF H2K TECHNOLOGIES, INC. BUYER SHALL HAVE THE USE OF MATERIALS AND INFORMATION FOR THE LIMITED PURPOSE OF INSTALLING AND MAINTAINING THE EQUIPMENT SOLD BY H2K TECHNOLOGIES, INC. NOT TO BE REPRODUCED WITHOUT WRITTEN PERMISSION.

UNLESS SPECIFIED OTHERWISE
• DIMENSIONS ARE IN INCHES
• DO NOT SCALE DRAWING
DRAWN BY: MK
DESIGNED BY: MK
PROJECT MGR.: MK
DATE: 9/27/03

REVISIONS

REV	DESCRIPTION	DATE	DWN

. Lubrication:
se transformer oil, Shell Tellus Turbo T
: equal. The ball bearings are of the
osed design and permanently greased.

Inspecting the hydraulic parts:
he pump housing (volute) and the
npeller should be visually inspected
very time the oil and stator is checked.
hange parts if excessive wear has
:curred or if performance of pump has
een reduced or impaired.

lote: If impeller is worn and needs to be
:placed, always install new oil lip seals
nd, on models with a shaft sleeve;
:place with a new shaft sleeve as well.

. Inspecting motor cable:
arefully inspect the outer shield and the
ire ends. If the outer shield has been
amaged, water can enter the pump
rough the core. The cable should never
e stretched by force. The pump should
ever be lifted by the motor cable. This
ould severely damage the power cable
nd the cable glands in the cable holder.
erform continuity test on each lead.

. Recommended tools
.LL-TEST III
crewdriver
fallet (rubber or plastic)
liers for cables
earing puller
ocket Wrench
/rench

Detailed overhaul

A complete overhaul should be made if water has been detected in the stator housing, or if the pump has been in daily use for a year. The intervals can be increased if the pump has beenpermanently installed as a sump pump with automatic controls. Dismantle the pump completely, replace damaged or worn parts with new, original parts. Clean all surfaces and check for cracks or damage. If water is present in stator housing and/or in oil chamber, replace mechanical seals, o-rings, oil seal and bearings.

For additional information concerning specific pump models, request detailed description.

WARNING

*Always disconnect power before performing any work on pump, cable or accessories.

*Keep plug dry and away from moisture or water.

*Do not lift pump by cable.

*Always use certified electrician to connect power.

BJM PUMPS
SERVICE MANUAL
GENERAL INFORMATION

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BJM CORP.
123 SPENCER PLAINS RD.
PO BOX 1138
OLD SAYBROOK, CT 06475
PHONE (860) 399-5937 FAX (860) 399-7784
EMAIL: info@bjmcorp.com

COPY RIGHT 6-9-94

Start-up Description

1. Ensure the power supply voltage is the same as that marked on the pump.
2. When permanently installing the pump, in a sump for example, make sure that the holding capacity of the sump is commensurate with the capacity of the pump. If the sump is too small the pump will stop and start too often resulting in damage to the pump.
3. Recommended maximum start-ups per hour is six (6).
4. If pump is used with a hose, check that no kinks or restrictions are present.

Electrical connection WARNING

Always disconnect power before undertaking any work on a pump, cable, control box or accessories.

Handling

Never lift a pump by its power cord. Lifting by the power cord can cause dangerous electrical shorts or pump failure. Always lift the pump by its handle. A rope or wire cable can be attached to the pump handle or lifting rings as an alternate handling method.

Rotation

Make sure that the impeller rotates in the correct direction. Tilt the pump slightly to one side and start up the pump for a short moment. The pump should twist in the opposite direction of the attached arrow. The arrow shows the running direction of the impeller.

Placing the pump

Never place the pump on loose or soft substances. The pump could sink and fill the pump housing with material which will block water flow to the impeller. If a solid bottom substance is not available, hang the pump by a wire. If the pump is hung by a wire, it will have to be restricted from twisting during start-up. This can be done by securing the pump to one side of the sump. Side discharge pumps should always be kept submerged by 1/3 of the pump for cooling effect.

Liquid temperature

The temperature of the water must not exceed 120 degrees Fahrenheit.

Submersion depth

The maximum depth is 33 ft. (10 m) or the length of the factory installed electrical cable, whichever is less.
If the initial start depth in water is less than 3 inches, the R400D must be primed.

Caution

Always mount control panels in a vertical position and in a dry area above ground near the pump. If outdoor installation is unavoidable, make sure a suitable control panel enclosure is used.

Cold weather

The pump will not freeze as long as it is submerged and in operation. If it is removed from the liquid, empty, clean and dry the pump. Store the pump in a place where the temperature does not go below 32 degrees Fahrenheit (0 Celsius). If the pump has been exposed to freezing temperatures, let it thaw slowly before it is started again. Never thaw using flame or direct heat as o-rings and seal damage may occur

Trouble Shooting

General

1. If the pump will not start:
Check the voltage,power supply, pump cable. Another situation is that the thermal contactor has opened due to an overheated motor caused by locked rotor or wrong connections.
1. Check the power supply, testing both voltage and amps.
2. Check any fuses and switches.
3. Check the cable, contactor and all connections. Test for continuity. Also test the stator for turn fault and insulation to ground.
4. Make sure that the impeller (and on KZN models the agitator) are clean and rotating freely.

2. Low capacity or low head:
Check for clogged or damaged passages. Some examples include: the strainer, a damaged or worn impeller or pump housing, broken pipes, damaged or kinked hoses or discharge pipe. Is the hose too long or too narrow. In the 3 phase model, this problem can also be caused by the wrong rotation due to miswiring.

3. Water in the stator housing:
If water is found in the stator housing the pump must be dismantled for a complete overhaul. Probable causes: Damaged or worn shaft seals and bad o-rings (Check oil housing for water contamination). Damaged cable entrance.

4. Water in the oil housing:
Check for worn or damaged oil lipseal and mechanical seals, leaking inspection plug or oilhouse cover.

Important!

When trouble shooting always follow local, state and federal regulations regarding procedures and safety. If pump still does not start, please contact the closest available recommended repair shop.

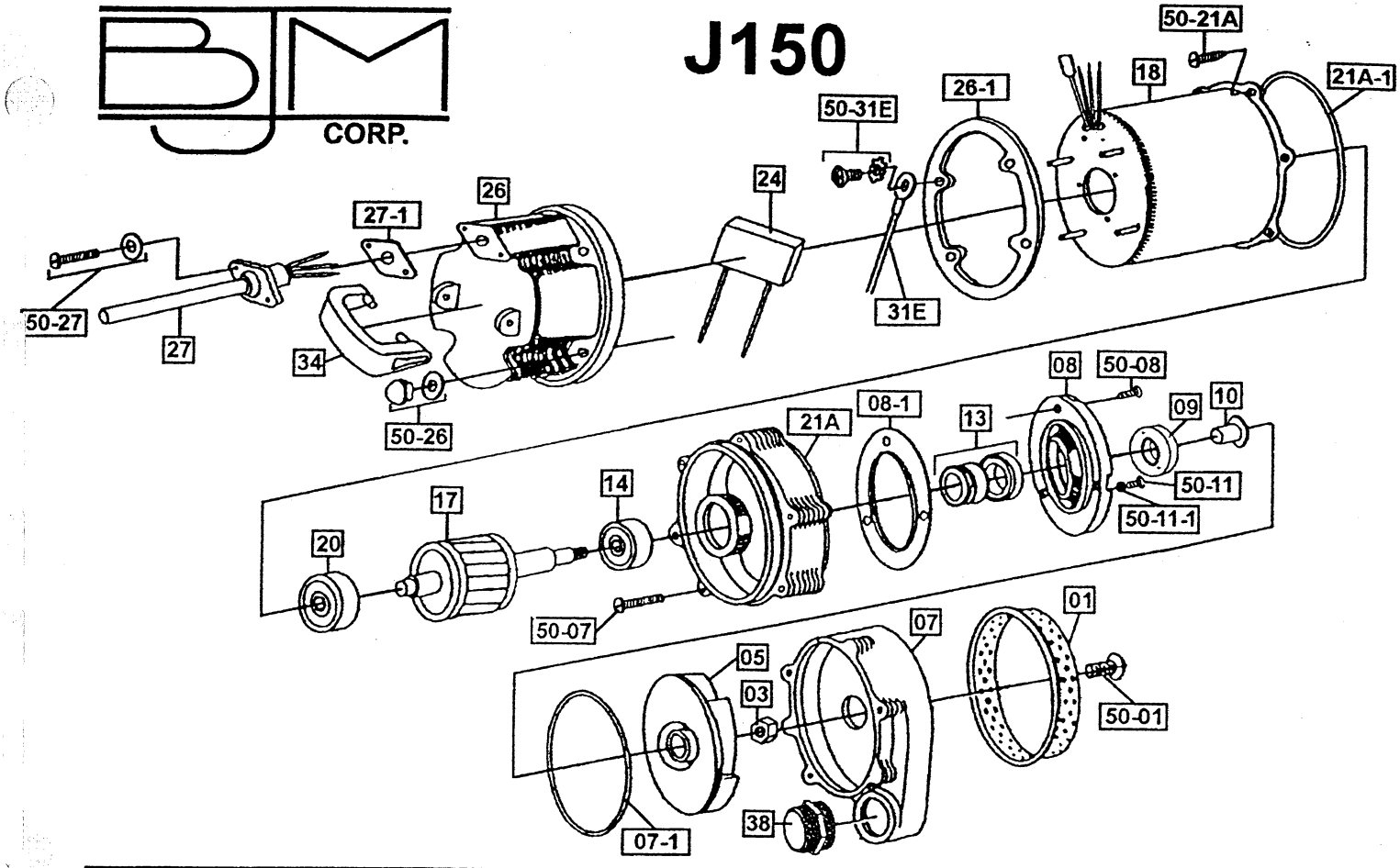
Overhaul

1. General dewatering needs:
If the pump, or the mechanical seals new, the oil should be checked after hours of running. A second check is ommended after 100 hours of use. A the initial checkups, a periodic maintenance check every 1000 hours of ning will suffice. If the liquid is very or laden with abrasive material, the pu should be checked every 10, 50 and hours. When inspecting the oil in the housing, make sure that no water present. Change the o-ring under the spection plug after each inspection. ditional instructions can be found der "Mechanical Seal Inspection".

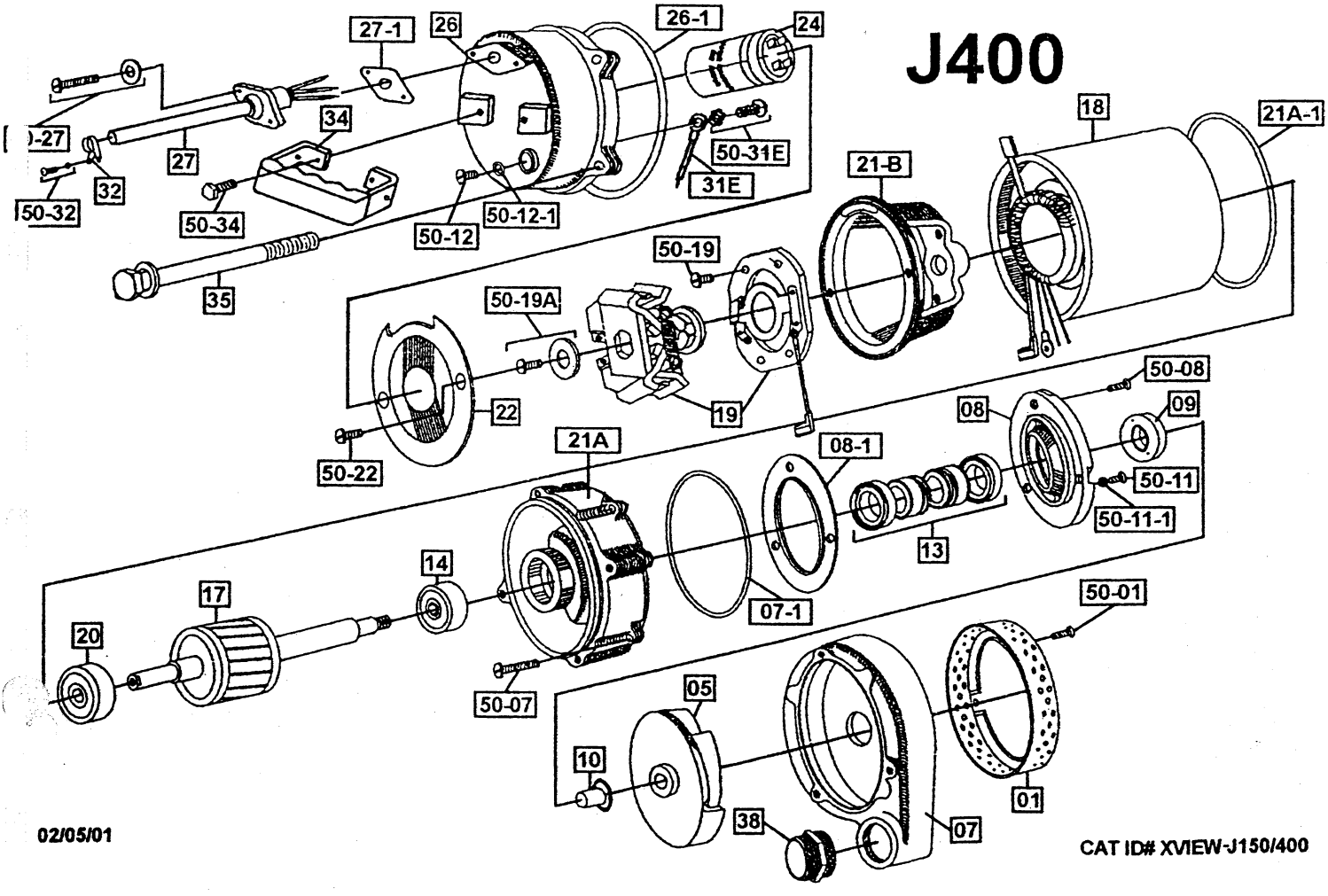
2. Mechanical seal inspection:
Remove the oil inspection plug loca on the outer casing on KZN models above the impeller on all others. Tilt pump so that some oil is drained fr the oil chamber. If the oil is free fr water and particles the lower mecha cal seal and the oilseal ring are C Check that the oil housing contains correct quantity of oil. If the oil is c taminated, ("milkish" in appearan remove and inspect the seals. Cha oil. Check oil again after 15 hours. peat the above steps. Use oil as sp fied under "lubrication", below. W installing mechanical seals, make s a sleeve is used and that the shaft is lubricated with the same oil as use the oil housing.

BJM CORP.

J150



J400



anchor scientific inc.
Box 378, Long Lake, MN 55356
952-473-7115 • FAX 952-473-6002 • www.anchorscientific.com

mini·float®
Form 2500-D

mini·float®

DESCRIPTION

Mini-floats are pilot duty devices designed for small diameter sumps and places where space is a determining factor in the selection of a level control device. Mini-floats control the function of motor load devices, such as contactors, motor starters, and power relays, to automatically cycle a pump or pumps. They can also be used for alarm signaling devices. Two Mini-Floats are needed for a one-pump operation; three for a two-pump operation.

SPECIFICATIONS

Cable	18-2 SJO W/A
Housing	Polypropylene
Clamp (Only on Type P models)	Adjustable 1"-4"
Temperature Rating	60° C.

MODELS

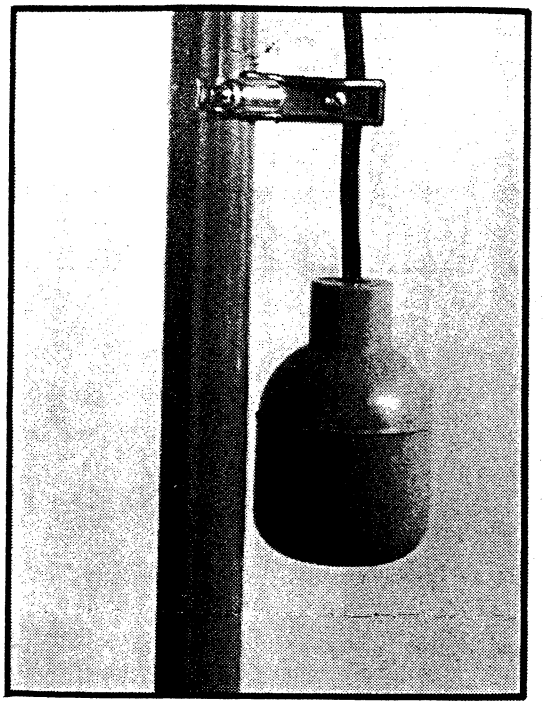
Mini-Floats are available in a combination of mounting styles, cable lengths, and circuit configurations. Mounting styles are shown at right: pipe mounted (Type P), and suspended (Type S). 10, 15, and 25-foot cable lengths are standard, but other lengths can be special ordered. Electrical configurations must be specificied; normally open, (NO), for pump out applications and normally closed, (NC), for pump in applications.

EXAMPLE:

P	M	10	NO
Mounting Style	Mini-Float	Cable Length	Electrical Configuration

ELECTRICAL CONFIGURATION	CABLE LENGTH	SUSPENDED TYPE 'S' MODEL NO.	PIPE MOUNTED TYPE 'P' MODEL NO.
NORMALLY OPEN	10	S M 10 NO	P M 10 NO
	15	S M 15 NO	P M 15 NO
	20	S M 20 NO	P M 20 NO
	25	S M 25 NO	P M 25 NO
	30	S M 30 NO	P M 30 NO
NORMALLY CLOSED	10	S M 10 NC	P M 10 NC
	15	S M 15 NC	P M 15 NC
	20	S M 20 NC	P M 20 NC
	25	S M 25 NC	P M 25 NC
	30	S M 30 NC	P M 30 NC

MOUNTING STYLES



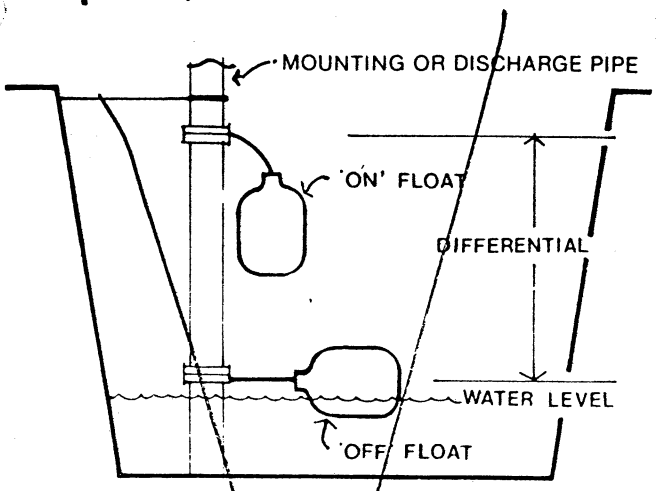
TYPE P - M



TYPE S - M

ONE FLOAT FOR ON/OFF

TYPICAL INSTALLATION



General Comments

1) Never work in the sump with the power on.

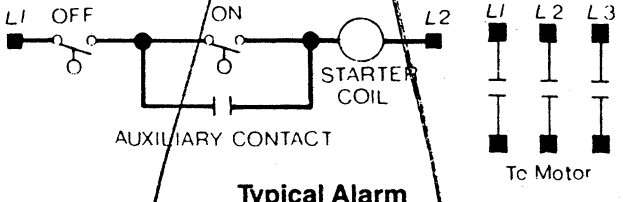
2) Attach the Type P Mini-Floats to the mounting pipe or the pump discharge pipe. The 'off' float should be below the 'on' float in a 'pump out' application.

3) Arrange the Mini-Floats so they do not tangle or hang up.

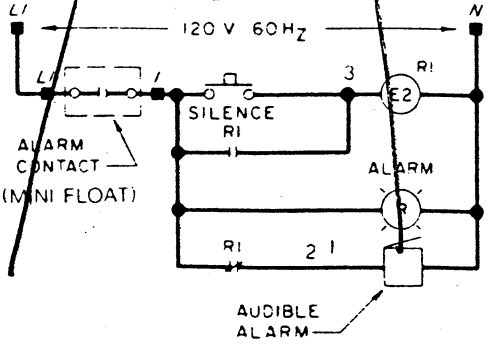
4) Thread the cable strap through the buckle with the ratchet pawl; cinch up tight; thread excess strapping through outer buckle slot.

5) Measuring the difference between mounting points gives the 'pump down' differential.

Typical Simplex Wiring Schematic



Typical Alarm Wiring Schematic



SPECIFICATIONS

Cable - 18-2 SJO W/A 34 x 41 strand. 90°C.
DIAMETER .30

Float - Polypropylene.

Clamp - Stainless Steel.

UL Listed
Ind. Con. Eq.
125 VA @ 115 VAC

Component Switch Rating
4.5A @ 120V., Res.
2.2A @ 230V., Res.

Temperature Rating - 60 C.

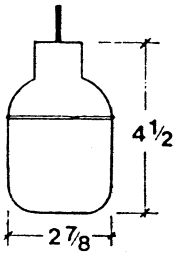
Normally Open - Blue Housing
Normally Closed - Red Housing

ELECTRICAL CONFIGURATION	CABLE LENGTH	SUSPENDED TYPE 'S' MODEL NO.	PIPE MOUNTED TYPE 'P' MODEL NO.
NORMALLY OPEN	10	S M 10 NO	P M 10 NO
	15	S M 15 NO	P M 15 NO
	20	S M 20 NO	P M 20 NO
	25	S M 25 NO	P M 25 NO
	30	S M 30 NO	P M 30 NO
NORMALLY CLOSED	10	S M 10 NC	P M 10 NC
	15	S M 15 NC	P M 15 NC
	20	S M 20 NC	P M 20 NC
	25	S M 25 NC	P M 25 NC
	30	S M 30 NC	P M 30 NC

SUBMITTAL APPROVAL

NAME

DATE



Float Dimensions

* Important Notes - Mini-Floats are pilot duty devices. They cannot be used to directly power pump motors. Also, do not use Mini-Floats in gasoline or other combustibles. These devices can be used with intrinsically safe relays for some hazardous locations. See Sec. 500 of NEC.

This product contains mercury. Dispose of in accordance with Local, State and Federal Regulations so that mercury does not contaminate the environment.
Not for use in potable water.

DWN BY PD	DATE 7-17-80		anchor scientific inc.
CKD BY JTP	DATE 7 20-80		Industrial Park, Long Lake, MN 55356 952-473-7115
APPD BY JTP	DATE 7-20		Typical installation and specification data for Mini-Floats
PROJECT NAME	Mini-Float		
FACTORY ORDER NO		DWG NO	2510-B

Appendix F

Citizen Contact List

APPENDIX F

Citizen Contact List

October 2006

Ms. Abby Snyder, Regional Director N.Y.S.D.E.C., Region 9 270 Michigan Avenue Buffalo, NY 14203	Mr. Daniel David N.Y.S.D.E.C., Region 9 270 Michigan Avenue Buffalo, NY 14203
Mr. Martin Doster N.Y.S.D.E.C., Region 9 270 Michigan Avenue Buffalo, NY 14203	Mr. Thomas Biel N.Y.S.D.E.C., Region 9 270 Michigan Avenue Buffalo, NY 14203
Ms. Meaghan Boice-Green N.Y.S.D.E.C., Region 9 270 Michigan Ave. Buffalo, N.Y 14203	Ms. Megan Gollwitzer N.Y.S.D.E.C., Region 9 270 Michigan Ave. Buffalo, N.Y 14203
Community Outreach File N.Y.S.D.E.C., Region 9 270 Michigan Ave. Buffalo, N.Y 14203	Mr. Cameron O'Connor N.Y.S.D.O.H. 584 Delaware Avenue Buffalo, NY 14202
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Assemblyman Jack Quinn 146th Assembly District 3812 South Park Ave. Buffalo, NY 14210	Congressman Brian Higgins 726 Exchange St. Buffalo, NY 14210
Senator William Stachowski 58th District, N.Y.S. Senate 2030 Clinton Street Buffalo, NY 14206	Honorable Joel Giambra Erie County Executive 95 Franklin Street Buffalo, NY 14202
Legislator Daniel Kozub Erie County Legislature, 1st. 609 Ridge Rd. Buffalo, NY 14216	Chairperson Lynn Marinelli Erie County Legislature 1701 Hertel Ave. Buffalo, NY 14216
Councilman Michael Kearns Buffalo Common Council, South 1401 City Hall Buffalo, NY 14202	Council President David Franczyk 1315 City Hall Buffalo, NY 14202

APPENDIX F

Citizen Contact List

October 2006

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Mayor Byron Brown Buffalo Mayor's Office, R 201 City Hall Buffalo, NY 14202	Mr. Joe Giambra Buffalo Public Works Dept. 503 City Hall Buffalo, NY 14202
Mr. Dennis Sutton Buffalo Urban Renewal Agency 901 City Hall Buffalo, NY 14202	Commissioner Andrew Eszak Erie Co. Environment & Plan. 95 Franklin Street Buffalo, NY 14202
Mr. Paul Krantz Erie Co. Environment & Plan. 95 Franklin Street Buffalo, NY 14202	Commissioner Anthony Billittier Erie Co. Health Dept., Rm 931 95 Franklin Street Buffalo, NY 14202
Honorable Joel Giambra Erie County Executive 95 Franklin Street Buffalo, NY 14202	Legislator Daniel Kozub Erie County Legislature, 1st. 609 Ridge Rd. Buffalo, NY 14216
Chairperson Lynn Marinelli Erie County Legislature 1701 Hertel Ave. Buffalo, NY 14216	Mr. Christopher Pawenski Erie County Dept. Env. & Planning 95 Franklin St. Buffalo, NY 14202
Mr. Peter Cammarata ECIDA 275 Oak St. Buffalo, NY 14203	Front Page, Inc. 2703 South Park Lackawanna, NY 14218
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News Director WIVB TV Channel 4 2077 Elmwood Avenue Buffalo, NY 14207	News Director WKBW TV Channel 7 7 Broadcast Plaza Buffalo, NY 14202
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APPENDIX F

Citizen Contact List

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News Director WUFO 1080 89 LaSalle Avenue Buffalo, NY 14214-1414	News Director WBNY 91.3 1300 Elmwood Avenue Buffalo, NY 14222-1004
News Director Citadel Communications 50 James E Casey Dr Buffalo, NY 14206-2367	News Director WNJA 89.7 PO Box 1263 Buffalo, NY 14240-1263
News Director WJJL 1440 920 Union Road West Seneca, NY 14224	Editor Buffalo News 1 News Plaza, PO Box 100 Buffalo, NY 14240
Editor Bee Group Newspapers P.O. Box 150 Buffalo, NY 14231-0150	Annemarie Franczyk Business First of Buffalo, Inc. 465 Main Street Buffalo, NY 14203-1793
Editor Metro Community News 25 Boxwood Lane Buffalo, NY 14227-2780	Buffalo Alternative Press PO Box 729 Buffalo, NY 14205
Editor ARTVOICE 810 Main Street Buffalo, NY 14202	League of Women Voters 1272 Delaware Ave. Buffalo, NY 14209
WNY Director Citizens' Environmental Coalition 543 Franklin Street, Suite 2 Buffalo, NY 14202-1109	Brian P. Smith CCE 3144 Main Street Buffalo, NY 14214

APPENDIX F

Citizen Contact List

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Ms. Peg Overdorf Valley Community Association 93 Leddy St. Buffalo, NY 14210	Dr. Joseph Gardella BEMC 178 Admiral Rd. Buffalo, NY 14216
Pierce & Stevens Inc. P.O. Box 1092 Buffalo, NY 14240	Rigidized Metals Corp. 658 Ohio St. Buffalo, NY 14203
Advance Metals Recycling P.O. Box 1131 Buffalo, NY 14240	Gelinmac Storage P.O. Box 198 Niagara Falls, NY
Irish Propane Crop. P.O. Box 0409 Buffalo, NY 14212	O'Connell Inc. 10 Katherine St. Buffalo, NY 14210
Current Resident 25 Ensign Buffalo, NY 14203	Current Resident 4 Ganson St. Buffalo, NY 14203
The B.O.C. Group/Current Resident 89 Katherine St. Buffalo, NY 14210	Current Resident 37 Ensign Buffalo, NY 14203
Ken & Dianne Skinner 148 South St. Buffalo, NY 14204	Mr. Norman Stramowski 12 Vandalia Buffalo, NY 14204
Daniel & Kathleen Granville 112 South St. Buffalo, NY 14204	

Appendix G

Project Organization

Appendix G
O M & M Plan
Sovereign Specialty Chemicals – Buffalo, NY
September 2006

Project Organization

