Post-Closure Monitoring and Facility Maintenance Plan for the Airco Parcel Niagara Falls, New York

Contract No. 12040.83

Prepared for

The BOC Group
100 Mountain Avenue
Murray Hill, New Jersey 07974

Prepared by

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February 2005
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1. INTRODUCTION

1.1 STATEMENT OF PURPOSE

This revised Post-Closure Monitoring and Facility Maintenance Plan has been prepared for the Airco Parcel located on Witmer Road in the Town of Niagara Falls, New York (Figure 1). This Plan describes the tasks necessary for maintenance of the site; periodic inspections; and monitoring of groundwater, surface water, and the groundwater collection and treatment system (GCTS). The intended use for this Plan is to provide a guide to the current landfill owners for maintenance and facility monitoring for a period of 30 years.

The following is required as part of the Post-Closure Monitoring and Facility Maintenance Plan:

- Drainage structures and ditches must be maintained to prevent ponding of water and erosion of the final landfill soil cap.
- Routine inspections conducted of sediment ponds and the engineered wetland to assess the presence of mosquito larvae.
- Soil cover integrity, slopes, cover vegetation, drainage structures, and the perimeter road must be maintained during the post-closure monitoring and maintenance period.
- Environmental monitoring points must be maintained and sampled during the post-closure period. Bi-annual summary reports must be submitted to the New York State Department of Environmental Conservation (NYSDEC) Division of Solid and Hazardous Materials, Region 9; the State of New York Department of Health in Albany, New York; and the document repository located at the Town of Niagara Town Clerk's Office.
- A vegetative cover must be maintained on all exposed final cover material, and adequate measures must be taken to ensure the integrity of the final vegetated cover, topsoil layer, and underlying barrier protection layer.
- The GCTS must be operated and maintained to effectively mitigate the release of groundwater recharging to surface water in the southwest corner of the Airco Parcel.
- Records must be maintained of all sampling and analysis results.

1.2 ORGANIZATION

Section 1 outlines the purpose of this Plan, and identifies applicable regulatory provisions. Section 2 details the maintenance inspection requirements. Section 3 outlines the groundwater monitoring and GCTS monitoring program. Section 4 discusses the sampling frequency and data reporting requirements. Appendix A contains the Operation and Maintenance Manual for the GCTS. Appendix B contains the standard operating procedures for the low-flow sampling method. Appendix C contains the field forms. Appendix D contains the well construction diagrams.

2. MAINTENANCE INSPECTIONS

Bi-annual landfill inspections, and inspections after major rainfall events (5-year storms), will be performed at the facility during the minimum 30-year post-closure period, unless specific approval is given by NYSDEC to eliminate some or all of these requirements. The inspections will be performed on the facility to ensure that the final landfill cover materials, site drainage structures, and onsite monitoring wells are maintained and functioning within the design standards. Advance notification of inspections will be made to NYSDEC 72 hours prior to commencement of inspection-related activities in the event NYSDEC attendance is desired. An example of the inspection checklist is provided in Appendix C. The landfill inspection reports will be submitted to NYSDEC along with the bi-annual monitoring reports.

2.1 DRAINAGE STRUCTURES

The inspections will include visual checks of culverts, drainage swales, and berms/benches, if present, to ensure erosion problems are not occurring. Any material defects and erosion occurrences discovered at the facility will be repaired immediately and restored to "new" condition. Eroded soil or cover material will be replaced as soon as possible. Exposed or unvegetated soil will be re-seeded, fertilized, and mulched.

2.2 COVER SYSTEM

Areas of concern within the final landfill cover system could include erosion, exposure, loss of vegetative cover, settlement, gravity sliding, or cracking on the top or side slopes of the landfill. Each quarter, the cover system, including topsoil layer and barrier protection layer, the geocomposite drainage layer, and the 40-mil liner low-density polyethylene membrane, will be inspected and records will be maintained.

Minor repairs to the cover system will be performed by hand, utilizing materials from the original borough source or newly approved borough source. The areas of minor erosion, sloughing, or cracking will be excavated by hand to allow for a concise repair. Materials will be placed, compacted appropriately by hand, and re-seeded. Additional erosion control measures, such as straw or hay bales, will be used accordingly to prevent future damage to the repaired areas.

In the event that major erosion, sloughing, or slumping is noted during an inspection, NYSDEC personnel will be notified within 48 hours of the problems observed. An action plan detailing the remedial measures to be taken to rectify the problem will be developed and submitted to NYSDEC for approval, prior to implementation of the remedy. Any repairs requiring patching or seaming of the liner low-density polyethylene membrane or geocomposite drainage layer will be conducted in accordance with manufacturers' construction specifications and outlined in the action plan.

2.3 VECTORS

The original vector inspection performed in December 1999 as part of the preparation of the approved Closure Plan (EA 2000[1]) indicated that vectors do not appear to pose a threat to the proposed landfill cap section. Although the habitat has been significantly improved after closure was completed, vectors have not been observed. However, continued monitoring for vectors will be performed as part of the inspections. The presence of any vectors (e.g., rodents, flies, etc.) on the site will be determined during the quarterly inspection. If present, extermination or treatment that will remove the vecting population(s) will be implemented

2.4 GROUNDWATER COLLECTION AND TREATMENT SYSTEM

Appendix A includes a comprehensive Operation and Maintenance Manual, which details the required activities to be performed routinely to ensure proper system operation. In general, the system includes pumps, tanks, and controls to convey collected water from the southwest corner of the site, to the northwest corner for treatment. Treatment includes aeration of the water with carbon dioxide gas to lower the pH, and reduction of the hexavalent chromium utilizing a bed of shredded zero valence iron. The system also includes two settling ponds and an engineered wetland to provide removal of insoluble precipitates.

2.4.1 Mosquito Larvae Inspection

During the monthly site inspections and maintenance activities, personnel will inspect the two sediment ponds and engineered wetland for the presence of mosquito larvae. If larvae are noted, then identification of the mosquito species will be performed. Subsequent mitigation of the mosquito population, either by addition of indigenous *Fundalis* minnows, or by applying a mono-molecular film, will be employed to control the population. Within 72 hours of observing mosquito larvae, NYSDEC will be contacted to assist in the identification. A letter work plan detailing the mitigation approach will be submitted for approval prior to initiation of mosquito abatement activities.

2.5 OTHER FACILITIES AND STRUCTURES

Monitoring well casings, casing locks, concrete aprons, fences, and gates will be inspected to ensure that they are undamaged and functional. Damages will be repaired immediately and structures re-secured. Mowing of the cap system will occur annually after 1 September to allow for enhancement of avian wildlife habitat.

1. EA Engineering, P.C. and its Affiliate EA Science and Technology. 2000. Closure Plan for the Witmer Road Landfill, Niagara Falls, New York. April.

2.6 INSPECTION REPORTING

Inspection reports will be prepared and submitted to NYSDEC Division of Solid and Hazardous Materials Region 9 office as an attachment to the bi-annual monitoring event report. The inspection report will include, at a minimum, the date and time of the inspection; personnel conducting the inspection; visual observations of the inspectors; a list of items inspected; and a brief description of any repair work, if required, including the nature of the damage, repairs completed, and estimated cost of the repairs. The report will also describe any items that will need future attention or repairs not completed during the course of the inspection, along with any other pertinent comments.

2.7 BI-ANNUAL MONITORING EVENT REPORT

A summary report will be prepared bi-annually to outline the previous year's monitoring and maintenance activities. The report will describe the previous year's trends with regards to constituents of concern, inspection report findings, and associated remedies, if required.

3. ENVIRONMENTAL MONITORING PROGRAM

This section provides a summary of the field activities to be performed as part of the post-closure environmental monitoring program at the Airco Parcel. Activities to be conducted at the site include:

- Groundwater monitoring
- Surface water sampling
- GCTS sampling.

3.1 GROUNDWATER MONITORING

The monitoring wells at the site will be sampled using the low-flow sampling methods (Appendix B). Prior to sampling, each well will be monitored until the water quality parameters (temperature, pH, specific conductivity, and turbidity) have stabilized. However, if a well(s) has a limited well volume and low recharge, dedicated bailers will be used. The well(s) will be bailed dry at least once and allowed to recharge to at least 90 percent of the static (i.e., before purging) water level prior to collecting the sample. Results will be logged on the Field Record of Well Gauging, Purging, and Sampling included in Appendix C. The samples will be collected bi-annually and analyzed for a limited number of metals, water quality parameters, and field parameters. Table 1 depicts the list of analyses to be performed.

3.1.1 Groundwater Gauging

In order to evaluate the groundwater flow direction at the site, groundwater level gauging will be performed on the onsite wells prior to sample collection. An electronic water level meter will be used for this field task capable of recording water elevations to within ±0.01-in. accuracy.

3.2 SURFACE WATER MONITORING

Surface water sampling is designed to evaluate the chemical quality surface water runoff, which may collect in the drainage swales prior to exiting the site in the southwest corner. Surface water samples, if present, will be collected from the southern and western drainage swales in the southwest corner of the site. Samples will be collected using a decontaminated stainless steel or Teflon dipper. The sample will be analyzed for the same list of parameters identified in Table 1.

3.3 GROUNDWATER COLLECTION AND TREATMENT SYSTEM MONITORING

During routine visits, the GCTS will be sampled at various locations to evaluate treatment system performance and compliance with discharge criteria. Samples will be collected prior to and after treatment via the zero valence iron tanks, and after the engineered wetland. These samples will be field analyzed using a Hach DR/4000 U spectrophotometer. Hexavalent chromium will be determined using Hach Method 8083, which used 1,5-diphenylcarbohydrazide to react with the hexavalent chromium to form a purple color. Hexavalent chromium

concentrations are measured spectrophotometrically at 540 nm. Total chromium will be determined using Hach Method 8084. This procedure oxidizes all chromium in the sample to hexavalent chromium using the alkaline hypobromide oxidation method, followed by analysis of hexavalent chromium using 1,5-diphenylcarbohydrazide as discussed above. The detection limit is 5 ppb for either total or hexavalent chromium.

3.3.1 State Pollutant Discharge Elimination System Permit Sampling

Pursuant to the NYSDEC-issued State Pollutant Discharge Elimination System Discharge Guidance Values (4 January 2004), the GCTS discharge will be sampled monthly until May 2004, quarterly in September and December 2004, and quarterly after December 2004. Discharge guidance values analyte list and limits are listed in Table 3. Treatment system discharge samples are collected from the effluent pipe of P7, after the engineered wetland, and sent for laboratory analysis to Life Science Laboratories, Inc., East Syracuse, New York.

3.4 FIELD QUALITY CONTROL SAMPLES

These samples are not included specifically as laboratory quality control samples but are analyzed when submitted. Data for these quality control samples are reported with associated samples.

3.4.1 Water Source Sample

Water source samples are samples of water used for field decontamination purposes. Specifically, water source samples will include laboratory-supplied, reagent-grade, de-ionized water used for decontamination activities. Water source samples will be analyzed for the parameters sampled during the field mobilization period. One water source sample will be collected from the source per sampling event. The water source sample will be collected early in the field effort to assess the quality of this source water.

3.4.2 Rinsate Blanks

A rinsate blank is a water sample collected after having been poured through or over a decontaminated piece of sampling equipment to assess and document the thoroughness of the decontamination process. At least one rinsate blank per sampling event will be collected. As noted above, laboratory-supplied, reagent-grade de-ionized water will be used.

3.4.3 Field Duplicates

Field duplicates are two samples of the same matrix that are collected, to the extent possible, from the same location at the same time using the same techniques. Field duplicates provide

information on the precision of the sampling and analysis process. Field duplicates will be collected at a frequency of 1 duplicate per 20 sample media. Quality control samples will be filled from the same discrete sample or composite mixture as the field samples.

3.4.4 Sample Labels

Field samples collected will each be assigned a unique sample tracking number. Sample designation will be an alpha-numeric code which will identify each sample by site and location.

Sample Codes:

AP	=	Airco Parcel
MW	=	Monitoring well
SP1	=	Sediment Pond No. 1
SP2	=	Sediment Pond No. 2
EWE	=	Engineered wetland effluent
SS	=	Surface water
RB	=	Rinsate blank
TB	=	Trip blank
DUP	=	Duplicate
SWB	=	Source water blank.

For example, the groundwater sample from MW-1B is labeled AP-MW-1B. Quality control samples are labeled by the type of sample followed by a sequential numerical identification. For example, the first source water blank was named SWB-01. In order to ensure blind laboratory analysis of duplicate samples from specific matrixes, "DUP" is replaced by the sample identification number. This ensures that the laboratory cannot identify the location of the duplicate sample. For example, the first groundwater duplicate sample collected was identified as DUP-01.

3.5 SAMPLE KITS AND HANDLING

Sample kits, which are coolers containing chain-of-custody forms, custody seals, sample containers (with preservatives), and packing material, are prepared by the laboratory. The chain-of-custody procedure begins with the preparation of sample containers and preservatives to be used in sample collection. Unless superseded by specific project requirements, the contracted laboratory purchases and distributes pre-cleaned sample containers. Vendors are required to provide documentation of analysis for each lot of containers, and the documentation is kept on file.

For the analyses specified for this project, Table 2 shows general guidelines for the type of sample container required, preservation techniques, and holding times for analytical samples collected. Preservatives will be added to the sample containers in the laboratory prior to shipment.

After the samples are collected, they are split as necessary among containers and preservatives appropriate to the parameters to be determined. Each container is provided with a sample label that is filled out at the time of collection. At this time, a chain-of-custody form is initiated. The collected samples are cooled, if necessary, and returned to the laboratory by the most expedient means to ensure that holding times will be met. The chain-of-custody form is signed and dated as necessary as the samples pass from the collectors to those persons responsible for their transportation.

3.6 SAMPLE DOCUMENTATION IN THE FIELD

Field personnel are issued serialized weatherproof logbooks. Field personnel are responsible for recording all pertinent project information including, but not limited to, field work documentation; field instrumentation readings; calculations; calibration records; work plan distributions; photograph references; sample tag/label numbers; meeting information; and important times and dates of telephone conversations, correspondence, or deliverables. The field logbook also contains an abbreviated version of notes listed in the team or individual field logbooks. The sample team or individual performing a particular sampling activity is required to maintain a field logbook that is filled out at the location of sample collection immediately after sampling. It contains sample particulars including sample number, sample collection time, sample location, sample descriptions, sampling methods used, daily weather conditions, field measurements, name of sampler, and other site-specific observations. The field logbook also addresses deviations from this Plan or the Health and Safety Plan, including authorization obtained and the rationale for the deviation, visitor's names or community contacts during sampling, and geologic and other site-specific information determined by field personnel as noteworthy. A sample log sheet is filled out for each sample from the information recorded in the field logbook. In addition, field personnel use appropriate forms applicable to field activities. These include Field Record of Well Gauging, Purging, and Sampling; Landfill Cap Inspection; and GCTS checklists.

3.7 DECONTAMINATION PROCEDURES

To minimize the potential for cross-contamination between sample locations, reusable sampling equipment (stainless steel pumps and water level/interface probes) is cleaned as follows:

- Wash with potable water and laboratory-grade detergent (e.g., Alconox® detergent)
- Rinse with potable water
- Rinse with deionized water
- Rinse with methanol
- Rinse with deionized water
- Air dry and wrap in aluminum foil if equipment will be stored.

All monitoring wells have a dedicated bailer assigned to the sampling location. The dedicated bailers will be stored onsite. The water level/interface probe and stainless steel pumps are non-dedicated and will be decontaminated prior to and after sampling at all monitoring well locations.

4. SAMPLING FREQUENCY AND DATA REPORTING

4.1 SAMPLING FREQUENCY

During 2003, BOC requested a reduction in the frequency of sampling and testing of the monitoring wells and the designated surface water locations. NYSDEC granted this request by reducing the frequency from quarterly to bi-annual.

4.1.1 Groundwater Sampling

Due to extensive sampling that has been performed at this site, beginning in 2004, the groundwater monitoring wells at the site (MW-1B through MW-8B) will be sampled and analyzed for two rounds of modified routine parameters (Table 1). Monitoring wells will be sampled from least contaminated to most contaminated (MW-2B, MW-4B, MW-8B, MW-7B, MW-1B, MW-3B, MW-6B, and MW5B). A sampling location map is provided in Figure 2. Bi-annual modified routine parameter sampling will be conducted in April and October of each calendar year.

4.1.2 Surface Water Sampling

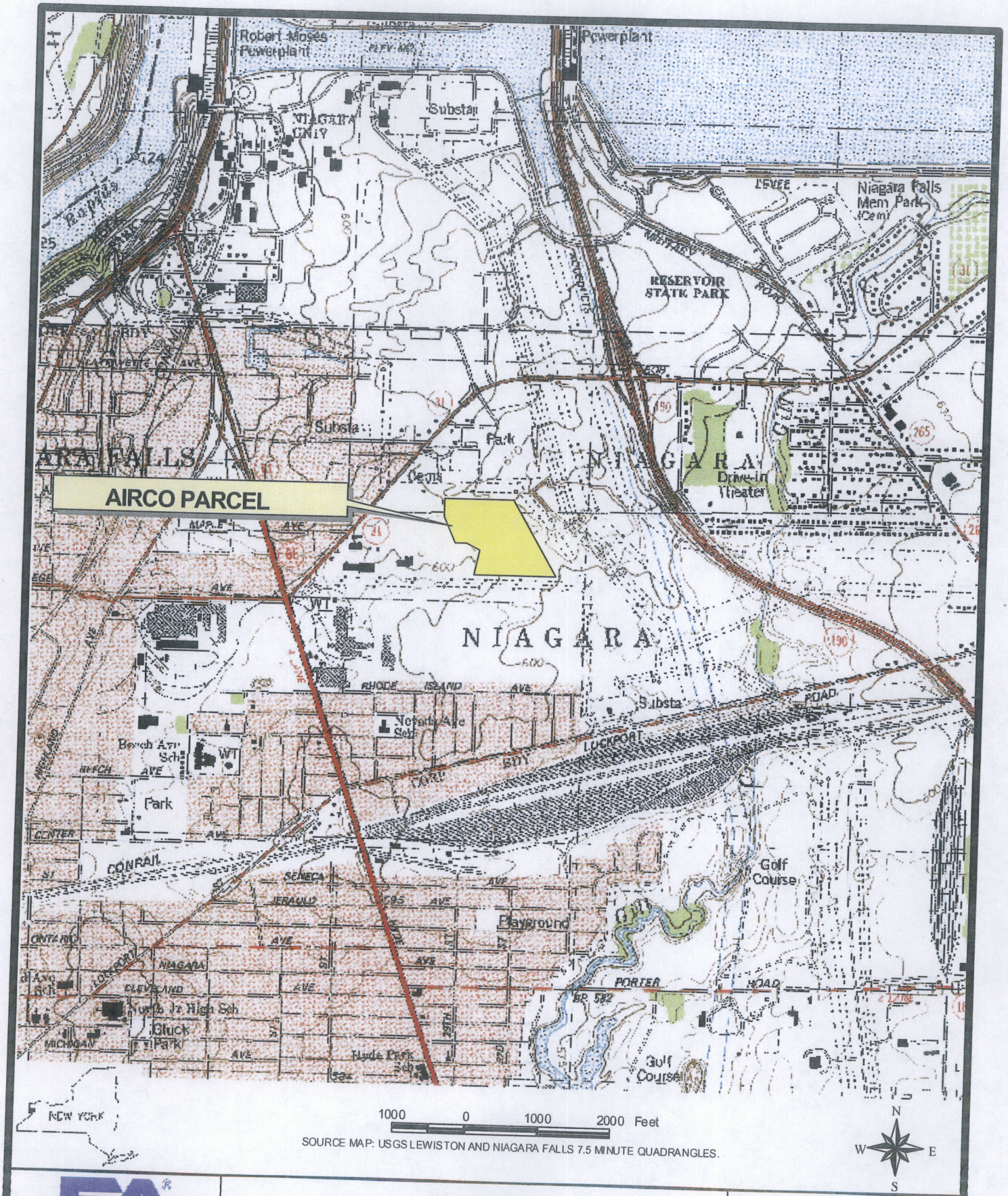
The designated surface water sampling point (SS-1) will be sampled on a bi-annual basis at the site. During the sampling event, the surface water sample is collected from the wetland adjacent to monitoring well MW-6B. As noted above, bi-annual modified routine parameter sampling will be conducted in April and October of each calendar year.

4.1.3 Groundwater Collection and Treatment System Sampling

The GCTS was sampled weekly for the first 8 weeks of operation, monthly for the ensuing 4 months, and quarterly thereafter. The first compliance sample was collected on 20 November 2003. Weekly sampling continued through the week ending 9 January 2004. Monthly compliance sampling will then occur from February to May, with 2 quarterly sampling events in September and December 2004. The sampling frequency after December 2004 will be quarterly. However, in the event of system modifications or upgrades, or periods of downtime greater than 2 weeks, weekly sampling using the Hach DR/4000 U spectrophotometer will be performed for 1 month after system restart.

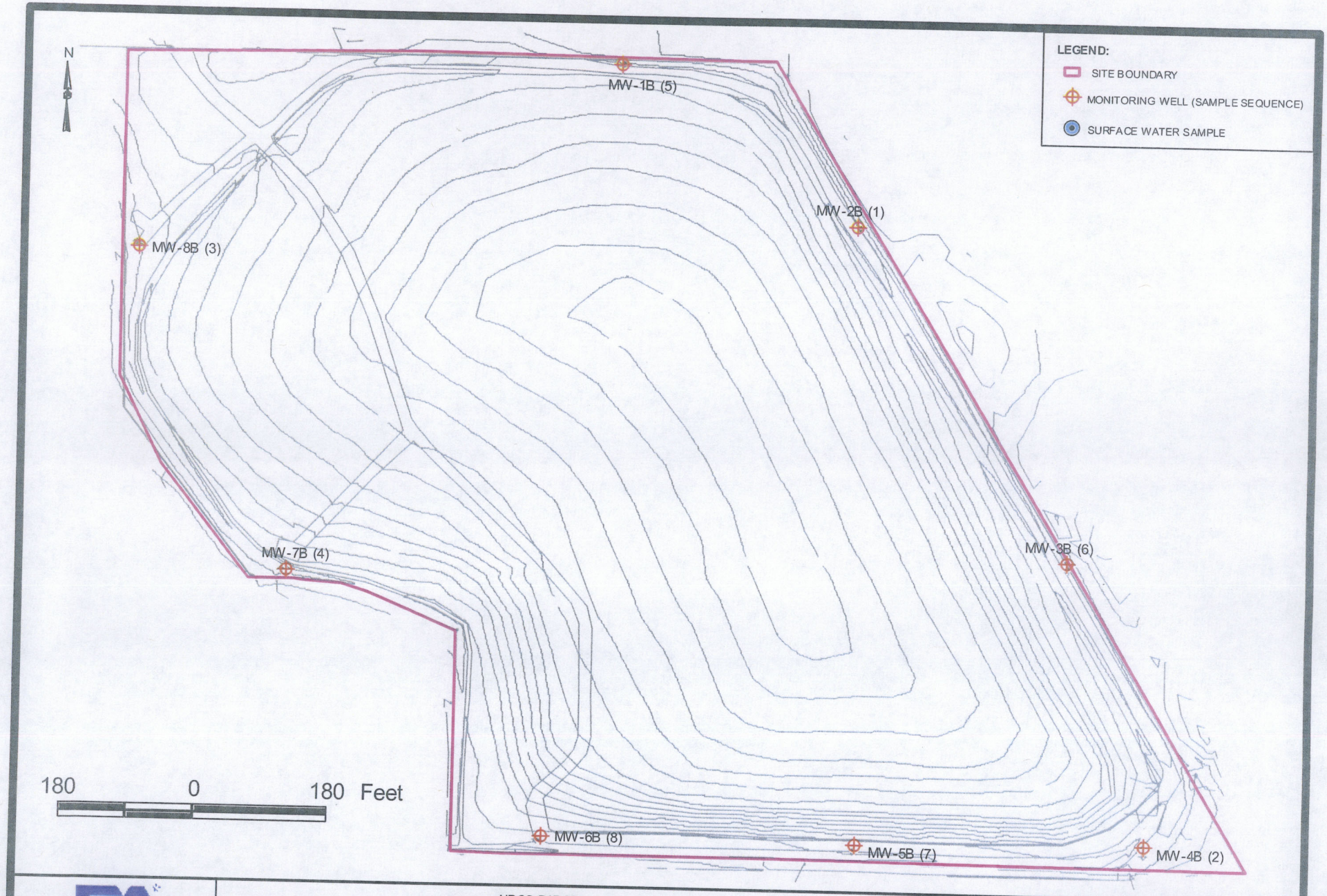
4.2 DATA REPORTING

The results of the two rounds of groundwater and surface water sampling, and the routine GCTS sampling, will consist of the field data sheets, chain-of-custody forms, and laboratory analysis results. A New York State-certified laboratory (Life Science Laboratory, Syracuse, New York) has been retained to analyze the water samples. Data collected in 2004 will be summarized in the bi-annual reports submitted after each groundwater sampling event.



EA	AIRCO PARCEL NIAGARA FALLS, NEW YORK	FIGURE 1 SITE LOCATION MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	RSC	RSC	CEM	AS SHOWN	10 SEP 2003	12040.69	I:\BOC-NIAGARA\FINAL.APR



EA	AIRCO PARCEL NIAGARA FALLS, NEW YORK					FIGURE 2 MONITORING WELL SITE MAP	
PROJECT MGR CEM	DESIGNED BY RSC	DRAWN BY RSC	CHECKED BY SLG	SCALE AS SHOWN	DATE 04 FEBURARY 2005	PROJECT No 12040.69	FILE No I:\BOC-NIAGARA-GIS\ FINAL.APR

TABLE 1 SUMMARY OF ANALYTES LIST AND ANALYTICAL METHODS FOR MONITORING WELL SAMPLES

Analyte List	Laboratory Analytical Method
Silicon	EPA 200.7 Total Metals
Cadmium	EPA 200.7 Total Metals
Chromium	EPA 200.7 Total Metals
Iron	EPA 200.7 Total Metals
Lead	EPA 200.7 Total Metals
Magnesium	EPA 200.7 Total Metals
Manganese	EPA 200.7 Total Metals
Selenium	EPA 200.7 Total Metals
Sodium	EPA 200.7 Total Metals
Thallium	EPA 200.7 Total Metals
Zinc	EPA 200.7 Total Metals
Ammonia as N	EPA 350.1, Ammonia
Phenolics, Total Recoverable	EPA 420.1, Recoverable Phenolics ML
Sulfate	EPA Method 300.0 A
Chromium, Hexavalent	SM 18 3500Cr-D, Hexavalent Chromium
pH	Field parameter recorded in the field
Conductivity	Field parameter recorded in the field
Turbidity	Field parameter recorded in the field
Dissolved Oxygen	Field parameter recorded in the field
Temperature	Field parameter recorded in the field
Oxidation Reduction Potential	Field parameter recorded in the field
NOTE: EPA = U.S. Environmental Protection Agency.	

TABLE 2 SUMMARY OF SAMPLE BOTTLES, PRESERVATIVE, AND HOLDING TIMES FOR MONITORING WELL AND GROUNDWATER COLLECTION AND TREATMENT SYSTEM SAMPLES

Monitoring Well Samples		
Sample Bottle and Analysis	Preservative	Holding Time
1 Amber liter (Total Phenolics)	H_2SO_4	28 days
1 Plastic 500 mL (Cr+6, SO4)	None	24 hours
1 Plastic 250 mL (Ammonia)	H_2SO_4	28 days
1 Plastic 250 mL (Metals)	HNO_3	6 months
Groundwater Collection and Treatment System Samples		
1 Amber liter (Total Phenolics)	H_2SO_4	28 days
1 Plastic 500 mL (Cr+6, BOD, TSS, pH, NO3, NO2, TDS)	None	24 hours
1 Plastic 500 mL (TKN, NH3, COD)	H_2SO_4	28 days
1 Plastic 500 mL (Ba, Cr, Cu, Fe, Ni, Se, Tl, Zn)	HNO_3	6 months
2 Volatile Organic Analytes 40 mL (601/602)	HCL	14 days

TABLE 3 SUMMARY OF STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM DISCHARGE GUIDANCE VALUES

Analyte List	Discharge Limitations
Flow Rate	21,600 gal per day
pH	6.5-8.5 standard unit
Total Kjeldahl Nitrogen	Monitor
Nitrate (expressed as N)	Monitor
Nitrite (expressed as N)	Monitor
Ammonia as N	5.0 (1 JUN – 31 OCT) mg/L 9.2 (1 NOV – 31 MAY) mg/L
Biological Oxygen Demand (BOD5)	5.0 mg/L
COD	40 mg/L
Total Suspended Solids	10 mg/L
Dissolved Oxygen	7 mg/L (minimum)
Total Dissolved Solids	Monitor
Chromium, total	100 µg/L
Iron, total	300 µg/L
Barium	2,000 µg/L
Copper, total	14.7 µg/L
Nickel, total	70 µg/L
Selenium, total	4.6 µg/L
Thallium	4 µg/L
Zinc, total	115 µg/L
Chromium, Hexavalent	11 µg/L
Phenolics	8 µg/L
1,1 Dichloroethane	5 µg/L
Trichloroethene	5 µg/L

Appendix A

Operation and Maintenance Manual Groundwater Collection and Treatment System

Operation and Maintenance Manual
Groundwater Collection and Treatment System
Airco Parcel
Niagara Falls, New York

Contract No. 12040.83

Prepared for

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1. INTRODUCTION

EA Engineering, P.C. and its affiliate EA Science and Technology have prepared this Operation and Maintenance (O&M) Manual for the groundwater collection and treatment system (GCTS) located at the Airco Parcel, Niagara Falls, New York. This Manual describes the O&M of the GCTS and is intended to serve as a general guide to operating personnel. The information contained within this Manual should be used in conjunction with manufacturer's information and recommendations included in the attachments. In addition, O&M functions should only be performed by authorized personnel. As such, this Manual does not describe specific O&M functions in detail. This Manual identifies normal operating procedures. The GCTS was installed during Summer and Fall of 2003, and officially began operation on 20 November 2003 when the first compliance sample was collected for offsite laboratory analysis.

During the first 6 months of the GCTS operation, it was observed that the groundwater collection system was yielding a significantly higher flow rate than was initially recorded during the design phase. To compensate for the higher flow rate, the GCTS was retrofitted to meet the collection system capacities. The modifications and upgrades were completed during the period June-July 2004. The GCTS was re-started on 29 July 2004, and the first compliance sample was collected for offsite laboratory analysis at that time.

1.1 SITE LOCATION AND HISTORY

The GCTS is part of the Interim Remedial Measures implemented at Airco Parcel located near Witmer Road in Niagara Falls, New York. The location of the site is presented on Figure 1. The Airco Parcel is the middle of three parcels that comprised the Vanadium Corporation of America site. The Airco Parcel was owned and used by the Vanadium Corporation of America from 1920 to 1964 for disposal of industrial slag and dust and other construction debris. A full description of the background, site use, and physical conditions of the site can be found in the Feasibility Study (EA 2003[1]).

The Airco Parcel was completed as a capped landfill in 2000. During construction of the capping system, a relief pipe system was installed to allow perched water to exit from under the cap without causing slope instability. Flow monitoring and quarterly sampling were initiated as part of post-closure operations and facility maintenance. The data collected since December 2000 indicated that the leachate was actually shallow groundwater recharging to surface water. The data also indicated that the recharge of groundwater at the site would continue to flow seasonally. The data further indicated that elevated hexavalent chromium (Cr^{6+}) concentrations and pH in groundwater, upon mixing with surface water, remained in excess of the ambient water quality criteria.

1. EA Engineering, P.C. and its Affiliate EA Science and Technology. 2003. Focused Groundwater Feasibility Study for the Airco Parcel, Niagara Falls, New York. March.

The GCTS is designed to implement additional remedial actions which have been deemed necessary to meet the goals of the Interim Remedial Measures Program. The main portion of the GCTS is located on the northwest corner of the site and contains the main control panel, carbon dioxide storage tank, carbon dioxide aeration system, two sediment ponds, duplex pump house, zero valence iron (ZVI) reaction tanks, engineered wetland, and an effluent pump station. At the southwest corner of the site, there is an influent wetwell pump station. The GCTS located at the site is presented on Figure 2.

1.2 PERSONNEL REQUIREMENTS AND EMERGENCY CONTACTS

Full-time operating personnel are not required for operation of the GCTS. For O&M requirements, it is anticipated that site visits will be conducted on a monthly basis by a technician in order to collect monitoring data and perform preventive maintenance. Additional site visits may be necessary based on operational or maintenance requirements.

Prior to performing work onsite, operating personnel should thoroughly review and be familiar with emergency procedures outlined in the Site Health and Safety Plan (EA 1999[2]).

1.3 MANUAL ORGANIZATION

This O&M Manual describes the function and O&M of each major component of the GCTS system. This O&M Manual is organized into the following sections:

- Section 1—Introduction
- Section 2—Process and Equipment Description
- Section 3—Process Controls and Instrumentation
- Section 4—System Startup and Shutdown Procedures
- Section 5—Maintenance.

Attachments A, B, and C include cut sheets and detailed O&M information for the GCTS system. The GCTS modification and upgrade drawings are provided in Attachment D.

2. EA Engineering, P.C. and its Affiliate EA Science and Technology. 1999. Pre-Design Investigation Site Health and Safety Plan, Witmer Road Landfill, Niagara Falls, New York. December.

2. PROCESS AND EQUIPMENT DESCRIPTION

2.1 PROCESS DESCRIPTION

To address the high pH (>12) and the elevated Cr^{6+} concentrations, the GCTS has been conceived. The general process flow includes collection of untreated water at the southwest corner of the site via a 6-in. high density polyethylene (HDPE) collection system. Conveyance of this water from the collection area is through the use of a wetwell pump station and 3-in. discharge line. The water flows to the northwest treatment area where initial pH adjustment occurs using carbon dioxide aeration. Primary settling of hardness precipitate occurs in the baffle system in Sediment Pond No. 1, prior to treatment for Cr^{6+} via contact reaction with ZVI. Secondary settling of iron and chromate precipitates occurs in Sediment Pond No 2, with final settling/clarification occurring in the engineered wetland. Discharged treated water flows from the wetland through a 2-in.discharge return line back to the initial collection area which outlets into an offsite wetland area. The following sections will detail each of these components, including design approach and process descriptions.

2.1.1 Groundwater Collection and Conveyance System

A 6-in. HDPE perforated collection pipe conveys water from the waste to the influent wetwell. There are three clean-outs along this line to facilitate cleaning, if required. The collection line is connected to a 30-in. diameter sump at the termination point of the collection system, which will allow for suspended sediments to be collected and removed. Routine maintenance is not anticipated to be required, although routine cleaning every few years is recommended.

2.1.2 Treatment Water pH Adjustment

To reduce the pH, the treatment process utilizes carbon dioxide aeration through a series of aerating disc diffusers installed in Sediment Pond No. 1. The process generates carbonic acid, which reacts to neutralize the water. A pH probe is installed in Sediment Pond No. 1 to monitor pH. If the observed pH is not below 8.0, then the programmable logic controller (PLC) will send an alarm signal and shut the system down. The settling pond is sized such that when collection water enters Sediment Pond No. 1 at a higher than desired pH, the volume of water per cycle, as compared to the volume of water in the settling pond, will not result in a pH value in excess of the allowable range due to dilution within the settling pond.

2.1.3 Primary Settling

The water that is to be treated exhibits a high hardness value, which results in the formation of a white calcium carbonate precipitate upon pH reduction. This white precipitate is not aesthetically desirable and is one of the treatment considerations. The Sediment Pond No. 1 baffle system was incorporated into the design to provide adequate settling time for the calcium carbonate prior to reaction with ZVI for Cr^{6+} reduction. The sediment pond is constructed with a 40-mil HDPE liner. The pond has a working volume of approximately 15,000 gal and has a

designed retention time of 4 hours based on a maximum flow rate of 60 gpm. The pond is designed to maintain the minimum retention time of 4 hours, while allowing for the storage of precipitate generated during the neutralization process.

2.1.4 Hexavalent Chromium Reduction

The reduction of Cr^{6+} occurs within a series of four vessels containing ZVI. The iron acts as an electron donor during the oxidation-reduction process. The Cr^{6+} will accept three electrons during the process to convert to trivalent chromium, and ultimately precipitate out as an insoluble compound. The ZVI vessels are configured to allow the required contact time at the maximum flow rate of 60 gpm, or 15 gpm per tank. The vessels, four separate concrete tanks with a minimum ZVI working volume of 120 ft^3 per tank, are designed with a 4-in. influent line which distributes water into a 12- to16-in. bed of pea stone to reduce the potential for short-circuiting through the vessel by inclusion of horizontal channels. The water then flows hydraulically up through 12-16 in. of ZVI, where the reaction occurs, then is gravity fed to a collection manhole equipped with a float-activated submersible pump. The ZVI vessels also contain a piezometer, which are used to check the Cr^{6+} concentrations within each vessel. This allows the operator to track breakthrough of the ZVI and calculate when ZVI replacement will be required. Based on the bench-scale studies, and proper selection of the ZVI source material, additional filtration is not anticipated to be required given the settling capacity of Sediment Pond No. 2 and the engineered wetland downstream of the ZVI process.

2.1.5 Secondary Settling

Sediment Pond No. 2 was incorporated into the design to provide adequate settling time for the iron and chromate precipitates which form after the water has been processed through the ZVI. The sediment pond is constructed with a 40-mil HDPE liner. The pond has an approximate volume of 25,000 gal and has a designed retention time of 4 hours based on a maximum flow rate of 60 gpm. During system upgrades in June 2004, an additional pH meter was installed in Sediment Pond No. 2 to ensure that the treated water is within the 6.0-8.0 compliance range for pH prior to entering the engineered wetland.

2.1.6 Engineered Wetland

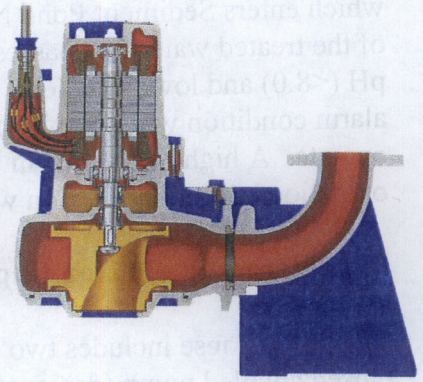
The final treatment step includes processing the water through an engineered wetland of approximately 4,019 ft^2. The water depth in this wetland varies based on pump cycles to convey the treated water from the wetland to the discharge area for release into the environment. The volume within the wetland ranges from a low of 23,162.5 gal to approximately 46,325 gal. The wetland is designed with a total retention time of approximately 1 day (based on average flow rate of 30 gpm), while maintaining sufficient capacity to control the 24-hour duration, 100-year return frequency storm event.

2.1.7 Treatment Water Discharge Conveyance System

The treated water exiting the engineered secondary wetland is conveyed, by pumping, back to the discharge area via a 2-in. line. The 2-in. HDPE line is installed in the same trench as the untreated influent line from the wetwell to the aeration chamber. Both lines are installed to a depth not less than 48 in. below ground surface.

2.2 EQUIPMENT DESCRIPTION

2.2.1 Influent Wetwell Pump Station



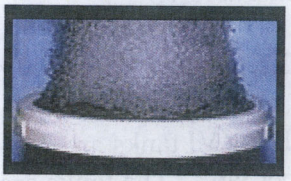
The pump station includes a KSB Model No. KRTF40-160/22X heavy duty submersible non-clog pump with a 3-h.p. explosion-proof motor rated for 3-phase, 60-hertz, 460-volt power. The pump (designated as P-1) is rated for 50 gpm at 40 ft of total discharge head. The KSB pump is contained in a 60-in. diameter, 84-in. deep reinforced fiberglass pump station (designated T-1) with aluminum hinged access hatch.

2.2.2 Carbon Dioxide Storage Tank

A 6-ton vertical carbon dioxide storage tank, and associated controls (supplied by BOC), is used to store the carbon dioxide for pH neutralization. The vaporizer maintains an operating pressure in the tank of 220-235 psi. If the tank pressure exceeds 300 psi, the pressure relief valves will activate to maintain the tank pressure at a safe level. Continued venting through the relief valve will result in a buildup of ice on the valve which could result in system shutdown if the valve freezes.

During startup and proveout of the GCTS, the system typically consumed approximately 3,000 lb of carbon dioxide per week, maintaining a 3-week (20-24 days) carbon dioxide storage tank refill cycle. The tank is fitted with a direct read level gauge calibrated in pounds of carbon dioxide. The tank level should be maintained above 2,000 lb to ensure availability of gas for the treatment process.

2.2.3 Carbon Dioxide Aeration System



The carbon dioxide aeration system is located in the deep portion of Sediment Pond No. 1 along the path of the first two baffle series. The aeration system consists of five Stamford Scientific International Model No. AFD350 12-in. disk diffusers. The collected groundwater enters Sediment Pond No. 1 into the first baffle where initial aeration occurs; following the baffle system, the water is again aerated in the second baffle, and then allowed to settle out precipitate through the remaining baffle series before entering the ZVI tanks.

The aeration system is fed via a 0.75-in. HDPE line connected to the distribution lines which supply carbon dioxide to the disc diffusers. Each line and disc diffuser is equipped with a 0.75-in. ball valve to regulate carbon dioxide flow to the pond.

2.2.4 Sediment Pond No. 1 Controls

The sediment pond (designated as T-3) is fitted with a pH probe and controller, and a pressure transducer for pump control and alarm condition status. The pH probe is installed in a 3-in. line which enters Sediment Pond No. 1 at its mid-point. This enables the controller to observe the pH of the treated water that passes by to the outlet suction line. An alarm condition includes high pH (<8.0) and low pH (<6.0). A high pH alarm condition will shut the system down. A low pH alarm condition will alert the operator that the condition exists, but the system will continue to operate. A high pH results in lower than desired reduction efficiency of the Cr^{6+} during the oxidation-reduction reaction which occurs in the ZVI tanks.

2.2.5 Zero Valence Iron Duplex Pump House

The pump house includes two Goulds Model No. SSH 1.5 × 2.5-6 closed coupled pump (designated as P-4A and P-4B) with a 1-h.p., totally enclosed fan cooled 1,750-rpm motor rated for 3-phase, 60-hertz, 460-volt power. The pump is rated for 60 gpm at 30 ft of total discharge head. The pumps are contained in a 5 ft × 5 ft × 6 ft wooden pump house. The pumps are mounted to the concrete sub-base flooring. The pumps have a 2.5-in. suction inlet and a 1.5-in. discharge outlet. Sampling ports are located in the discharge piping of each pump.

Pump 4A, which draws water from Sediment Pond No. 1 and pumps the water through the ZVI tanks to the gravity fed manhole, is controlled by a variable frequency drive located in the control panel. The pump is designed to maintain the liquid level in Sediment Pond No. 1 at an elevation of 616.0 ft mean sea level (msl). A full list of the system set points is provided in Table 1.

Pump 4B, which draws water from Sediment Pond No. 2 and pumps the water to the engineered wetland, is controlled by the PLC, and set points generated by the pressure transducer which measures the water level in Sediment Pond No. 2. A full list of the system set points is provided in Table 1.

2.2.6 Zero Valence Iron Reaction Tanks

The ZVI tanks are 7 ft wide × 13 ft long × 4 ft high and contain approximately 5.6 tons of iron per tank. The tanks are filled with 12-16 in. of pea stone and 12-16-in. of ZVI on top of the stone. It is estimated that the iron will require replacement annually.

2.2.7 Manhole Collection Sump

The treated water exiting the ZVI tanks gravity drains to the manhole collection sump. The sump is equipped with a Goulds Model 3885 submersible pump. The pump is rated for 60 gpm at 20 ft of total discharge head. The pump is controlled by an "ON" and "OFF" float switch. This pump conveys treated water from the manhole to Sediment Pond No. 2.

2.2.8 Sediment Pond No. 2 Controls

The sediment pond (designated as T-6) is fitted with a pressure transducer for pump control and alarm condition status. The PLC monitors the water surface elevation and activates P-4B when the water surface elevation reaches 616.5 ft msl, and shuts the pump off at an elevation of 615.0 ft msl. An additional pH meter was installed in Sediment Pond No. 2 to ensure pH discharge does not exceed 8.0.

2.2.9 Engineered Wetland Controls

The wetland (designated as T-7) is fitted with a pressure transducer for pump control and alarm condition status. The PLC monitors mean sea level, and shuts the pump off at an elevation of 614.0 ft msl. An overflow pipe will convey water from the wetland to the existing stormwater swale.

2.2.10 Engineered Wetland Effluent Pump Station

The pump station (designated T-7) includes one Goulds Model No. SSH 1.5 × 2.5-6 closed coupled pump with a 1-h.p., totally enclosed fan cooled 1,750-rpm motor rated for 3-phase, 60-hertz, 460-volt power. The pump is rated for 60 gpm at 30 ft of total discharge head. The pump is contained in a 48-in. diameter, 60-in. deep reinforced fiberglass pump station with aluminum hinged access hatch. The pump has a 2.5 -in. suction inlet and a 1.5 -in. discharge outlet.

Pump P-7 draws water from the engineered wetland and pumps the water to an outlet structure in the southwest corner of the Airco Parcel. The PLC monitors the water surface elevation and activates P-7 when the water surface elevation reaches 614.5 ft msl, and shuts the pump off at an elevation of 614.0 ft msl.

3. PROCESS CONTROLS AND INSTRUMENTATION

This section provides a description of the GCTS process instrumentation and control sequence.

3.1 ANALOG AND DISCRETE INPUTS

The GCTS utilizes one control panel with a keypad interface to allow the user to view and modify system set points. The control panel utilizes a PLC for logical control of the GCTS. Table 2 depicts the various PLC inputs.

There are no alarm indicator lights on the exterior of the control panel. Alarms are displayed at the PLC located inside the control panel and audibly available through the autodialer. If an alarm should occur in the GCTS, the following PLC output lights will indicate the cause of the shutdown:

- ***Alarm Condition No. 1*:**

  — ***CO2 Failure***—System shutdown, technician to site

  — ***P1 Failure***—System shutdown, technician to site

  — ***P4A Failure***—System shutdown, technician to site

  — ***P4B Failure***—System shutdown, technician to site

  — ***P7 Failure***—System shutdown, technician to site

  — ***Manhole Pump Failure***—System shutdown, technician to site

  — ***T1 High Level***—Acknowledge to clear, system will continue to operate

  — ***T1 Low Level***—Acknowledge to clear, system will continue to operate

  — ***T3 Low Level***—Acknowledge to clear indicates that the water level in Sediment Pond A is below 615.0 ft msl; alarm will reset when water level reaches 615.5 ft msl; system will continue to operate.

  — ***T6 Low Level***—Acknowledge to clear indicates that the water level in Sediment Pond B is below 614.5 ft msl; alarm will reset when water level reaches 615.0 ft msl; system will continue to operate

— ***T7 High Level***—Acknowledge to clear indicates that the water level in Engineered Wetland is above 615.5 ft msl; alarm will reset when water level drops below 616.0 ft msl; system will continue to operate (technician to site to pump out dry well T7)

— ***T7 Low Level***—Acknowledge to clear indicates that the water level in Engineered Wetland is below 612.3 ft msl; alarm will reset when water level reaches 612.8 ft msl; system will continue to operate

- ***Alarm Condition No. 2:***

— ***T1 Pressure Transducer Low Level***—Indicates that the water table is low; system will shut down until water level resets alarm condition

- ***Alarm Condition No. 3:***

— ***pH High***—System shutdown, technician to site

- ***Alarm Condition No. 4:***

— ***T3 High Level***—Acknowledge to clear indicates that the water level in Sediment Pond A is above 617.0 ft msl, alarm will reset when water level drops below 616.5 ft msl; system will continue to operate.

— ***T6 High Level***—Acknowledge to clear indicates that the water level in Sediment Pond B is above 617.2 ft msl, alarm will reset when water level drops below 616.7 ft msl; system will continue to operate.

The autodial is programmed to dial out in the event of system shutdown to report the various alarm conditions and/or power failures. To acknowledge alarm calls, enter 555 after alarm message is complete.

4. SYSTEM STARTUP AND SHUTDOWN PROCEDURES

This section describes the procedures to be utilized to start up or shut down the components of the GCTS.

4.1 SYSTEM STARTUP PROCEDURES

The following steps should be performed during initial startup of the GCTS.

4.1.1 System

- ***Step 1***—Turn on the main power disconnect, which is mounted on a back panel near the main control panel, and check to make sure all the breakers contained in the load center (480/240 VAC, 3-phase) in the main control panel, and the small load center (220/110 VAC, 1 Phase) in the junction box on the backside of the control panel, are in the ON position. Turn the power disconnect to P1, in the southwest corner, to the ON position.

- ***Step 2***—Utilizing the keypad interface, press the status button to display the status of the process equipment. Using the touch keypad, place each piece of process equipment into to AUTO mode.
  - — The system will begin to operate; monitor 2-3 treatment cycles to ensure system is operating properly
  - — Monitor the cycle times of the pumps and visually observe aerator system
  - — Monitor the pH in Sediment Pond No. 1 and Sediment Pond No. 2; desired pH is approximately 6.7
  - — Verify heater operation (winter only).

4.2 SYSTEM SHUTDOWN PROCEDURES

In the event that the GCTS needs to be turned off for an extended period of time, the system startup procedure should be reversed. The following steps should be performed.

4.2.1 System

- ***Step 1***—Utilizing the keypad interface, press the status button to display the status of the process equipment. Using the touch keypad, place each piece of process equipment into OFF mode. Check each piece of process equipment's operating status at the keypad interface to ensure that the process equipment is STOPPED.

- ***Step 2***—Turn the main power disconnect to the OFF position. Turn the power disconnect to P1, in southwest corner, to the OFF position.

5. MAINTENANCE

5.1 INTRODUCTION

The GCTS contains specialized and complex process equipment. Routine maintenance is required to ensure that process equipment continues to operate properly. Disabled or improperly working equipment will reduce treatment efficiency. Repair costs for poorly maintained equipment usually exceed the cost of a regular preventative maintenance program and may increase the downtime of the treatment system. In addition to regular preventive maintenance, routine system monitoring is required to assess the effectiveness of the GCTS and identify and correct any irregular maintenance issues that arise.

The following are the basic objectives of the GCTS maintenance program:

- Reduce the overall cost of maintenance by making critical equipment more reliable and minimizing unnecessary maintenance
- Prevent sudden failure of critical equipment by systematically inspecting, servicing, and repairing operating equipment.

The following components comprise the GCTS maintenance program:

- Equipment maintenance scheduling
- Spare parts inventory and control
- Lubrication
- Housekeeping
- Monitoring.

5.2 EQUIPMENT MAINTENANCE SCHEDULING

Maintenance should be planned and scheduled to distribute tasks throughout the year. A list summarizing recommended routine maintenance tasks and frequencies is provided in Table 3. The maintenance schedule includes the component, interval of inspection or maintenance, and action required. The manufacturer's O&M Manual should be consulted before maintenance is performed.

5.3 SPARE PARTS

Certain items of equipment require spare parts to be maintained in stock to prevent prolonged equipment downtime. The recommended spare parts for equipment will include various pump seals, O-rings, and gauges that are listed in the manufacturer's information included in Attachments A, B, and C.

Spare parts should be stored in areas readily accessible to the equipment items for which they are provided. They should be stored in their original packing and containers, in accordance with manufacturer's instructions.

5.4 LUBRICATION

Lubrication frequencies for each piece of equipment are included in Table 3. For detailed information regarding lubricant specifications, the operator should refer to specific equipment manufacturer's instructions (Attachments A, B, and C).

5.5 HOUSEKEEPING

The routine housekeeping schedule should cover the GCTS, surrounding grounds, and the areas around the drywells. Poor housekeeping creates safety and health hazards and can mask or create process and mechanical problems.

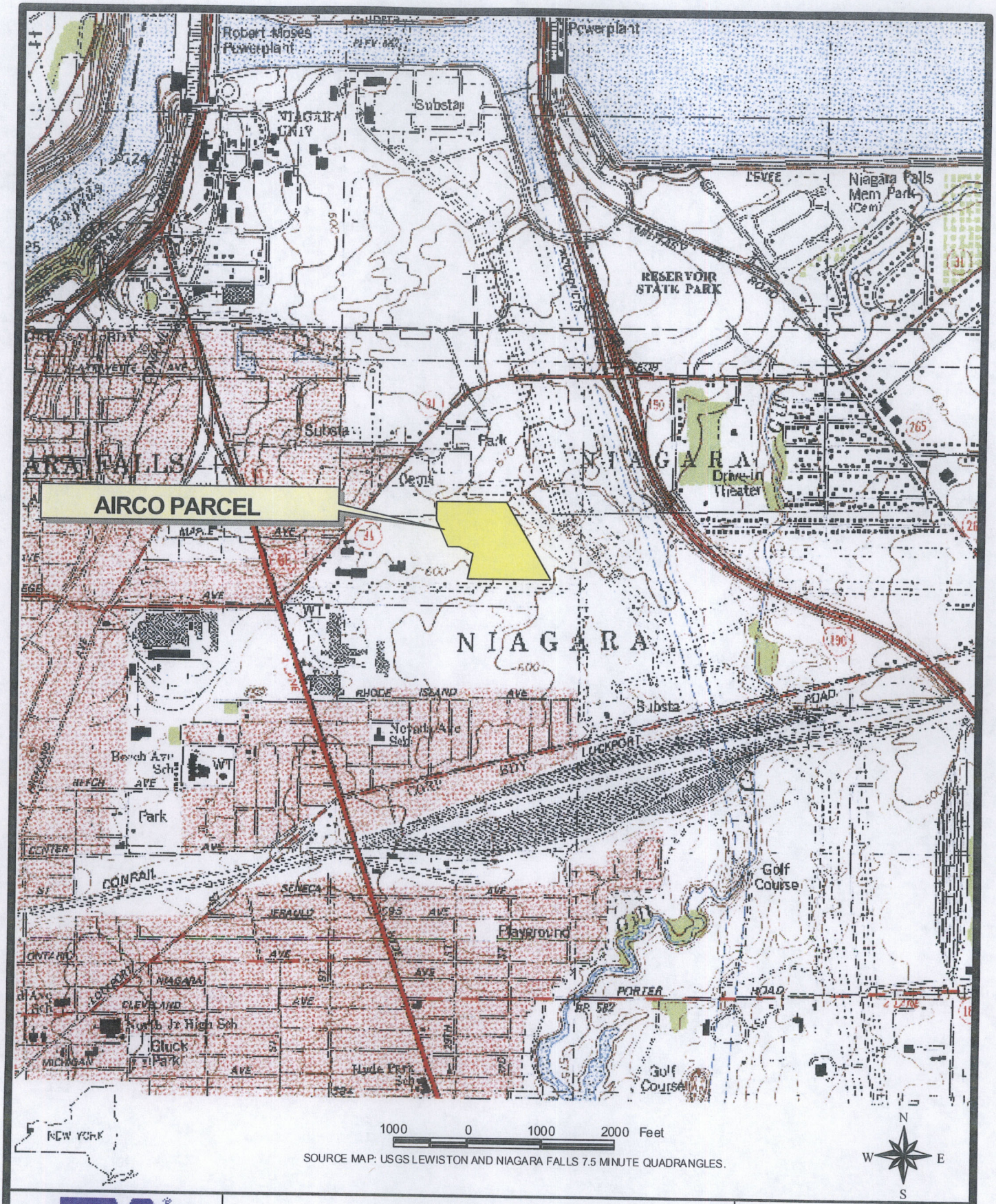
Process equipment should be cleaned and painted as required to enhance the overall appearance of the system. Building interiors and exteriors should be kept clean and in good repair. Outside maintenance work should be scheduled as required.

5.6 MONITORING

System monitoring should be performed on a regular basis to evaluate the operational parameters and influence of the GCTS and to identify potential maintenance issues. Operational parameters normally monitored include flow rates, vacuums, pressures, temperatures, and volatile organic compound concentrations. The results of each monitoring visit should be recorded and a copy of all monitoring data should be maintained onsite. A sample data recording sheet for the GCTS is included as Table 4.

The complete sampling and monitoring plan for the GCTS is detailed in the Revised Final Post-Closure Monitoring and Facility Maintenance Plan (EA 2001[3]). Groundwater samples of the system effluent are also required to meet New York State Department of Environmental Conservation issued guideline standards for the treatment system discharge. The current requirements include analysis of phenolics by U.S. Environmental Protection Agency (EPA) Method 420.1; total metals including barium, total chromium, total copper, total iron, total nickel, total selenium, thallium, and total zinc by EPA Method 200.7; pH by EPA Method 150.1; total Kjeldahl nitrogen by EPA Method 351.2; ammonia as N by EPA Method 350.1; total dissolved solids by Method SIM18-2540C; total suspended solids by EPA Method 160.2; biochemical oxygen demand by EPA Method 405.1; chemical oxygen demand by HACH Method 8000; nitrate/nitrite as N by EPA Method 300.0; hexavalent chromium by Method SM 18 3500Cr-D; and volatiles 624 by EPA Method 601/602. Analytical parameters and discharge criteria are provided in Table 5. Analytical parameters and sampling strategies will be re-evaluated yearly in order to ensure compliance with discharge regulations.

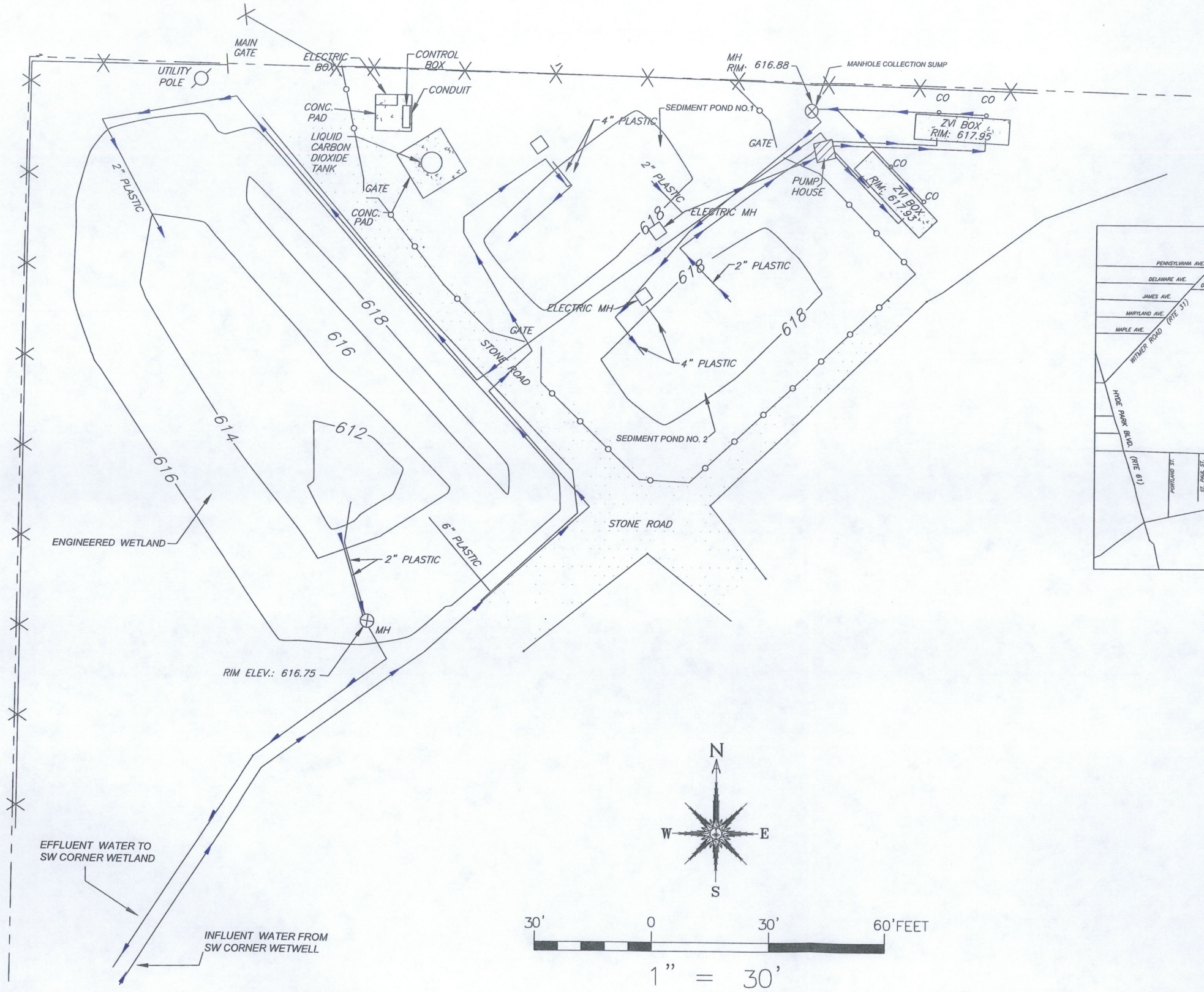
3. EA Engineering P.C. and its Affiliate EA Science and Technology. 2001. Interim Remedial Measure Report Documenting Closure of the Witmer Road Landfill, Niagara Falls, New York. Appendix A – Revised Final Post-Closure Monitoring and Facility Maintenance Plan. January.

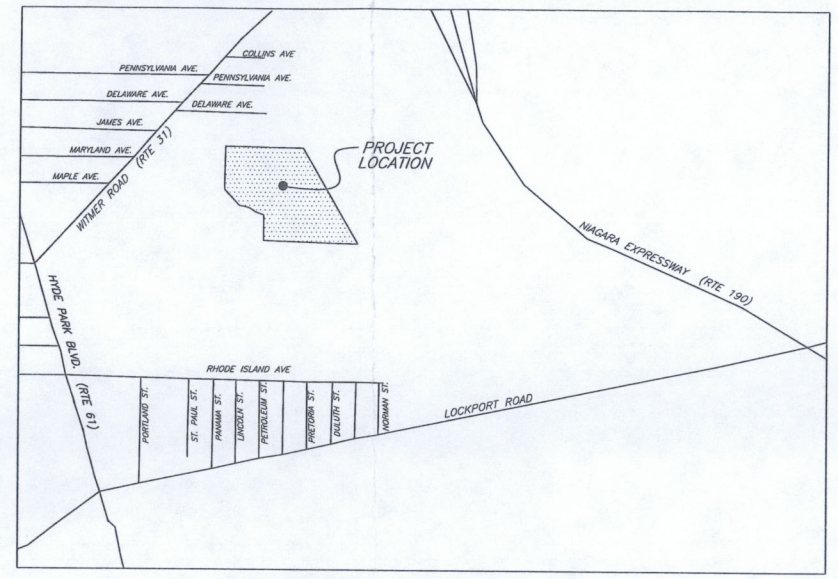


SOURCE MAP: USGS LEWISTON AND NIAGARA FALLS 7.5 MINUTE QUADRANGLES.

EA	AIRCO PARCEL NIAGARA FALLS, NEW YORK	FIGURE 1 SITE LOCATION MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	RSC	RSC	CEM	AS SHOWN	10 SEP 2003	12040.69	I:\BOC-NIAGARA\FINAL.APR





LOCATION MAP: NOT TO SCALE

LEGEND

CO = CLEANOUT
DIA. = DIAMETER
CONC. = CONCRETE
ELEV. = ELEVATION
MH = MANHOLE

- XXX = MAJOR CONTOUR LINE (FINAL CONDITIONS 2003)
- XXX = MINOR CONTOUR LINE (FINAL CONDITIONS 2003)
- XXX = MAJOR CONTOUR LINE (FINAL CONDITIONS 2000)
- = MINOR CONTOUR LINE (FINAL CONDITIONS 2000)
- = CHAIN LINK FENCE (EXISTING)
- = CHAIN LINK FNC. (NEW)
- = PROPERTY LINE (APPROXIMATE)
- = COLLECTION WATER FLOW DIRECTION

GENERAL NOTES:

1.) HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM NAD 1983, NEW YORK WEST ZONE
2.) VERTICAL DATUM: NGVD 1929
3.) VERTICAL AND HORIZONTAL DATUMS TIED INTO 1991 CITY OF NIAGARA FALLS GIS CONTROL PROJECT MONUMENTS SMC 20A AND SMC 45
4.) ALL UNITS MEASURED IN U.S. SURVEY FEET
5.) ALL DATA AND FEATURES PLOTTED IN GRAY IS FROM DATA GATHERED BY WENDEL DUCHSCHERER IN 2000.

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AND ITS AFFILIATE
EA SCIENCE AND TECHNOLOGY

FIGURE 2

GROUNDWATER COLLECTION AND TREATMENT SYSTEM
SITE LOCATION MAP
AIRCO PARCEL, NIAGARA FALLS, NEW YORK

DRAWN BY: RSC
CHECKED BY: CEM
DATE: 27 SEPTEMBER 2004
FILE PATH: SYR_FP/AIRCO PARCEL/O&M MANUAL

TABLE 1 SUMMARY OF GROUNDWATER COLLECTION AND TREATMENT SYSTEM COMPONENT SET POINTS

System Component	Set Points
Carbon Dioxide Aeration System	
Sparge Time	Continuous until pH <6
Sediment Pond No. 1/Pump 4A	
Pressure Transducer Elevation	613.3 ft msl
Low Level Alarm On	615.0 ft msl
Low Level Alarm Off	615.5 ft msl
Pump Off	615.5 ft msl
Pump On	616.0 ft msl
High Level Alarm On	617.0 ft msl
High Level Alarm Off	616.5 ft msl
Pressure Gauge	10 psi
Sediment Pond No. 2/Pump 4B	
Pressure Transducer Elevation	612.2 ft msl
Low Level Alarm On	614.5 ft msl
Low Level Alarm Off	615.0 ft msl
Pump Off	615.0 ft msl
Pump On	616.5 ft msl
High Level Alarm Off	616.7 ft msl
High Level Alarm On	617.2 ft msl
Engineered Wetlands/Pump 7	
Pressure Transducer Elevation	611.3 ft msl
Low Level Alarm On	612.3 ft msl
Low Level Alarm Off	612.8 ft msl
Pump Off	614.0 ft msl
Pump On	614.5 ft msl
High Level Alarm Off	615.0 ft msl
High Level Alarm On	615.5 ft msl
Carbon Dioxide Storage Tank	
Carbon Dioxide Normal Operating Range	Low = 220 High = 235
Carbon Dioxide Feed Line	220-253 psf
Carbon Dioxide Feed Load	100 psf
Liquid Carbon Dioxide Storage Capacity (lb)	2,000-12,000 lb
Carbon Dioxide Aeration System	
Carbon Dioxide Feed Line	100 psi
Carbon Dioxide Feed Load	12 psi
Carbon Dioxide Rate	150 scfm
Sediment Ponds Aeration Lines	
Sediment Pond No. 1	10 scfh
Sediment Pond No. 2	10 scfh

NOTE: msl = Mean sea level.
psf = Pounds per square foot.
psi = Pounds per square inch.
scfm = Standard cubic feet per minute.
scfh = Standard cubic feet per hour.

TABLE 2 VARIOUS PROGRAMMABLE LOGIC CONTROLLER INPUTS

Indicator Description	Programmable Logical Controller Input/Output No.	Signal Type	Set Point	Control Function
Influent Wetwell Pressure Transducer				
LLA		4-20 mA Signal	597.0 ft msl	Places system in standby
LLA Reset		4-20 mA Signal	597.5 ft msl	Resets system to automatic
Carbon Dioxide Aeration System				
HLA		Discrete	pH > 8	Turns off P-1, alarms out
Sediment Pond No. 1 Pressure Transducer				
LLA		4-20 mA Signal	615.0 ft msl	Turns off P-4A, alarms out
LLA Reset		4-20 mA Signal	615.5 ft msl	Resets alarm condition
Pump Setpoint		4-20 mA Signal	616.0 ft msl	Water level to be maintained by variable frequency drive
HLA Reset		4-20 mA Signal	617.0 ft msl	Resets alarm condition
HLA		4-20 mA Signal	617.5 ft msl	Shuts system down
Sediment Pond No. 1 pH Controller				
Low pH Alarm		4-20 mA Signal	6.0 pH units	Alarms out
High pH Alarm		4-20 mA Signal	8.0 pH units	Shuts system down
Sediment Pond No. 2 Pressure Transducer				
LLA		4-20 mA Signal	614.5 ft msl	Turns off P-4B, alarms out
LLA Reset		4-20 mA Signal	615.0 ft msl	Resets alarm condition
Pump Off		4-20 mA Signal	615.5 ft msl	Turns P-4B off
Pump On		4-20 mA Signal	616.5 ft msl	Turns P-4B on
HLA Reset		4-20 mA Signal	616.7 ft msl	Resets alarm condition
HLA		4-20 mA Signal	617.2 ft msl	Shuts system down
Engineered Wetland Pressure Transducer				
LLA		4-20 mA Signal	612.3 ft msl	Turns off P-4B, alarms out
LLA Reset		4-20 mA Signal	612.8 ft msl	Resets alarm condition
Pump Off		4-20 mA Signal	614.0 ft msl	Turns P-4B off
Pump On		4-20 mA Signal	614.5 ft msl	Turns P-4B on
HLA Reset		4-20 mA Signal	615.0 ft msl	Resets alarm condition
HLA		4-20 mA Signal	615.5 ft msl	Alarms out

NOTE: LLA = Low Level Alarm.
mA = Milliamp.
msl = Mean sea level.
HLA = High Level Alarm.

TABLE 3 SUMMARY OF GROUNDWATER COLLECTION AND TREATMENT SYSTEM MAINTENANCE SCHEDULE INTERVALS

System Component	Maintenance interval
Carbon Dioxide Aeration System	
Stamford Scientific International Model No. AFD350 12-in. disk diffuser	Change/clean disk diffuser when aeration flow becomes diminished
Carbon dioxide regulator heater operational	Check monthly (winter only)
Carbon dioxide pressure relief valves in operational condition	Check monthly
Sediment Pond No. 1 (T3)/Pump 4A	
T3 Pressure transducer	Clean monthly
T3 pH probe	Clean monthly
Goulds Model No. SSH 1.5 × 2.5 -6 (Pump 4A)	Check pressure monthly, replace seals as necessary, oil change every 10,000 hours or 3 years
Sediment Pond No. 1	Schedule removal of precipitate as needed
Sediment Pond No. 2 (T6)/Pump 4B	
T6 Pressure transducer	Clean monthly
Goulds Model No. SSH 1.5 × 2.5 -6 (Pump 4B)	Check pressure monthly, replace seals as necessary, oil change every 10,000 hours or 3 years
Sediment Pond No.1	Schedule removal of precipitate as needed
Zero Valance Iron Reaction Tanks	
Effluent outflow pipe	Check monthly
Piezometer sampling	Completed monthly when field data is collected
Zero valance iron insulation	Visually inspect monthly (winter only)
Iron change-out	As needed, per field sampling results
Collection Manhole/Pump	
ON/OFF Floats	Visually inspect monthly
Influent line	Visually observer during operation
Goulds Model No. 3885	Check effluent line monthly, ensure check valve is operating properly
Engineered Wetlands/Pump 7	
P7 Pressure transducer	Clean monthly
Goulds Model No. SSH 1.5 × 2.5-6 (Pump 7)	Check pressure monthly, replace seals as necessary, oil change every 10,000 hours or 3 years
Overflow pipe	Check monthly
Carbon Dioxide Storage Tank	
Carbon dioxide feed line	Check monthly
Carbon dioxide feed load	Check monthly
Liquid carbon dioxide storage tank	Schedule refills every 21-24 days
Influent Wetwell Pump Station	
Wetwell pump station	Check monthly
KSB Model No. KRTF 40-160/22XG-125 (Pump 1)	Visually inspect monthly
Electrical cables and lifting chain to pump	Visual inspection every 4,000 hours or yearly
Insulation resistance check	Inspect every 4,000 hours or yearly
Monitoring equipment	Inspect every 4,000 hours or yearly
Oil change	Change oil every 10,000 hours or every 3 years

System Component	Maintenance interval
Sediment Ponds Aeration Lines	
Sediment Pond No. 1	Check monthly
Sediment Pond No. 2	Check monthly
General Site Inspection	
Bird netting	Check monthly
Policing of enclosed groundwater collection and treatment system area	Check monthly
Policing of enclosed landfill area	Check monthly
Inspection of groundwater collection and treatment system fencing	Check monthly
Inspection of perimeter fencing	Check monthly
Inspection of drainage swales	Bi-annual
Mowing of landfill	Annual

TABLE 4 GROUNDWATER COLLECTION AND TREATMENT SYSTEM DATA RECORDING SHEET

Date:	**Project No.:**	**EA Personnel:**
Weather:		

Reading	Item
	Carbon Dioxide Storage Tank Pressure (220-235 psi)
	Carbon Dioxide Tank Liquid Level
	P1 Running Status ON/OFF
	T3 Water Elevation
	T3 pH Reading
	Pump 4A Operational Status ON/OFF
	Pump 4A Pressure Gauge Reading (Normal = 10 psi)
	T6 Water Elevation Reading
	Pump 4B Operational Status ON/OFF
	T7 Water Level Reading
	Pump 7 Operational Status

Date:	**Project No.:**	**EA Personnel:**
Weather:		

Reading	Standard	Item
	(0.011 mg/L)	Sample Port 4A Hexavalent, Chromium Concentration (mg/L)
	(0.05 mg/L)	Sample Port 4A Total, Chromium Concentration (mg/L)
	(0.011 mg/L)	Sample Port 4B Hexavalent, Chromium Concentration (mg/L)
	(0.05 mg/L)	Sample Port 4B Total, Chromium Concentration (mg/L)
	(0.011 mg/L)	Sample Port 7 Hexavalent, Chromium Concentration (mg/L)
	(0.05 mg/L)	Sample Port 7 Total, Chromium Concentration (mg/L)

pH Reading	Sample Location
	Sample Port 4A
	Sample Port 4B
	Sample Port 7

TABLE 5 SUMMARY OF ANALYTES LIST, ANALYTICAL METHODS, AND DISCHARGE CRITERIA FOR GROUNDWATER COLLECTION AND TREATMENT SYSTEM SAMPLES COLLECTED

Parameter	Suggested Laboratory Method	New York State Department of Environmental Conservation Discharge Criteria
pH	EPA 150.1	6.5-8.5 SU
Chemical Oxygen Demand	HACH 8000	40 mg/L
Total Suspended Solids	EPA 160.2	10 mg/L
Dissolved Oxygen	Field Monitor	7 mg/L
Ammonia as N	EPA 350.1	5.0 mg/L
Biochemical Oxygen Demand	EPA 405.1	5.0 mg/L
Phenolics, Total Recoverable	EPA 420.1	8 µg/L
Hexavalent Chromium	SM 18 3500Cr	11µg/L
Flow	Monitor	21,600 gal daily max
Total Dissolved Solids	SM18-2540C	Monitor
Total Kjeldahl Nitrogen	EPA 351.2	Monitor
Nitrate/Nitrite as N	EPA 300.0	Monitor
TOTAL METALS		
Barium	EPA 200.7	2,000 µg/L
Chromium	EPA 200.7	100 µg/L
Copper	EPA 200.7	14.7 µg/L
Iron	EPA 200.7	300 µg/L
Nickel	EPA 200.7	70 µg/L
Selenium	EPA 200.7	4.6 µg/L
Thallium	EPA 200.7	4 µg/L
Zinc	EPA 200.7	115 µg/L
VOLATILES		
Benzene	EPA 601/602	10 µg/L
Bromodichloromethane	EPA 601/602	50 µg/L
Bromoform	EPA 601/602	50 µg/L
Bromomethane	EPA 601/602	5 µg/L
Carbon Tetrachloride	EPA 601/602	5 µg/L
Chlorobenzene	EPA 601/602	5 µg/L
Chloroethane	EPA 601/602	5 µg/L
2-Chloroethylvinyl ether	EPA 601/602	5 µg/L
Chloroform	EPA 601/602	7 µg/L
Chloromethane	EPA 601/602	5 µg/L
Dibromochloromethane	EPA 601/602	5 µg/L
1,2-Dichlorobenzene	EPA 601/602	3 µg/L
1,3-Dichlorobenzene	EPA 601/602	3 µg/L
1,4-Dichlorobenzene	EPA 601/602	3 µg/L
Dichlorodifluoromethane	EPA 601/602	5 µg/L
1,1-Dichloroethane	EPA 601/602	5 µg/L
1,2-Dichloroethane	EPA 601/602	0.6 µg/L
1,1-Dichloroethene	EPA 601/602	5 µg/L
trans-1,2-Dichloroethene	EPA 601/602	5 µg/L

NOTE: EPA = U.S. Environmental Protection Agency.
SM = Standard method.

Parameter	Suggested Laboratory Method	New York State Department of Environmental Conservation Discharge Criteria
VOLATILES (Continued)		
1,2-Dichloropropane	EPA 601/602	1 µg/L
cis-1,3-Dichloropropene	EPA 601/602	5 µg/L
trans-1,3-Dichloropropene	EPA 601/602	5 µg/L
Ethyl benzene	EPA 601/602	5 µg/L
Methylene chloride	EPA 601/602	5 µg/L
Vinyl chloride	EPA 601/602	2 µg/L
Tetrachloroethene	EPA 601/602	5 µg/L
Toulene	EPA 601/602	5 µg/L
1,1,1-Trichloroethane	EPA 601/602	5 µg/L
Trichloroethene	EPA 601/602	5 µg/L
Trichlorofluoromethane (Freon 11)	EPA 601/602	5 µg/L
1,1,1,2-Tetrachloroethane	EPA 601/602	5 µg/L
Xylenes (Total)	EPA 601/602	5 µg/L

Attachment A

Packaged Leachate Manholes and Pumps Manual

OPERATION & MAINTENANCE MANUAL

Niagara Falls, NY

Packaged Leachate Manholes and Pumps

Equipment Supplier:
Gayle Corporation
40 Lloyd Avenue, Suite 205
Malvern, PA 19355
Phone (610) 296-0970 : Fax (610) 640-4599
Contact: Dan Weaver

Equipment List

Leachate Pump Station:

One(1) - Fiberglass station 60" dia. x 84" deep complete with Aluminum hinged door cover, FRP antiflotation flange, 3" internal PVC sch 80 discharge piping, 3" cast iron base elbow installed, 3" PVC check and ball valve, 3" outlet connection, 4" inlet hub - loose for field mounting, 2" vent assembly coupling, SS float bracket, and SS guide rail system for pump removal.

One(1) – KSB model KRTF40-160/22X heavy duty submersible non-clog pump in cast iron construction complete with cast iron recessed type wastewater impeller with 1.25" solids capability, 3.0 HP explosionproof motor rated for 3/60/230-460 Volt power, 30 Ft. of power and control cable, Viton Orings, motor thermal protection switches, motor moisture sensor, and 316 SS lifting chain. Pump to be designed for leachate service with 316 SS hardware. Pumps rated for 50 GPM @ 40 Ft. TDH.

Carbon Dioxide Reaction Manhole:

One(1) - Fiberglass manhole 60" dia. x 66" deep complete with Aluminum hinged door cover, FRP antiflotation flange, two(2) 3" PVC flanged connection with sleeve and link seal (factory installed), 3" inlet connection with field installed sleeve and link seal, 4" vent assembly.

ZVI Pump Station: (Two pumps)

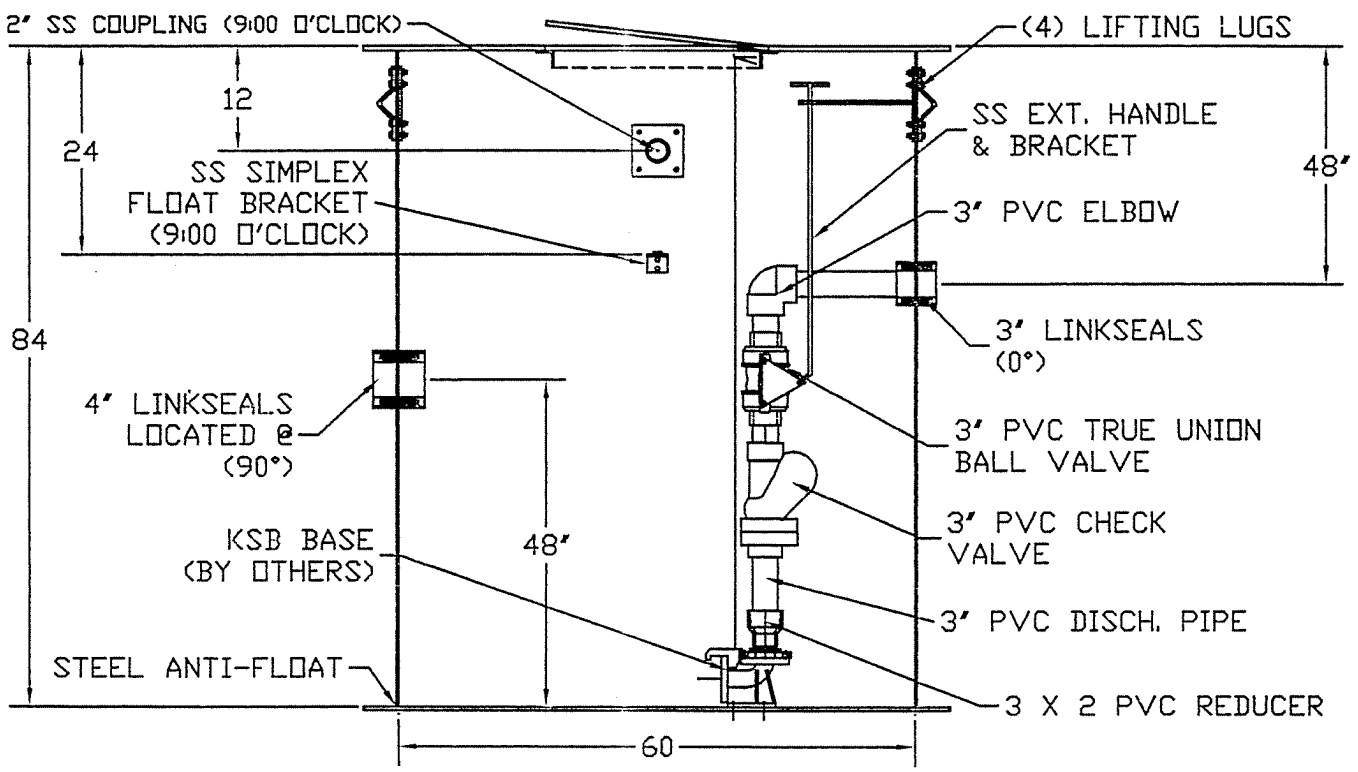
One(1) - Fiberglass station 60" dia. X 60" deep complete with Aluminum hinged door cover, FRP antiflotation flange, 2" internal PVC sch 80 piping, 2" PVC check and ball valve, 2" flanged outlet connection with sleeve and link seal, 2" flanged PVC inlet with sleeve and link seal, 2" vent assembly coupling, and Aluminum ladder. Below pump to be mounted and piped prior to shipment.

Two(2) – Goulds SSH 1x2-6 end suction close coupled pump in 316 SS wetted parts, single mechanical seal, Viton Orings and 1.0 HP 3/60/230-460 VAC TEFC 1750 RPM motor. Pump is rated for 35 GPM @ 15 Ft. TDH. Pump to be mounted on 304 SS baseplate.

Effluent Pump Station: (One Pump)

One(1) - Fiberglass station 48" dia. X 60" deep complete with FRP hinged door cover, FRP antiflotation flange, 2" internal PVC sch 80 piping, 2" PVC check and ball valve, 2" flanged outlet connection with sleeve and link seal, 2" flanged PVC inlet with sleeve and link seal, 2" vent assembly coupling, and Aluminum ladder. Below pump to be mounted and piped prior to shipment.

One(1) – Goulds SSH 1x2-6 end suction close coupled pump in 316 SS wetted parts, single mechanical seal, Viton Orings and 1.0 HP 3/60/230-460 VAC TEFC 1750 RPM motor. Pump is rated for 35 GPM @ 15 Ft. TDH. Pump to be mounted on 304 SS baseplate.



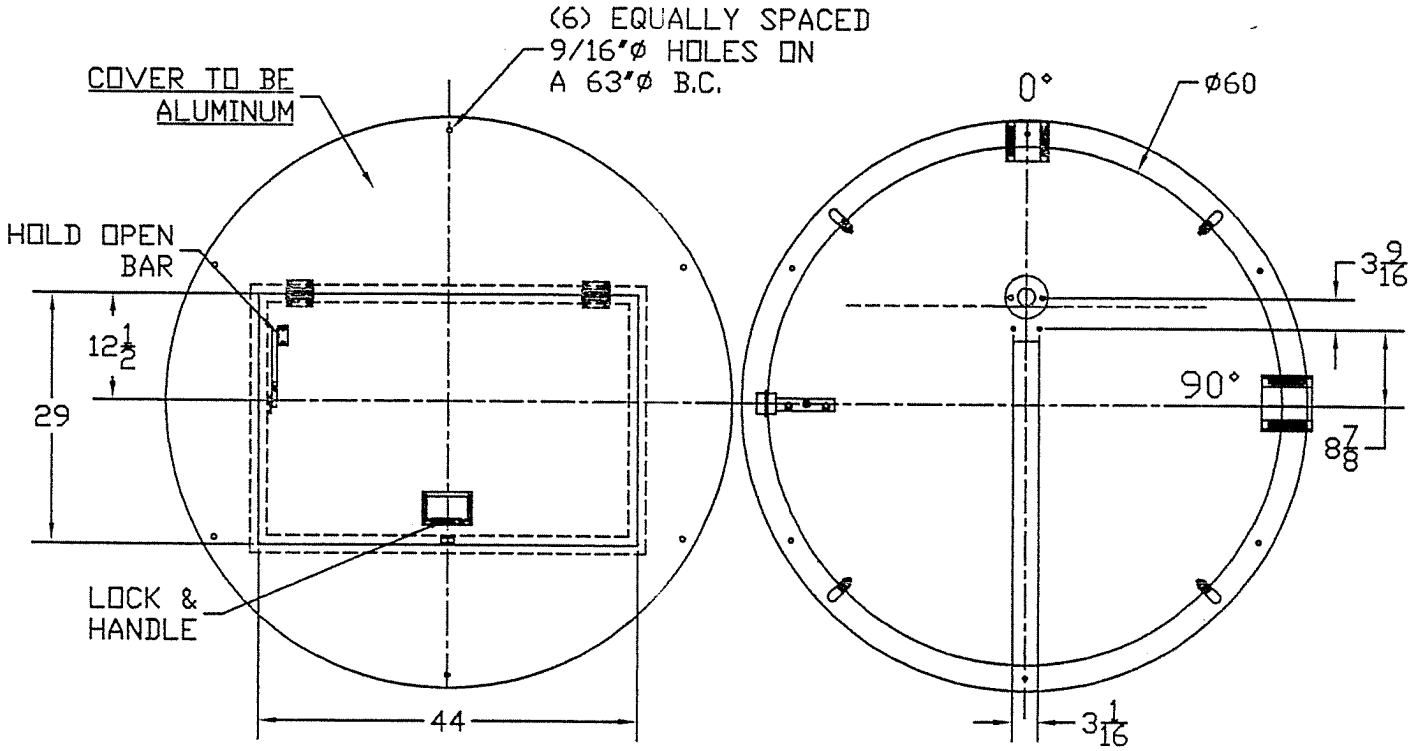
TO CUSTOMER:

EXAMINE THIS DRAWING CAREFULLY. VERIFY ALL DIMENSIONS, LOCATIONS, AND ELEVATIONS FOR ACCURACY. SIGN AND DATE AT LINE. ANY MODIFICATIONS OR CHANGES TO THIS DRAWING OR FINISHED PRODUCT, AFTER IT HAS BEEN SIGNED, MAY RESULT IN ADDITIONAL CHARGES AND SHIPPING DELAYS. NO JOB WILL BE STARTED UNTIL CONFORMATION THROUGH SIGNATURE.

_____
(REQUESTED SIGNATURE & DATE PER ABOVE)

CONFIRMATION THROUGH SIGNATURE RELEASES ORDER FOR PRODUCTION

2055 PIDCO DRIVE PLYMOUTH, IN 46563 (574) 936-6022	Notes: REV. 1	DRAWN FOR: GAYLE CORP.			
DESCRIPTION: 60 X 84 – 300	P.O.#: ---	DRAWN & CHECKED BY: A.DAVIS ☐	DATE: 6/3/03	Revision: 0	DISCONNECT DESIGN: KSB 40-160
COVER DESCRIPTION: ALUMINUM	QUOTE #: 11977	AK PART NO.: N/A	SHEET 2 OF 2		PUMP MODEL NUMBER: -----



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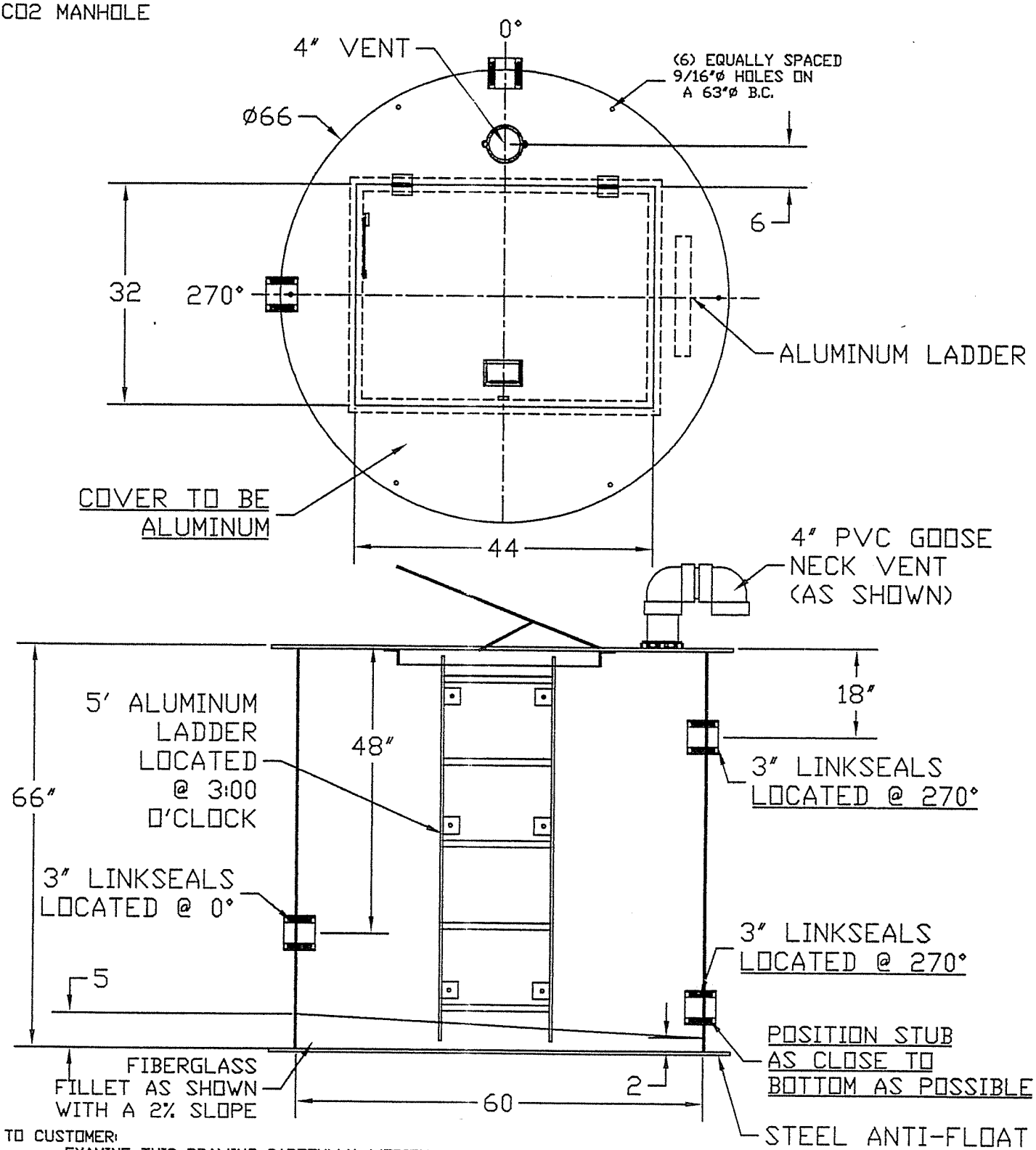
DESCRIPTION: 60 X 84 - 300	P.O.#: ----	DRAWN & CHECKED BY: A.DAVIS	DATE: 6/3/03	Revision: 0	DISCONNECT DESIGN: KSB 40-160
COVER DESCRIPTION: ALUMINUM	QUOTE #: 11977	A.K. PART NO.: N/A	SHEET 2 OF 2		PUMP MODEL NUMBER: -----

CO2 MANHOLE



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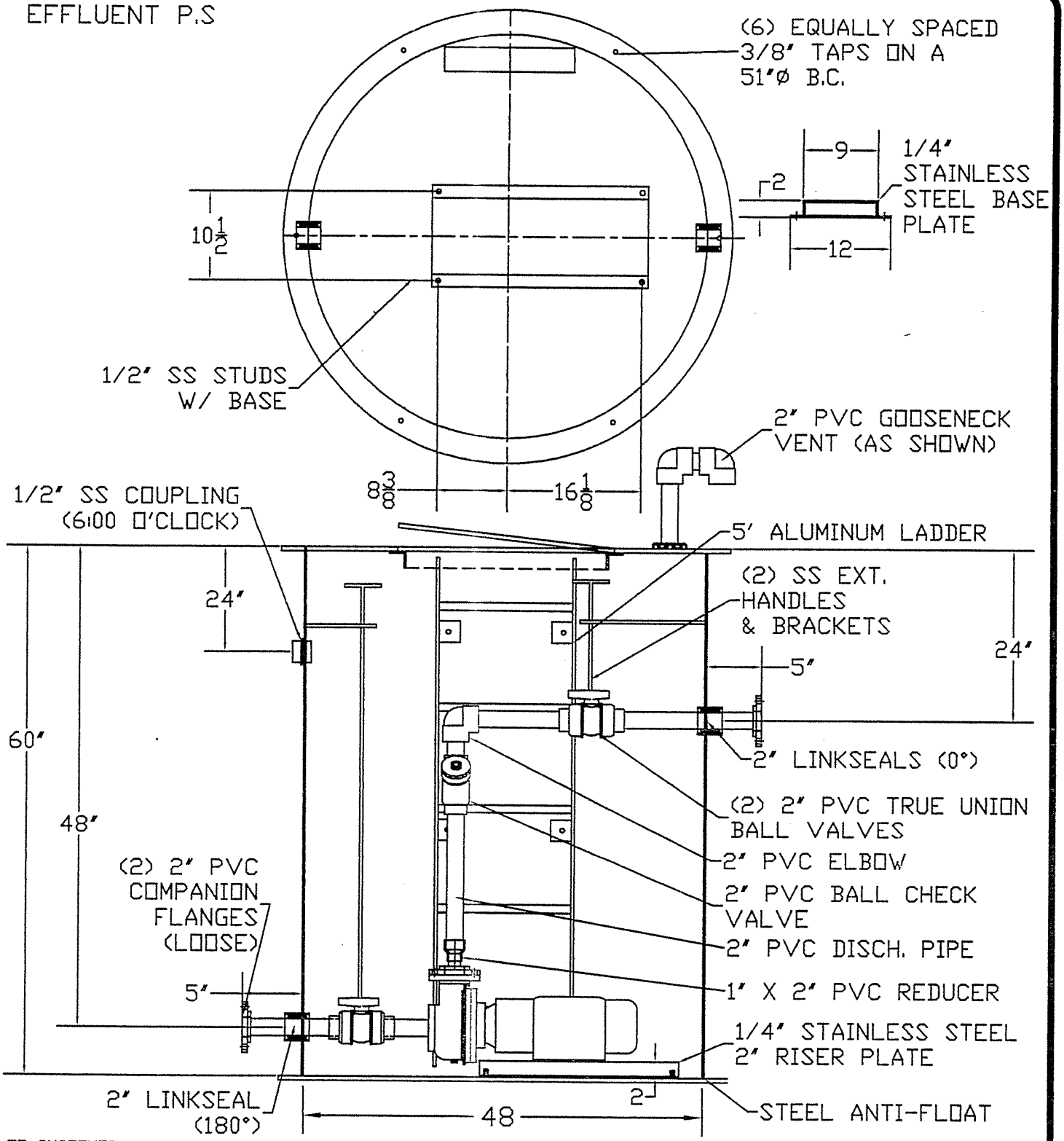
CONFIRMATION THROUGH SIGNATURE RELEASES ORDER FOR PRODUCTION

2055 PIDCO DRIVE
PLYMOUTH, IN
46563
(574) 936-6022

	Notes: REV. 1	DRAWN FOR: GAYLE CORP.		
BASIN DESCRIPTION: 60 X 66 – 300	P.O.# ---	DRAWN & CHECKED BY: A.DAVIS	DATE 6/9/03	DISCONNECT DESIGN ---
COVER DESCRIPTION: ALUMINUM	QUOTE # 11971	Revision 1	SHEET 1 OF 1	PUMP MODEL NUMBER ---

EFFLUENT P.S



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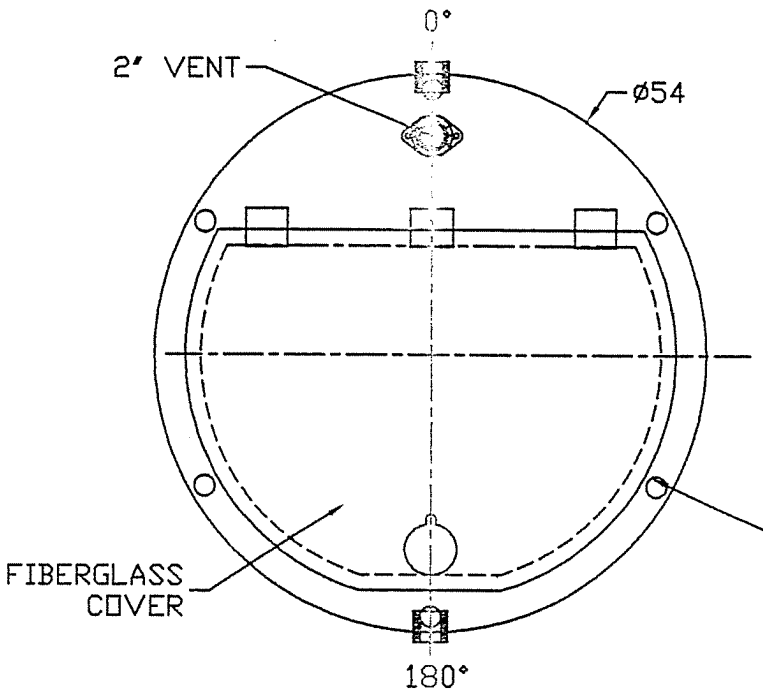
CONFIRMATION THROUGH SIGNATURE RELEASES ORDER FOR PRODUCTION

2055 PIDCO DRIVE
PLYMOUTH, IN
46563
(574) 936-6022

Notes: ---	DRAWN FOR: GAYLE CORP.			
BASIN DESCRIPTION: 48 X 60 – 300	PO#: ---	DRAWN & CHECKED BY: A.DAVIS	DATE: 6/9/03	DISCONNECT DESIGN: ---
COVER DESCRIPTION: FIBERGLASS	QUOTE #: 11972	Revision 2	SHEET 1 OF 2	PUMP MODEL NUMBER: ---



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CONFIRMATION THROUGH SIGNATURE RELEASES ORDER FOR PRODUCTION

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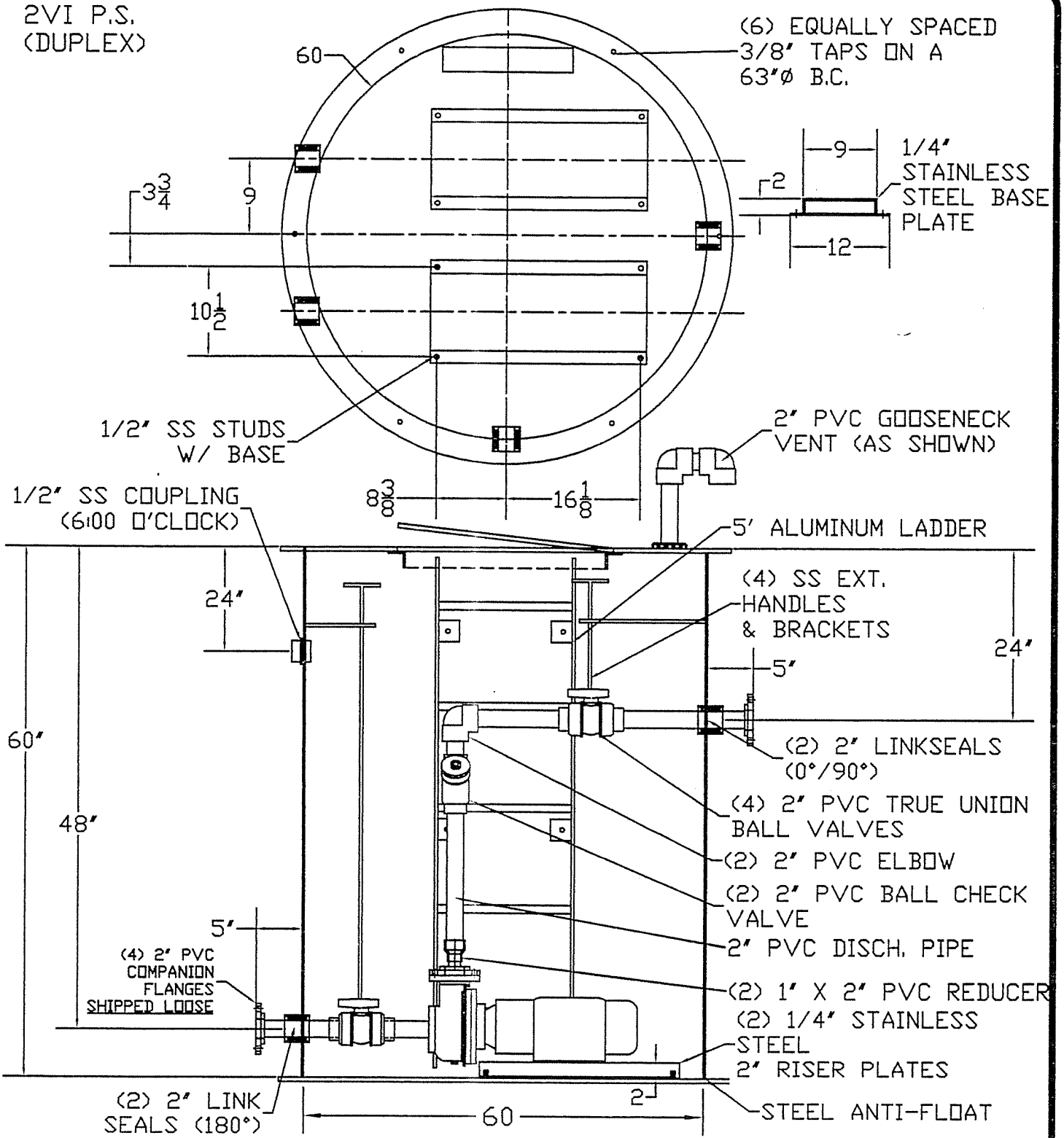
DESCRIPTION: 48 X 60 – 300	PO#: ----	DRAWN BY: A.DAVIS	DATE: 6/9/03	DISCONNECT DESIGN: -----
COVER DESCRIPTION: FIBERGLASS	QUOTE #: 11972	AK PART NO.: N/A	SHEET 2 OF 2	PUMP MODEL NUMBER: -----

2VI P.S.
(DUPLEX)



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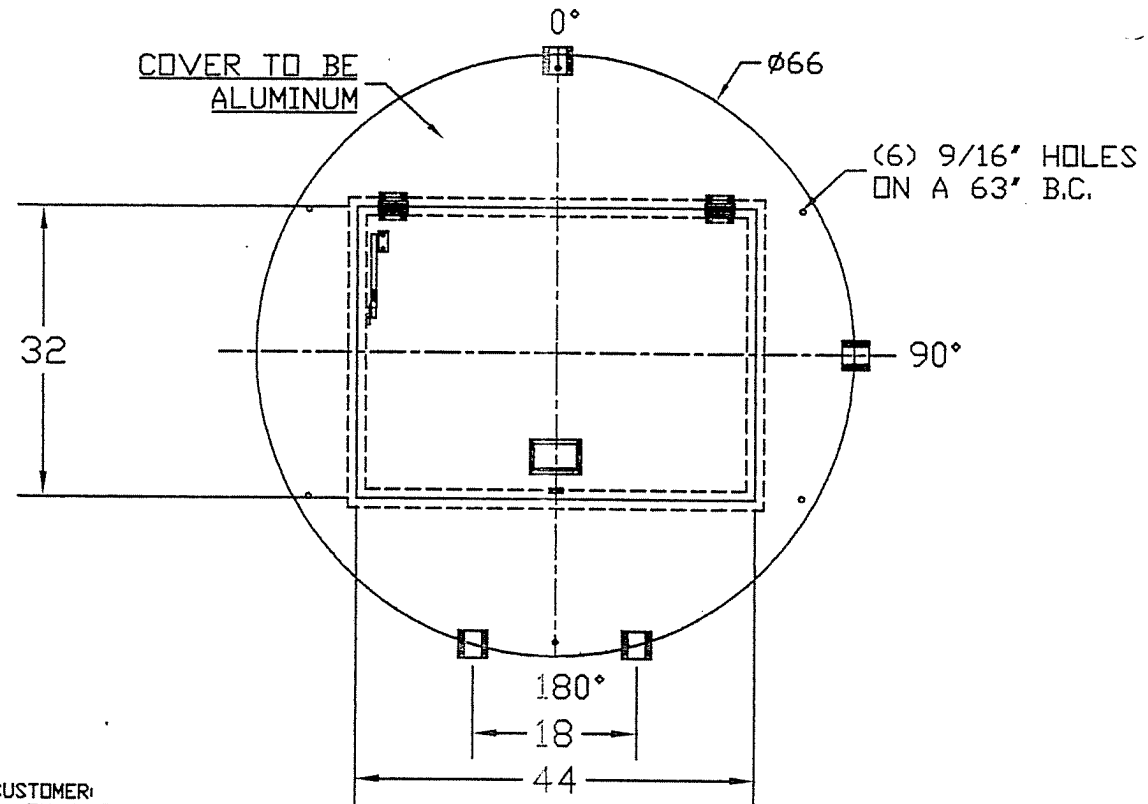
CONFIRMATION THROUGH SIGNATURE RELEASES ORDER FOR PRODUCTION

2055 PIDCO DRIVE
PLYMOUTH, IN
46563
(574) 936-6022

	Notes: ---	DRAWN FOR: GAYLE CORP.			
BASIN DESCRIPTION: 60X 60 – 300	P.O.#: ---	DRAWN & CHECKED BY: A.DAVIS		DATE: 6/10/03	DISCONNECT DESIGN: ---
COVER DESCRIPTION: ALUMINUM	QUOTE #: 12190	Revision	1	SHEET 1 OF 2	PUMP MODEL NUMBER: ---



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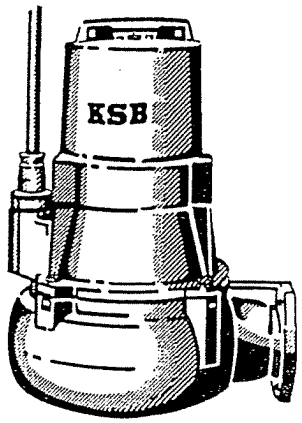
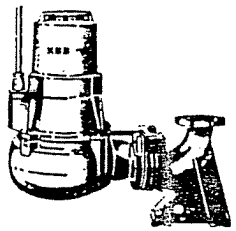
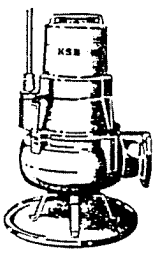
2055 PIDCO DRIVE PLYMOUTH, IN 46563 (574) 936-6022	Notes: —	DRAWN FOR: GAYLE CORP.			
DESCRIPTION: 60 X 60 – 300	PO#: ----	DRAWN & CHECKED BY: A.DAVIS ☐	DATE: 6/3/03	Revision: 0	DISCONNECT DESIGN: -----
COVER DESCRIPTION: ALUMINUM	QUOTE #: 12190	AK PART NO.: N/A	SHEET 2 OF 2		PUMP MODEL NUMBER: -----

Submersible motor pumps 2" up to 28" for wet installation

Cast iron and various materials for municipal and industrial wastewater







60 Hz
standard range

For designs incorporating features which are outside the documented standards consult factory.

For additional hydraulic selections and material combinations see Type Series Booklet 2553.5231-14, 2" up to 4".

For Dry-Pit Installed Submersible Pumps please refer to KRTB **DRY-PIT SUBMERSIBLE** Catalog

Applications

KRT submersible motor pumps are used for pumping all types of sewage and effluent in water treatment and industry, especially untreated sewage with long fibrous and solid substances, liquids containing air and gas as well as raw, activated and digested sludge.

Operating data

Discharge sizes	to 28"	(700 mm)
Capacites	to 45 000 US gpm	(10 000 m^3/h)
Heads	to 400 ft	(120 m)
Motor ratings	to 1080 hp	(800 kW)
Liquid temperatures	to 140 °F	(60 °C)

Higher operating parameters available upon request.

Material combinations

G, G1, G2: Standard version of Cast Iron (G) with stainless steel impeller (G1) or hardmetal impeller (G2)

GH, H: High chrom white iron versions

C1, C2: Duplex stainless steel versions

Designation

example: → KRT F40-160/22XG-125 ←

KRT K 150 -315 / 12 6 X G - 295

- Pump type
- Impeller type (E, F, K, S)
- Hydraulic size
- Motor code
- Material combination
- Impeller size [mm]

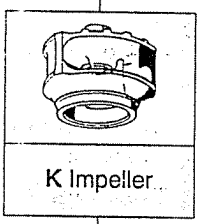
KSB

Pump Hydraulics

Since no one type of impeller is best suited for all applications, KSB has developed numerous impeller types, casing shapes, and pump sizes so as to best meet any specific requirement. KSB's extensive range of recessed, single vane and multivane impellers allows for the selection of an optimum impeller/casing/motor combination that best satisfies the full range of operational requirements of flow, head, efficiency, solid size passage, wear resistance, and gas content. **KSB offers the right impeller for cost effective and reliable operation.**

Closed, non-clogging 2 or 3 vane (K) impeller for highest efficiencies pumping all types of industrial and municipal wastewater.

- Raw Sewage
- Activated & Return Sludge
- Industrial Wastewater
- Process Media
- Abrasive Laden Media
- Chemically Aggressive Media
- Stormwater



K Impeller

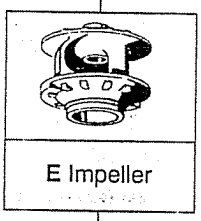
Pump Model: KRT K 40 to 700
2" to 28"

- Capacities to 45,000 GPM (10,000 m^3/h)
- Heads to 400 Ft. (120 m)
- Thrulets to 5 $^1/_4$ in. (133 mm)

KRT K 600 to 700 / 24" to 28"
consult factory

Closed, non-clogging single vane (E) impeller for fluids containing large solids and long fibrous material.

- Raw Sewage
- Digested Sludge
- Return Sludge



E Impeller

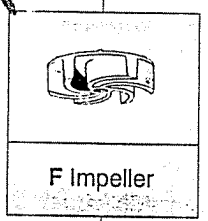
Pump Model: KRT E 80 to 200
3" to 8"

- Capacities to 4,300 GPM (980 m^3/h)
- Heads to 120 Ft. (36 m)
- Thrulets to 5 $^5/_8$ in. (143 mm)

KRT E 80-200
see Type Series Booklet 2553.5231-14

Recessed, non-clogging torque-flow (F) impeller for fluids containing large solids, long fibrous admixtures, and entrained or dissolved gasses.

- Raw Sewage
- Activated & Return Sludge
- Abrasive Laden Media
- Industrial Wastewater



F Impeller

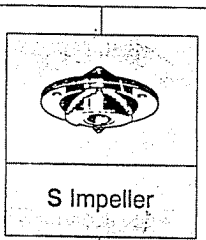
Pump Model: KRT F 40 to 150
2" to 6"

- Capacities to 2,600 GPM (590 m^3/h)
- Heads to 260 Ft. (80 m)
- Thrulets to 5 $^5/_{16}$ in. (135 mm)

KRT F 40, 65, 80
see Type Series Booklet 2553.5231-14

Cutting and grinding (S) impeller for high pressure domestic sewage systems containing long fibrous admixtures.

- Effluents
- Domestic Sewage



S Impeller

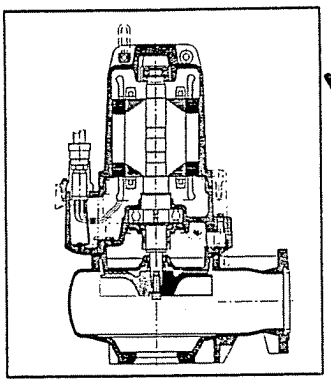
Pump Model: KRT S 40 · 1 $^1/_2$"

- Capacities to 115 GPM (25 m^3/h)
- Heads to 260 Ft. (80 m)

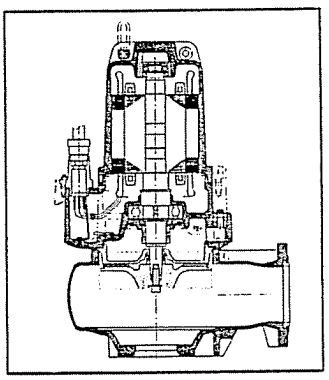
KRT S 40-160 see also
Type Series Booklet 2553.5231-14

Material combinations

Grey cast iron

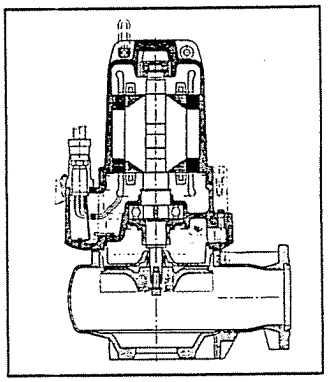


G = **standard version**
major components in cast iron
G1 = cast iron with duplex steel impeller
G2 = cast iron with high chrome white iron impeller

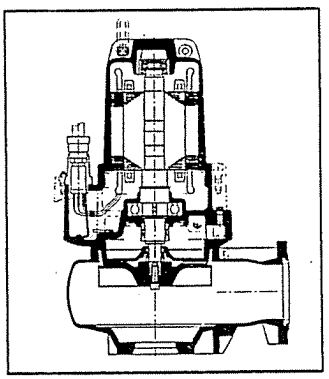


GH = cast iron with impeller and intermediate casing in high chrome white iron

Spezial materials



H = liquid end components of high chrome white iron with a slurry mechanical seal

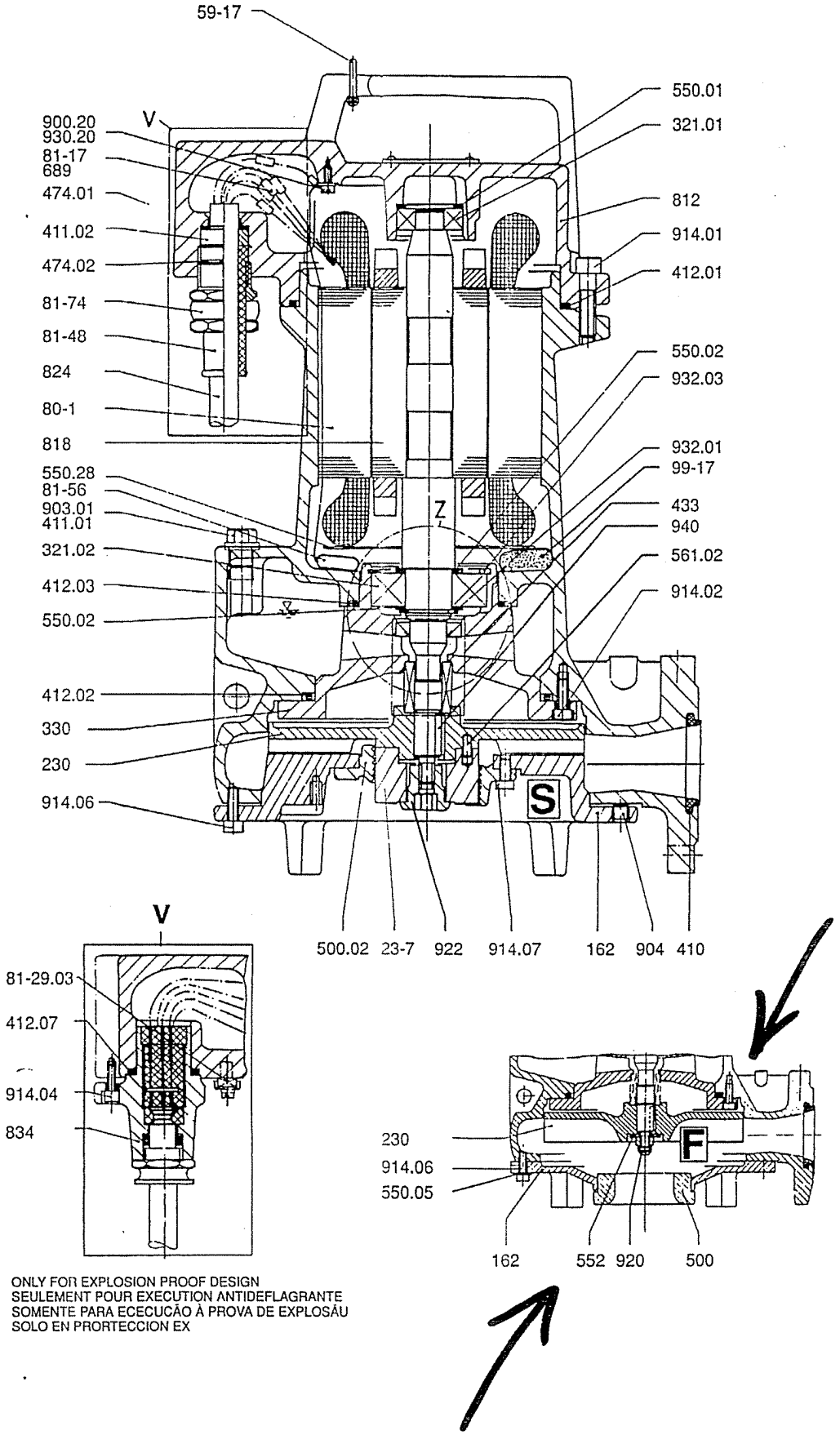


C1 = major components of duplex steel with elastomer bellows-type mechanical seal

C2 = major components of duplex steel with a slurry mechanical seal; bolts in A 276 S 31803 and Tefzel cable

Part-No.	Component	Material combination						
		G	G1	G2	GH	H	C1	C2
Pump unit								
101	Pump casing	A 48 class 35 B				A 532 II C 15 % CrMo-Hc	A 743 CD 4 MCU	
502	Casing wear ring (if existing)	A 48 Class 35 B				AISI 329		
230	Impeller	A 48 Class 35 B	A 743 CD 4 MCU			A 532 II C 15 % CrMo-Hc	A 743 CD 4 MCU	
113	Intermediate casing	A 48 class 35 B				A 532 II C 15 % CrMo-Hc	A 743 CD 4 MCU	
433.01	Mechanical seal (motor end)	Carbon/Si-Carbide						
433.02	Mechanical seal (pump end)	Si-Carbide/Si-Carbide						
210	Shaft	A 276 Type 420 (up to 80 hp (60 kW)); A 576 Gr. 1045 with shaft protection sleeve (over 80 hp (60 kW))					A 276 S 31803/A 576 Gr. 1045	
330	Bearing bracket	A 48 Class 35 B					A 743 CD 4 MCU	
811	Motor casing	A 48 Class 35 B					A 743 CD 4 MCU	
410	Elastomers	Nitrile rubber (NBR)						Viton (FKM)
900	Bolts	A 276 Type 316 Ti						A 276 S 31803
Installation parts								
72-1	Discharge elbow	A 48 class 35 B				A 532 II C 15 % CrMo-Hc	A 743 CD 4 MCU	
732	Claw	A 48 class 35 B				A 48 class 35 B with liner of AISI 329	A 743 CD 4 MCU	
894	Bracket	A 276 Type 316 Ti up to DN 200; galv. steel for sizes from 200-500 on						A 743 CD 4 MCU
572	Clamp	A 276 Type 316 Ti up to DN 200; A 48 Class 35 B for sizes from 200-500 on						A 743 CD 4 MCU
59-24	Guide cable	A 276 Type 316						A 276 Type 316 Teflon coated
892	Foot plate	galv. steel					A 276 Type 316 Ti	A 743 CD 4 MCU
885	Lifting chain /-Rope	galv. steel, A 276 Type 316 upon request					Polypropylene (PP)	

Sectional drawing KRT 40-160

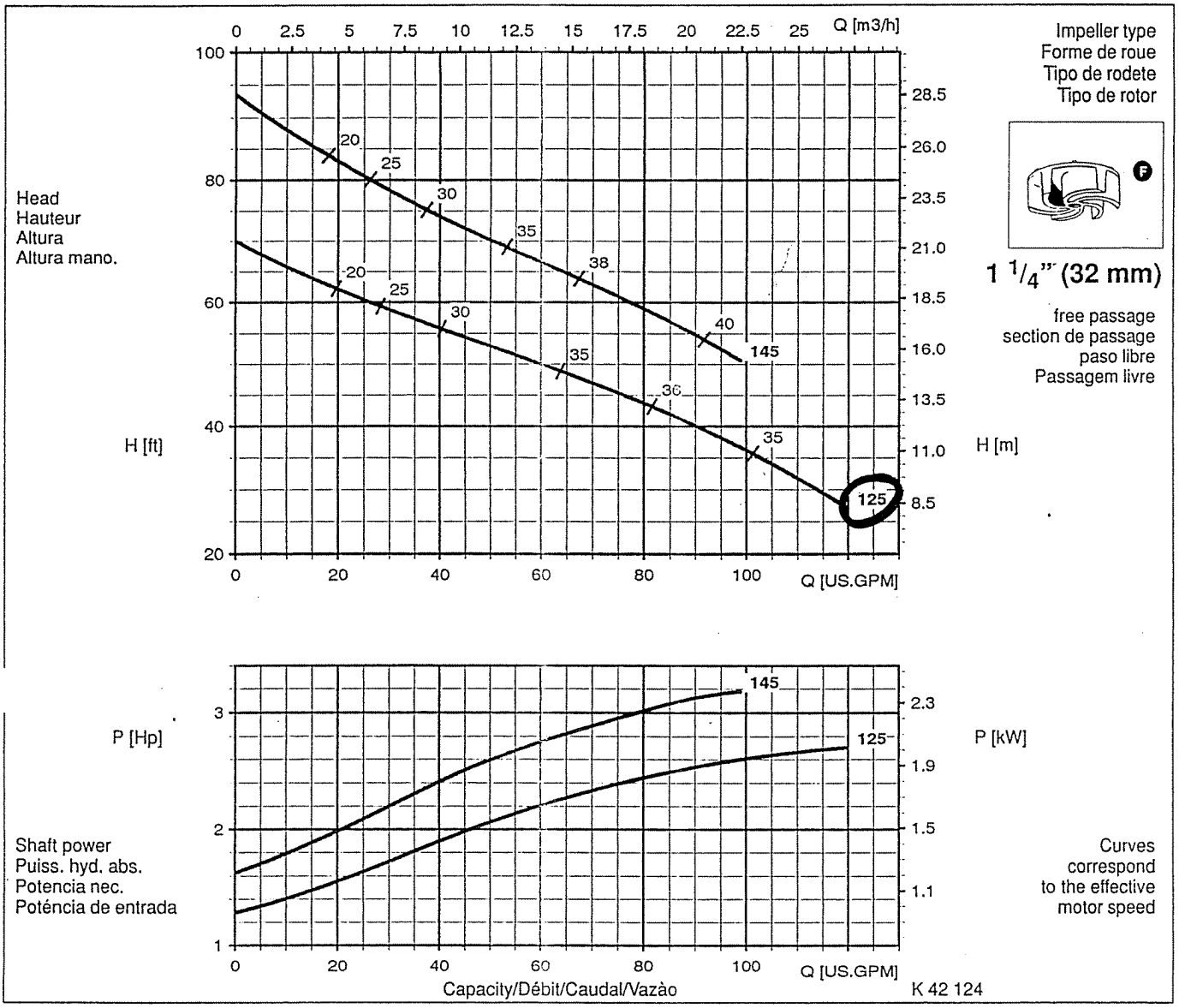


ONLY FOR EXPLOSION PROOF DESIGN
SEULEMENT POUR EXECUTION ANTIDEFLAGRANTE
SOMENTE PARA ECECUCÃO À PROVA DE EXPLOSÃU
SOLO EN PRORTECCION EX

0W 309 001–00

KRT F 40-160 / ...

3500 rpm



Suitable motor sizes/Définition taille moteur/Tamaños de motor aplicables/Tamanhos apropriados de motores

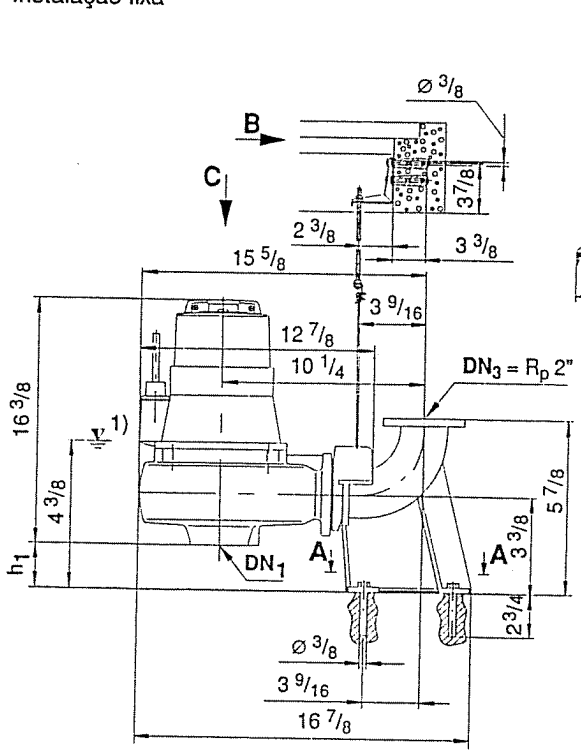
MOTOR RATING Material G Hp (kW)	MAX. LIQUID TEMP. °F (°C)	MOTOR CODE
2.0 (1.5)	131 (55)	2 2 UG
3.0 (2.2)	104 (40)	2 2 XG (FM)
3.5 (2.6)	131 (55)	2 2 UG

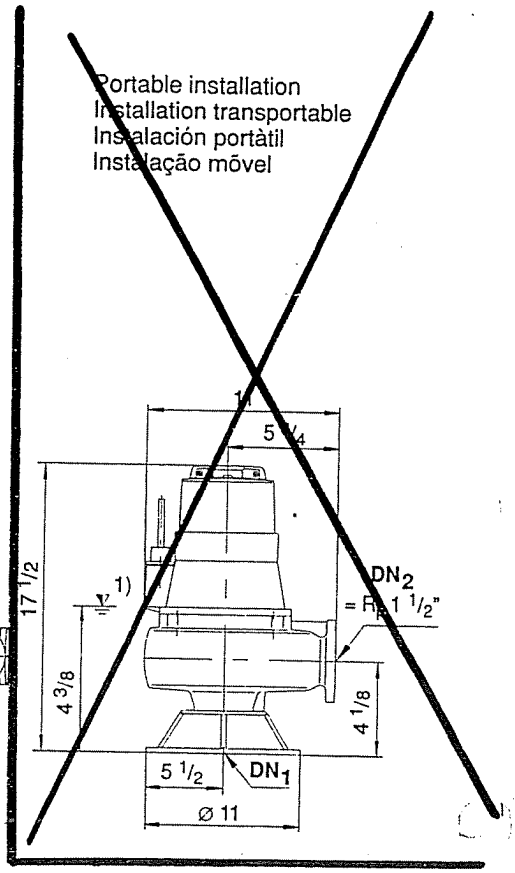
(FM) = Explosionproof to Class I, Division 1, Groups C & D
(Explosionproof according to IEC 79 (EEx d II B) on request).

Dimension table

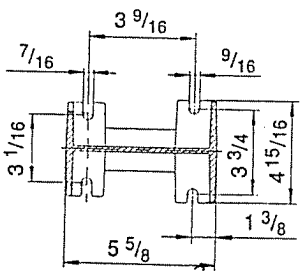
Size: 40-160

Permanent installation
Installation stationnaire
Instalación fija
Instalação fixa

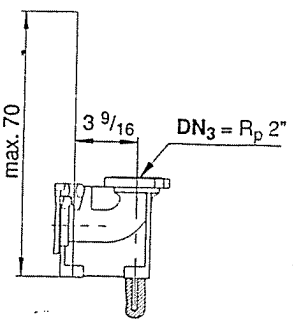




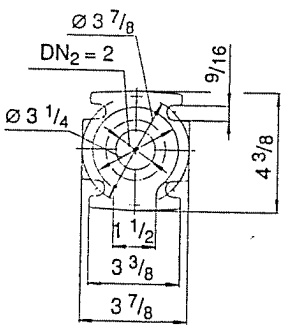
A - A



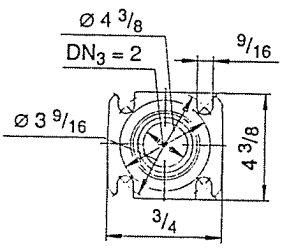
with free standing guide rail
avec étrier de guidage
con horquilla guia
com trilho guia



Pump flange DN_2
Bride de pompe DN_2
Flange da bomba DN_2
Brida bomba DN_2



Discharge connection flange DN_3
Bride du coude DN_3
Brida codo DN_3
Flange da curva de saida DN_3



1) Lowest shut-off point for automatic operation
1) Point d' arrêt le plus bas en service automatique
1) Nivel mínimo de parada en operación automática
1) Menor ponto de shut-off com operação automática

KRT ...-... /... U X	Dimensions in inches/Cotes eñ inches/ Dimensiones eñ inches/Dimensões em polegadas		Weight [lbs]
	DN_1	h_1	
F 40-160/22	2 1/8	1 5/8	88
S 40-160/22	—	2 1/8	90.5
S 40-160/02	—		

0W 382 510–50

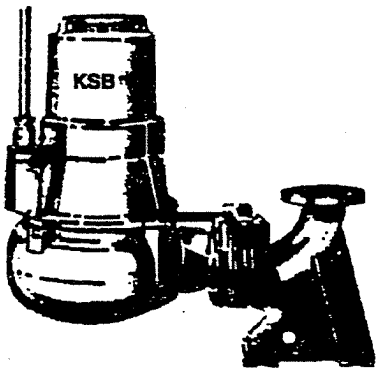
dimension

MOTORDATA **2- POLE** **460 V** **60 Hz** **3~**

motor starting: direct on line (D.O.L)
switching frequency: up to 10 HP max. 30/hour
material: G; G1; G2; GH; H

motor-type	motor rating P2 [HP]	max. temp. of pum-ped-media [°F]	speed nom. [rpm]	FLA [A]	LRA for DOL start [A]	NEMA code letter	electric cable for power dedicated control (+) if necessary Qty.	type	Ø [inch] min - max	motor data function of motor rating P2 (data for 1/4 to 4/4 –load) load	motor input [kW]	curr. [A]	effic. [%]	power factor
22UG	2.00	131	3495	3.9	30	N	1	AWG15-8	0.65-0.75	4/4	1.81	3.9	82.4	0.59
										3/4	1.41	3.6	79.5	0.49
										2/4	1.03	3.5	72.4	0.38
										1/4	0.68	3.4	55.0	0.26
22UG	3.50	131	3420	5.2	30	H	1	AWG15-8	0.65-0.75	4/4	3.13	5.2	83.4	0.77
										3/4	2.34	4.3	83.9	0.68
										2/4	1.61	3.8	81.3	0.54
										1/4	0.94	3.4	69.1	0.35
22XG	1.50	104	3520	3.6	30	R	1	AWG15-8	0.65-0.75	4/4	1.42	3.6	79.2	0.49
										3/4	1.13	3.5	74.6	0.41
										2/4	0.85	3.4	65.7	0.32
										1/4	0.59	3.3	47.2	0.23
22XG	3.00	104	3445	4.6	30	J	1	AWG15-8	0.65-0.75	4/4	2.67	4.6	83.8	0.73
										3/4	2.02	4.0	83.3	0.63
										2/4	1.41	3.6	79.4	0.49
										1/4	0.85	3.4	65.5	0.32
32UG	3.40	104	3490	5.6	40	L	1	AWG15-8	0.65-0.75	4/4	3.36	5.6	75.6	0.76
										3/4	2.61	4.8	72.8	0.69
										2/4	1.91	4.2	66.4	0.58
										1/4	1.26	3.7	50.6	0.43
32UG	4.50	104	3455	6.9	40	H	1	AWG15-8	0.65-0.75	4/4	4.39	6.9	76.5	0.81
										3/4	3.34	5.6	75.5	0.75
										2/4	2.36	4.6	71.2	0.65
										1/4	1.46	3.8	57.4	0.48
32XG	4.50	104	3455	6.9	40	H	1	AWG15-8	0.65-0.75	4/4	4.39	6.9	76.5	0.81
										3/4	3.34	5.6	75.5	0.75
										2/4	2.36	4.6	71.2	0.65
										1/4	1.46	3.8	57.4	0.48
32WG	3.40	140	3490	5.6	40	L	1	AWG15-8	0.65-0.75	4/4	3.36	5.6	75.6	0.76
										3/4	2.61	4.8	72.8	0.69
										2/4	1.91	4.2	66.4	0.58
										1/4	1.26	3.7	50.6	0.43

Submersible motor pumps KRTF KRTS 40-160



Series	KRT
Size	DN 40 1½"
Motor size	2 2
Material types	G

Serial-No.: see nameplate

This operating manual contains important information and hazard/danger warnings. It is important to read the instructions set out in this manual prior to installation, making electrical connections and commissioning. Any additional operating instructions relating to the station will also have to be observed.

In principle, if any work has to be carried out on the pump, all electrical supplies (including the control cable) should be disconnected at the main supply. The pump has to be protected against accidental starting.

Ident-No. 01 056 818 - KSB,Inc

KSB

This operating manual contains important notes for the individual material versions of the pump models:

Model	Material version			
	G	G1	G2	GH
S, F 40 - 160	S, F			
E 80 - 251	E	--	--	--
K 80 - 315	K	K	--	K
F 100 - 250	F	F	F	F
E, K 100 - 251	E	K	--	K
F, K 100 - 316	F, K	F, K	F	F, K
F, E, K 150 - 315	F, E, K	F, K	F	F, K
K 200 - 280	K	K	--	K
K 200 - 281	K	–		

Contents

1. General

This KSB pump has been developed with the latest technology, it was manufactured with great care and was subject to constant quality control.
The operating manual is designed to introduce the pump to you and to make operation safe and effective.The operating manual contains important information. It is imperative to observe the contents of the operating manual to ensure reliability and long operating life of the pump and to avoid dangerous practices.
The operating manual does not take into account any local regulations which have to be complied with by the operator or by any installation staff.
This pump must never be operated outside the limits laid down in the technical documentation with regard to pumped media, rate of flow, speed, density, pressure and temperature, including motor rating or contrary to any other instructions stipulated in the operating manual or contract documentation. The nameplate states series / size, the most important operating data and the Serial No., which must always be stated when making inquiries, subsequent orders and especially when ordering spare / replacement parts. Should any additional information or instructions be required, or if there is any damage to the equipment, please contact KSB.

2. Safety

This operating manual contains basic instructions, which must be observed during installation, operation and servicing. Therefore it is important that this manual is read prior to assembly by the fitter and relevant staff and operators, and it must always be kept within easy access.
Do not only observe the general safety notes under this section, but as well any other notes regarding safety included in the manual.

2.1 Identification of symbols used within the operating manual

The symbols contained within this manual calling attention to situations where non-observance could endanger lives, are especially identified such as:

Calling attention to electric current with

Safety instructions relating to situations where non-observance could damage the machine and its functions are identified with the word

Attention

Any instructions which are actually printed on the machine such as:
- arrow indicating the direction of rotation
- identification for fluid connections

must be observed without fail and be kept clean and legible.

2.2 Personnel skills and training

Operators as well as service, inspection and assembly personnel must have the appropriate skills to carry out such work. Area of responsibility, allocation and supervision of the personnel must be controlled by the operator. Should the personnel not have the required knowledge, training must be arranged. If required, the operator can arrange such training to be carried out by KSB. The operator must also ensure that the instruction manual is fully understood by the personnel.

2.3 Dangerous practices non-observance of safety instructions

Non-compliance with the safety instructions can endanger people's lives, the environment and the pumps.
In detail, non-compliance could, **for example**, cause the following:

- Failure of pump / plant to operate
- Faulty servicing and maintenance methods
- Endangering people by contact with electrical, mechanical and chemical hazards
- Contamination of the environment by leakage of dangerous substances.

2.4 Safe working methods

The operator must observe all safety instructions outlined in this manual, the existing national/local safety precautions to prevent accidents, and also any inter-company working, operating and safety regulations.

2.5 Safety instructions for operators

- If hot or cold machine parts are considered a danger, then these parts must be protected where contact is possible.
- Safety equipment to prevent contact with hot or cold movable parts must not be removed while the machine is in operation.
- Leakages (for example at shaft seals) of dangerous media (e.g. explosive, poisonous, hot liquids) must be disposed of in such a manner as to avoid any danger to personnel and environment.
- Danger caused by electric supply must be eliminated.

2.6 Safety instructions during maintenance, inspection and installation

The operator bears the responsibility to ensure that all service, inspection and maintenance work is carried out by authorized and fully trained personnel, who have read and are familiar with the operating instructions.
Basically, all work to the pump should only be carried out when the machine is not operating. The operating instructions relating to the method of switching off the equipment must be adhered to without fail.
Pumps pumping dangerous media must be decontaminated.
Once maintenance work is completed, all safety equipment must be reinstated again and checked to ensure they function correctly.
Read and follow the point listed in the paragraph **6.1** prior to installation.

2.7 Unauthorized modifications to the pump and fitting of spare parts

Modifications to the pump can only be carried out after authorization has been obtained from the manufacturer. Original spare parts supplied by the manufacturer provide safety. Installation of any other parts cancels the warranty for any pump failure which occurs as a result of installing non-manufacturer's parts.

2.8 Unauthorized modes of operation

Operating safety of the equipment is only guaranteed if all operating instructions as outlined in paragraph 1 - General - are observed. The limits given in the data sheet must not be exceeded.

3. Transport and interim storage

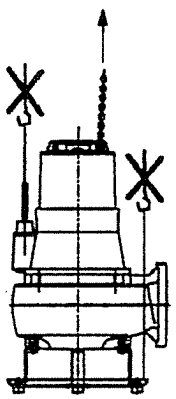
The chain or lifting wire which is supplied must only be used for lifting the appropriate pump unit. General use for lifting heavy loads is not permitted. Do not lift pump over people.

Do not lift the pump by the motor cable.

The pump must be handled carefully during transport. The chain or lifting wire must be attached securely at the pump and crane end. Personnel can be injured and the pump unit damaged should the pump slip out of the chain/guide rope.

3.1 Transport

The motor housing/cover of the pump has been designed for attaching the chain supplied with the unit. For lifting the unit during unpacking, only this designed fixing should be used for attaching the lifting chain.



3.2 Storage and Conservation

The procedure has been outlined in paragraph 6.3 "Shutdown".

4. Description of pump

4.1 General description

KSB submersible pumps are close-coupled units which are non-self-priming. The impellers in these pumps can vary, depending on the impeller type required to suit a particular application. Usually, the pumps are operated fully submerged. For short periods, they may run dry until the minimum allowable liquid level is reached.

4.2 Identification data

Identification data can be found on the nameplate, which is fitted to the motor.

KRT E 100-250 / 11 4 X G - 238

Series

Impeller type (E,F,K,S)
- E = single-vane impeller
- F = free-flow impeller
- K = non-clogging impeller
- S = with cutter

Hydraulic size

Motor size (kW)

Number of poles
- 2-pole (3500 RPM)
- 4-pole (1750 RPM)
- 6-pole (1160 RPM)

Motor version (U, W, X, Z)
- U = standard version
- W = warm water version
- X = explosionproof standard
- Z = explosionproof warm water

Material combination

(G, G1, G2, GH/H, C1/C2)
- G = Pump complete in cast iron
- G1 = GG Pump with impeller in duplex steel A 743 CD 4 MCU (1.4517)
- G2 = GG Pump with impeller in chilled casting A 532 II C 15 % CrMo-Hc (0.9635)
- GH = GG Pump with impeller and discharge cover in chilled casting A 532 II C 15 % CrMo-Hc (0.9635)
- H = Pump manufactured in chilled casting A 532 II C 15 % CrMo-Hc (0.9635)
- C1/C2 = Pump manufactured in duplex steel A 743 CD 4 MCU

Impeller diameter

4.3 Construction

4.3.1 Driver

KSB submersible pump sets are supplied with three-phase asynchronous motors complete with connecting cable. Starting method standard: direct.

4.3.1.1 Motors in explosionproof design

In accordance with NEC 500, listed by Factory Mutual <FM>:
Class I, Division I, Group C & D.

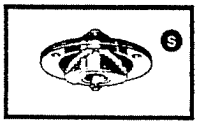
4.3.2 Shaft seal

The shaft seal consists of two mechanical seals, which are independent of the direction of rotation; at pump and motor end. The oil chamber which is between the two mechanical seals ensures cooling and lubrication.

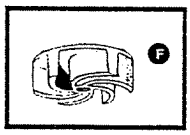
4.3.3 Bearing assembly

All sizes are fitted with grease-lubricated for life, maintenance–free deep– groove anti-friction bearings.

4.3.4 Impeller type



Cutter (S) for domestic sewage and sewage containing long fibrous admixture



Free-flow impeller (F-impeller) for pumping liquids containing large solids and fibers liable to twist and bunch and also gas and air inclusions.

4.3.5 Installation methods

- stationary wet-well installation
- transportable installation

For detailed installation description, see item 5.6.

4.3.6 Dimensions

Information regarding dimensions and weight can be found in appendix **"Dimension tables"**.

4.4 Ancillary equipment

Recommended equipment is described in appendix **"Electrical connection diagrams"**.

Any information relating to other ancillary equipment will be given by our Sales Office.

5. Assembly/Installation

5.1 Safety regulations

It is not permitted for any person to enter the pit during operation of the pump unless special safety precautions have been taken in accordance with current safety regulations.

5.2 Checking procedure prior to installation

Construction lay-out must be in accordance with measurements set out on the table of dimensions. The strength of the concrete foundations should be min. 3000 psi to ensure a secure and functionally correct installation. Concrete foundations must have set before installation of the unit. Its surface must be level and even.

5.3 Installation

Examine the unit carefully prior to commencement of installation regarding any damage to the unit or cabling during transport. Before installation of the pump all items listed in paragraph 6.1 have to be checked in sequence. A separate nameplate stating pump and motor data is supplied with the pump. This nameplate should be fixed in a clearly visible position outside the pit (for example switch panel, pipework, mounting bracket).

5.3.1 Checking of operating data

A check must be carried out to ensure that the details stated on the nameplate correspond to the order and pump data (for example operating voltage, frequency and pumped media temperature etc.).

5.3.2 Oil level control

The oil chambers of our submersible pumps were filled with environmentally safe non-toxic paraffin oil at the factory.

The oil level must be checked prior to initial operation of the unit.

Procedure see item 6.1.1

5.3.3 Checking of the direction of rotation

Before starting with the installation, make sure that the direction of rotation is correct, according to paragraph 5.5.6.

5.4 Connection of the pipe

(Appendix **"General outline-installation set" Fig 1**).
The discharge pipe must be connected to the pump without stress.

Attention **Under no circumstances must the pump be used as an anchoring point for the pipeline.**

Any forces in the pipe system must be isolated by taking appropriate corrective measures, to ensure that the pump does not come under undue stress due to pipeline forces and torques.

Excessive pipeline forces can cause leakages of pumped media.

Attention **Screwed pipeline joints where plastic parts were used, must not be damaged by careless handling of tools during the installation of pump and pipeline.**

Fitting of a non-return valve is recommended to avoid backflow when the pump is turned off. Ensure that air venting is taken into account when installing a non-return valve.

5.5 Electrical connection

The electrical connection must be carried out in compliance with local regulations. The voltage must comply with the voltage indicated on the nameplate.

Electrical installation must be in accordance with the appendix **"Electrical connection diagrams"** for the appropriate motor sizes. The pump is delivered with cable.

Attention **Do not remove the protective cover, which is located at the cable end until immediately before installation.**

The individual wires of the cable ends bear marking tapes (e.g. U1/(T1),V1/(T2),W1/(T3),U2/(T4),V2/(T5),W2/(T6) 21,22, or 10,11, ...) If cables have to be shortened, take note of the wire index number or color imprints. In such a case, remove the marking tapes and reattach them afterwards.

Attention **When laying a conduit between the pump station and the electrical switchgear, additional control cable (min. AWG 15) must be installed for pump monitoring equipment. Adjust cores to suit requirement. When Variable Frequency .Drive (VFD) is being used, the control cable must be installed in a separate conduit.**

5.5.1 Monitoring equipment

The unit has been supplied with monitoring equipment to prevent damage. Installation, description and functioning of the monitoring equipment can be taken from appendix **"Electrical connection diagrams"**.

5.5.2 Installing the electric cabling

Attention **After installing the unit, position and support the motor cable so not to have it sucked into the pump during operation.**

For correct installation of the electric cabling within the pump sump (appendix **"General pump outline" Fig. 3**) we recommend using cable socks, which can be supplied for additional cost (paragraph 4.4). Slack installation of cables could cause damage to the electric cabling when the pump is operating.

Fitting of cable protection sheath:

If a protection sheath is included in the scope of supply for the electric cabling, it has to be fitted according to the instructions given in the supplementary operating manual **"Assembly of protection sheath"**.

5.5.3 Overcurrent relay

The motor must be protected against overloading by a thermally compensated overcurrent relay to comply with NEC and regulations which are in accordance with local requirements. This must be adjusted to the nominal motor current indicated on the nameplate.

5.5.4 Level control switch

Pumping stations with automatic pump operation should be fitted with a level control switch. The cut-off point should be set at "1)" as shown on appendix **"Dimension tables"**.

5.5.5 Checking of the direction of rotation

Once the electrical connections are completed, the following should be checked:

Attention **The pump cannot reach its duty point if the direction of rotation is incorrect. Non-observance can damage the pump.**

Prior to the rotation check, make sure no foreign objects are in the pump casing.

Never put hands or any objects into the pump when the pump can be accidentally started. Prior to carrying out rotation check, make sure no foreign objects are in the pump casing.

Attention **The running time should be short (approx. 1 minute).**

Correct direction of rotation:

If the right phase sequence of the circuit is known, the correct direction of rotation will occur automatically, providing the instructions in 5.5 have been carried out correctly (rotating of the motor to the left).
The direction of rotation is checked by short pump operation and observations of the impeller.
When looking at the pump discharge, the impeller must move to the left (with some pumps, the direction of rotation is marked by an arrow).
(See appendix **"General pump outline" Fig. 5**).

If the direction of rotation is incorrect, interchange 2 of the 3 phases at the disconnect switch or motor control.

5.6 Assembly kit installation

The following assembly kits are available for assembly / installation of the KRT pump unit.

– 5.6.1 Stationary wet–well installation
– 5.6.2 Transportable installation

5.6.1 Stationary installation with guide cable

5.6.1.1 Description

(Appendix **"General outline - installation set" Fig. 1).**

Stationary installation provides the facility to insert and lift out the pump unit at any time regardless of liquid level within the sump by means of a double guide cable.

Guided securely by two parallel stainless steel cables the pump slides into the well or tank and attaches itself to the discharge elbow. The weight of the pump acts to seal the connection between pump and discharge elbow. A profile gasket between the pump and discharge elbow assures a zero leakage.

5.6.1.2 Scope of supply for stationary wet-well installation

Please refer to the appendix **"Wet-well installation with guide cables".**

5.6.1.3 Installation of pump with claw connection

Use appendix **"Wet-well installation"** for guidance.

1. Prior to lowering the pump fit claw (part #732) to the discharge flange of the pump housing.
   Screws have to be tightened in accordance with the instructions. This is described under item 7.5.1 in the table **"Bolt tightening torque".**

2. Fit profile seal (part #410.35 or 99-6) into the groove of the claw / pump casing flange.

5.6.1.4 Installation of the mounting bracket / discharge elbow / guide cable

Construction of the base foundations should be sufficiently strong (min. 3000 psi) to ensure a functionally correct fixing of guide cable equipment and discharge elbow.

Refer to the drawing as illustrated in appendix **"Wet-well installation"**,for all installation tasks outlined below.

1. Secure mounting bracket (part #894) using anchor bolt (part #90-3.37) at the sump opening rim. Borehole diameter and depth for the anchor bolt to be taken from appendix **"Dimension tables".** Bolt tightening instructions are outlined in the tables at right.

   Anchor bolts are not furnished by KSB.

   For the bolt of the mounting bracket refer to appendix **"Dimension tables".**

2. Install threaded bolt (part #904) with support piece (part #572) to the mounting bracket (part #894). Do not unscrew upper hexagonal nuts (part #920.36) too much, just enough to allow sufficient play for tightening the cable later.

3. The discharge elbow should be positioned and secured to the base of the sump so that the tightened cable will run vertically later on. Should construction / pipework etc. require the cable to run off the vertical, then a maximum angle of 5° should be adhered to, thus ensuring proper sealing. Securing of the discharge elbow is done by using steel anchor bolts (part #90-3.38) or foundation bolts (part #900.38) regardless of pump size or material combination. Refer to appendix **"Dimension tables"** and appendix **"Wet-well installation"** for details relating to appropriate fitting instructions and hole dimensions.

4. Insertion of cable 59-24.01 and fitting. Install u-clamps (part #571) with nuts (part #920.37) onto support piece, and securve one end of cable. Lead the cable around the discharge elbow (part #72-1) and back again towards the guide bracket and insert into u-clamps and tighten u-clamp nuts.

5. Tighten the cable by tightening the hexagonal nut 920.36 situated on top of the mounting bracket. Tighten the hexagonal nut with a torque of M_A as outlined in the table **"Guide cable tension"** to achieve sufficient cable tension. Lock in place using second hexagonal nut. Be sure to properly lubricate threaded bolt and first hexagonal nut before tightening, to assure proper cable tension.

6. The loose end of the cable at the u-clamps can either be twisted into a ring or the end can be cut off. After length adjustment, tape off ends to avoid fraying.

7. Place hook (part #59-18) into the mounting bracket to enable the lifting chain (part #885) or rope (part #59-24.02) to be attached at a later stage.

Table **Bolt tightening torque: Steel anchor bolt**

Size (ø) (mm)	Torque (ft-lb)
10	10
18	60

Table **Bolt tightening torque: Foundation bolt**

Size (ø)) (mm)	Torque (ft-lb)
12	20
16	50
20	95

Table **Guide cable - tension**

Size		M_A (ft-lb)	P (lb)
40-160	100-316	5	675
80-251	150-315		
80-315	200-280		
100-250	200-281		
100-251			

M_A = tightening torque

P = cable tension

For instructions concerning installation of Cable Guide Spacers, refer to Appendix "Cable guide spacer

5.6.1.5 Assembly of chain or lifting rope stationary wet-well installation

Installation of this equipment should be carried out in accordance with the **"General pump outline", Fig. 1a** by inserting the chain/ lifting rope into motor lifting point opposite the discharge. Further details can be found in **"Wet-well installation".** This type of fixing permits the proper fitting of the pump to the discharge elbow.

5.6.1.6 Installation of the pump

(Appendix **"General outline - installation set" Fig. 1**).

The pump is lowered into the sump by guiding it from above over the support piece 572. It is then attached to the guide cable or rails and slowly lowered into the sump. Once the pump is lowered, it will attach itself to the discharge elbow 72-1 and is then securely fixed to the outlet pipe ready for use. Finally, attach the chain or rope to the hook 59-18 on the mounting bracket, or other suitable support.

5.6.1.7 Connection of the pipeline

(Appendix **"General outline-installation set" Fig. 1**).

For procedure, see para. 5.4.

5.6.2 Transportable installation

5.6.2.1 Description

Pumps for transportable installation are supplied with a pump stand. The outlet flange can be used for fitting either rigid or flexible piping. Examples for typical installation possibilities can be taken from appendix **"General outline-installation set " Fig. 2.**
Ancillary equipment can be requested and purchased from our sales offices.

5.6.2.2 Components / extent of supply for transportable installation

For parts supplied and detailed illustration, see appendix **"General Arrangement Drawing - Wet-well installation transportable"**.

5.6.2.3 Assembly kit installation

Please refer to drawing in appendix **"Wet-well installation - transportable"** for assembly.

The base plate or the pump stand must be fitted prior to installing the pump. All screws must be tightened according to instructions. Refer to table **"Bolt tightening torque"** paragraph 7.5.1 for instructions.

5.6.2.4 Assembly chain or lifting rope transportable installation

Fitting of chain / lifting rope should be carried out as outlined in appendix **"Wet-well installation-transportable.**
Always use the lifting point which is fitted on the discharge side of the motor, see appendix **"General pump outline" Fig. 1b.**

5.6.2.5 Installation of pump

Transportable installation permits to operate the pumps in different locations.
For example, they can be used for draining mines, the emergency draining of canals, pumping water out of rivers etc.
For such applications the pump must be installed in a vertical position with the stand resting on a firm base.

6 Start up / shut down

Attention **It is important to follow these requirements. Any damage incurred as a result of non–compliance is not covered by the guarantee.**

Attention **Do not pump any media which is unsuitable for the material outlined in the technical documentation.**

6.1 Initial start up of pump

Prior to starting the pump the following points have been checked and executed:

- Operating data (see 5.3.1), oil level (see 6.1.1) and direction of rotation (see 5.5.5).

- Check that the installation of the electrical supply was carried out correctly in accordance with appendix **"Electrical connection diagrams".**

Attention **Temperature monitoring in the winding protects the motor in case of insufficient cooling. Reliable operation and explosion-proof protection can only be guaranteed if the circuits for temperature monitoring function properly.**

- Ensure that the pump has been installed correctly to comply with **installation kit** paragraph 5.6.
- Should the pump have been out of service for a long period, then the steps outlined in paragraph 6.4 must be carried out.

6.1.1 Oil level check

Procedure according to appendix **„General pump outline" Fig. 2.** Remove screwed plug (part #903.03) with joint ring (part #411.03). The minimum oil level must not fall short of measure "M". If it is lower, fill the oil chamber via feed opening until overflow. Regarding oil quality and quantity, see point 7.2.4 (Oil change). Tighten the filling plug with joint ring again.

6.2 Limitations of the operating range

6.2.1 Minimum liquid level

The pump is ready for operation when the liquid level has reached measuring mark **"R"**. This minimum liquid level also applies to pumping stations with automatic pump operation.
(Appendix **"General pump outline" Fig. 6**).

"R" = Lowest switch-off point for automatic operation

Built-in temperature controls within the winding will protect the motor from overheating. If the motor overheats the built-in temperature controls will switch off the motor and turn it on again automatically after cooling down. The control system must provide a protection against dry running by stopping the pump automatically at water levels **"R"** and below.

Attention **Dry running leads to increased wear and should be avoided.**

6.2.2 Temperature of pumped media and surroundings

The maximum temperature is indicated on the nameplate.

KRT	version U, X:	104 °F/ 40 °C
KRT	version W, Z:	140 °F/ 60 °C

Do not operate the equipment at temperatures higher than those indicated, unless KSB has given written consent. Damage caused due to non–observance of this warning will not be covered by the guarantee.

6.2.3 Density of pumped media

Power input of the pump increases directly with the density of the pumped medium. To avoid overloading of the motor this density must comply with the data stated in the order

6.2.4 Abrasive media

When pumping media containing abrasive particles, increased wear of hydraulic and mechanical seals must be expected. The maintenance intervals must be halved compared to those usually recommended (as outlined in paragraph 7.2). In addition, it is recommended to limit the flow velocity in the pipe to > 5 ft/sec < 15 ft/sec in order to achieve maximum reliability.

6.2.5 Starting frequency

In order to avoid overloading of winding, seals and bearings, the following number of starting cycles must not be exceeded:

Motor ratings up to 10 Hp: max. 30/hr

6.2.6 Operating voltage

The maximum admissible deviation of the operating voltage is ± 10% of the rated voltage. The maximum admissible voltage difference between phases is ± 1%.

6.2.7 Frequency converter operation

If frequency converters are used, the power output of the motor P_2 is limited to 95 % of nominal value maximum.
For the possible speed range the following criteria have to be observed:

- Q_{min} and Q_{max} according to characteristic curve
- minimum speed capable to carry solids
- minimum flow velocity to fully open a non-return valve
- inherent frequency ranges of pipe system.

6.3 Shutdown / storage / preservation

If operation is not required until some time after delivery, we recommend the following steps for storage of the pump:

6.3.1 Storage of new pumps

- Spray the inside of the pump housing with oil, paying special attention to the area around the impeller wear ring. Spray oil through inlet and outlet flanges. It is then recommended to protect the flanges with plastic caps or similar.
- Store the pump in an upright position in a dry place. Support all electrical cables at cable entry points to avoid permanent deformation.
- Electric connecting cables are capped securely for protection purposes prior to delivery. This protection must not be removed.

6.3.2 Measures for prolonged shutdown periods

1. **The pump remains installed ready for operation when required.**
   In order to maintain pump availability, the pump should be switched on for brief periods (approx. 1 minute) once every month.

2. **The pump is dismantled and stored**
Prior to storage the pump should be checked and maintained in accordance with paragraph 7.1 and 7.2. Also, the preservation outlined in paragraph 6.3.1 must be carried out.

6.4 Re-starting pump after storage

Prior to re-starting the pump, all checks and maintenance steps outlined in **paragraphs 7.1 and 7.2** have to be carried out. In addition, free-spinning of the impeller should be checked by hand.

Always disconnect all electrical supplies prior to working on the pump. Safeguard the pump from being started accidentally. Otherwise, there will be danger to life.

When restarting the pump the items outlined in **paragraph 6.1 and 6.2** have to be observed.

Immediately after completion of the maintenance work, all safety and protection equipment has to be installed and working properly.

7. Service and maintenance

7.1 General instructions

The operator must ensure that all maintenance, inspection and repair work is carried out by qualified, authorized staff who are familiar with the equipment and who have read the operating instructions.

By compiling a maintenance plan it is possible to cut maintenance expenses and avoid extensive down-time, thus achieving trouble-free and reliable operation of the pump.

Always disconnect all electricity supplies prior to working on the pump. Safeguard the pump from being started accidentally. Otherwise, there will be danger to life.

If the pumped media are harmful, the pump must be decontaminated. Special care should be taken to prevent endangering personnel and the environment when draining leakage liquid /oil. All official regulations must be adhered to.

7.2 Service/Inspection

The following points must be observed to ensure reliable operation:

This work must be carried out by experienced personnel!

Item	Maintenance tasks	Maintenance to be carried out at following intervals
7.2.1	Insulation resistance check	A
7.2.2	Visual inspection of electric cables	A
7.2.3	Check of monitoring equipment	A
7.2.4	Oil change	B
7.2.5	Visual check of lifting chain / rope	A
	Complete inspection	every 5 years

Interval A: After every 4000 hours of operation, or every year, whichever occurs first.

Interval B: After every 10000 hours of operation, or every 3 years, whichever occurs first.

The pump/motor shaft is supplied with grease-lubricated for life ball bearings. They need no maintenance tasks.

7.2.1 Insulation resistance check

Measurements should be taken at the motor cable ends (disconnected at the control panel or station J-box). The measurement should be taken by using a megger.

- Measuring voltage: max 1,000 V d.c. voltage.

The measurements to be taken are:

a) Winding against ground

- All winding leads connected together, and measured to ground lead (green-yellow).

b) Winding temperature sensor against ground

- All winding leads connected to ground.
- All cable leads of the temperature sensors (21/22 r 10/11) must be connected together, otherwise the sensors will be damaged. Then measure to ground lead.(green-yellow)

The insulation resistance of the motor winding and sensors must not be less than 5 MΩ. If measurements are less, then cable and motor must be checked separately. For that measurement procedure the cable must be disconnected at the motor.

Insulation resistance for the electric supply cable of less than 5 MΩ indicates a damaged cable; replace cable.

Insulation resistance for the motor less of than 5 MΩ indicates there is a fault in the winding. If this is the case, motor needs repair; contact KSB.

7.2.2 Inspection of the electric cable

- Visual inspection of the electric cable.

  Whenever the pump is inspected, the electic cables should be checked for damage such as cuts, cracks or bubbles. If such damage is detected, the cables should be replaced.

- Checking the protective grounding conductors.

  Resistance between green-yellow cores and any exposed metal surface on pump should be < 1Ω .

7.2.3 Checking the monitoring equipment

a) **Temperature switch** – Resistance between wire ends 21 and 22: R < 1 Ω.

b) **PTC–thermistor**– resistance between leads 10 and 11:

100 Ω < R < 750 Ω.

If the given values are exceeded, disconnect the electric cable at the motor and check again directly at the motor. If values are exceeded here also, the motor must be repaired; contact KSB.

c) **Moisture protection electrode**

The motor area is monitored by a moisture monitoring electrode which is fitted into the motor area (Part #81-56). It is not always fitted as standard. Cable lead identification 9 will show whether or not it has been installed.
Instructions relating to performance and technical data can be found in appendix **"Moisture monitoring".**
The moisture monitoring electrode is okay If the insulation resistance measured between the electrode and ground is >1 MΩ. Lower values indicate moisture or even intrusion of water into the motor. In such cases, the motor needs to be inspected.

A new moisture sensor must be fitted in the event of damage to the sensor.

7.2.4 Oil change

The oil chamber of our submersible pump has been filled with environmentally friendly, non-toxic paraffin oil of food quality on the pump end.

Pumped liquid may enter the oil chamber during operation, which can cause a pressure rise within the chamber. It is, therefore, advisable to cover the filling plug (part #903) with a cloth during the opening process to avoid liquid escaping.

Procedure
(Appendix **"General pump outline"**)

Erect the pump as shown in **Fig. 2** and put a suitable container under the plug. Unscrew drain plug (part #903) with joint ring (part #411.03) and drain the oil. The oil is light in color and transparent in appearance. Slight discolouring, caused by the pumped media will have no adverse effect. Severe contamination of the oil by the pump media, however, indicates damaged mechanical seals. In this case, replace the mechanical seal.

Refilling
Erect the pump as shown in **Fig. 7** and fill the oil chamber with oil until overflow (see also paragraph 6.1.1). Replace the plug part # 903 and fit a new joint ring part # 411.03.

Recommended quality of oil:
Marcol 87 made by EXXON, Shellplex 210 made by Shell, Paraffinoil, free-flowing, Merkur Pharma 40, made by DEA, Duoprime 90 made by LYONDELL or equivalent,non-toxic.
These oils are harmless and comply with regulations applicable to food.

Alternative:
All motor oils of classes SAE 10 W up to SAE 20 W can be used for lubrication of the mechanical seals. With regard to disposal all general Government regulations must be observed.

Attention

Regional regulations must be observed so that the oil does not contaminate the pumped media (e.g. potable water) and for the proper disposal of used oil.

7.2.4.1 Refill quantity

Oil quantity: (oz.) 14

7.2.5 Visual check of lifting chain/lifting rope

Maintenance checks to the pump should also include checking the lifting chain/lifting rope including the shackles for damage. Damaged parts must be replaced by manufacturer's original spare parts.

7.3 Drainage/Disposal

Attention

If the pump has been used to pump hazardous media, care must be taken when draining the oil so that personnel and environment are not endangered. All Government regulations must be observed.

7.4 Dismantling

7.4.1 Basic guidelines and instructions

All repair and maintenance work to the pump must be carried out by trained straff, and **original replacement parts** must be used.
The safety precautions as outlined in paragraph 7.1 and 7.4.4 must to be observed.

Dismantling and re-assembly may only be carried out in line with the appropriate sectional drawing. The sectional drawing and other instructions are detailed in the appendix . The dismantling sequence should be carried out as outlined in the sectional drawing. If there are any problems, please contact KSB service department for advice.

7.4.2 Preparing for dismantling

Prior to dismantling the oil chamber should be emptied.

7.4.3 Dismantling the pump section

Dismantling the pump section is carried out as illustrated in the drawing (appendix **"General arrangement drawing"**). To facilitate stripping of the pump casing (part no. 101) from the intermediate casing (part no. 113) jacking screws have been installed, sealed with plastic stoppers. Special tools are not required.

7.4.3.1 Special points relating to dismantling the impeller

Size: KRTS 40-160
The impeller is enclosed and an auxillary device is required for dismantling. All other procedures are outlined in **Appendix 8.2.**

The impeller/shaft connection is made by using a parallel seat with locating keys. No auxillary equipment is required to lower the impeller.

7.4.3.2 Dismantling of mechanical seal

Exact instructions relating to fitting positions of the mechanical seals, either motor side or pump side, are outlined in appendix **"Installation plan - mechanical seal".**

7.4.4 Dismantling the motor

Please ensure when dismantling the motor and the electric cable, that core identifications are clearly marked for future reference during re-assembly.

Special points for explosionproof motors

All work relating to the motor, such as new windings and mechanical repairs to the motor and bearing housings, require a subsequent approval by a KSB engineer or have to be carried out at KSB or KSB certified repair center.

7.5 Re-assembly

7.5.1 General instructions

Assembly of the pump must be carried out in accordance with sound mechanical practices. All parts which were dismantled must be cleaned and tested with regard to wear and structural integrity. Damaged or worn parts must be replaced by using **manufacturer's original spare parts.** Ensure that all sealing surfaces are clean and the O-rings or flat seals fit properly. O-rings made from continuous strips which were glued together must not be used.

Assembly of the pump takes place in reverse order of dismantling. The drawing combined with the individual parts index should be used as a guide. General instructions in this respect are outlined in and special points are stated in the installation instructions. All screws must be tightened during assembly as outlined in the table below **"bolt tightening torque"**. Assure bolts are lubricated prior to tightening.

Table: **Bolt tightening torque**

Thread	Torque (ft-lb) A 276 Type 316 Ti (A4-70) / A 276 S 31803 (1.4462)
M 5	3
M 6	5
M 8	13
M 10	26
M 12	44
M 16	110
M 20	215

7.5.2 Special points relating to components for re-assembly

7.5.2.1 Mechanical seal

In principle, we recommend to use new manufacturer's spare parts for mechanical seals. In this respect it should be noted:

To achieve optimum performance, it is important to ensure that all parts are very clean and that greatest care is taken during the fitting of the mechanical seal. Protectors of the moving surfaces must not be removed until immediately before fitting the part. The surface of the shaft must be very clean and undamaged.

In principle to assist with the fitting of the bellows style mechanical seal, the inside of the bellows may be wetted with soapy water (do not use oil).

Fitting of the bellows mechanical seal at the motor end.

To avoid damage to the rubber bellows by a keyway or shaft recess, the shaft should be covered with a thin sheet of foil or plastic (approx. 5...15 mils thick). Push the rotating unit over the cover and place into final position; then remove the cover.

7.5.2.2 Impeller assembly

See paragraph 7.4.3.1.

7.5.2.3 Checking seals

After assembly the mechanical seal part oil chamber should be tested for leaks.

Procedure:
(Appendix **"General pump outline" Fig. 8**).

The oil fill/drain hole is used for the test.
Securely screw the testing device into the hole.

Test media: air
Test pressure: max. 7.25 psi (0.5 bar)
Test duration: 2 min.

Make sure that the pressure does not decrease during the test. Afterwards, fill the oil chamber (see para. 7.2.4).

7.5.2.4 Motor

Ensure prior to re-assembly of **explosionproof motors** that all the special points outlined in paragraph 7.4.4 were observed. All motors must be tested electrically in accordance with paragraph 6.1, 6.2 and 7.2.

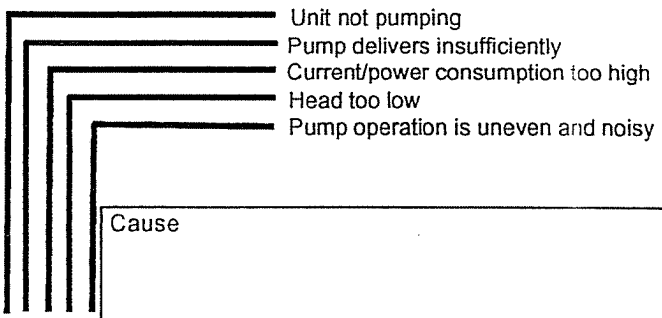
7.6 Spare parts

Always provide the following data when ordering spare parts:

Pump type: (e.g. KRTF100-250/114XG(238))
Works-No./Serial-No. (e.g. 5-M07-777222/3, or 888999)
Motor-No. (e.g. 015234, or blank)

This data can be taken from the nameplate.

8. Trouble-shooting

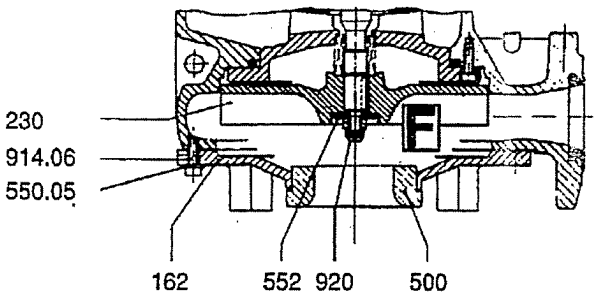


Cause	Remedy: **Prior to carrying out work to the pressure containing parts - release pressure from the pump!** **Disconnect power supply to the pump!**
Pump delivers against excessively high discharge pressure	Open discharge valve further until duty point is reached, or install larger impeller.
Valve in discharge pipe not fully open	Open valve completely
Pump not running within operating limits	Check operating data of the pump
Pump and/or pipeline are not completely vented or primed	Vent pump by lifting off the discharge elbow and lowering it back again.
Pump inlet blocked by deposits	Clean inlet, pump parts and non return valve.
Inlet pipe or impeller blocked	Remove deposits from within the pump and/or pipelines
Blockage in impeller ports	Check impeller - if necessary clean hydraulic
Wear of internal pump parts	Replace worn parts
Damaged discharge pipe (pipe and gaskets)	Replace defective pipe Renew gaskets
Unacceptable air or gas content within the pumped media	Contact your nearest authorized KSB agent
Oscillations caused by pipe system	Contact your nearest authorized KSB agent
Wrong direction of rotation	Switch two phases of the circuit
Insufficient operating voltage	Check electric supply Check cable connections
Motor not running due to no voltage supply	Check electrical installation Inform electrical company
Motor running on two phases only	Replace defective fuses Check electric cable connections
Motor winding or electric cable defective	Replace by new original KSB cabling or contact your nearest authorized KSB agent
Radial bearing in the motor defective	Contact your nearest authorized KSB agent
With star delta connection - Motor only running in star position	Check star delta connection
Water level dropping excessively during operation	Check supply and capacity of system - (sump depth) check level control
Temperature monitor for winding control has tripped due to excessively high winding temperature	The motor will switch on automatically after cooling down
Moisture protection relay has tripped due to moisture within the motor	Check the pump for moisture in the motor

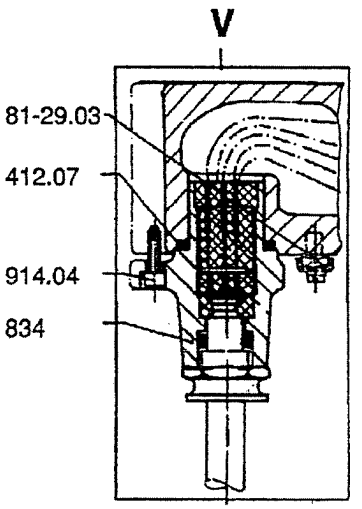
Attention: If working inside the pump is necessary while the pump is under warranty, contact your nearest authorized KSB agent prior to commencement of work. Non-observance may negate any warranty claims.

9. Appendix

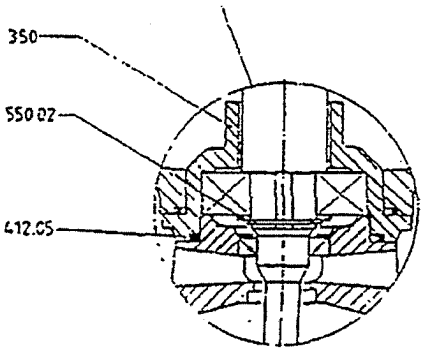
General arrangement drawing



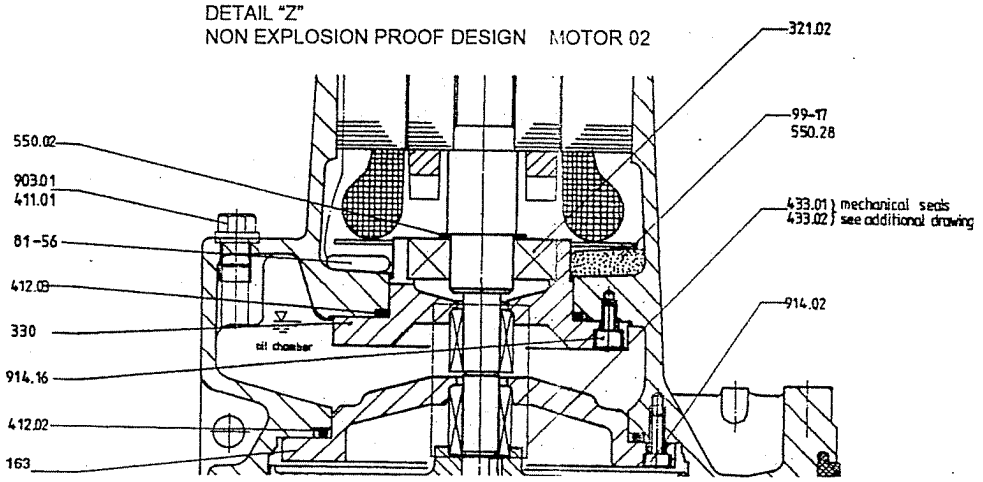
DETAIL "V" MOTOR 22
ONLY FOR FM APPROVED DESIGN



DETAIL "Z" MOTOR 22
ONLY FOR FM APPROVED DESIGN



DETAIL "Z"
NON EXPLOSION PROOF DESIGN MOTOR 02



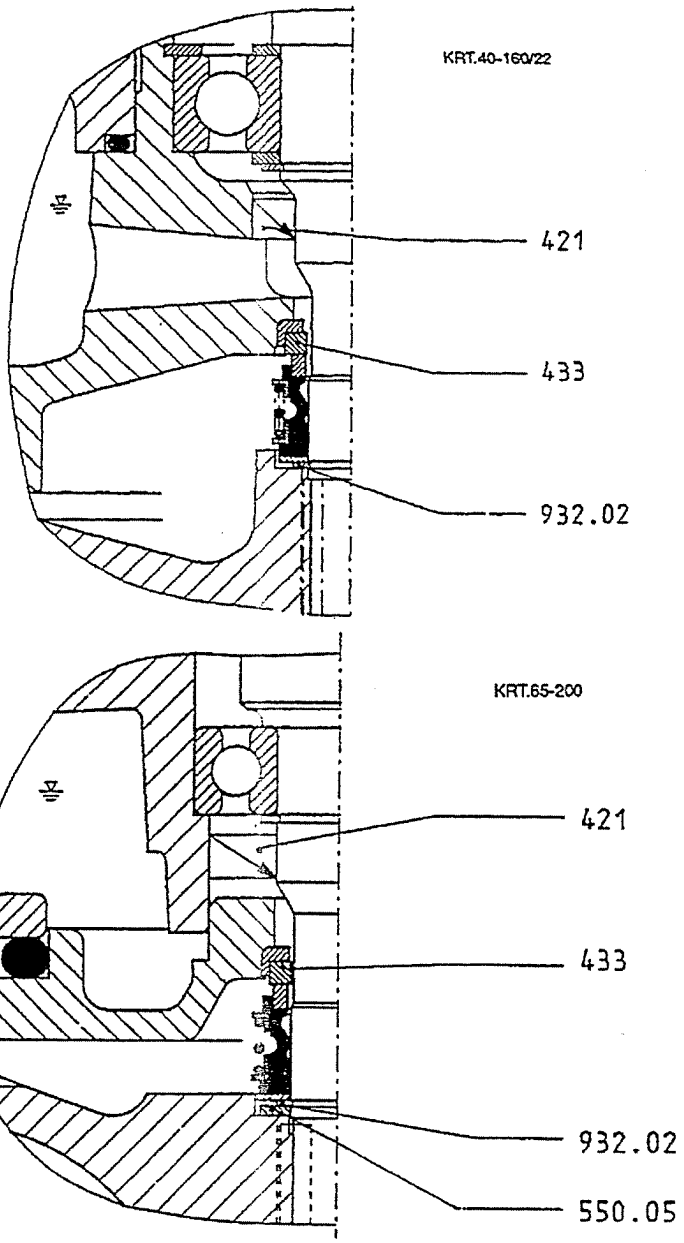
A.N. 30522

DRAWING
General arrangement pump

OW 380301-00 01.04.93 Dr.Geinitz 0

Installation plan - Mechanical Seal

KRT .40-160



Part no.	Part designation	G
421	Rotary shaft seal	
433	Mechanical seal	
550	Disc	
932	Circlip	

General outline - installation set

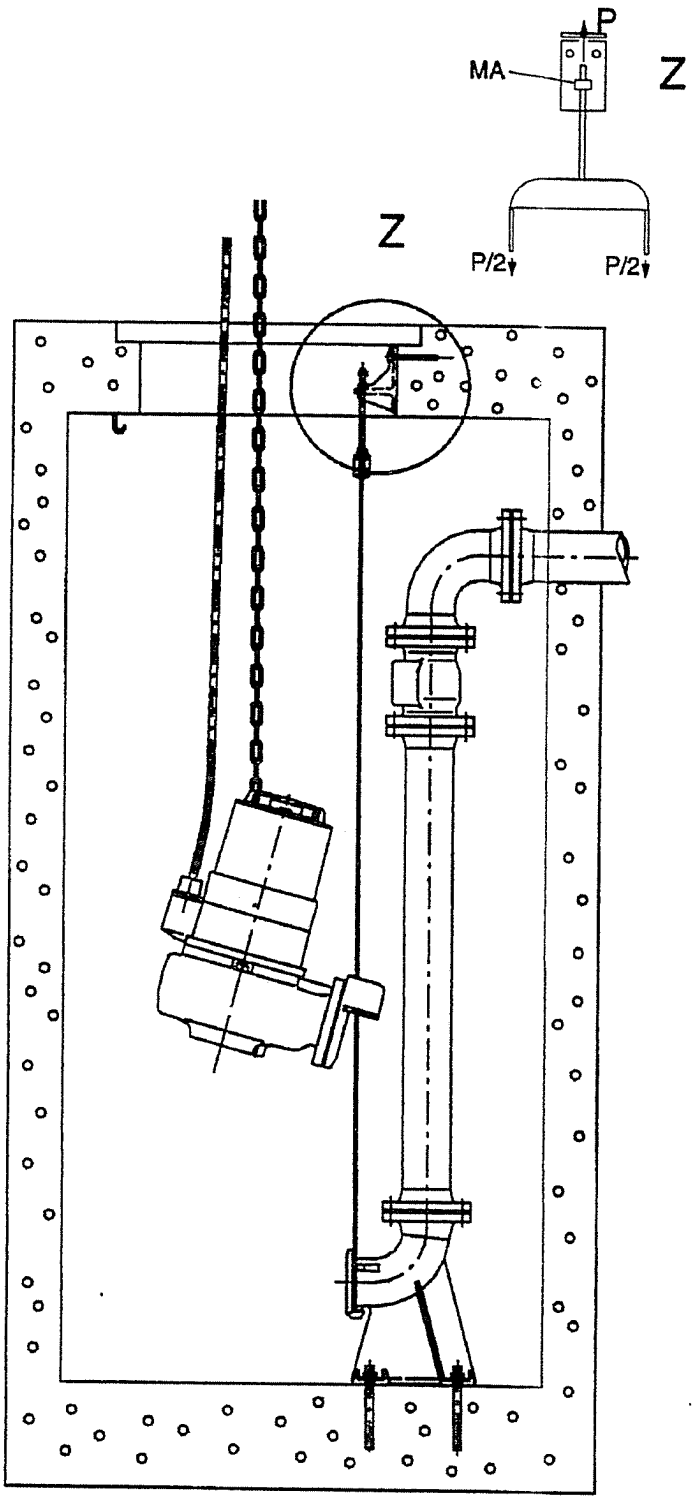
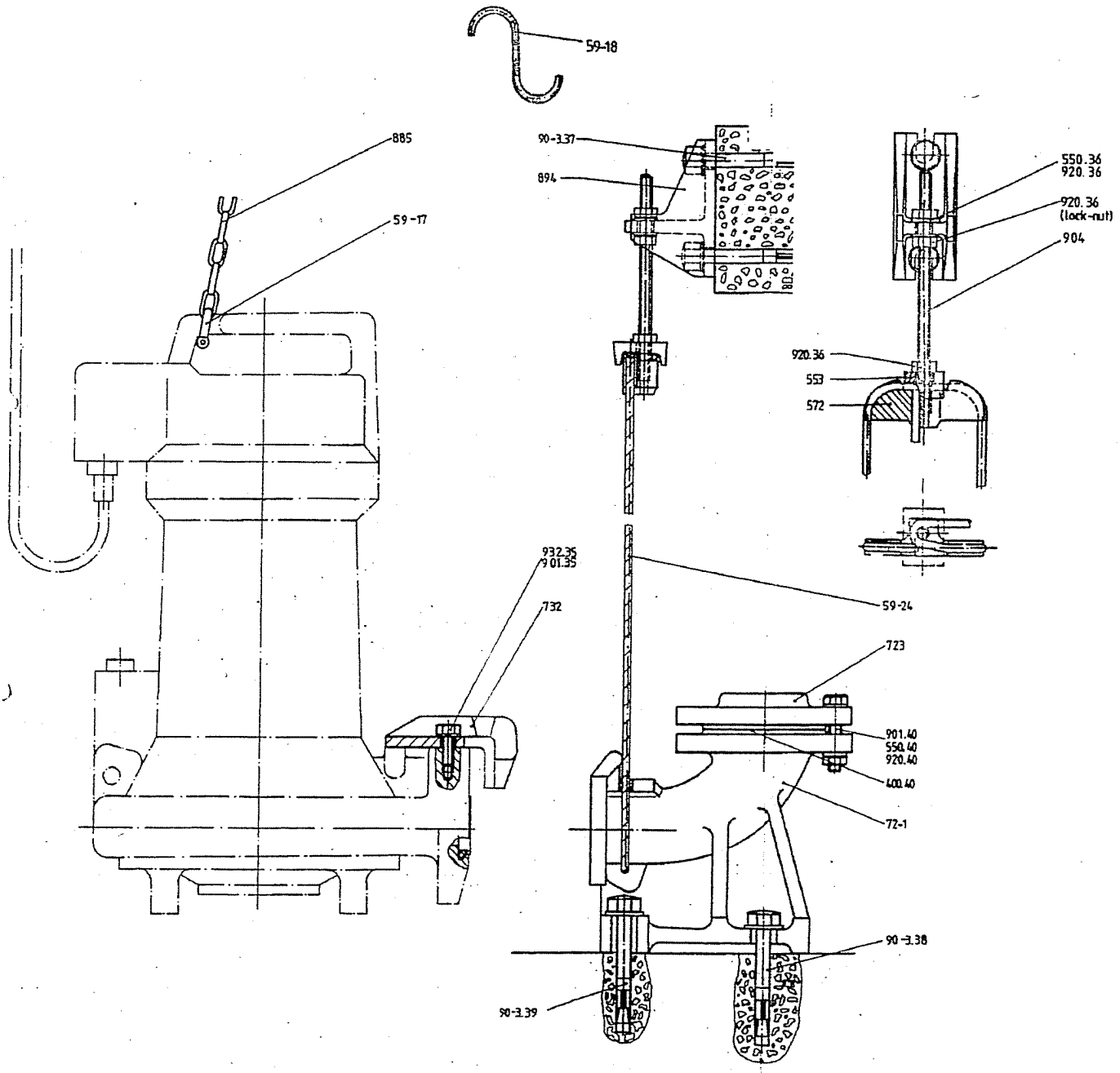


Fig.1

Wet-well Installation with guide cable



Wet-well installation with guide cable

Part No.	Part description
59-17	Shackle
59-18	Hook
59-24.01/02	Rope
72-1	Discharge Elbow
90-3	Dowel
410	Profile joint
550	Washer
572	Clamp
723	Flange
732	Holder
885	Chain
894	Bracket
901	Hex head bolt
904	Threaded pin
920	Nut
932	Circlip

SSH-C/SSH-F Numbering System
Sistema de Numeración del Grupo SSH

Example Product Code, *Ejemplo Código del Producto*

9 SH 1 G 1 E 0

9SHE5A0

Mechanical Seal and O-Ring
0 = Pre-engineered Standard
For optional Mechanical Seal modify catalog order no. with Seal Code listed below.,
Sello Mecánico y Anillo-O
0 = Estándar aprobado
Para sello mecánico opcional modificar el número de orden del catálago con la lista del código de sello que se encuentra abajo.

John Crane Type 21 Mechanical Seal, *Sello Mecánico John Crane Tipo 21*						
Seal Code, *Código del Sello*	**Rotary, *Rotativo***	**Stationary, *Estacionario***	**Elastomers, *Elastómeros***	**Metal Parts, *Partes Metálicas***	**Part No., *Pieza Número***	**Casing O-Ring, *Anillo en 'O' de la Carcasa***
0	Carbon	Ceramic	BUNA	316 SS, *316 Acero inoxidable*	10K13	BUNA
2		Ni-Resist	EPR		10K19	Viton
3		Ceramic	Viton		10K25	
4		Sil-Carb			10K27	
5		Ceramic	EPR		10K44	EPR

Impeller Option Code . . .No Adder Required
For optional impeller diameters modify catalog no. with impeller code listed below.
Select optional impeller diameter from pump performance curve.
Código de opción del impulsor . . .No Se Requiere Mezclador
Para diámetros opcionales de impulsor modificar el número de orden del catálogo con el código del impulsor enumerados abajo.
Seleccionar el diámetro del impulsor de la curva característica de la bomba.

Impeller Code, *Código del Impulsor*	Diameter, *Diámetro*							
	9SH 1 x 2-6	10SH 1 x 2-8	11SH 1 x 2-10	4SH 1½ x 2½-6	7SH 1½ x 2½-8	5SH 2 x 2½-6	8SH 2 x 2½-8	6SH 2½ x 3-6
A	6⅞	8 11/16	10 5/16	6½	8 1/16	6¼	8 1/16	7 1/16
B	6 11/16	7 15/16	9 11/16	6⅜	7 15/16	6 3/16	7⅞	7⅛
C	5 15/16	7⅛	9⅛	6 1/16	7	5 15/16	7 1/16	6 15/16
D	5⅛	7⅛	8¾	5⅞	6⅞	5⅞	7 1/16	6 15/16
E				5 13/16	6 11/16	5¾	6⅞	6¾
F				4 15/16	6⅝	4 15/16	6 13/16	6 11/16
G				4⅞		4 13/16		5⅞
H				4 13/16		4¾		
J				3⅞				

Driver, *Fuerza Motriz*
1 = 1 PH, ODP 6 = 575 V, TEFC
2 = 3 PH, ODP 7 = 3 PH,XP
3 = 575 V, ODP 8 = 575 V, XP
4 = 1 PH, TEFC 9 = 3 PH, TEFC (1.25 S.F.)
5 = 3 PH, TEFC 0 = 1 PH, XP

HP Rating, *HP Potencia*
C = ½ HP G = 2 HP L = 10 HP
D = ¾ HP H = 3 HP M = 15 HP
E = 1 HP J = 5 HP N = 20 HP
F = 1½ HP K = 7½ HP P = 25 HP

Driver: Hertz/Pole/RPM, *Motor: Hercios/Polo/RPM*
1 = 60 Hz, 2 pole, 3500 RPM
2 = 60 Hz, 4 pole, 1750 RPM
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole,1450 RPM

Material
SH = 316L Stainless steel, *Acero inoxidable 316L*

Pump Size, *Tamaño de la Bomba*
9 = 1 x 2 – 6 4 = 1½ x 2½ – 6 8 = 2 x 2½ – 8
10 = 1 x 2 – 8 7 = 1½ x 2½ – 8 6 = 2½ x 3-6
11 = 1 x 2 – 10 5 = 2 x 2½ – 6

For frame mounted version, substitute the letters "FRM" in these positions.

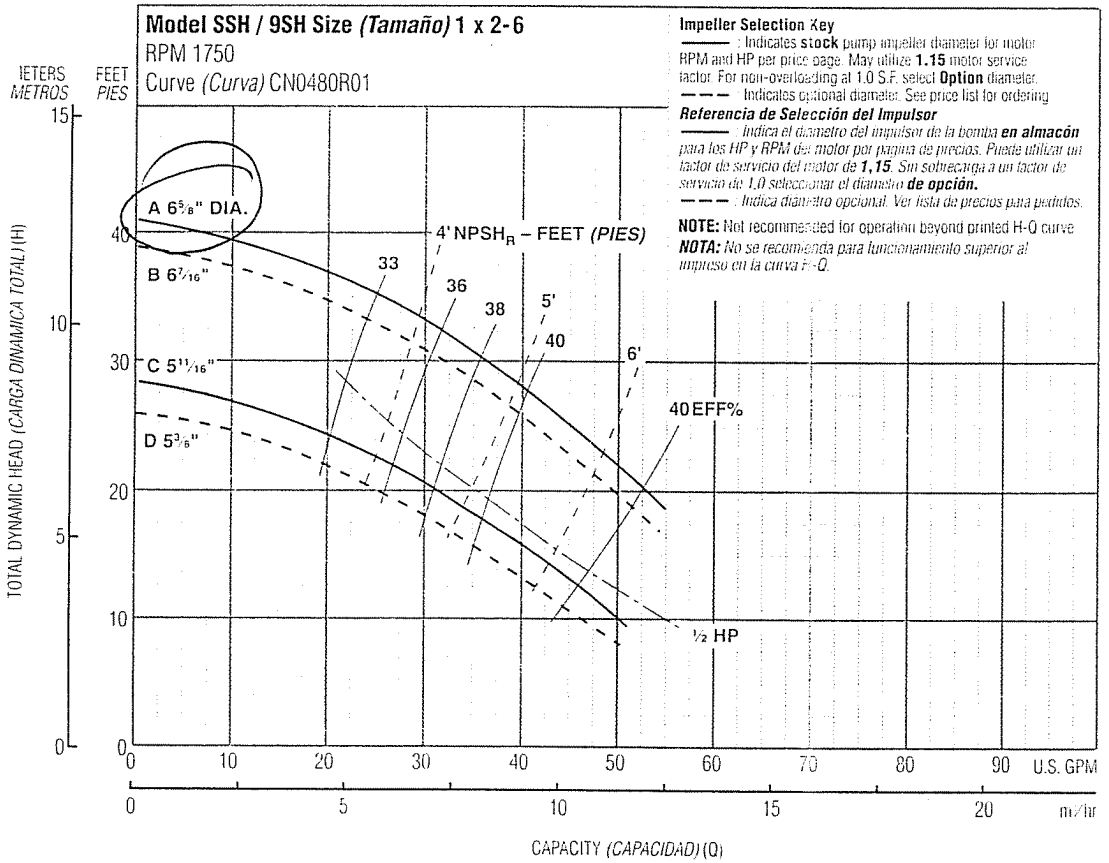
Para las bombas de caja montada sustituir las letras "FRM".

Note: Not recommended for operation beyond printed H-Q curve.
For critical application conditions consult factory.

Nota: *No se recomienda para funcionamiento más allá del indicado en la curva H-Q.*
Para condiciones críticas de aplicación consultar con la fábrica.

Note: Not all combinations of motor, impeller and seal options are available for every pump model. Please check with G&L on non-cataloged numbers.

Nota: *No todas las combinaciones de las opciones de motor, impulsor y sello se encuentran disponibles para cada modelo de bomba. por favor, comprobar con G&L en los números no catalogados.*



Impeller Selection Key

——— : Indicates **stock** pump impeller diameter for motor RPM and HP per price page. May utilize **1.15** motor service factor. For non-overloading at 1.0 S.F. select **Option** diameter.

– – – : Indicates optional diameter. See price list for ordering.

Referencia de Selección del Impulsor

——— : *Indica el diámetro del impulsor de la bomba **en almacón** para los HP y RPM del motor por página de precios. Puede utilizar un factor de servicio del motor de **1,15**. Sin sobrecarga a un factor de servicio de 1,0 seleccionar el diámetro **de opción.***

– – – : *Indica diámetro opcional. Ver lista de precios para pedidos.*

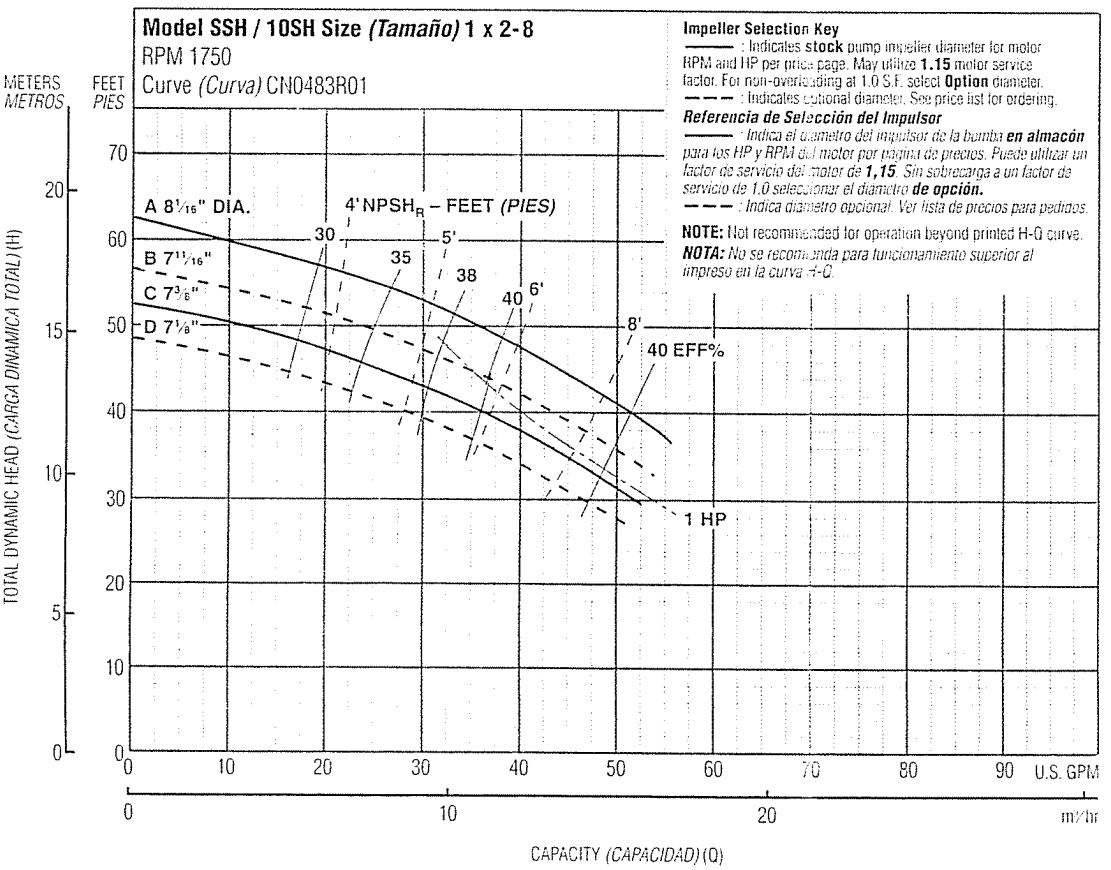
NOTE: Not recommended for operation beyond printed H-Q curve.

***NOTA:** No se recomienda para funcionamiento superior al impreso en la curva H-Q.*

Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	**Dia., *Diá.***	**Motor HP, *HP del motor***
A	6⅝"	½
B	6⁷⁄₁₆	½
C	5¹¹⁄₁₆	½
D	5⅜	½

NOTE: Pump will pass a sphere to ⅛" diameter.

***NOTA:** La bomba pasara una esfera a ⅛" diámetro.*



Impeller Selection Key

——— : Indicates **stock** pump impeller diameter for motor RPM and HP per price page. May utilize **1.15** motor service factor. For non-overloading at 1.0 S.F. select **Option** diameter.

– – – : Indicates optional diameter. See price list for ordering.

Referencia de Selección del Impulsor

——— : *Indica el diámetro del impulsor de la bomba **en almacón** para los HP y RPM del motor por página de precios. Puede utilizar un factor de servicio del motor de **1,15**. Sin sobrecarga a un factor de servicio de 1,0 seleccionar el diámetro **de opción.***

– – – : *Indica diámetro opcional. Ver lista de precios para pedidos.*

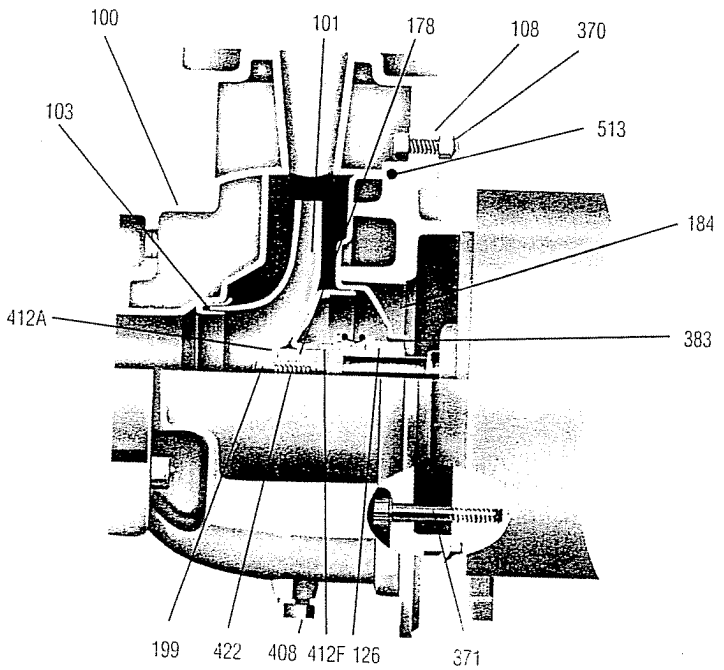
NOTE: Not recommended for operation beyond printed H-Q curve.

***NOTA:** No se recomienda para funcionamiento superior al impreso en la curva H-Q.*

Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	**Dia., *Diá.***	**Motor HP, *HP del motor***
A	8¹⁄₁₆"	1
B	7¹¹⁄₁₆	1
C	7⅜	¾
D	7⅛	¾

NOTE: Pump will pass a sphere to ⅛" diameter.

***NOTA:** La bomba pasara una esfera a ⅛" diámetro.*



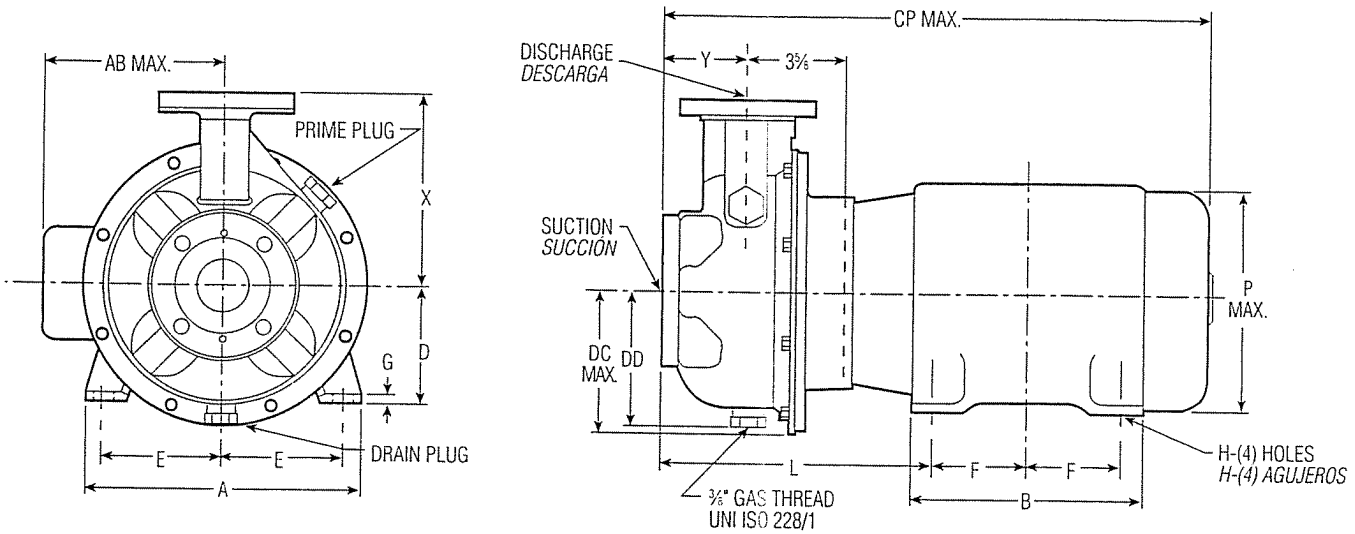
Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
J0	Casing, *Carcasa*	316L SS
101	Impeller, *Impulsor*	
103	Wear ring, *Anillo de desgaste*	
184	Seal housing, *Alojamiento del sello*	
178	Impeller key, *Llave del impulsor*	Steel, *Acero*
126	Shaft sleeve, *Camisa del eje*	316 SS
422	Impeller Stud, *Perno del impulsor*	Steel, *Acero*
199	Impeller washer, *Arandela del impulsor*	316 SS
370	Casing bolt with nut (casing to adapter), *Tornillo de la carcasa con tuerca (carcasa para adaptador)*	316L SS
108	Adapter, *Adaptador*	Cast iron ASTM A48 CL20, *Hierro fundido ASTM A48CL20*
371	Hex head cap screw (adapter to motor), *Tornillo de cabeza hexagonal (adaptador para motor)*	Steel SAE 1200 series, *Acero SAE series 1200*
412A	O-ring, Impeller, *Anillo en O, impulsor*	BUNA-N
412F	O-ring, shaft sleeve, *Anillo en O, camisa del eje*	
513	O-ring, *Anillo en O*	BUNA-N (standard, *estándar*)
408	Drain plug – ⅛" GAS, *Tapón de drenaje – ⅛" GAS*	AISI SS, 316L *AISI acero inoxidable, 316L*
383	Mechanical seal, *Sello mecánico*	See seal chart, *Ver tabla del sello*

Mechanical Seal, *Sello Mecánico*

John Crane Type 21 Mechanical Seal, *Sello Mecánico John Crane Tipo 21*						
Item, *Parte*	Part No., *Pieza Número*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Intended Duty, *Servicio Propuesto*
383 Options, *383 Opciones*	10K13	Carbon	Ceramic	BUNA	316 SS, *316 Acero inoxidable*	Standard, *Estándar*
	10K19		Ni-Resist	EPR		Hi–Temp., *Alta-temp.*
	10K25		Ceramic	Viton		Chemical, *Químico*
	10K27		Tung. Carb.			Mild Abrasive, *Abrasivo suave*

SSH Close Coupled – Dimensions and Weights
SSH Acople Cerrado – Dimensiones y Pesos

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)
(Todas las dimensiones en pulgadas y pesos en libras. No usar para propósitos de construcción.)



Dimensions "L" Determined by Pump and Motor, *Dimensiones "L" Determinadas por la Bomba y el Motor*

Pump, *Bomba*	150 lb. Flange, *Brida de 150 lib.* Suct.*, *Succ.**	Disch.*, *Desc.**	CP Max., *CP Máx.*	DC Max., *DC Máx.*	DD	X	Y	Motor Frame Size, *Tamaño del Armazón del Motor* 143/145	182/184	213/215	254/256	Wt. (lbs.), *Pesos (libras)*
9SH 1 x 2 – 6	2	1	25⅞	5	4¼	6⅛	3⅛	9⅝	10¼	11¼	–	24
10SH 1 x 2 – 8				5⅛	5⅛	7⅛						32
11SH 1 x 2 – 10			27⅛	6⅛	6⅛	8⅛	4	10½	11⅛	12⅛	12⅛	54
4SH 1½ x 2½ – 6	2½	1½	25½	5	4¼	6⅛	3¼	9¾	10⅜	11⅜	—	25
7SH 1½ x 2½ – 8			27⅛	5⅛	5⅛	7⅛	4	10½	11⅛	12⅛	12⅛	34
5SH 2 x 2½ – 6		2		5	4¼	6⅛						25
8SH 2 x 2½ – 8				6	4¼	7 15/16						36
6SH 2½ x 3 – 6	3	2½										27

* For use with ANSI class 150 mating flanges.
* *Para usar con bridas que casan ANSI clase 150.*

NOTE:
1. Pumps shipped in vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜– 16 bolts to 12 ft./lbs., ⅝– 14 bolts to 20 ft./lbs.
2. ALL dimensions in inches.
3. Motor dimensions may vary with motor manufacturer.
4. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán en descarga vertical como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, ⅝ – 14 tornillos a 20 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *Las dimensiones puede que varíen con los fabricantes.*
4. *No para propósitos de construcción.*

Dimensions Determined by JM Motor Frame,
Dimensiones Determinadas por el Armazón del Motor JM

JM Frame, *JM Armazón*	A	AB	B	D	E	F	G	H Dia., *H Diám.*	P Max., *P Máx.*	Motor Wt. (lbs.) *Peso Motor (lib.)*
143JM	6½	5¼	6	3½	2⅜	2	⅛	11/32	6⅝	41
145JM						2½				57
182JM	8½	5⅞	6½	4½	3¾	2¼	3/16	13/32	7⅞	77
184JM						2¾				97
213JM	9½	7⅜	8	5¼	4¼		7/32		9⅝	122
215JM						3½				155
254TCZ	11¼	9	9½	6¼	5	4½	¼	17/32	11½	265
256TCZ			11¾			5				320

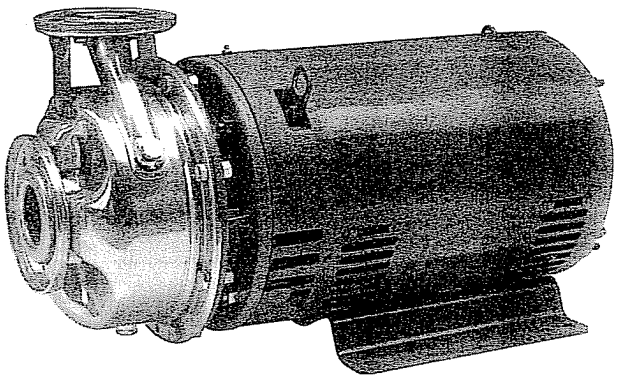
Motor Frame Selections,
Selecciones del Armazón del Motor

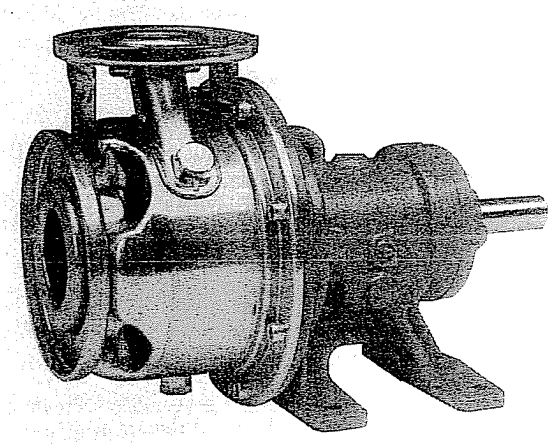
Motor Frame, *Armazón del Motor*	Motor Horsepower, *Potencia del Motor*							
	3500 RPM, *3500 RPM*				1750 RPM, *1750 RPM*			
	1Ø, *Monofásicos*		3Ø, *Trifásicos*		1Ø, *Monofásicos*		3Ø, *Trifásicos*	
	ODP	TEFC*	ODP	TEFC	ODP	TEFC*	ODP	TEFC
143JM	–	–	–	–	–	–	1	1
145JM	2	2	2-3	2	1-1½	1-1½	1½-2	1½-2
182JM	3	3	5	3	2	2-3	3	3
184JM	5	5	7½	5	3	–	5	5
213JM	7½	–	10	7½	5	–	7½	7½
215JM	10	–	15	10-15	–	–	–	–
254TCZ	–	–	20	–	–	–	–	–
256TCZ	–	–	25	20-25	–	–	–	–

G&L Pumps

Installation, Operation and Maintenance Instructions

Models SSH-C and SSH-F





Owner's Information

Please fill in data from your pump nameplate.
Warranty information is on page 28.

Pump Model: _____

Serial Number: _____

Dealer: _____

Dealer's Phone Number: _____

Date of Purchase: _____

Installation Date: _____

Table of Contents

Goulds Pumps

ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that WILL cause serious personal injury, death or major property damage.

⚠WARNING Warns of hazards that CAN cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that CAN cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠WARNING

Hazardous fluids can cause fire, burns or death.

UNIT NOT DESIGNED FOR USE WITH HAZARDOUS LIQUIDS OR FLAMMABLE GASES. THESE FLUIDS MAY BE PRESENT IN CONTAINMENT AREAS.

NOTICE: INSPECT UNIT FOR DAMAGE AND REPORT ALL DAMAGE TO THE CARRIER OR DEALER IMMEDIATELY.

1. Important Instructions

1. Inspect unit for damage. Report damage to carrier immediately.
2. Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., per National and Local electrical codes. Install an all-leg disconnect switch near pump.

⚠WARNING

Hazardous voltage can shock, burn or cause death.

ALWAYS DISCONNECT ELECTRICAL POWER WHEN HANDLING PUMP OR CONTROLS.

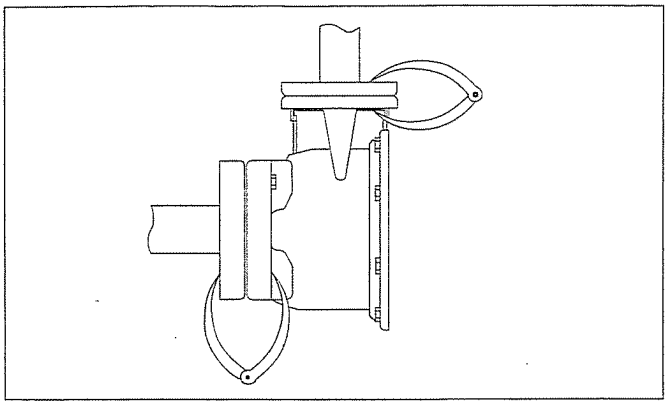
3. Motors must be wired for proper voltage (check nameplate). Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.
4. Single-Phase: Thermal protection for single-phase units is sometimes built-in (Check nameplate). If no built-in protection is provided, use a contactor with proper overload. Fusing is permissible if properly fused.
5. Three-Phase: Provide three-leg protection with proper size magnetic starter and thermal overloads.
6. Maximum Liquid Temperatures:
   212°F (100°C) with standard seal.
   250°F (120°C) with optional high-temperature seal.
7. Maximum allowable operating pressure: 230 PSI (15 bars).
8. Maximum number of starts per hour: 20, evenly distributed.
9. Regular Inspection and Maintenance will increase service life. Base schedule on operating time.

2. Installation

1. Close-coupled units may be installed inclined or vertical.

⚠ CAUTION DO NOT INSTALL WITH MOTOR BELOW PUMP. CONDENSATION WILL BUILD UP IN MOTOR.

2. Locate pump as near liquid source as possible (below level of liquid for automatic operation).
3. Protect from freezing or floods.
4. Allow adequate space for servicing and ventilation.
5. For close-coupled pumps, the foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration. Tighten motor hold-down bolts before connecting piping to pump.
6. For frame-mounted pumps, permanent and solid foundation is required for smooth operation. Bedplate must be grouted to a foundation with solid footing.
7. Place unit in position on wedges located at four points (Two below approximate center of driver and two below approximate center of pump). Adjust wedges to level unit, bringing coupling halves into reasonable alignment. Level or plumb suction and discharge flanges.
8. Make sure bedplate is not distorted and final coupling alignment can be made within the limits of movement of motor and by shimming if necessary.
9. Tighten foundation bolts finger tight and build dam around foundation. Pour grout under bedplate making sure the areas under pump and motor feet are filled solid. Allow grout to harden 48 hours before further tightening foundation bolts.
10. All piping must be supported independently of the pump, and must "line-up" naturally. **Never draw piping into place by forcing the pump suction and discharge connections!**
11. Angular alignment of the flanges can best be accomplished using calipers at bolt locations (See illustration).



12. On frame-mounted units, tighten foundation, pump and driver hold-down bolts before connecting piping to pump.
13. Avoid unnecessary fittings. Select sizes to keep friction losses low.
14. After completing piping, rotate unit by hand to check for binding. **Note:** A screwdriver slot or flats are provided in end of motor shaft.

3. Alignment

1. No field alignment is necessary on close-coupled pumps.
2. Even though the pump-motor unit may have a factory alignment, in transit this alignment could be disturbed and must be checked prior to running.
3. Check the tightness of all hold-down bolts before checking the alignment.
4. If re-alignment is necessary, always move the motor. Shim as required.
5. Final alignment is achieved when parallel and angular requirements are achieved with both pump and motor hold down bolts tight.

⚠ CAUTION ALWAYS RECHECK BOTH ALIGNMENTS AFTER MAKING ADJUSTMENTS.

6. Parallel misalignment exists when the shafts are not concentric. Place dial indicator on one hub and rotate this hub 360° while taking readings on the outside diameter of the other hub. Parallel alignment occurs when Total Indicator Reading is .005" or less.
7. Angular misalignment exists when the shafts are not parallel. Place dial indicator on one hub and rotate this hub 360° while taking readings on the face of the other hub. Angular alignment is achieved when Total Indicator Reading is .005" or less.

4. Suction Piping

1. Low static lift and short, direct suction piping is desired. For suction lift over 15 feet, consult pump performance curve for *Net Positive Suction Head Required.*
2. Suction pipe size must be at least equal to suction connection of pump.
3. If larger pipe is used, an eccentric pipe reducer (with straight side up) must be used at the pump.
4. Installation with pump below source of supply:
   4.1. Install isolation valve in piping for inspection and maintenance.
   4.2. Do not use suction isolation valve to throttle pump!
5. Installation with pump above source of supply:
   5.1. To avoid air pockets, no part of piping should be higher than pump suction connection. Slope piping upwards from liquid source.
   5.2. All joints must be airtight.
   5.3. Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.
   5.4. Suction strainer open area must be at least triple the pipe area.
6. Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump.

5. Discharge Piping

1. Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or inspection of pump or check valve.
2. If reducer is required, place between check valve and pump.

6. Rotation

⚠WARNING

DO NOT PLACE HANDS IN PUMP WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

1. Pumps are right-hand rotation (Clockwise when viewed from the driver end). Switch power on and off. Observe shaft rotation. On frame-mounted units, check rotation before coupling pump to motor.
2. Single-Phase: Refer to wiring diagram on motor if rotation must be changed.
3. Three-Phase: Interchange any two power supply leads to change rotation.

7. Operation

1. Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.

⚠ CAUTION PUMPED LIQUID PROVIDES LUBRICATION. IF PUMP IS RUN DRY, ROTATING PARTS WILL SEIZE AND MECHANICAL SEAL WILL BE DAMAGED.

2. Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping. Check coupling alignment.
3. Do not operate at or near zero flow. Energy imparted to the liquid is converted into heat. Liquid may flash to vapor. Rotating parts require liquid to prevent scoring or seizing.

8. Maintenance

⚠WARNING
Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY MAINTENANCE CAN CAUSE SHOCK, BURNS OR DEATH.

1. Bearings are located in and are part of the motor. For lubrication procedure, refer to manufacturer's instructions.
2. On frame-mounted units, regrease at 2,000 hours use or after 3 months. Use #2 Sodium or Lithium grease and fill until grease comes out of the relief fitting.

9. Disassembly

1. Always turn power off.
2. Drain system. Flush if necessary.
3. Remove motor hold-down bolts on close-coupled or disconnect coupling and remove spacer.
4. Remove casing bolts and pump hold-down bolts.
5. Remove motor and rotating element from casing.
6. Unscrew impeller bolt with a socket wrench. **Do not insert screwdriver between impeller vanes to prevent rotation.** It may be necessary to use a strap wrench around the impeller if impacting the socket wrench will not loosen the impeller bolt.
7. Remove impeller o-ring.
8. Insert two pry bars (180° apart) between impeller and seal housing. Pry off impeller.
9. Remove shaft sleeve, seal spring, cupwasher, seal rotary and impeller key.
10. Remove seal housing.
11. Place seal housing on flat surface. Press out stationary seal parts.
12. Remove deflector from shaft on frame-mounted units.
13. Remove bolts holding bearing cover to frame and remove bearing cover (frame-mount).
14. Remove lip seals from bearing frame and bearing cover (frame-mount).
15. Remove shaft and bearings from frame (frame-mount).
16. Remove bearing retaining ring (frame-mount).
17. Use bearing puller or arbor press to remove ball bearings (frame-mount).
18. Remove wear ring if excessively worn. Use pry bar and/or vicegrips.

10. Reassembly

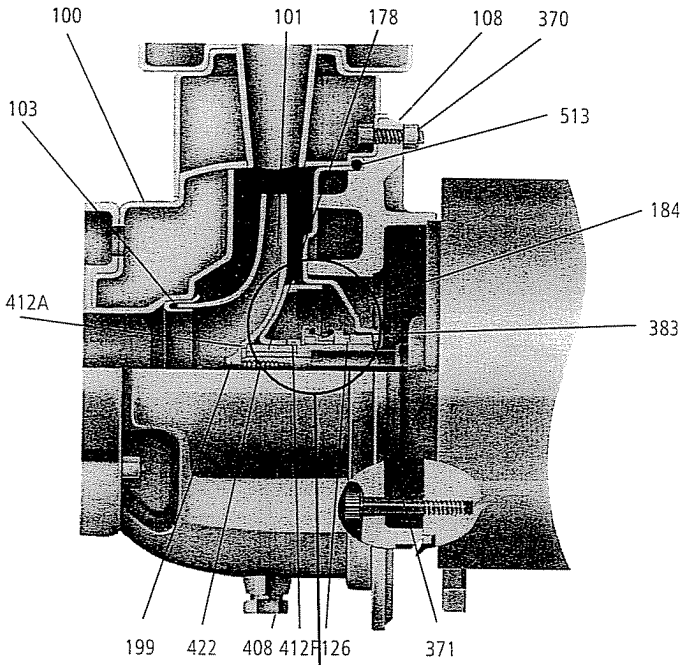
1. All parts should be cleaned before assembly.
2. Refer to parts list to identify required replacement items.
3. Reassembly is the reverse of the disassembly procedure.
4. Replace lip seals if worn or damaged (frame-mount only).
5. Replace ball bearings if loose, rough or noisy when rotated (frame-mount only).
6. Check shaft for maximum runout of .005" TIR. Bearing seats and lip seal areas must be smooth and free of scratches or grooves. Replace if necessary (frame-mount only).
7. All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly, whenever seal has been removed, is good standard practice.
8. If wear ring is being replaced, do not use lubricants on the metal-to-metal fit when pressing in the replacement.
9. If the impeller is removed, as for example to effect a mechanical seal change, this procedure must be followed: Old impeller bolt and impeller o-ring cannot be reused.
10. Install the mechanical seal stationary seat in the seal housing, using soapy water as a lubricant to ease insertion.
11. **S-Group** – Install the mechanical seal spring retainer, spring and rotary assembly on the shaft sleeve using soapy water to lubricate. Slide the shaft sleeve over the pump shaft, be sure that a new shaft sleeve o-ring is used.

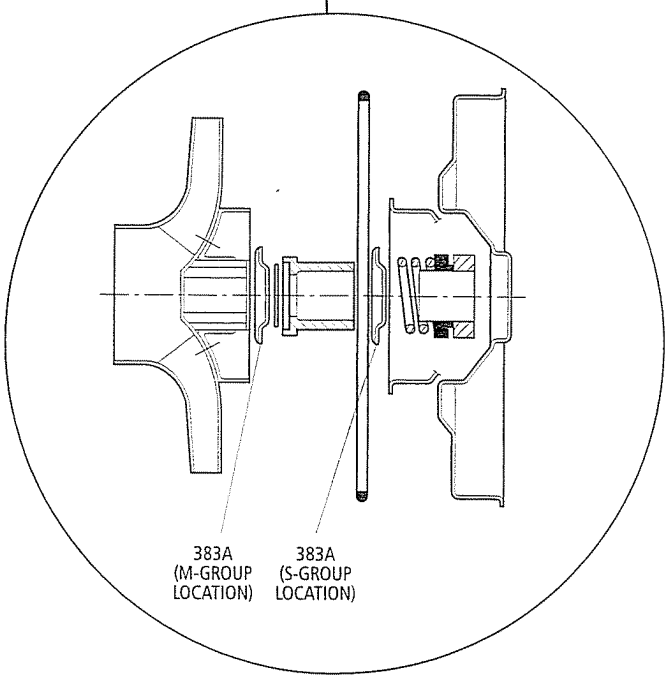
NOTE: THE SHAFT SLEEVE O-RING AND IMPELLER WASHER O-RING ARE ALMOST IDENTICAL IN DIAMETER. BE SURE TO USE THE SQUARE CROSS-SECTION O-RING IN THE IMPELLER WASHER. THE ROUND CROSS-SECTION O-RING IS USED IN THE SHAFT SLEEVE.

11. **M-Group** – Install the mechanical seal spring and rotary on the shaft sleeve using soapy water to lubricate. Slide the shaft sleeve over the pump shaft. Be sure that a new shaft sleeve o-ring is used. Place the mechanical seal spring retainer over the impeller hub.
12. Place the impeller key into the shaft keyway and slide the impeller in place. Install the impeller stud and impeller washer. Be sure that a new impeller o-ring is used. Tighten S-Group (⅜" thread) to 17 lb.ft. and M-Group (½" thread) to 38 lb.ft.

11. Troubleshooting

1. Motor does not start, and no noise or vibration occurs:
   1.1. Power supply not connected.
   1.2. Fuses or protection device tripped or defective.
   1.3. Loose or broken electrical connections.
2. Motor will not start, but generates noise and vibration:
   2.1. Motor not wired as directed on diagram.
   2.2. Shaft locked due to mechanical obstructions in motor or pump.
   2.3. Low voltage or phase loss on three phase supply.
3. Pump does not deliver rated capacity:
   3.1. Pump not filled and primed.
   3.2. Pump has lost prime due to leaks in suction line.
   3.3. Direction of rotation incorrect. See Rotation.
   3.4. Head required is higher than that originally specified. (Valve may be partially closed.)
   3.5. Foot valve clogged.
   3.6. Suction lift too high.
   3.7. Suction pipe diameter too small.
4. Protection trips as unit starts:
   4.1. Phase loss on three-phase supply.
   4.2. Protection device may be defective.
   4.3. Loose or broken electrical connections.
   4.4. Check motor resistance and insulation to ground.
5. Protection device trips too often:
   5.1. Protection may be set to a value lower than motor full load.
   5.2. Phase loss due to faulty contacts or supply cable.
   5.3. Liquid is viscous or its specific gravity is too high.
   5.4. Rubbing occurs between rotating and stationary parts.
6. Shaft spins with difficulty:
   6.1. Check for obstructions in the motor or the pump.
   6.2. Rubbing occurs between rotating and stationary parts.
   6.3. Check bearings for proper conditions.
7. Pump vibrates, runs noisily, and flow rate is uneven:
   7.1. Pump runs beyond rated capacity.
   7.2. Pump or piping not properly secured.
   7.3. Suction lift too high.
   7.4. Suction pipe diameter too small.
   7.5. Cavitation caused by insufficient liquid supply or excessive suction losses.
   7.6. Impeller blockage.
8. When stopped, unit turns slowly in the reverse direction:
   8.1. Leaks on air locks in suction pipe.
   8.2. Partial blockage in check valve.
9. In pressure boosting applications, the unit starts and stops too often:
   9.1. Pressure switch settings are incorrect.
   9.2. Tank size may be incorrect.
10. In pressure boosting applications, the unit does not stop:
    10.1. Pressure switch maximum setting is higher than was specified.
    10.2. Direction of rotation incorrect. See **Rotation**.



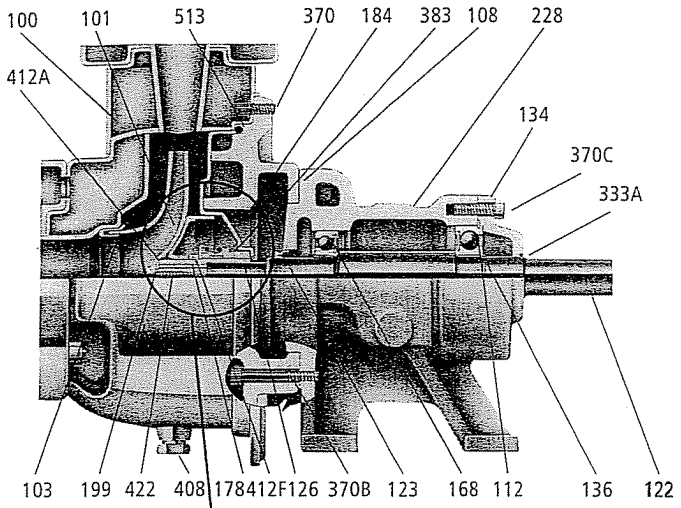


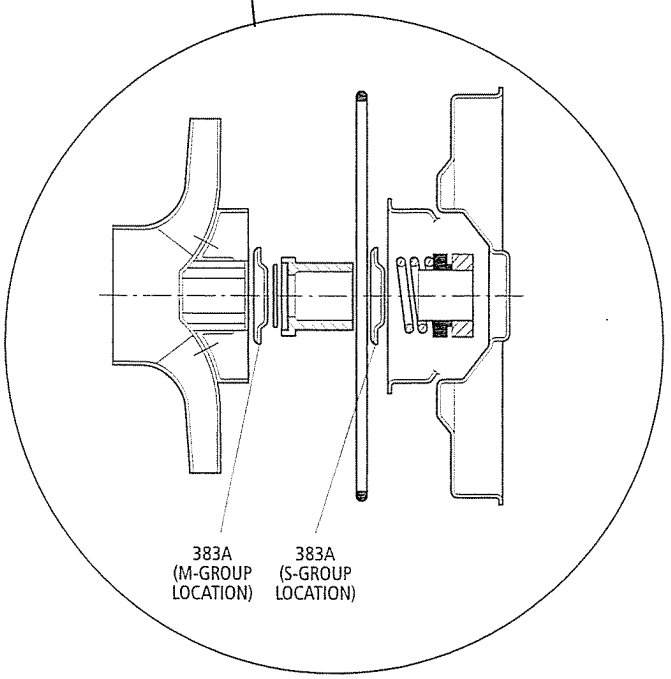
MATERIALS OF CONSTRUCTION

Item	Description	Material
100 101 103 184 370	Casing Impeller Wear Ring Seal Housing Socket Head Cap Screw (Casing to Adapter)	AISI TYPE 316L Stainless Steel
408	Drain Plug — ⅜ NPT	AISI TYPE 316 SS
126	Shaft Sleeve	316 SS
178	Impeller Key	Steel
422	Impeller Stud	Steel
199	Impeller Washer	316 SS
108	Adapter	Cast Iron ASTM A48CL20
371	Hex Head Cap Screw (Adapter to Motor)	Steel
412A	O-ring, impeller	BUNA-N
412F	O-ring, shaft sleeve	BUNA-N
513	O-Ring	BUNA-N
383	Mechanical Seal Part No. 10K13	Carbon/Ceramic Buna Elastomers 316 SS Metal Parts
383A	Spring Retainer	AISI Type 316 SS

OPTIONAL MECHANICAL SEALS

John Crane Type 21 Mechanical Seals						
Item	Part No.	Rotary	Stationary	Elastomers	Metal Parts	Intended Duty
383 Options	10K19	Carbon	Ni-Resist	EPR	316 SS	Hi-Temperature
	10K25		Ni-Resist	Viton		Chemical
	10K27		Tungsten Carbide	EPR		Hi-Temperature Mild Abrasive





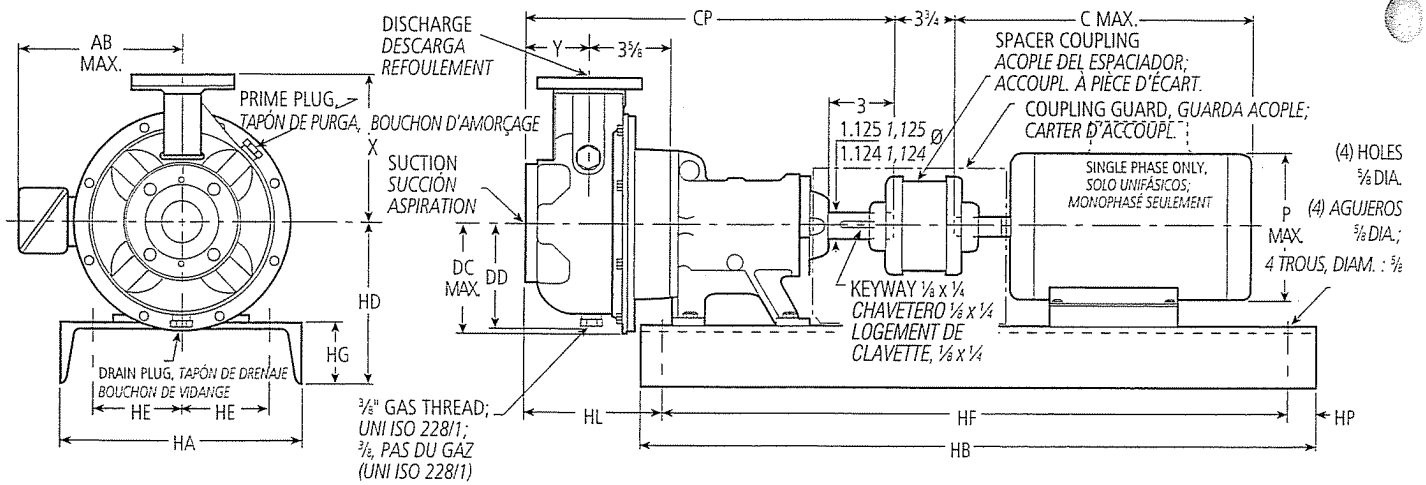
MATERIALS OF CONSTRUCTION

Item		Description	Material
Pump End Components	100 101 103 184 370	Casing Impeller Wear Ring Seal Housing Socket Head Cap Screw	AISI TYPE 316L Stainless Steel
	408	Drain plug – ⅜ NPT	AISI TYPE 316 SS
	126	Shaft Sleeve	316 SS
	178	Impeller Key	Steel
	422	Impeller Stud	Steel
	199	Impeller Washer	316 SS
	412A	O-ring, impeller	BUNA-N
	412F	O-ring, shaft sleeve	BUNA-N
	513	O-Ring	BUNA-N
	383	Mechanical Seal Standard Part No. 10K13	Carbon/Ceramic BUNA-N Elastomers 316 SS Metal Parts
	383A	Spring Retainer	AISI Type 316SS
Power End Components	108 228 134	Adapter Bearing Frame Bearing Cover	Cast Iron ASTM A48 CL20
	122 168 112 136 370B 370C	Pump Shaft Ball Bearing (Inboard) Ball Bearing (Outboard) Retaining Ring Hex Head Cap Screw (Adapter to Bearing Frame) Hex Head Cap Screw (Bearing Frame to Cover)	Steel
	333A	Lip Seal	BUNA-N
	193	Grease Fitting	Steel
	123	V-Ring Deflector	BUNA-N

OPTIONAL MECHANICAL SEALS

John Crane Type 21 Mechanical Seals						
Item	Part No.	Rotary	Stationary	Elastomers	Metal Parts	Intended Duty
383 Options	10K19	Carbon	Ni-Resist	EPR	316 SS	Hi-Temperature
	10K25		Ni-Resist	Viton		Chemical
	10K27		Tungsten Carbide	EPR		Hi-Temperature Mild Abrasive

Channel Steel Bedplate, Clockwise Rotation Viewed from Drive End;
Fundación de Acero, Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor;
Plaque de base profilée en U et rotation en sens horaire (vue de l'extrémité du moteur)



Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba;
Dimensions et poids – pompe

Pump, *Bomba, Pompe*		Suction ① *Succión Aspir.*	Discharge *Descarga* ① *Refoul.*	CP	DC Max., *DC Máx. DC max.*	DD	X	Y	Wt. (lbs.), *Peso (lib.) Poids*	Dimension "HL" Determined by Pump and Bedplate, *Dimensión "HL" determinada la bomba y el motor, Dimensions HL – pompe et plaque de base* Motor Frame Size, *Tamaño del bastidor del motor, Carcasse de moteur* 143/145	183/184	213/215	254/256	284/286
9SH	1 X 2–6	2	1	16⅜	5	4¾	6⅜	3⅛	56	9⅛		7⅝		3⅞
10SH	1 X 2–8				5⅝	5⅜	7⅛		64					
11SH	1 X 2–10			17¼	6⅞	6⅝	8⅞		86	10		8½		4¾
4SH	1½ X 2½–6	2½	1½	16½	5	4¾	6⅜	3¼	57	9¼		7¾		4
7SH	1½ X 2½–8			17¼	5⅝	5⅜	7⅛	4	66	10		8½		4¾
5SH	2 X 2½–6		2		5	4¾			57					
8SH	2 X 2½–8				6	5¾	7¹⁵⁄₁₆		68					
6SH	2½ X 3–6	3	2½						59					

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. All pumps shipped in vertical discharge position. May be rotated in 90° increments. Tighten ⅜ – 16 casing bolts to 12 ft./lbs. torque.
2. Dimensions in inches.
3. Motor dimensions may vary with motor manufacturer.
4. Not to be used for construction purposes.

NOTAS:
1. Todas las bombas transportadas en posición de descarga vertical. Pueden rotarse en aumentos de 90°. Apretar ⅜ – 16 tornillos de carcasa a 12 pies/libras potencia.
2. Las dimensiones en pulgadas.
3. Las dimensiones puede que varíen con los fabricantes..
4. No para propósitos de construcción.

NOTA :
1. L'orifice de refoulement est orienté vers le haut. On peut le tourner de 90° en 90°. Serrer les vis ⅜ - 16 du corps de pompe à 12 lbf·pi.
2. Les dimensions sont en pouces, et le poids,en livres.
3. Les dimensions et le poids du moteur peuvent varier selon le fabricant.
4. Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor
Dimensions et poids – moteur et plaque de base

Motor Frame, *Armazón del Motor, Carcasse de moteur*	HP @ 3500 RPM, *HP a 3500 RPM, hp à 3 500 tr/min*				HP @ 1750 RPM, *HP a 1750 RPM, hp à 1 750 tr/min*				AB Max., *AB Máx., AB max.*	C Max., *C Máx., C max.*	P Max., *P Máx., P max.*	Wt. Max., *Peso Máx., Poids max.*	Bedplate Data, *Datos de la Fundación, Plaque de base* HA	HB	HD*	HE	HF	HG	HP*	Wt. (lbs.), *Peso (libras), Poids*	Motor Shim, *Plancha de relleno del motor Cale de moteur*	Bearing Frame Shim, *Plancha de relleno del bastidor del cojinete, Cale de palier*
	Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicos, 3 Ø*		Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicos, 3 Ø*															
	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC														
143T					1	1	1	1	5¼	13⅜	6⅝	45	10	28	8	3¾	24	2¾	¾	48	1¾	–
145T	2	2	2 or ou 3	2	1½	1½	1½ or ou 2	1½ or ou 2		14¼		53										
182T	3	3	5	3	2	2	3	3	5⅞	16⅝	7⅞	74										
184T	5	5	7½	5	3 or ou 5	3	5	3		18⅛		95										
213T			10	7½					7⅜	18	9⅝	116	12	31	8¼	4¼	29	3	1	65	–	–
215T			15	10						19⅛		136										
254T			20	15					10⅛	21⅝	13	266	13	42	9¼	5¼	38½	4	1¾	110	–	1
256T			25	20						23⅝		264										
284TS			30	25					12⅝	24⅞	15	392	15	44	10½	5¾	40½	3½		124	–	1¾
286TS			40	30						26⅝		432										

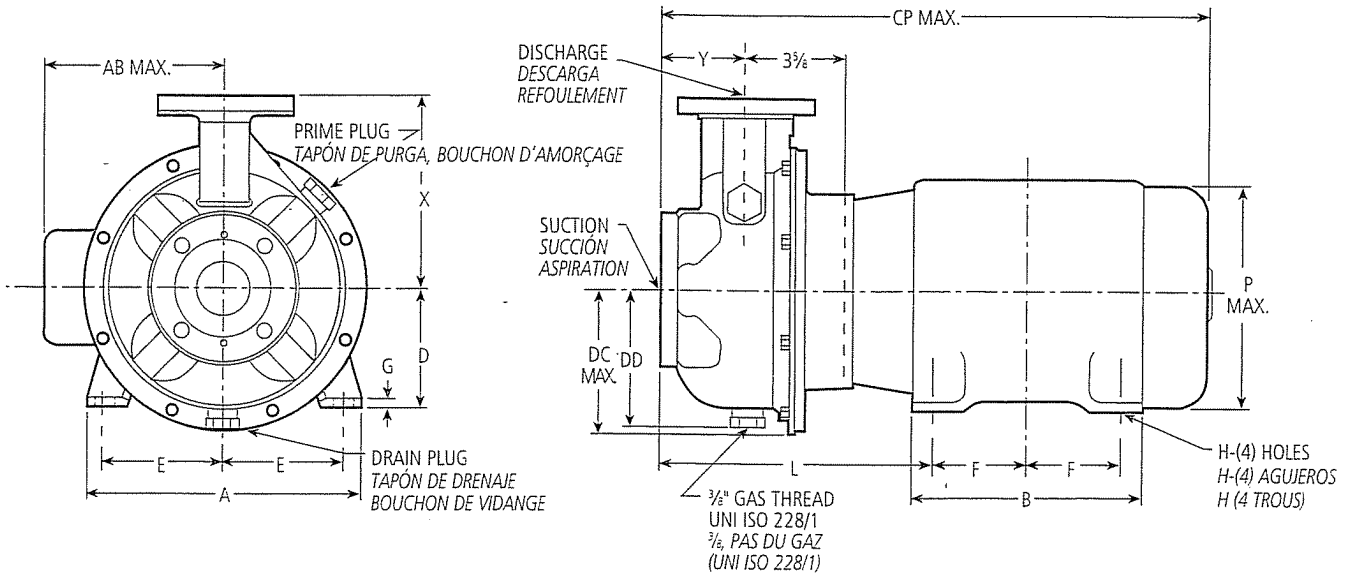
Dimensions and weights vary with manufacturers. Dimensions in inches and weights in lbs.
"HP" Dimensions at motor end only.
* "HD" Dimension for 254T/256T motor frame on 1 x 2-10 only is 11"; A ¾" motor shim and a 1¾" bearing frame shim are required.

Dimensiones y pesos varían con los fabricantes. Dimensiones en pulgadas y pesos en libras.
Dimensiones "HP" sólo en el extremo del motor.
** La dimensión "HD" para el bastidor del motor 254T/256T de 1 x 2 - 10 es sólo 11"; se requieren una cuña del motor de ¾" y una cuña del bastidor de apoyo de 1¾".*

ODP = carcasse abritée (à ouvertures de ventilation protégées) ; TEFC = carcasse fermée autoventilée.
**Dimensions HP à l'extrémité du moteur seulement. La dimension HD pour la carcasse 254T ou 256T, version 1X2-10 seulement, est de 11 po ; une cale de moteur de ¾ po et une cale de palier de 1¾ po sont requises.*

SSH S-Group Close Coupled – Dimensions and Weights, *SSH Acople Cerrado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur moteur, groupe S*

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)
(Todas las dimensiones en pulgadas y pesos en libras. No usar para propósitos de construcción.)



Dimensions "L" Determined by Pump and Motor, *Dimensiones "L" Determinadas por la Bomba y el Motor, Dimensions L – pompe et moteur*

Pump, *Bomba, Pompe*		150 lb. Flange, *Brida de 150 lib., Bride, 150 lb/po²* Suct. *Succ.* ① *Aspir.*	Disch. *Desc.* ① *Refoul.*	CP Max., *CP Máx., CP max.*	DC Max., *DC Máx., DC max.*	DD	X	Y	Motor Frame Size, *Tamaño del Armazón del Motor, Carcasse de moteur* 143/145	182/184	213/215	254/256	Wt. (lbs.), *Pesos (libras), Poids*
9SH	1 x 2 – 6	2	1	25⅜	5	4¾	6⅜	3⅛	9⅝	10¼	11¼	–	24
10SH	1 x 2 – 8				5⅜	5⅜	7⅛						32
11SH	1 x 2 – 10			27⅛	6⅞	6⅝	8⅞	4	10½	11⅛	12⅛	12⅜	54
4SH	1½ x 2½ – 6	2½	1½	25½	5	4¾	6⅜	3¼	9¾	10⅜	11⅜	—	25
7SH	1½ x 2½ – 8			27⅛	5⅝	5⅜	7⅛	4	10½	11⅛	12⅛	12⅜	34
5SH	2 x 2½ – 6		2		5	4¾	6⅜						25
8SH	2 x 2½ – 8				6	4¾	7¹⁵⁄₁₆						36
6SH	2½ x 3 – 6	3	2½										27

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps shipped in vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜ – 16 bolts to 12 ft./lbs., ⁷⁄₁₆ – 14 bolts to 20 ft./lbs.
2. ALL dimensions in inches.
3. Motor dimensions may vary with motor manufacturer.
4. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán en descarga vertical como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, ⁷⁄₁₆ – 14 tornillos a 20 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *Las dimensiones puede que varien con los fabricantes.*
4. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ - 16 à 12 lbf·pi et ⁷⁄₁₆ - 14 à 20 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

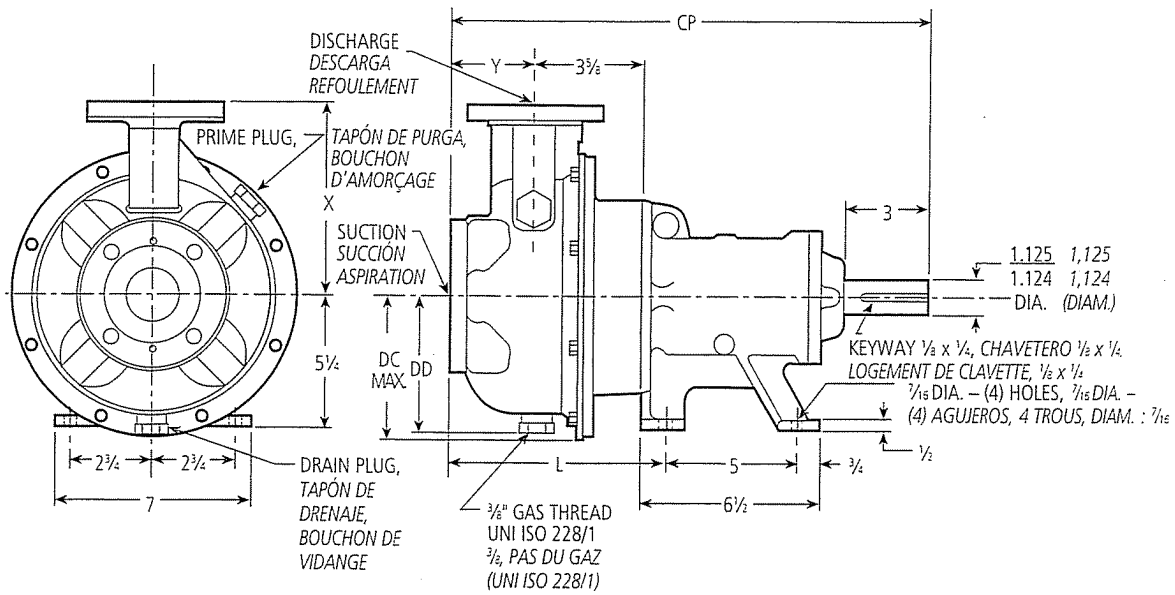
Dimensions Determined by JM Motor Frame, *Dimensiones Determinadas por el Armazón del Motor JM, Dimensions – carcasse de moteur JM*

JM Frame, *JM Armazón, Carcasse*	A	AB	B	D	E	F	G	H Dia., *H Diám., H (diam.)*	P Max., *P Máx., P max.*	Motor Wt. (lbs.) *Peso Motor (lib.), Poids du moteur*
143JM	6½	5¼	6	3½	2¾	2	⅛	¹¹⁄₃₂	6⅝	41
145JM						2½				57
182JM	8½	5⅞	6½	4½	3¾	2¼	³⁄₁₆	¹³⁄₃₂	7⅞	77
184JM						2¾				97
213JM	9½	7⅜	8	5¼	4¼	2¾	⁷⁄₃₂		9⅝	122
215JM						3½				155
254TCZ	11¼	9	9½	6¼	5	4⅛	¼	¹⁷⁄₃₂	11½	265
256TCZ			11¾			5				320

Motor Frame Selections, *Selecciones del Armazón del Motor, Choix de carcasses de moteur*

Motor Frame, *Armazón del Motor, Carcasse*	Motor Horsepower, *Potencia del Motor, Puissance (hp)*							
	3500 RPM, *3500 RPM, 3 500 tr/min*				1750 RPM, *1750 RPM, 1750 tr/min*			
	1Ø, *Monofásicos 1 Ø*		3Ø, *Trifásicos 3 Ø*		1Ø, *Monofásicos 1 Ø*		3Ø, *Trifásicos 3 Ø*	
	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
143JM	–	–	–	–	–	–	1	1
145JM	2	2	2-3	2	1-1½	1-1½	1½-2	1½-2
182JM	3	3	5	3	2	2-3	3	3
184JM	5	5	7½	5	3	–	5	5
213JM	7½	–	10	7½	5	–	7½	7½
215JM	10	–	15	10-15	–	–	–	–
254TCZ	–	–	20	–	–	–	–	–
256TCZ	–	–	25	20-25	–	–	–	–

ODP = carcasse abritée (à ouvertures de ventilation protégées) ;
TEFC = carcasse fermée autoventilée.



Dimensions and Weights – Bare Pump Only,
Dimensiones y Pesos – Solamente Bomba,
Dimensions et poids – pompe nue seulement

Pump, *Bomba, Pompe*		150 lb. Flange, *Brida de 150 lib., Bride, 150 lb/po²*		DC Max., *DC Máx., DC max.*	DD	CP Max., *CP Máx., CP max.*	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
		Suction ① *Succión ① Aspir.*	Discharge ① *Descarga ① Refoul.*							
9SH	1 x 2 – 6	2	1	5	4¾	16⅜	7⅜	6⅜	3⅛	56
10SH	1 x 2 – 8			5⅝	5⅜			7⅛		64
11SH	1 x 2 – 10			6⅞	6⅝	17¼	8½	8⅜	4	86
4SH	1½ x 2½ – 6	2½	1½	5	4¾	16½	7¾	6⅜	3¼	56
7SH	1½ x 2½ – 8			5⅝	5⅜	16½	8½	7⅛	4	64
5SH	2 x 2½ – 6		2	5	4¾					57
8SH	2 x 2½ – 8			6	5¾			6⅜		66
6SH	2½ x 3 – 6	3	2½							57

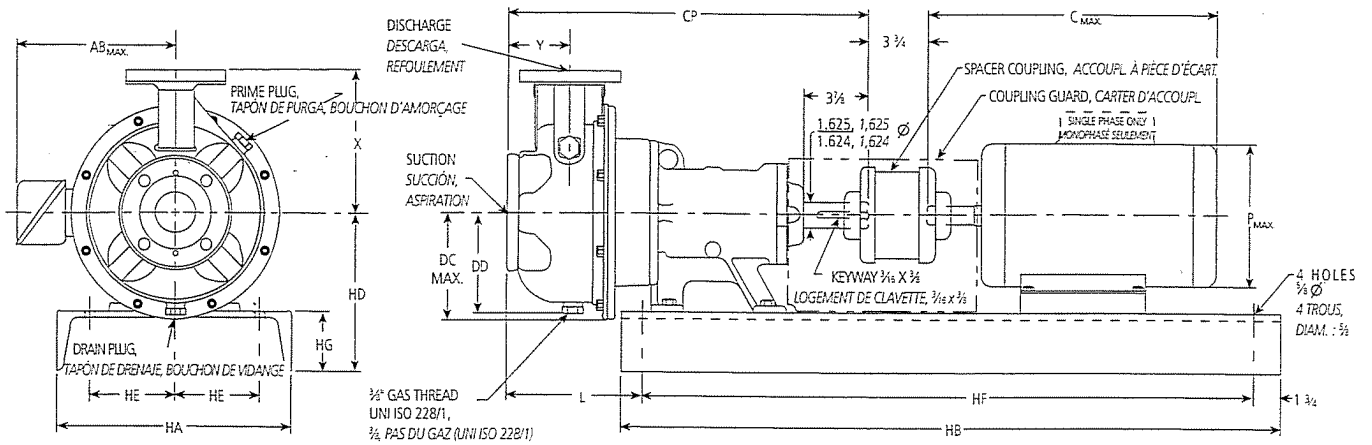
① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜ –16 bolts to 12 ft./lbs., 7/16 – 14 bolts to 20 ft./lbs.
2. ALL dimensions in inches.
3. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, 7/16 – 14 tornillos a 20 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ – 16 à 12 lbf·pi et 7/16 – 14 à 20 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Channel Steel Bedplate, Clockwise Rotation Viewed from Drive End;
Fundación de Acero, Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor;
Plaque de base profilée en U et rotation en sens horaire (vue de l'extrémité du moteur)



Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba,
Dimensions et poids – pompe

Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP	DC Max., *DC Máx., DC max.*	DD	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
24SH	1½ x 2 ½-10	2½	1½	23	6⅞	6⅝	10⅛	8 15/16	4	125
25SH	2 x 2½-10		2							125
22SH	2½ x 3-8	3	2½		6⅛	5⅞				125
27SH	2½ x 3-10				6⅞	6⅝		9 15/16		134
23SH	3 x 4-8	4	3	24			11⅛		5	136
28SH	3 x 4-10				7⅝	7⅜		11⅛		148

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position and tighten ⅜ – 16 bolts to 12 ft./lbs.
2. ALL dimensions in inches.
3. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ - 16 à 12 lbf-pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor,
Dimensions et poids – moteur et plaque de base

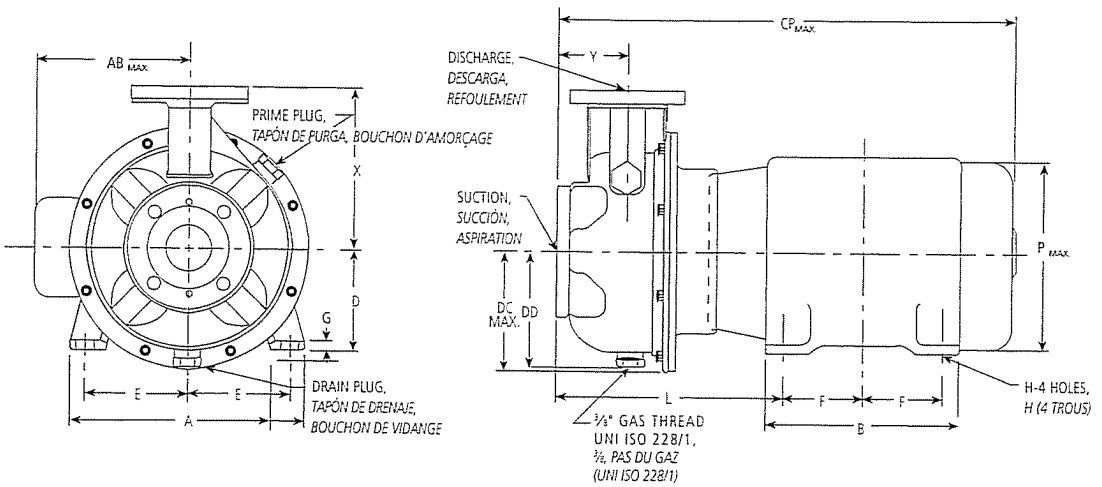
Motor Frame, *Armazón del Motor, Carcasse de moteur*	HP @ 3500 RPM, *hp à 3 500 tr/min*		HP @ 1750 RPM – T-Frame Only *hp à 1 750 tr/min – carc. T seulem.*				AB Max., *AB Máx., AB max.*	C Max., *C Máx., C max.*	P Max., *P Máx., P max.*	Wt. Max., *Peso Máx., Poids max.*	Bedplate Data, *Datos de la Fundación, Plaque de base*						
	Three Phase, *Trifásicos, 3 Ø*		Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicos, 3 Ø*						HA	HB	HD	HE	HF	HG	Wt. (lbs.), *Peso (libras), Poids*
	ODP	TEFC	ODP	TEFC	ODP	TEFC											
184T			3 or ou 5	3	5	5	5⅞	18⅛	7⅞	95	13	42	10¼	5¼	38½	4	111
213T					7½	7½	7⅜	18	9⅝	116							
215T	15				10	10		19⅛		136							
254T	20	15			15	15	9½	21⅝	13	266							
256T	25	20			20	20		23⅜		264							
284TS/T	30	25			25	25	12⅝	24⅞	15	392	15	44	10½	5¾	40½	3½	124
286TS/T	40	30						26⅝		422							
324TS/T	50	40					14⅛	28¾	17⅜	592	18	48	12	7¼	44½	4	183
326TS/T	60	50						30¼		634							
364TS/T	75	60					15⅛	31⅝	18⅞	834			13				
365TS/T	100	75						32⅝		1000							
405TS/T		100					18	36⅞	20⅝	1060	22	56	14	7¼	52½	4	214

Dimensions and weights vary with manufacturers. Dimensions in inches and weights in lbs.
Dimensiones y pesos varían con los fabricantes. Dimensiones en pulgadas y pesos en libras.

ODP = carcasse abritée (à ouvertures de ventilation protégées) ; TEFC = carcasse fermée autoventilée.

SSH M-Group Close Coupled – Dimensions and Weights, *SSH Acople Cerrado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur moteur, groupe M*

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)
(Todas las dimensiones en pulgadas y pesos en libras. No usar para propósitos de construcción.)



Dimensions "L" Determined by Pump and Motor, *Dimensiones "L" Determinadas por la Bomba y el Motor, Dimensions L – pompe et moteur*

Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP Max., *CP Máx., CP max.*	DC Max., *DC Máx., DC max.*	DD	X	Y	Wt. (lbs.), *Peso (libras), Poids*	Motor Frame Size, *Tamaño del Armazón del Motor, Carcasse de moteur*						
										140	180	210	250	280	320	360
24SH	1½ x 2 ½-10	2½	1½	34½	6⅞	6⅝	8 15/16	4	75	10½	11⅛	12⅛	13⅞		14⅜	-
25SH	2 x 2½-10		2	36					75							15
22SH	2½ x 3-8	3	2½		6⅛	5⅞			72	-						
27SH	2½ x 3-10				6⅞	6⅝	9 15/16		84	-	-					
23SH	3 x 4-8	4	3	37				5	86	11½	12⅛	13⅜	14⅞		15⅜	16
28SH	3 x 4-10				7⅝	7⅜	11⅛		98	-	-					

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. Pumps shipped in vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜ – 16 bolts to 12 ft./lbs., 7/16 – 14 bolts to 20 ft./lbs., ½ – 13 bolts to 35 ft./lbs.
2. Motor dimensions may vary with motor manufacturer.
3. Not for construction purposes.

NOTAS:
1. *Las bombas se transportarán en descarga vertical como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, 7/16 – 14 tornillos a 20 pies/libras, ½ – 13 tornillos a 35 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ - 16 à 12 lbf·pi, 7/16 - 14 à 20 lbf·pi et ½ - 13 à 35 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Dimensions Determined by JM Motor Frame, *Dimensiones Determinadas por el Armazón del Motor JM, Dimensions – carcasse de moteur JM*

Frame, *Armazón, Carcasse*	A	AB Max., *AB max.*	B	D	E	F	G	H	P Max., *P Máx., P max.*
145JM	6½	5¼	6	3½	2¾	2½	⅛	11/32	7 3/16
182JM	8½	5⅞	6½	4½	3¾	2¼	3/16	13/32	8½
184JM						2¾			
213JM	9½	7⅜	8	5¼	4¼	3½	7/32		10 3/16
215JM									
254JM	11¼	9	11¾	6¼	5	4⅛	¼	17/32	13¼
256JM						5			
284JM	12¼	12¼	12¼	7	5½	4¾			15
286JM						5½			
324JM	14	13¼	14	8	6¼	5¼	5/16	21/32	16 15/16
326JM						5½			
364TCZ	17¾	15⅛	15½	9	7	5⅝	1		19
365TCZ						6⅛			

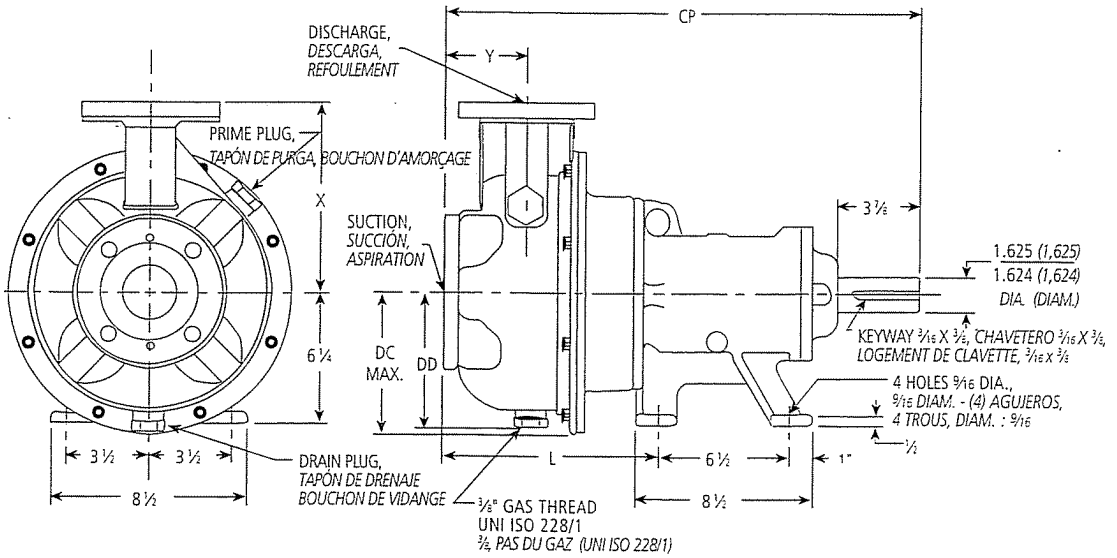
364TCZ and 365TCZ frames are built with 326JM shaft extensions.
Dimensions may vary with manufacturer.;
Los armazones 364TCZ y 365TCZ se construyen con extensiones del eje 326JM.
Las dimensiones puede que varíen con los fabricantes.;
Les carcasses 364TCZ et 365TCZ possèdent la rallonge d'arbre de la 326JM.

Motor Frame Selections, *Selecciones del Armazón del Motor, Choix de carcasses de moteur*

Frame, *Armazón, Carcasse*	Motor Horsepower, *Potencia del Motor, Puissance (hp)*						Wt. Max., *Peso Máx., Poids max.*
	3500 RPM, *3500 trimin*		1750 RPM, *1750 trimin*				
	3 PH, *Trifásicos, 3 Ø*		1 PH, *Monofásicos, 1 Ø*		3 PH, *Trifásicos, 3Ø*		
	ODP	TEFC	ODP	TEFC	ODP	TEFC	
145JM	–	–	–	–	2	2	57
182JM	–	–	2	2, 3	3	3	77
184JM	–	–	3	–	5	5	97
213JM	10	–	5	–	7½	7½	141
215JM	15	10	–	–	10	10	155
254JM	20	15	–	–	15	15	265
256JM	25	20	–	–	20	20	320
284JM	30	25	–	–	25	25	419
286JM	40	30	–	–	–	–	422
324JM	50	40	–	–	–	–	562
326JM	60	50	–	–	–	–	625
364TCZ	75	60	–	–	–	–	775
365TCZ	100	75, 100	–	–	–	–	905

364TCZ and 365TCZ frames are built with 326JM shaft extensions.
Los armazones 364TCZ y 365TCZ se construyen con extensiones del eje 326JM.
ODP = carcasse abritée (à ouvertures de ventilation protégées) ; TEFC = carcasse fermée autoventilée. Les carcasses 364TCZ et 365TCZ possèdent la rallonge d'arbre de la 326JM.

SSH M-Group Frame Mounted – Dimensions and Weights, *SSH Armazón Montado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur palier, groupe M*



Dimensions and Weights – Bare Pump Only,
Dimensiones y Pesos – Solamente Bomba
Dimensions et poids – pompe nue seulement

Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP	DC Max., *DC Máx., DC max.*	DD	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
24SH	1½ x 2 ½-10	2½	1½	23	6⅞	6⅝	10½	8 15/16	4	125
25SH	2 x 2½-10		2							125
22SH	2½ x 3-8	3	2½		6⅛	5⅞				125
27SH	2½ x 3-10				6⅞	6⅝		9 15/16		134
23SH	3 x 4-8	4	3	24			11½		5	136
28SH	3 x 4-10				7⅝	7⅜		11⅛		148

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten ⅜–16 bolts to 12 ft./lbs.
2. Motor dimensions may vary with motor manufacturer.
3. Not for construction purposes.

NOTAS:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ – 16 à 12 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

G&L Pumps

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized GouldsPumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

GARANTÍA LIMITADA DE GOULDS PUMPS

Esta garantía es aplicable a todas las bombas para sistemas de agua fabricadas por Goulds Pumps. Toda parte o partes que resultaren defectuosas dentro del período de garantía serán reemplazadas, sin cargo para el comerciante, durante dicho período de garantía. Tal período de garantía se extiende por doce (12) meses a partir de la fecha de instalación, o dieciocho (18) meses a partir de la fecha de fabricación, cualquiera se cumpla primero.

Todo comerciante que considere que existe lugar a un reclamo de garantía deberá ponerse en contacto con el distribuidor autorizado de Goulds Pumps del cual adquiriera la bomba y ofrecer información detallada con respecto al reclamo El distribuidor está autorizado a liquidar todos los reclamos por garantía a través del Departamento de Servicios a Clientes de Goulds Pumps.

La presente garantía excluye:

(a) La mano de obra, el transporte y los costos relacionados en los que incurra el comerciante;
(b) los costos de reinstalación del equipo reparado;
(c) los costos de reinstalación del equipo reemplazado;
(d) daños emergentes de cualquier naturaleza; y
(e) el reembolso de cualquier pérdida causada por la interrupción del servicio

A los fines de esta garantía, los términos "Distribuidor", "Comerciante" y "Cliente" se definen como sigue:

(1) "Distribuidor" es aquel individuo, sociedad, corporación, asociación u otra persona jurídica que opera en relación legal entre Goulds Pumps y el comerciante para la compra, consignación o contratos de venta de las bombas en cuestión.
(2) "Comerciante" es todo individuo, sociedad, corporación, asociación u otra persona jurídica que en el marco de una relación legal realiza negocios de venta o alquiler-venta (leasing) de bombas a clientes.
(3) "Cliente" es toda entidad que compra o que adquiere bajo la modalidad de leasing las bombas en cuestión de un comerciante. El término "cliente" puede significar un individuo, sociedad, corporación, sociedad de responsabilidad limitada, asociación o cualquier otra persona jurídica con actividades en cualquier tipo de negocios.

LA PRESENTE GARANTÍA SE EXTIENDE AL COMERCIANTE ÚNICAMENTE.

GARANTIE LIMITÉE DE GOULDS PUMPS

La présente garantie s'applique à chaque pompe de système d'alimentation en eau fabriquée par Goulds Pumps.

Toute pièce se révélant défectueuse sera remplacée sans frais pour le détaillant durant la période de garantie suivante expirant la première : douze (12) mois à compter de la date d'installation ou dix-huit (18) mois à partir de la date de fabrication.

Le détaillant qui, aux termes de cette garantie, désire effectuer une demande de règlement doit s'adresser au distributeur Goulds Pumps agréé chez lequel la pompe a été achetée et fournir tous les détails à l'appui de sa demande. Le distributeur est autorisé à régler toute demande par le biais du service à la clientèle de Goulds Pumps.

La garantie ne couvre pas :

a) les frais de main-d'œuvre ou de transport ni les frais connexes encourus par le détaillant ;
b) les frais de réinstallation de l'équipement réparé ;
c) les frais de réinstallation de l'équipement de remplacement ;
d) les dommages indirects de quelque nature que ce soit ;
e) ni les pertes découlant de la panne.

Aux fins de la présente garantie, les termes ci-dessous sont définis comme suit :

1) « Distributeur » signifie une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique servant d'intermédiaire entre Goulds Pumps et le détaillant pour les achats, les consignations ou les contrats de vente des pompes en question.
2) « Détaillant » veut dire une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique dont les activités commerciales sont la vente ou la location de pompes à des clients.
3) « Client » signifie une entité qui achète ou loue les pompes en question chez un détaillant. Un « client » peut être une personne, une société de personnes, une société de capitaux, une société à responsabilité limitée, une association ou autre entité juridique se livrant à quelque activité que ce soit.

CETTE GARANTIE SE RAPPORTE AU DÉTAILLANT SEULEMENT.

Goulds Pumps

ITT Industries

Attachment B

Airflex Disc and Tube Aeration System Manual

Stamford Scientific International, Inc.
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Airflex™ Disc Aeration System Installation, Operation and Maintenance Manual

www.stamfordscientific.com

SSI Airflex™ Disc Diffuser
Installation, Operation & Maintenance Manual

Comment Sheet

1. Installation, Operation and Maintenance Manual contains detailed information on the SSI Airflex™ Disc Diffuser unit. This manual covers start-up, operation and maintenance procedures.

2. SSI Airflex™ Disc diffuser unit has an operating headloss of approximately 8 -12 inches of water when operated in normal airflow ranges (0 to 3 scfm normal, 5 scfm maximum). Confirmation of blower pressure requirements provided by others.

SSI Airflex™ Tube Aeration - Mixing System

Aeration System
Operation and Maintenance Manual

Table of Contents

SSI Airflex™ Aeration - Mixing System

Section 1

General Information

SSI Airflex™ Brochure

SSI Airflex™ Tube Aeration - Mixing System

Section 2

Typical Airflex™ Tube Aeration System Details

Section 3

Installation and Start-up Instructions

SSI Airflex™ Aeration/Mixing System

INSTALLATION INSTRUCTIONS FOR THE AIRFLEX™ TUBE DIFFUSER

General

The Airflex™ Tube diffuser units are furnished completely factory assembled. The only work required by the Contractor is the installation and placement of the diffuser units on the laterals piping.

Airflex™ diffusers utilize rubber sheath membranes as the air diffusion media. Alternate membrane materials are available for special applications.

SSI recommends care in handling and storage to prevent tearing, puncturing or fouling of the rubber membranes. If units are to be stored before installation, SSI recommends utilizing the original unopened shipping cartons. Store in a clean, cool location that avoids potential mechanical damage.

Air distribution through the Airflex™ diffuser is a function of the individual diffuser elevation. For proper system operation, SSI recommends a leveling tolerance of ± *3/8"* for the diffuser unit. If the diffusers are mounted with excessive elevation tolerances, the airflow distribution in the system will be adversely impacted.

Shipment/Storage of Equipment

1. Upon delivery, check equipment for structural damage during shipment. Damages must be reported to SSI within 10 days of delivery.

2. Store Airflex™ units in a location that prevents exposure to excessive heat, mineral oils or aromatic hydrocarbons. Unopened crates exposed to direct sunlight should be covered with a tarp.

Installation of Airflex™ Tube Diffuser Assembly

1. SSI designed the Airflex™ Tube diffuser for field installation on predrilled and tapped lateral piping. The lateral pipping must have a 3/4" or optional 1" NPT tapped outlet placed horizontally in the lateral pipping.

2. When threading the Airflex™ Tube diffuser into PVC piping, SSI recommends using Teflon pipe joint compound. If metal piping is used for the air laterals, either Teflon pipe dope or Teflon tape may be used.

3. Place the threaded end of the diffuser into the threaded outlet hole in the lateral pipe. Hands tighten the diffuser unit by rotating clockwise. DO NOT OVER TIGHTEN. Tighten the unit an additional 1/2 to 3/4 turns with channel lock pliers on the non-threaded portion f the nipple. DO NOT TIGHTEN THE UNIT ON THE PVC SECTION OF THE ASSEMBLY. Over tightening the unit will cause failure to lateral piping, diffuser unit or both. Diffusers should be installed with the ear on top of the diffuser assembly. Detail drawing of the Airflex™ Tube diffuser unit may be found in Section 2.

When blower assemblies, header piping, air laterals, and all units are properly installed, system is ready for start-up. Refer to Airflex™ Start-up Instructions for details.

AIRFLEX ™ START-UP INSTRUCTIONS

General

These instructions cover the general start-up requirements for the Airflex ™ diffuser system. Special start-up requirements outlined in the Engineer's specifications, contract documents, or instructions offered by SSI shall be supplementary to or take precedent over these general instructions.

An overview of Start-up procedures is related below:

1. Confirm that piping and diffusers are level by filling the basin with water. Adjust supports for diffusers as required.

2. Continue filling the basin with water until the diffusers are 1" to 2" under water. In the event of air leaks, the diffusers are accessible.

3. Activate the blower and introduce air to the Airflex™ system. Check piping and diffusers for leaks, and repair if required.

4. While maintaining air to the system, continue filling the basin until the design depth is reached.

A. Blower Components

Reference the blower installation and start-up to assure all blowers components are mounted properly and ready for operation.

B. General Air Piping

Contractor is to confirm the cleanliness of the air piping. If existing header piping is used, the air purge or water flush cleaning procedure is recommended prior to installation of Airflex™ units to remove any internal debris that may have accumulated in the header piping. Inspect air piping and diffuser connections for loose fittings or damaged pipe. Damaged piping sections and connections should be repaired prior to commencing system operations. Refer to cleaning procedures in this Section.

SSI Airflex™ Aeration/Mixing System

(Optional) Water Flush and Air Purge Cleaning of Piping

General: These instructions cover the general procedure, which may be utilized to clean the piping in a fine or medium bubble diffuser system. Special pipe cleaning requirements outlined in the Engineer's specifications, contract documents, or instructions offered by SSI shall be supplementary to or take precedent over the general instructions outlined below. Note: Diffuser should not be installed during cleaning procedure. Debris may dislodge and plug units.

A. Water Flush Cleaning

1. Water flush cleaning is the recommended method to clean assembled piping systems where pipe segments are too long for manual cleaning. This procedure can be used in conjunction with air purge cleaning and is recommended when fine debris is not removed prior to assembly of piping. When both water flush and air purge is used, the water flush procedure should be implemented first.

2. To water flush the system, connect a water supply to the air header or make individual connections to each lateral. If flush water is piped to the header, it is imperative that the header be valved or stubbed such that water does not flood the blowers.

3. Clean water must be employed. It is not necessary to use potable water but the hush water must be free of silt or debris.

4. Flush header assembly prior to water flushing the laterals. Header, fill it with water and open the end lateral to create a in the header of at least two feet per second (if possible).

5. The laterals are to be individually flushed next. A flush velocity of five to six feet per second is recommended for lateral cleaning. Opening one isolation valve will produce a significant flushing action in the lateral as water is pumped through the header. The lateral end cap or one or two drilled air outlet holes should be uncapped to allow water and debris to be flushed out of the piping.

6. The cleaning procedure in the previous step should be completed for each of the laterals. This is done by sequentially opening and closing the isolation valves on the individual laterals.

7. As an alternate to using the main header/lateral flush procedure, the individual laterals may be cleaned independent of the main header. For this operation, the individual laterals.

B. Air Purge Cleaning

1. Remove weights and cap from the pressure relief valve during initial start-up of the system. This eliminates potential damage to the blowers from blocked valves or obstructions in piping system. Cap and weights can be added back to the pressure relief valve as necessary to provide proper operating pressure capability.

   Note: When a blow-off valve is provided for the blower system, it may be operated in lieu of using the pressure relief valve procedure listed above.

2. Open all lateral valves prior to start-up of the blowers. Provide an opening at the end of the air laterals to allow air and foreign materials to be discharged from the system. The opening may be made at the end of the air lateral by leaving the end cap off of the lateral or by removing two feeder airlines plugs at the end of the lateral.

3. In order to increase the velocity of air through the header and air laterals, it may be desirable to operate at maximum blower capacity. In addition, it may be necessary to close some of the lateral throttling valves to achieve a high velocity through the balance of the laterals that are open to the aosphere. A high velocity is required in order to blow out any accumulated foreign matter.

4. As laterals are consecutively cleaned, the isolation valves are operated in a manner that allows the remaining laterals to be cleaned by an air purge.

5. Upon completion of the air purge, the blowers are shut down and the laterals are capped. Airflex™ units are installed on laterals and all isolation valves are opened prior to filling the basin with water.

6. If only an air purge is used to clean the piping, the basins are now ready to be filled with water to check the operation of the Airflex™ units.

Section 4

Operation & Maintenance Instructions

OPERATION INSTRUCTIONS FOR AERATED BASINS
SSI Airflex™ Aeration-Mixing System

Descnption of the Airflex™ Aeration-Mixing System

The Airflex™ aeration-mixing system employs individual diffuser assemblies attached directly to the lateral piping. SSI normally designs the aeration piping system to provide uniform distribution of air without requiring adjustment of the isolation/throttling valves on the laterals with the exception in situations where water level variation exists. However, these valves are typically provided for direct control of airflow distribution on large aeration systems or for process control.

Normal Operation of the Aeration Svstem

The following procedures should be followed on a regular basis to assure consistent and satisfactory performance of the Airflex™ aeration-mixing system.

The air rate to the system may be adjusted to maintain the desired dissolved oxygen levels in the basin. When adjusting the air flowrate, the diffusers should be operated within the normal operating range of the diffuser. Excessive air flowrates will result in high-pressure drops across the diffuser and reduced oxygen transfer performance. Low air flowrates may result in incomplete utilization of the diffuser media and reduced air distribution.

The Airflex™ aeration-mixing system is designed to provide uniform aeration. Positive dissolved oxygen concentrations should be present throughout the entire system during normal operation. A dissolved oxygen profile analysis may be used to confirm the performance of the aeration system. Typically, the dissolved oxygen levels are measured at the inlet, the outlet, and the midpoint locations of each basin to determine the aeration system performance. In regulating the system airflow to control dissolved oxygen levels, the diffuser units should be operated within their minimum and maximum airflow limits.

Varying Water Level Onerations

In applications where water level variations may exist between aeration basins supplied by a single blower, the isolation valves may need to be adjusted to maintain adequate airflow distribution. This normally requires valving back the air to the basin with the reduced water level. NOTE: It is important to confirm

the operating airflow range of the diffuser units before valving back any isolation valve. Damage could result to the aeration diffuser if airflow is above the recommendations enclosed herein. Please consult SSI Engineering Department to confirm operating procedure before adjusting any aeration isolation/throttling valve.

Trouble Shooting

The Airflex™ aeration system requires very little maintenance for long term operation. Periodic visual inspection of the system should allow tile Operator to determine if the system is performing at optimum levels. For example, diffuser unit elevation variations greater than the design tolerance, typically ± 3/8", will reduce the uniformity of air distribution in the system. In addition, operating airflows below the design condition will also reduce the uniformity of air distribution. If operating conditions warrant air flowrates below the design condition, contact SSI for additional operational guidelines.

Below are symptoms and procedures to follow if inspection of the aeration system reveals abnormal operating characteristics.

1. Large volume of air in localized area

   Possible Cause: a. Air leak in aeration piping.
   b. Diffuser sleeve damaged or missing.

   Procedure:
   a. Drain basin to access area in question. Maintain airflow to units. Inspect joints for evidence of breakage.
   b. Inspect diffuser units for sleeve damage. Repair as required.

2. Decreased diffuser activity and increased backpressure noted at blower.

   Possible Cause: a. Diffusers becoming fouled.
   b. Reduced blower discharge air volume.
   c. Restriction in air header.

   Procedure: a. Access diffusers and inspect for external fouling.

b. Confirm blower operating point and rpm reading.
c. Confirm isolation valve position on header and drops.

3. Dissolved oxygen profile not satisfactory throughout basin.

Possible Cause: a. Increased loading to system.
b. Reduced blower discharge air volume.
c. Improper distribution of air in system.
d. Air leak in system.

Procedure: a. Confirm loading to system.
b. Confirm blower operations.
c. Reference items 1 and 2 above.

Normal Operation of the Blower System

The Airflex™ Aeration-Mixing System normally utilizes a centrifugal or positive displacement (PD) blower system consisting of one or more blower units for normal operation plus one on-line spare unit. All blower units including the spare unit must be operated on a regular basis to maintain their proper working condition. SSI recommends that blower units be operated sequentially with idle blower units brought on-line weekly. SSI does not recommend the simultaneous operation of on-line and spare blowers for an extended period. This operating condition may deliver airflows exceeding the air capacity of the diffuser units.

All blower components should be serviced on a regular basis. For additional information concerning proper blower operation, service requirements or service intervals, reference the Blower Operation and Maintenance manual.

Shutdown Conditions

If an interruption in air service is experienced at any time, restoration of air service should be instituted as soon as possible. When restarting positive displacement blower units, follow blower suppliers recommended procedures. Operate water purge devices if provided. If the PRV releases air for an extended period of time, the relief setting should be checked.

If the basin is to be idle for a prolonged time period, the basin should be drained and cleaned. Note, maintain the minimum airflow to the system during the drain down procedure. For maximum protection of the aeration system, refill the basin to completely submerge the aeration system. This provides thermal protection in the event of severe cold or hot weather conditions.

Contact SSI for additional operation and maintenance information if it is necessary to decrease the system airflow during cold weather.

Operation of the Airflex™ Diffuser

The Airflex™ unit has no moving parts and requires very little maintenance for long term operation. SSI recommends that the air supply to the diffusers be maintained at all times for optimum performance. The airflow to the Airflex™ units must be kept within the ranges summarized in Table 1 to maintain the structural and operating characteristics of the diffuser media. Continuous application of high airfiows, greater than denoted for normal operation may result in physical damage to the diffuser media. Under no circumstances should the airfiows indicated as maximum be exceeded. Note: Use caution when adjusting several lateral throttling valves in the same piping system. This procedure can result in elevated airfiows in sections of the basin, exceeding the maximum allowable airflow to each Airflex™ unit.

TABLE 1: Recommended Airfiows for Airflex™ Tube units 62mm x 610mm

	Normal Operating Condition (SCFM)	Maximum Operating Condition (SCFM)
Airflex™ Tube Unit	0 to 5	8

MAINTENANCE INSTRUCTIONS FOR AERATED BASINS
SSI Airflex™ Aeration-Mixing System

Maintenance of the Airflex™ Diffuser

The SSI Airflex™ unit is a fine pore aeration device that offers maximum benefits for oxygen transfer and mixing. Proper operation and maintenance of the Airflex™ diffuser can provide years of long term performance with minimum energy cost and minimum maintenance cost. For all fine pore diffusers, it is necessary to follow preventive maintenance procedures to sustain peak or optimum performance, prolong equipment life, and avoid emergency situations or a system failure. Proper maintenance procedures will also minimize the frequency of system interruptions. The following guidelines should be referenced in maintaining the Airflex™ diffuser system and EPDM diffuser media.

1. The diffuser sheaths should be protected from petroleum products, ie; mineral oils and aromatic hydrocarbons. Contact with such substances will degrade the membrane.

2. Good air filtration is required with all fine bubble diffusers including Airflex™ units. The blower system should be equipped with paper inlet filters having a performance efficiency of 99.5% removal of 2 micron particles to prevent clogging of the diffuser media. SSI is available to evaluate existing filtration efficiencies to confirm acceptability with Airflex™ diffuser units.

3. Some evidence of increased headloss through the diffuser unit may be experienced over a long period of operation. This pressure build-up is often the result of biological and/or inorganic materials building up on the media surface. The propensity for this condition is job specific and is a function of the type of waste, and the specific operating characteristics of the system. To restore media performance and decrease the operating headloss, refer to the following sections.

Accessing the Airflex™ Diffuser Assembly

SSI recommends that the Airflex™ units be accessed on a regular basis (annually) to visually inspect the units. The Airflex™ aeration system is designed to allow the diffuser units to be accessed by dropping the water level in the basin being serviced. The air to the basin being serviced should be turned off to prevent the possibility of excessive airflows to the units or damage to the blower unit.

The following items may be helpful in servicing the Airflex™ diffuser assemblies during periodic inspections or maintenance procedures:

1. Ladder to access the de-watered basin
2. Protective gloves and clothing
3. Crimping or nipper pliers
4. Long-handled bristle brush for cleaning assembly for observation
5. Spare Airflex™ sheaths and crimping clamps

Insitu Cleaning of Media

Typically rubber membrane diffuser units will require cleaning because of two common types of surface build-up; biological and inorganic scaling. The recommended cleaning procedure for both types of build-up are detailed below.

1. Biological build-up is characterized by a moss like growth. The recommended cleaning procedure is to physically dislodge the growth either through gently brushing the substance off or using low or high pressure hosing. The hosing method is effective in removing loose surface deposits on the diffuser media. Maintain minimum air rate to the diffuser during hosing operation. The length of time required to remove deposits is dependent on the type of surface foulant, water pressure, distance from unit, etc. Typically, 5 to 10 seconds is required per unit.

2. Inorganic scaling is characterized by a granular mineral like precipitate that can form on the membrane surface. If brushing and hosing the diffuser media does not remove the scaling, contact SSI for further instructions.

Replacing Airflex™ Diffuser Sheaths

If routine inspections reveal the need to replace a rubber sheath, the following guidelines should be followed.

1. Remove the stainless steel (SS) crimping clamps. This is easily accomplished by bending back the small tab on the clamp with a crimping tool or screwdriver. The operator should not attempt to snip or cut the ear of the clamp. The SS material is very strong and excessive force is required to shear the material.

2. Gently pull the rubber sheath off the PVC support. Care should be taken not to break or damage the PVC support during this removal operation.

3. Installation of the new sheath is done by reversing the above procedure. SS crimp clamps should be fully compressed with an all-purpose crimper. Outside edge of the stainless steel clamp should be located 1/4" from the edge of the sleeve.

NOTE: The 1" non-perforated portion of the membrane should be installed on the bottom of the diffuser and centered over the air discharge holes to provide check valve action. The 3/4" non-perforated zone is located at the top of the diffuser.

Replacing Airflex™ Diffuser Assembly

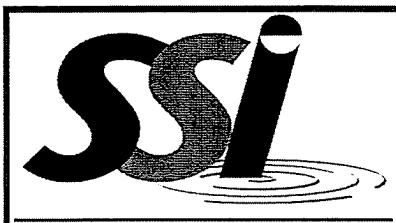
If it becomes necessary to remove an entire Airflex™ assembly, the general procedures outlined below should be followed.

1. Shut off air supplies to unit.

2. Unthread unit from lateral piping.

3. Reinstall the diffuser unit following installation details in Section 3.

Properly operated and maintained, the Airflex™ aeration and mixing system will provide years of high efficiency treatment with minimum operator attention. Questions regarding Airflex™ system operation, maintenance, etc. should be forwarded to the Engineering Department, Stamford Scientific International Incorporated, 303 Mill Street, Poughkeepsie, N.Y. 12601 U.S.A.
Tel: (914) 454-8171 Fax: (914) 454-8094 Email: info@stamfordscientific.com



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Airflex™ Tube Aeration System Installation, Operation and Maintenance Manual

www.stamfordscientific.com

SSI Airflex™ Aeration - Mixing System

Section 1

General Information

SSI Airflex™ Brochure

SSI Airflex™ Disc Aeration - Mixing System

Section 2

Typical Airflex™ Disc Aeration System Details

SSI Airflex™ Disc Diffuser Unit

Section 3

Installation and Start-up Instructions

SSI Airflex™ Aeration/Mixing System

INSTALLATION INSTRUCTIONS FOR THE AIRFLEX™ DISC DIFFUSER

General

The Airflex™ Disc diffuser units are furnished completely factory assembled. The only work required by the Contractor is the installation and placement of the diffuser units on the laterals piping.

Airflex™ diffusers utilize rubber membranes as the air diffusion media. Alternate membrane materials are available for special applications.

SSI recommends care in handling and storage to prevent tearing, puncturing or fouling of the rubber membranes. If units are to be stored before installation, SSI recommends utilizing the original unopened shipping cartons. Store in a clean, cool location that avoids potential mechanical damage.

Air distribution through the Airflex™ diffuser is a function of the individual diffuser elevation. For proper system operation, SSI recommends a leveling tolerance of ± 3/8" for the diffuser unit. If the diffusers are mounted with excessive elevation tolerances, the airflow distribution in the system will be adversely impacted.

Shipment/Storage of Equipment

1. Upon delivery, check equipment for structural damage during shipment. Damages must be reported to SSI within 10 days of delivery.

2. Store Airflex™ units in a location that prevents exposure to excessive heat, mineral oils or aromatic hydrocarbons. Unopened crates exposed to direct sunlight should be covered with a tarp.

Installation of Airflex™ Disc Diffuser Assembly

1. SSI designed the Airflex™ Disc diffuser for field installation on predrilled and tapped lateral piping. The lateral piping must have a 3/4" NPT tapped outlet placed vertically in the lateral piping.

2. Place the threaded end of the diffuser into the threaded outlet hole in the lateral pipe. Hands tighten the diffuser unit by rotating clockwise. DO NOT OVER TIGHTEN. Over tightening the unit will cause failure to lateral piping, diffuser unit or both. Detail drawing of the Airflex™ Disc diffuser unit may be found in Section 2.

When blower assemblies, header piping, air laterals, and all units are properly installed, system is ready for start-up. Refer to Airflex™ Start-up Instructions for details.

\AIRFLEX ™ START-UP INSTRUCTIONS

General

These instructions cover the general start-up requirements for the Airflex ™ diffuser system. Special start-up requirements outlined in the Engineer's specifications, contract documents, or instructions offered by SSI shall be supplementary to or take precedent over these general instructions.

An overview of Start-up procedures is related below:

1. Confirm that piping and diffusers are level by filling the basin with water. Adjust supports for diffusers as required.

2. Continue filling the basin with water until the diffusers are 1" to 2" under water. In the event of air leaks, the diffusers are accessible.

3. Activate the blower and introduce air to the Airflex™ system. Check piping and diffusers for leaks, and repair if required.

4. While maintaining air to the system, continue filling the basin until the design depth is reached.

A. Blower Components

Refer to the blower installation and start-up to ensure that all blower components are mounted properly and ready for operation.

B. General Air Piping

Contractor is to confirm the cleanliness of the air piping. If existing header piping is used, the air purge or water flush cleaning procedure is recommended prior to installation of Airflex™ units to remove any internal debris that may have accumulated in the header piping. Inspect air piping and diffuser connections for loose fittings or damaged pipe. Damaged piping sections and connections should be repaired prior to commencing system operations. Refer to cleaning procedures in this Section.

SSI Airflex™ Aeration/Mixing System

(Optional) Water Flush and Air Purge Cleaning of Piping

General: These instructions cover the general procedure which may be utilized to clean the piping in a fine or medium bubble diffuser system. Special pipe cleaning requirements outlined in the Engineer's specifications, contract documents, or instructions offered by SSI shall be supplementary to or take precedent over the general instructions outlined below. Note: Diffuser should not be installed during cleaning procedure. Debris may dislodge and plug units.

A. Water Flush Cleaning

1. Water flush cleaning is the recommended method to clean assembled piping systems where pipe segments are too long for manual cleaning. This procedure can be used in conjunction with air purge cleaning and is recommended when fine debris is not removed prior to assembly of piping. When both water flush and air purge is used, the water flush procedure should be implemented first.

2. To water flush the system, connect a water supply to the air header or make individual connections to each lateral. If flush water is piped to the header, it is imperative that the header be valved or stubbed such that water does not flood the blowers.

3. Clean water must be employed. It is not necessary to use potable water but the hush water must be free of silt or debris.

4. Flush header assembly prior to water flushing the laterals. Header, fill it with water and open the end lateral to create a in the header of at least two feet per second (if possible).

5. The laterals are to be individually flushed next. A flush velocity of five to six feet per second is recommended for lateral cleaning. Opening one isolation valve will produce a significant flushing action in the lateral as water is pumped through the header. The lateral end cap or one or two drilled air outlet holes should be uncapped to allow water and debris to be flushed out of the piping.

6. The cleaning procedure in the previous step should be completed for each of the laterals. This is done by sequentially opening and closing the isolation valves on the individual laterals.

7. As an alternate to using the main header/lateral flush procedure, the individual laterals may be cleaned independent of the main header. For this operation, the individual laterals.

B. Air Purge Cleaning

1. Remove weights and cap from the pressure relief valve during initial startup of the system. This eliminates potentialdamage to the blowers from blocked valves or obstructions in piping system. Cap and weights can be added back to the pressure relief valve as necessary to provide proper operating pressure capability.

   Note: When a blow-off valve is provided for the blower system, it may be operated in lieu of using the pressure relief valve procedure listed above.

2. Open all lateral valves prior to start-up of the blowers. Provide an opening at the end of the air laterals to allow air and foreign materials to be discharged from the system. The opening may be made at the end of the air lateral by leaving the end cap off of the lateral or by removing two feeder airlines plugs at the end of the lateral.

3. In order to increase the velocity of air through the header and air laterals, it may be desirable to operate at maximum blower capacity. In addition, it may be necessary to close some of the lateral throttling valves to achieve a high velocity through the balance of the laterals that are open to the atmosphere. A high velocity is required in order to blow out any accumulated foreign matter.

4. As laterals are consecutively cleaned, the isolation valves are operated in a manner that allows the remaining laterals to be cleaned by an air purge.

5. Upon completion of the air purge, the blowers are shut down and the laterals are capped. Airflex™ units are installed on laterals and all isolation valves are opened prior to filling the basin with water.

6. If only an air purge is used to clean the piping, the basins are now ready to be filled with water to check the operation of the Airflex™ units.

SSI Airflex™ Disc Diffuser Unit

Section 4

Operation & Maintenance Instructions

OPERATION INSTRUCTIONS PAGE

MAINTENANCE INSTRUCTIONS PAGE

OPERATION INSTRUCTIONS FOR AERATED BASINS

SSI Airflex™ Aeration-Mixing System

Descnption of the Airflex™ Aeration-Mixing System

The Airflex™ aeration-mixing system employs individual diffuser assemblies attached directly to the lateral piping. SSI normally designs the aeration piping system to provide uniform distribution of air without requiring adjustment of the isolation/throttling valves on the laterals with the exception in situations where water level variation exists. However, these valves are typically provided for direct control of airflow distribution on large aeration systems or for process control.

Normal Operation of the Aeration Svstem

The following procedures should be followed on a regular basis to assure consistent and satisfactory performance of the Airflex™ aeration-mixing system.

The air rate to the system may be adjusted to maintain the desired dissolved oxygen levels in the basin. When adjusting the air flowrate, the diffusers should be operated within the normal operating range of the diffuser. Excessive air flowrates will result in high-pressure drops across the diffuser and reduced oxygen transfer performance. Low air flowrates may result in incomplete utilization of the diffuser media and reduced air distribution.

The Airflex™ aeration-mixing system is designed to provide uniform aeration. Positive dissolved oxygen concentrations should be present throughout the entire system during normal operation. A dissolved oxygen profile analysis may be used to confirm the performance of the aeration system. Typically, the dissolved oxygen levels are measured at the inlet, the outlet, and the midpoint locations of each basin to determine the aeration system performance. In regulating the system airflow to control dissolved oxygen levels, the diffuser units should be operated within their minimum and maximum airflow limits.

Varying Water Level Onerations

In applications where water level variations may exist between aeration basins supplied by a single blower, the isolation valves may need to be adjusted to maintain adequate airflow distribution. This normally requires valving back the air to the basin with the reduced water level. NOTE: It is important to confirm

the operating airflow range of the diffuser units before valving back any isolation valve. Damage could result to the aeration diffuser if airflow is above the recommendations enclosed herein. Please consult SSI Engineering Department to confirm operating procedure before adjusting any aeration isolation/throttling valve.

Trouble Shooting

The Airflex™ aeration system requires very little maintenance for long term operation. Periodic visual inspection of the system should allow tile Operator to determine if the system is performing at optimum levels. For example, diffuser unit elevation variations greater than the design tolerance, typically ± 3/8" will reduce the uniformity of air distribution in the system. In addition, operating airflows below the design condition will also reduce the uniformity of air distribution. If operating conditions warrant air flowrates below the design condition, contact SSI for additional operational guidelines.

Below are symptoms and procedures to follow if inspection of the aeration system reveals abnormal operating characteristics.

1. Large volume of air in localized area

   Possible Cause:
   a. Air leak in aeration piping.
   b. Diffuser sheath damaged or missing.

   Procedure:
   a. Drain basin to access area in question. Maintain airflow to units. Inspect joints for evidence of breakage.
   b. Inspect diffuser units for sheath damage. Repair as required.

2. Decreased diffuser activity and increased backpressure noted at blower.

   Possible Cause:
   a. Diffusers becoming fouled.
   b. Reduced blower discharge air volume.
   c. Restriction in air header.

   Procedure:
   a. Access diffusers and inspect for external fouling.

b. Confirm blower operating point and rpm reading.
c. Confirm isolation valve position on header and drops.

3. Dissolved oxygen profile not satisfactory throughout basin.

Possible Cause:
a. Increased loading to system.
b. Reduced blower discharge air volume.
c. Improper distribution of air in system.
d. Air leak in system.

Procedure:
a. Confirm loading to system.
b. Confirm blower operations.
c. Reference items 1 and 2 above.

Normal Operation of the Blower System

The Airflex™ Aeration-Mixing System normally utilizes a centrifugal or positive displacement (PD) blower system consisting of one or more blower units for normal operation plus one on-line spare unit. All blower units including the spare unit must be operated on a regular basis to maintain their proper working condition. SSI recommends that blower units be operated sequentially with idle blower units brought on-line weekly. SSI does not recommend the simultaneous operation of on-line and spare blowers for an extended period. This operating condition may deliver airflows exceeding the air capacity of the diffuser units.

All blower components should be serviced on a regular basis. For additional information concerning proper blower operation, service requirements or service intervals, reference the Blower Operation and Maintenance manual.

Shutdown Conditions

If an interruption in air service is experienced at any time, restoration of air service should be instituted as soon as possible. When restarting positive displacement blower units, follow blower suppliers recommended procedures. Operate water purge devices if provided. If the PRV releases air for an extended period of time, the relief setting should be checked.

If the basin is to be idle for a prolonged time period, the basin should be drained and cleaned. Note, maintain the minimum airflow to the system during the drain down procedure. For maximum protection of the aeration system, refill the basin to completely submerge the aeration system. This provides thermal protection in the event of severe cold or hot weather conditions.

Contact SSI for additional operation and maintenance information if it is necessary to decrease the system airflow during cold weather.

Operation of the Airflex™ Diffuser

The Airflex™ unit has no moving parts and requires very little maintenance for long-term operation. SSI recommends that the air supply to the diffusers be maintained at all times for optimum performance. The airflow to the Airflex™ units must be kept within the ranges summarized in Table 1 to maintain the structural and operating characteristics of the diffuser media. Continuous application of high airflows, greater than denoted for normal operation may result in physical damage to the diffuser media. Under no circumstances should the airflows indicated as maximum be exceeded. Note: Use caution when adjusting several lateral throttling valves in the same piping system. This procedure can result in elevated airflows in sections of the basin, exceeding the maximum allowable airflow to each Airflex™ unit.

TABLE 1: Recommended Airflows for Airflex™ Disc units

Operating	Normal Operating Condition (SCFM)	Maximum Condition (SCFM)
Airflex™ Disc Unit	0 to 3	5

MAINTENANCE INSTRUCTIONS FOR AERATED BASINS
SSI Airflex™ Aeration-Mixing System

Maintenance of the Airflex™ Diffuser

The SSI Airflex™ unit is a fine pore aeration device that offers maximum benefits for oxygen transfer and mixing. Proper operation and maintenance of the Airflex™ diffuser can provide years of long term performance with minimum energy cost and minimum maintenance cost. For all fine pore diffusers, it is necessary to follow preventive maintenance procedures to sustain peak or optimum performance, prolong equipment life, and avoid emergency situations or a system failure. Proper maintenance procedures will also minimize the frequency of system interruptions. The following guidelines should be referenced in maintaining the Airflex™ diffuser system and EPDM diffuser media.

1. The diffuser discs should be protected from petroleum products, ie; mineral oils and aromatic hydrocarbons. Contact with such substances will degrade the membrane.

2. Good air filtration is required with all fine bubble diffusers including Airflex™ units. The blower system should be equipped with paper inlet filters having a performance efficiency of 99.5% removal of 2 micron particles to prevent clogging of the diffuser media. SSI is available to evaluate existing filtration efficiencies to confirm acceptability with Airflex™ diffuser units.

3. Some evidence of increased headloss through the diffuser unit may be experienced over a long period of operation. This pressure build-up is often the result of biological and/or inorganic materials building up on the media surface. The propensity for this condition is job specific and is a function of the type of waste, and the specific operating characteristics of the system. To restore media performance and decrease the operating headloss, refer to the following sections.

Accessing the Airflex™ Diffuser Assembly

SSI recommends that the Airflex™ units be accessed on a regular basis (annually) to visually inspect the units. The Airflex™ aeration system is designed to allow the diffuser units to be accessed by dropping the water level in the basin being serviced. The air to the basin being serviced should be turned off to prevent the possibility of excessive airflows to the units or damage to the blower unit.

The following items may be helpful in servicing the Airflex™ diffuser assemblies during periodic inspections or maintenance procedures:

1. Ladder to access the de-watered basin
2. Protective gloves and clothing
3. Crimping or nipper pliers
4. Long-handled bristle brush for cleaning assembly for observation
5. Spare Airflex™ disc membranes

Insitu Cleaning of Media

Typically rubber membrane diffuser units will require cleaning because of two common types of surface build-up; biological and inorganic scaling. The recommended cleaning procedure for both types of build-up are detailed below.

1. Biological build-up is characterized by a moss like growth. The recommended cleaning procedure is to physically dislodge the growth either through gently brushing the substance off or using low or high pressure hosing. The hosing method is effective in removing loose surface deposits on the diffuser media. Maintain minimum air rate to the diffuser during hosing operation. The length of time required to remove deposits is dependent on the type of surface foulant, water pressure, distance from unit, etc. Typically, 5 to 10 seconds is required per unit.

2. Inorganic scaling is characterized by a granular mineral like precipitate that can form on the membrane surface. If brushing and hosing the diffuser media does not remove the scaling, contact SSI for further instructions.

Replacing Airflex™ Diffuser Disc Membranes

If routine inspections reveal the need to replace a rubber disc membrane, the following guidelines should be followed.

1. Unscrew diffuser from saddle. This can be done gently by hand.

2. Remove the retaining ring. This is accomplished by holding the base tight with a vice or wrench while unscrewing the ring.

3. Gently pull the rubber disc membrane off the PP support. Care should be taken not to break or damage the PP support during this removal operation.

4. Installation of the new sheath is done by reversing the above procedure. Apply non-petroleum lubricant such as liquid soap around the edges of membrane before tightening ring.

Replacing Airflex™ Diffuser Assembly

If it becomes necessary to remove an entire Airflex™ assembly, the general procedures outlined below should be followed.

1. Shut off air supplies to unit.

2. Unthread unit from lateral piping.

3. Reinstall the diffuser unit following installation details in Section 3.

Properly operated and maintained, the Airflex™ aeration and mixing system will provide years of high efficiency treatment with minimum operator attention. Questions regarding Airflex™ system operation, maintenance, etc. should be forwarded to the Engineering Department, Stamford Scientific International Incorporated, 303 Mill Street, Poughkeepsie, N.Y. 12601 U.S.A.
Tel: (914) 454-8171 Fax: (914) 454-8094 Email: info@stamfordscientific.com

Attachment C

Miscellaneous Manuals

Catalog Section **A**
Series **A19**
Bulletin No. **3529-E**
Supersedes **3529-D**

JOHNSON CONTROLS

Johnson Controls, Inc.
Control Products Division
507 East Michigan Street
Milwaukee, WI 53202

Type A19BAG Thermostat For Portable Heaters With Thermostat Extension Cord and Beaded Chain Hanger

Application

The A19BAG special thermostat for portable heaters is a single-pole, single-throw control with contacts opening on a rise in temperature. The thermostats are supplied with an adjustable range and a fixed differential. A "No Heat" position on the dial permits manual shutdown of the heater without disconnecting the thermostat or the power supply. A special 3-wire extension cord and "series plug" are an integral part of this control to permit "plugging" the heater cord into the thermostat extension cord for automatic operation. A beaded chain hanger is supplied to permit supporting the thermostat in any convenient location.

All Series A19 thermostats are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

General Description

The A19BAG is a sturdy, compact thermostat with visible scale and an adjustable set point knob. An exposed helical sensing element is specially designed and field proven for rapid response and dependability. The enclosed snap-acting contacts are dust protected. The thermostat has a NEMA Type 1 enclosure and is designed for portable heater applications.

A strain relief bushing on the extension cord minimizes undue strain on the wire connections at the terminals.

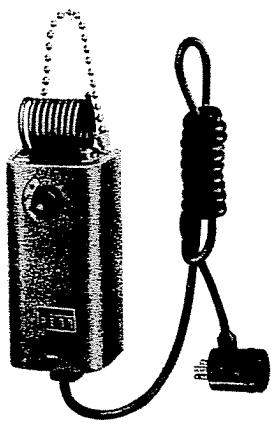


Fig. 1 — Product Number A19BAG-1 showing beaded chain and thermostat extension cord.

Specifications

Product Number	**A19BAG-1**	Thermostat with Adjustable Range, "No Heat" Position
Range		35 to 95°F (2 to 35°C)
Differential		3 1/2F° (1.9C°) Nonadjustable
Finish		Gray Baked Enamel
Material	**Case**	.062" (1.6 mm) Cold Rolled Steel
	Cover	.025" (0.6 mm) Cold Rolled Steel
Electrical Connection		Extension Cord 6' (1.8 m) Long, HSJ Class Specification, Rubber Covered 3-Prong Plug and "Series" Socket for 120 Volt Service, 15 Amp. Rating. The Case is Electrically Connected to Green "Ground" Wire
Switch		Enclosed, Dust Protected ,SPST Pennswitch
Chain Kit		7" Beaded Brass Chain with Sleeves and Snap Plugs with Each Thermostat
Sensing Element		Liquid Charge,Coiled Copper Air Bulb, Cadmium Plated with Supplemental DichromateTreatment, Black Vinyl Coated
Shipping Weight	**Individual Pack**	1.6 lb (0.7 kg)

Ordering Information

To order specify Product Number A19BAG-1 only.

Installation

The A19BAG comes with the thermostat extension cord factory installed. The following installation steps are all that is necessary to ready the A19BAG for service.

1. Remove the beaded chain, with sleeves and snap plugs (2) from envelope.

2. Place ends of the beaded chain into the slots in the back of the case (opposite cord end). Push in the snap plugs to hold the chain. (See Fig. 3.)

3. Hang the thermostat in a convenient location where the thermostat extension cord can be plugged into a power supply. The supply outlet must be a 3-prong

Fig. 2 — Beaded chain with sleeves installed. The "snap" plugs are used to hold the chain in the thermostat.

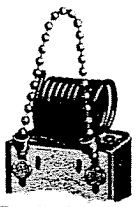


Fig. 3 — Back view of thermostat illustrating method of installing chain.

type for 120 Volt service. "Green" wire should be connected to "Ground."

All wiring should conform to the National Electrical Code and local regulations.

4. Be sure the thermostat is installed in a location where direct air from doors, windows and other cold air sources; or heat from heater discharge, lights and other heat sources will not unduly affect the thermostat operation.

5. Plug the heater cord into the thermostat extension cord. The heater cord should be 3-wire type with 3-prong plug for 120 Volt service and the "Green" wire should be connected to heater enclosure. For longer runs use only 3-wire extension cords which have 3-prong grounding type plugs and adequate wire size.

CAUTION: Do not dent or deform the sensitive bulb of this control. Denting or deforming will change the calibration and cause the control to cycle at a temperature lower than the dial setting.

Electrical Ratings

Volts, AC	120
Full Load Amps.	15
Locked Rotor Amps.	90
Non-Inductive	1800 Watts 120 VAC
Pilot Duty — 125 VA, 24/120 VAC	

Checkout Procedure

Before leaving the installation, observe at least three complete operating cycles to be sure that all components are functioning correctly.

Repairs and Replacement

Field repairs must not be made. For a replacement thermostat, contact the nearest Johnson Controls wholesaler.

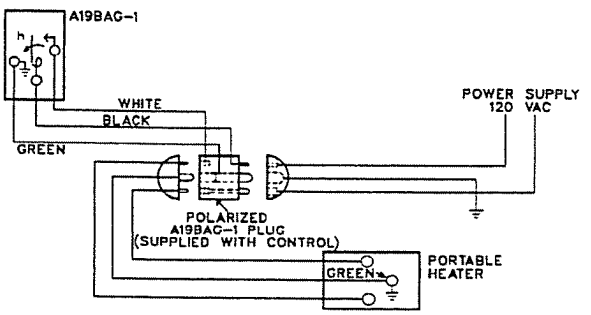
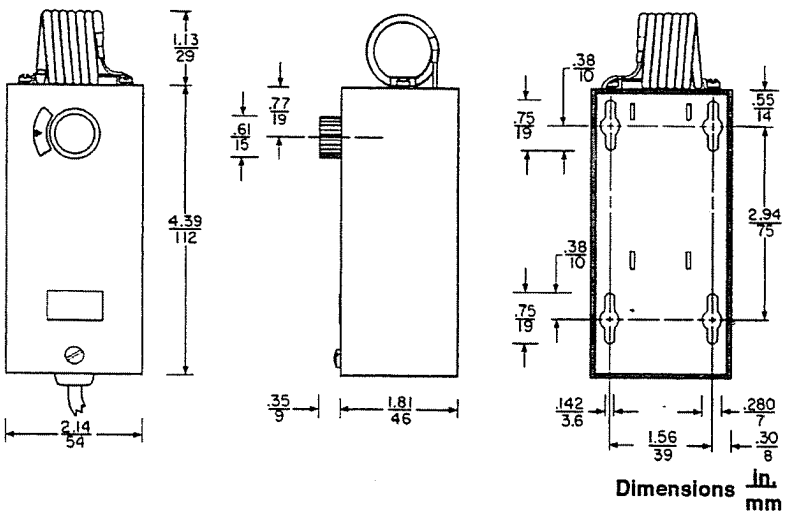


Fig. 4 — Schematic wiring hookup of Product Number A19BAG-1 with portable construction heater.



Performance specifications appearing herein are nominal and are subject to accepted manufacturing tolerances and application variables.

Litho in U.S.A. 0788-Z

Water/Wastewater
IT Systems
Agribusiness
HVACR
Cabins & Homes
Oil & Gas
Industrial/Chemical
RX/Lab/Health

Sensaphone 1100 Desktop Series

Sensaphone 1104 | Sensaphone 1108 | CottageSitter

SENSAPHONE® 1104

Sensaphone 1104 Specifications

Up to 4 dial-out numbers

Size:	71 2" W, 2" H, 81 2" D
Shipping Weight:	4 lbs.
Batteries:	(6) 1.5 Volt "D" cell alkaline (not included).
Telephone Connection:	Telephone Interface: FCC approved RJ-11 plug-in modular connector with 6' cord.
Operating Temperature Range:	Operating Range: Unit should be kept between 32° F and 120° F.
Remote Temperature Probe:	Temperature Sensing Range: -20° F to 150° F with remote temperature sensor.
NRTL listed for compliance with U.L. Standard 1459.	

Part No.	Description
FGD-1104	Standard Model 1104
FGD-1104-BS	BBusinessSitter w/ Alarm Relay Output
FGD-1104-RC	Remote Control with Controllable Output Relay
FGD-1114	1104 w/ Line Seizure Feature

GOULDS PUMPS

Wastewater Pumps
Dewatering, Effluent and Sewage
Installation and Operation Manual

Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Control Model Number: _____

Dealer: _____

Dealer Phone No. _____

Date of Purchase: _____ Installation: _____

Current Readings at Startup:

1Ø	3Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

Table of Contents

Goulds Pumps

ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that WILL cause serious personal injury, death or major property damage.

⚠ WARNING Warns of hazards that CAN cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that CAN cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠ WARNING All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury or death, damaged equipment, provide unsatisfactory performance, and may void manufacturer's warranty.

⚠ WARNING Standard units are not designed for use in swimming pools, open bodies of water, hazardous liquids, or where flammable gases exist. These fluids and gases may be present in containment areas. Tank or wetwell must be vented per local codes.

Only pumps specifically Listed for Class 1, Division 1 are allowable in hazardous liquids and where flammable gases may exist. *See specific pump catalog bulletins or pump nameplate for all agency Listings.*

⚠ WARNING Disconnect and lockout electrical power before installing or servicing any electrical equipment. Many pumps are equipped with automatic thermal overload protection which may allow an overheated pump to restart unexpectedly.

⚠ CAUTION All three phase (3Ø) control panels for submersible pumps must provide Class 10, quick-trip, overload protection.

PRE-INSTALLATION CHECKS

Open all cartons and inspect for shipping damage. Report any damage to your supplier or shipping carrier immediately.

Important: Always verify that the pump nameplate Amps, Voltage, Phase, and HP ratings match your control panel and power supply.

Many of our sewage pumps are oil-filled. If there are any signs of oil leakage or if the unit has been stored for an extended period check the oil level in the motor dome and the seal housing, if so equipped.

Check the motor cover oil level through the pipe plug on top of the unit. The motor chamber oil should just cover the motor. Do not overfill, leave room for expansion!

To check the seal housing oil level, where used, lay the unit on its side with the fill plug at 12 o'clock. Remove the plug. The oil should be within ½" (13mm) of the top. If low, refill with an ASTM 150 turbine oil. Replace the plug.

Oil is available in 5 gallon cans through our distributors. You can also source oil locally at motor repair shops. Typical oil brands are: Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 and Mobil DTE Light.

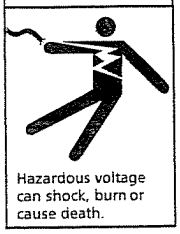
Check the strain relief nut on power cable strain assemblies. Power cables should be torqued to 75 in. lbs. for #16 cables and 80 in. lbs. for all other cable assemblies. Seal/heat sensor cables, where used, should be torqued to 75 in. lbs.

Warranty does not cover damage caused by connecting pumps and controls to an incorrect power source (voltage/phase supply).

Record the model numbers and serial numbers from the pumps and control panel on the front of this instruction manual for future reference. Give it to the owner or affix it to the control panel when finished with the installation.

LIFTING OF PUMP

⚠ WARNING



DO NOT LIFT, CARRY OR HANG PUMP BY THE ELECTRICAL CABLES. DAMAGE TO THE ELECTRICAL CABLES CAN CAUSE SHOCK, BURNS OR DEATH.

Lift the pump with an adequately sized chain or cable attached to the lifting eye bolt. DO NOT damage electrical and sensor cables while raising and lowering unit.

OPTIONAL GUIDE RAIL OR LIFT-OUT SYSTEM

In many effluent and sewage basins or lift stations it is advisable to install the pump on a guide rail system or on a lift-out adapter to facilitate installation and removal for inspection and/or service. Most codes do not allow personnel to enter a wetwell without the correct protective equipment and training. Guide rails are designed to allow easy removal of the pump without the need for entry into the wetwell or need to disturb piping. The guide rail or lift-out adapter should locate the pump opposite the influent

opening preventing stagnate areas where solids can settle. The basin or pit must be capable of supporting the weight of the pump and guide rail. The pit floor must be flat.

NOTICE: FOLLOW THE INSTRUCTIONS THAT ARE PROVIDED WITH THE GUIDE RAIL ASSEMBLY.

PIPING

Discharge piping should be no smaller than the pump discharge diameter and kept as short as possible, avoiding unnecessary fittings to minimize friction losses.

Install an adequately sized check valve matched to the solids handling capability of the pump to prevent fluid backflow. Backflow can allow the pump to "turbine" backwards and may cause premature seal and/or bearing wear. If the pump is turning backwards when it is called on to start the increased torque may cause damage to the pump motor and/or motor shaft and some single-phase pumps may actually run backwards.

Install an adequately sized gate valve **AFTER** the check valve for pump, plumbing and check valve maintenance.

Important – Before pump installation. Drill a 3⁄16" (4.8mm) relief hole in the discharge pipe. It should be located within the wetwell, 2" (51mm) above the pump discharge but below the check valve. The relief hole allows any air to escape from the casing. Allowing liquid into the casing will insure that the pump can start when the liquid level rises. Unless a relief hole is provided, a bottom intake pump could "air lock" and will not pump water even though the impeller turns.

All piping must be adequately supported, so as not to impart any piping strain or loads on the pump.

The pit access cover must be of sufficient size to allow for inspection, maintenance and crane or hoist service.

WIRING AND GROUNDING

Important notice: Read Safety Instructions before proceeding with any wiring.

⚠ Use only stranded copper wire to pump/motor and ground. The ground wire must be at least as large as the power supply wires. Wires should be color coded for ease of maintenance and troubleshooting.

⚠ Install wire and ground according to the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes.

⚠ Install an all leg disconnect switch where required by code.

⚠ Disconnect and lockout electrical power before performing any service or installation.

⚠ The electrical supply voltage and phase must match all equipment requirements. Incorrect voltage or phase can cause fire, motor and control damage, and voids the warranty.

⚠ All splices must be waterproof. If using splice kits follow manufacturer's instructions.

⚠ WARNING Select the correct type and NEMA grade junction box for the application and location. The junction box must insure dry, safe wiring connections.

⚠ WARNING Seal all controls from gases present which may damage electrical components.

⚠ WARNING Hazardous voltage

FAILURE TO PERMANENTLY GROUND THE PUMP, MOTOR AND CONTROLS BEFORE CONNECTING TO POWER CAN CAUSE SHOCK, BURNS OR DEATH.

SELECTING AND WIRING PUMP CONTROL PANELS AND SWITCHES

FLOAT SWITCH TYPES

There are two basic float switch designs; single-action and wide-angle. Single-action switches operate over a range of 15° so they open and close quickly. Wide-angle floats operate over a 90° swing with the tether length between the float body and the pivot point controlling the On-Off range. The design determines how many floats are required with different systems or controls.

Floats may be normally open (NO) for pump down applications or to empty a tank. Normally closed (NC) switches are used to pump up or to fill a tank.

A single-action control switch may be used only with a control panel, never direct connected to a pump.

The wide-angle, pump down switches may be used as direct connected pump switches or as control switches.

SETTING THE FLOAT SWITCHES

There are no absolute rules for where to set the float switches, it varies from job to job.

Suggested Rules to Follow:
All floats should be set below the Inlet pipe!

Off Float: Best: set so the water level is always above the top of the pump (motor dome). **Next Best:** set so the water level is not more than 6" below the top of the pump.

On Float: set so the volume of water between the On and Off floats allows pumps of 1½ HP and under to operate for 1 minute minimum. Two (2) HP and larger pumps should run a minimum of 2 minutes. Basin literature states the gallons of storage per inch of basin height.

Lag/Alarm Float(s): should be staggered above the Off and On floats. Try to use most of the available storage provided by the basin, save some space for reserve storage capacity. *See Diagrams and Charts in Float Switch Chart Section.*

PANEL WIRING DIAGRAMS

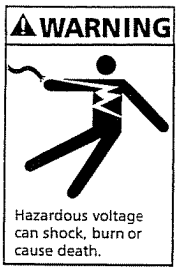
Our control panels are shipped with instructions and wiring diagrams. Use those instructions in conjunction with this IOM. Electrical installation should be performed only by qualified technicians. Any problem or questions pertaining to another brand control must be referred to that control supplier or manufacturer. Our technical people have no technical schematics or trouble shooting information for other companies' controls.

ALARMS

We recommend the installation of an alarm on all Wastewater pump installations. Many standard control panels come equipped with alarm circuits. If a control panel is not used, a stand alone high liquid level alarm is available. The alarm alerts the owner of a high liquid level in the system so they can contact the appropriate service personnel to investigate the situation.

SINGLE PHASE PUMPS
Single phase (1Ø) pumps may be operated using a piggyback or hard wired float switch, a contactor, or a Simplex or Duplex control panel. *See Figures 1, 2 and 5.*

All 1/3 and 1/2 HP, 115 or 230 volt pumps, and some 3/4 and 1 HP pumps, are supplied with plug style power cords. They may be plugged into piggyback float switches for simple installations. It is allowable to remove the plugs in order to hardwire or connect to a Simplex or Duplex controller. Removing the plug neither voids the warranty nor violates the agency Listings. *See Figure 5.*



PLUG-CONNECTED UNITS MUST BE CONNECTED TO A PROPERLY GROUNDED, GROUNDING TYPE RECEPTACLE.

ON NON-PLUG UNITS, DO NOT REMOVE CORD AND STRAIN RELIEF. DO NOT CONNECT CONDUIT TO PUMP.

Pumps with bare lead power cords can be hard-wired to a float switch, wired to a 1Ø contactor, a Simplex controller or a Duplex controller. Always verify that the float switch is rated for the maximum run amperage, maximum starting amperage, and the HP rating on the pump. Single-phase wastewater pumps contain on-winding overloads, unless noted on the pump nameplate. *See Figures 1 and 2.*

THREE PHASE PUMPS:
As a Minimum a 3Ø pump requires a 3 pole circuit breaker/fused circuit, an across the line magnetic starter rated for the pump HP, and ambient compensated Quick Trip Class 10 overloads.

SINGLE AND THREE PHASE CONTROL PANELS:
Control panels are available as Simplex (controls 1 pump) or Duplex (controls 2 pumps). Our standard SES Series Panels are available with many standard features and can be built with our most popular options. We also custom build panels which offer many more design options than the SES panels. Custom control panels are available in many different configurations. Custom panel quote requests may be forwarded to Customer Service through any authorized distributor.

Our "SES" Duplex panels feature a solid-state printed circuit board design with standard high level alarm circuits. Other standard features are: an auxiliary dry alarm contact for signaling a remote alarm and float switch position indicator lights. Our 3Ø panels have built-in, adjustable, Class 10 overloads. The adjustable overloads on all our 3Ø panels mean less labor for the installer and no need to order specific overloads. Most SES panels are in stock for immediate delivery.

On pumps equipped with seal fail and/or heat (high temperature) sensors it is recommended that you use our control panel with the appropriate options. The pump sensors do not function without a seal fail relay or terminal connection in the control panel and a warning device such as a bell, horn or light.

Seal Failure Circuit - Some dual seal pumps are equipped with a standard, built-in seal failure circuit, which may also be called a moisture detection circuit. This circuit must be connected to a control panel with an optional seal fail relay. The panel must be special ordered with the seal fail relay and alarm. There are also stand alone seal fail panels such as the A4-3 or A4-4 available as standard items. The pumps can be identified by an extra control cable exiting the motor cover. The cable contains two wires, a black wire, connects to panel "terminal" going to "probe"; and a white wire, connects to the panel "terminal" going to the relay ground. Do not connect to the panel ground screw. Follow the wiring instructions supplied with the panel.

Heat Sensor and Seal Failure Circuit - Some pumps are equipped with a seal fail and normally closed, on-winding high temperature thermostats (heat sensors). The pumps have a control cable with four (4) leads, black (probe) and green (relay ground) for the seal fail circuit and red and white for the high temperature circuit. Connect the high temperature (heat sensor) circuit to the panel terminal strip as indicated on the panel drawing using the red and white wires. The high temperature panel circuit is also an optional item which you must specifically order when you order your control panel. The high temperature circuit is different from the Class 10 overloads which are always required on three phase pumps. *Follow the wiring instructions supplied with the panel.*

INSTALLATION

Connect the pump(s) to the guide rail pump adapters or to the discharge piping. Slide rail bases should be anchored to the wetwell floor.

Complete all wiring per the control panel wiring diagrams and NEC, Canadian, state, provincial and/or local codes. This a good time to check for proper rotation of the motors/impellers.

DO NOT PLACE HANDS IN PUMP SUCTION WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

Always verify correct rotation. Correct rotation is indicated on the pump casing. Three phase motors are reversible. It is allowable to bump or jog the motor for a few seconds to check impeller rotation. It is easier to check rotation before installing the pump. Switch any two power leads to reverse rotation.

Lower the pump(s) into the wetwell.

Check to insure that the floats will operate freely and not contact the piping.

OPERATION

Once the piping connections are made and checked you can run the pumps.

Piggyback Switch Operation – Plug the piggyback switch into a dedicated grounded outlet and then plug the pump into the switch. Test the pump by filling the wetwell until the pump goes On. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Check the operating range to insure a minimum one minute run time and that the pump goes Off in the correct position.

Control Panel Operation – Fill the wetwell with clear water.

Use the pump H-O-A (Hand-Off-Automatic) switches in Hand to test the pumps. If they operate well in Hand proceed to test Automatic operation. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Place Control Panel switch(es) in Automatic position and thoroughly test the operation of the ON, OFF, and Alarm floats by filling the wetwell with clear water. **Important:** Failure to provide a Neutral from the power supply to a 1Ø, 230 volt Control Panel will not allow the panel control circuit to operate. The Neutral is necessary to complete the 115 volt control circuit.

Check voltage and amperage and record the data on the front of this manual for future reference. Compare the amperage readings to the pump nameplate maximum amperage. If higher than nameplate amperage investigate cause. Operating the pump off the curve, i.e. with too little head or with high or low voltage will increase amperage. The motor will operate properly with voltage not more than 10% above or below pump nameplate ratings. Performance within this range will not necessarily be the same as the published performance at the exact rated nameplate frequency and voltage. Correct the problem before proceeding. Three phase unbalance is also a possible cause. *See Three Phase Power Unbalance and follow the instructions.*

Reset the Alarm circuit, place pump switch(es) in the Automatic position and Control Switch in ON position. The system is now ready for automatic operation.

Explain the operation of the pumps, controls and alarms to the end user. Leave the paperwork with the owner or at the control panel if in a dry, secure location.

FLOAT SWITCH AND PANEL CHART

The purpose of this chart is to show the required switch quantities and the function of each switch in a typical wastewater system. The quantities required vary depending on the switch type, single-action or wide-angle. Switch quantities also vary by panel type: simplex with and without alarms, and duplex with alarms.

Duplex Panels using single-action switches:

Three Float Panel Wiring

SW1	Bottom	Pumps Off
SW2	Middle	1st Pump On
SW3	Top	2nd Pump & Alarm On

Four Float Panel Wiring ②

SW1	Bottom	Pumps Off
SW2	2nd	1st Pump On
SW3	3rd	2nd Pump On
SW4	Top	Alarm On

Duplex Panels using wide-angle switches:

Three Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Top	2nd Pump & Alarm On

Four Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Middle	2nd Pump On
SW3	Top	Alarm On

Simplex Panel using single-action switches:

Simplex Panel with Alarm ①

SW1	Bottom	Pump Off
SW2	Middle	Pump On
SW3	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Bottom	Pump Off
SW2	Top	Pump On

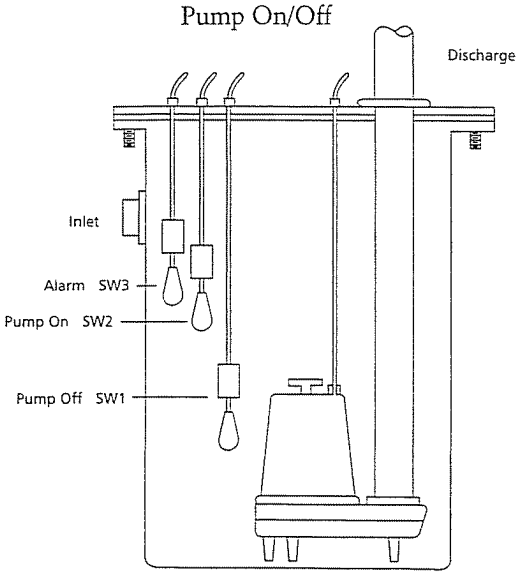
Simplex Panel using wide-angle switches:

Simplex Panel with Alarm

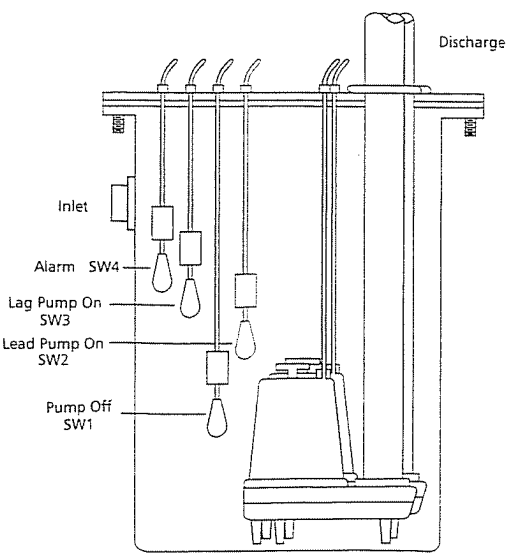
SW1	Bottom	Pump On/Off
SW2	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Pump On/Off



Simplex ①



Duplex ②

THREE PHASE POWER UNBALANCE

A full three phase supply consisting of three individual transformers or one three phase transformer is recommended. "Open" delta or wye connections using only two transformers can be used, but are more likely to cause poor performance, overload tripping or early motor failure due to current unbalance.

Check the current in each of the three motor leads and calculate the current unbalance as explained below.

If the current unbalance is 2% or less, leave the leads as connected.

If the current unbalance is more than 2%, current readings should be checked on each leg using each of the three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.

To calculate percent of current unbalance:

A. Add the three line amp values together.

B. Divide the sum by three, yielding average current.

C. Pick the amp value which is furthest from the average current (either high or low).

D. Determine the difference between this amp value (furthest from average) and the average.

E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance.

Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source.

Contact your local power company to resolve the imbalance.

	Hookup 1			Hookup 2			Hookup 3		
Starter Terminals	L1	L2	L3	L1	L2	L3	L1	L2	L3
	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T
Motor Leads	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Example:

T3-R = 51 amps	T2-W = 50 amps	T1-B = 50 amps
T1-B = 46 amps	T3-R = 48 amps	T2-W = 49 amps
T2-W = 53 amps	T1-B = 52 amps	T3-R = 51 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 or 8%	2 ÷ 50 = .04 or 4%	1 ÷ 50 = .02 or 2%

INSULATION RESISTANCE READINGS

Normal Ohm and Megohm Values between all leads and ground

Condition of Motor and Leads	Ohm Value	Megohm Value
A new motor (without drop cable).	20,000,000 (or more)	20 (or more)
A used motor which can be reinstalled in well.	10,000,000 (or more)	10 (or more)
Motor in well Readings are for drop cable plus motor		
New motor.	2,000,000 (or more)	2 (or more)
Motor in good condition.	500,000 - 2,000,000	.5 - 2
Insulation damage, locate and repair.	Less than 500,000	Less than .5

Insulation resistance varies very little with rating. Motors of all HP, voltage and phase ratings have similar values of insulation resistance.

Insulation resistance values above are based on readings taken with a megohmmeter with a 500V DC output. Readings may vary using a lower voltage ohmmeter, consult factory if readings are in question.

This table was reprinted through the courtesy of Franklin Electric.

ENGINEERING DATA

Engineering data for specific models may be found in your catalog and on our website (address is on the cover).

Control panel wiring diagrams are shipped with the control panels. Please use the control panel drawings in conjunction with this instruction manual to complete the wiring.

PUMP CONSTRUCTION	
Minimum Submergence	
Continuous Duty	Fully Submerged
Intermittent Duty	6" Below Top of Motor

Maximum Fluid Temperature	
Continuous Operation	104° F 40° C
Intermittent Operation	140° F 60° C

Pumpmaster and Pumpmaster Plus - Hard Wired

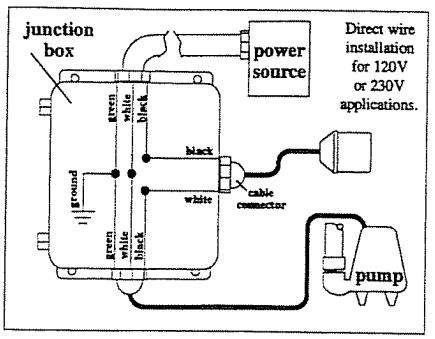


Fig. 1

Single-Action Float Switch "Typical" Installation

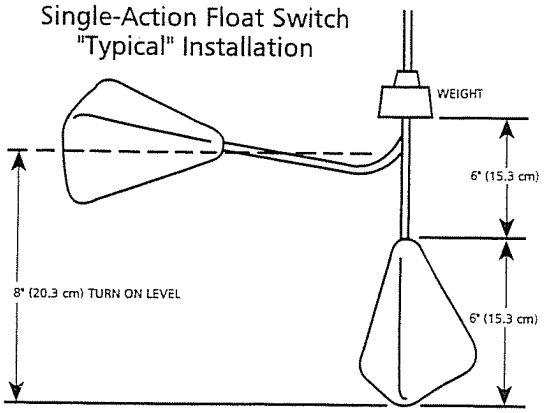


Fig. 4

Double Float - Hard Wired

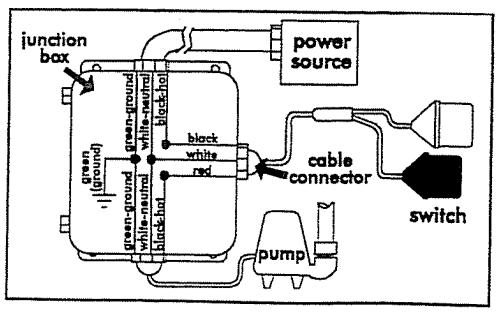


Fig. 2

Wide-Angle Float Switch

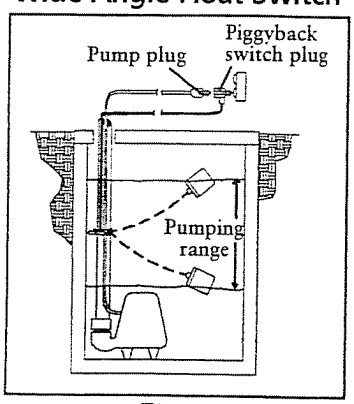


Fig. 5

Determining Pumping Range

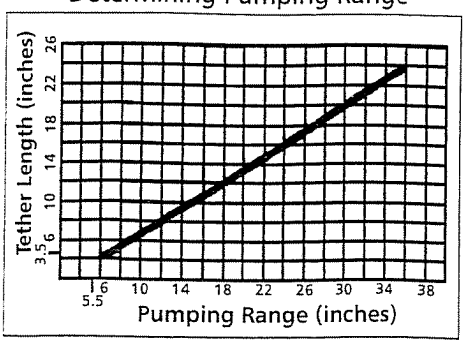


Fig. 3

Three Phase Connection Diagram

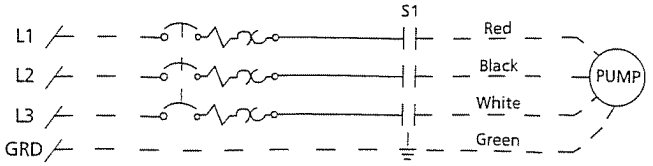
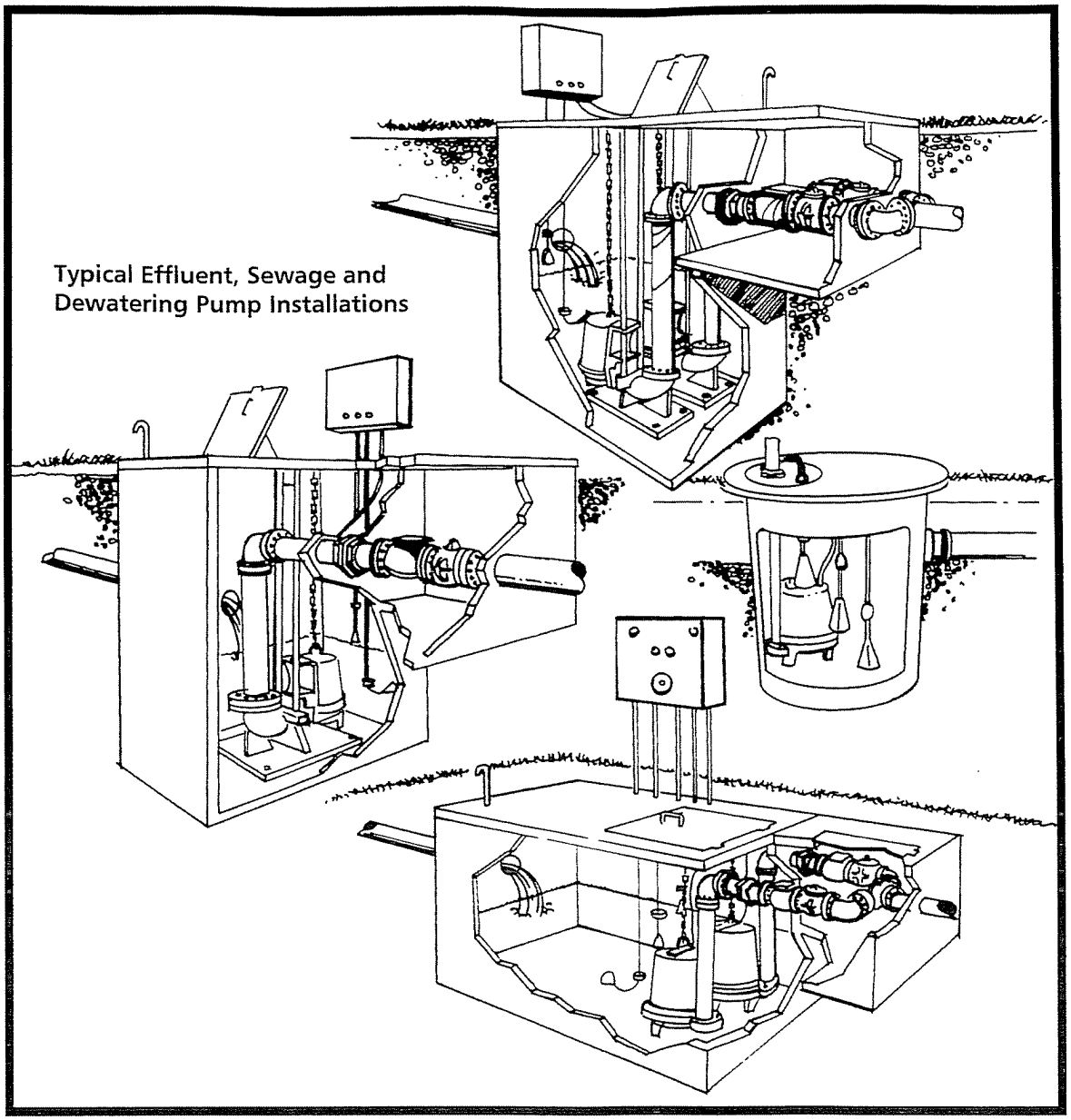


Fig. 6



Typical Effluent, Sewage and Dewatering Pump Installations

TROUBLE SHOOTING

⚠WARNING Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY SERVICE CAN CAUSE SHOCK, BURNS OR DEATH.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
MOTOR NOT RUNNING NOTE: If circuit breaker "OPENS" repeatedly, DO NOT reset. Call qualified electrician.	Motor thermal protector tripped.	Allow motor to cool. Insure minimum pump submergence. Clear debris from casing and impeller.
	Open circuit breaker or blown fuse.	Determine cause, call a qualified electrician.
	Pump impeller binding or jammed.	Check motor amp draw. If two or more times higher than listed on pump nameplate, impeller is locked, motor bearings or shaft is damaged. Clear debris from casing and impeller, consult with dealer.
a) Manual operation	Power cable is damaged.	
	Inadequate electrical connection in control panel.	
b) Automatic operation	No neutral wire connected to control panel.	Resistance between power leads and ground should read infinity. If any reading is incorrect, call a qualified electrician.
	Inadequate electrical connection in control panel.	Inspect control panel wiring. Call a qualified electrician.
NOTE: Check the pump in manual mode first to confirm operation. If pump operates, the automatic control or wiring is at fault. If pump does not operate, see above.	Defective liquid level switch.	With switch disconnected, check continuity while activating liquid level switch. Replace switch, as required.
	Insufficient liquid level to activate controls.	Allow liquid level to rise 3" to 4" (76 mm - 101 mm) above turn-on level.
	Liquid level cords tangled.	Untangle cords and insure free operation.
PUMP WILL NOT TURN OFF	Liquid level cords tangled.	Untangle cords and insure free operation.
	Pump is air locked.	Shut off pump for approximately one minute, then restart. Repeat until air lock clears. If air locking persists in a system with a check valve, a 3/16" (4.8 mm) hole may be drilled in the discharge pipe approximately 2" (51 mm) above the discharge connection.
	Influent flow is matching pump's discharge capacity.	Larger pump may be required.
LITTLE OR NO LIQUID DELIVERED BY PUMP	Check valve installed backwards, plugged or stuck closed.	Check flow arrow on valve and check valve operation.
	Excessive system head.	Consult with dealer.
	Pump inlet plugged.	Inspect and clear as required.
	Improper voltage or wired incorrectly.	Check pump rotation, voltage and wiring. Consult with qualified electrician.
	Pump is air locked.	See recommended action, above.
	Impeller is worn or damaged.	Inspect impeller, replace as required.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
PUMP CYCLES CONSTANTLY	Discharge check valve inoperative.	Inspect, repair or replace as required.
	Sewage containment area too small.	Consult with dealer.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
	Influent excessive for this size pump.	Consult with dealer.

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.
Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.
A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

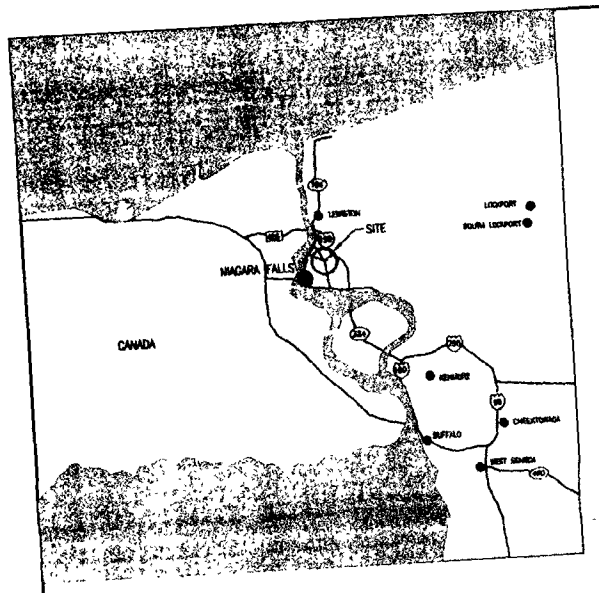
Goulds Pumps

ITT Industrie

Printed in U.S.A.

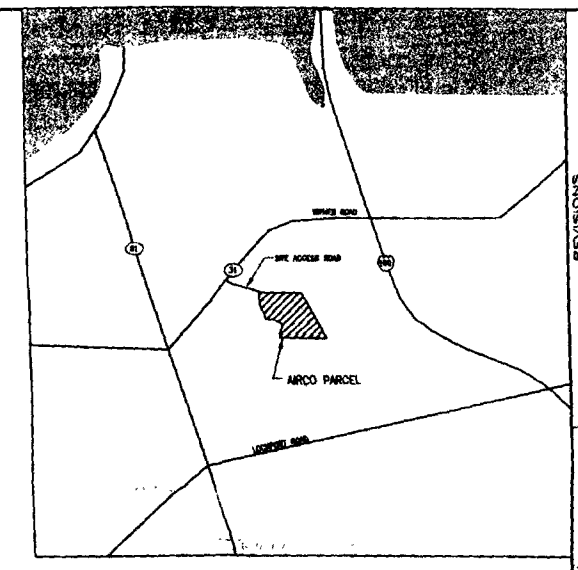
Attachment D

Drawings



VICINITY MAP

APPROXIMATE SCALE 1"=8 MILES



LOCATION MAP

AS-BUILTS

AIRCO PARCEL GROUNDWATER COLLECTION AND TREATMENT SYSTEM NIAGARA FALLS, NEW YORK

DRAWING NUMBER	SHEET NUMBER	DRAWING TITLE
T-1	1 OF 5	TITLE SHEET
C-1	2 OF 5	AS-BUILT SITE PLAN
C-2	3 OF 5	PROCESS DESIGN AS-BUILT
C-3	4 OF 5	PUMP STATION DETAILS
E-1	5 OF 5	ELECTRICAL LAYOUT

REVISIONS			
NO	DATE	BY	DESCRIPTION

SEAL

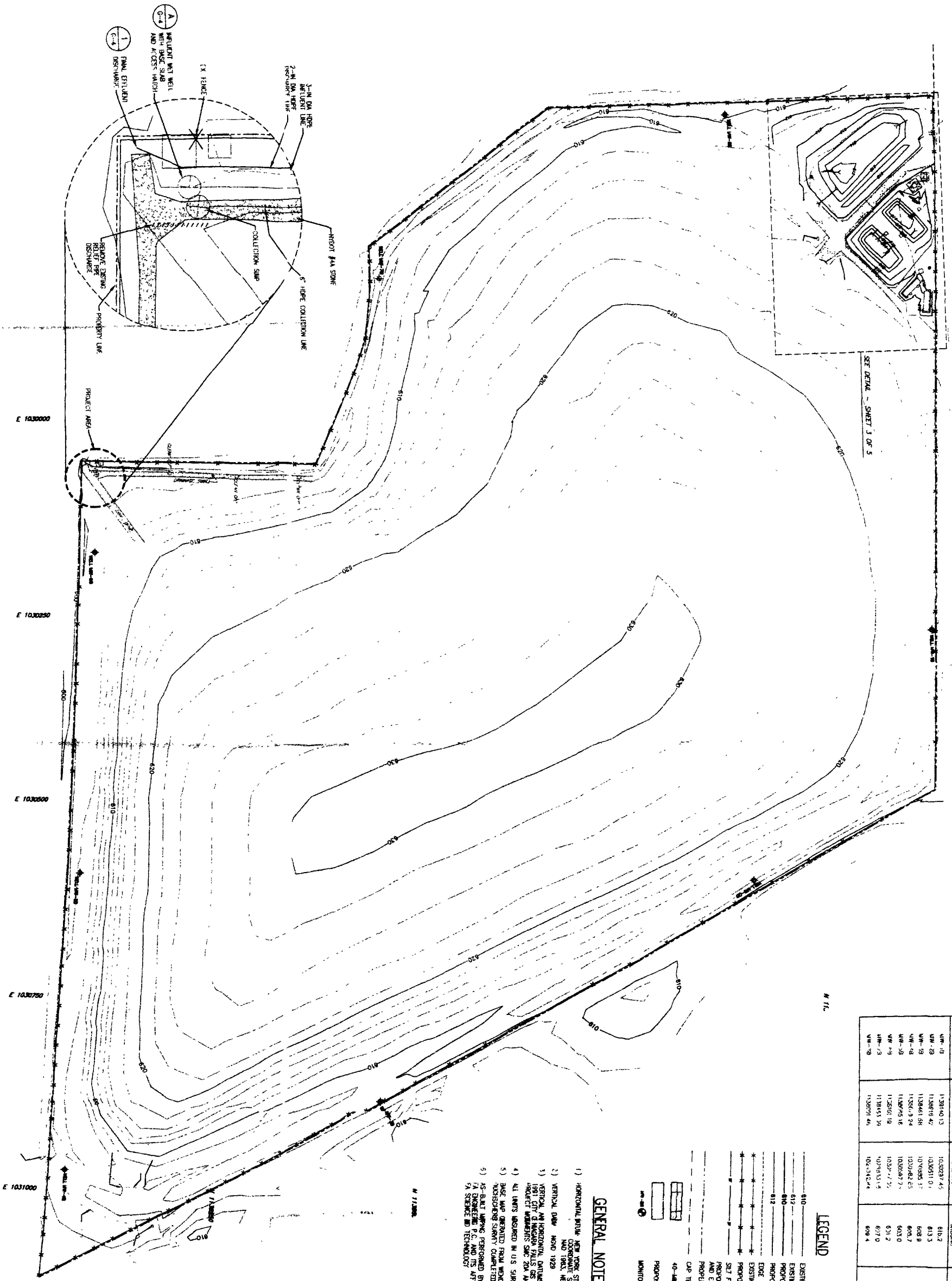
AIRCO PARCEL
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
NIAGARA FALLS, NEW YORK

TITLE SHEET

EA ENGINEERING, P.C. AND ITS AFFILIATE EA SCIENCE AND TECHNOLOGY

3 Washington Center
Newburgh, New York 12550
(845) 565-8100

DATE	NOVEMBER 2004
DESIGNED BY	SJR
DRAWN BY	JAP
CHECKED BY	SER
PROJECT MANAGER	CEM
PROJECT NUMBER	12040.83
SCALE	AS SHOWN
FILE NAME	



WELL TABLE

LOCATION		ELEVATIONS (feet)		
NORTHING	EASTING	GROUND	CASING	RISER
11,391.40 13	1,030,237.45	616.2	617.77	617.58
11,386.16 47	1,030,511.01	613.3	615.89	615.42
11,384.61 58	1,030,985.37	608.9	611.22	610.95
11,356.39 24	1,030,982.65	605.7	606.68	606.45
11,387.75 16	1,030,697.71	603.0	605.46	605.08
11,358.01 19	1,030,777.20	601.2	603.47	603.27
11,384.53 39	1,029,953.15	607.0	609.48	609.23
11,358.91 46	1,029,742.44	609.4	611.82	611.64

LEGEND

- 610 — EXISTING MAJOR CONTOUR LINE
- 612 — EXISTING MINOR CONTOUR LINE
- 610 — PROPOSED MAJOR CONTOUR LINE
- 612 — PROPOSED MINOR CONTOUR LINE
- EDGE OF STONE ROAD
- EXISTING CHAIN LINK FENCE
- PROPOSED CHAIN LINK FENCE
- SILT FENCE
- PROPOSED CONTROL AND ELECTRICAL LINE
- PROPERTY LINE
- CAP TERMINATION
- 40-MIL TEXTURED LLDPE PANEL LAYOUT
- PROPOSED ACCESS ROAD IMPROVEMENTS
- MW-48 MONITORING WELL

GENERAL NOTES:

1) HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM, NAD 1983, NEW YORK WEST ZONE
2) VERTICAL DATUM: NGVD 1929
3) VERTICAL AND HORIZONTAL DATUMS TIED INTO 1991 CITY OF NIAGARA FALLS GIS CONTROL PROJECT MONUMENTS SMC 20A AND SMC 45
4) ALL UNITS MEASURED IN U.S. SURVEY FEET
5) BASE MAP GENERATED FROM WENDEL-NIAGARA/CHERRY SURVEY COMPLETED OCTOBER 2000
6) AS-BUILT MAPPING PERFORMED BY EA ENGINEERING, P.C. AND ITS AFFILIATE EA SCIENCE AND TECHNOLOGY

EA ENGINEERING, P.C. AND ITS AFFILIATE EA SCIENCE AND TECHNOLOGY
3 Washington Center
Newburgh, New York 12550
(845) 565-8100

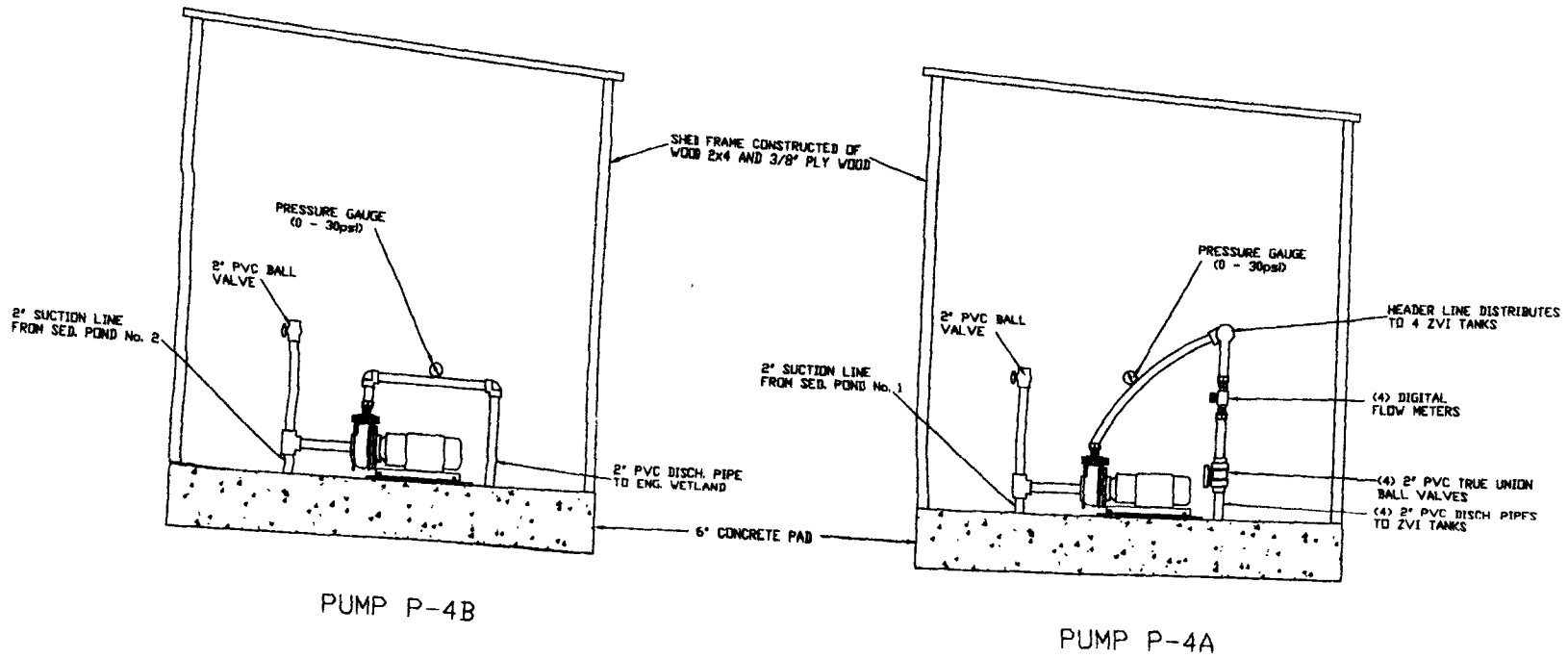
AIRCO PARCEL
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
NIAGARA FALLS, NEW YORK

AS-BUILT SITE PLAN

DATE	NOVEMBER 2004
DESIGNED BY	SJR
DRAWN BY	JAP
CHECKED BY	SER
PROJECT MANAGER	CEM
PROJECT NUMBER	12040.85
SCALE	AS SHOWN
FILE NAME	

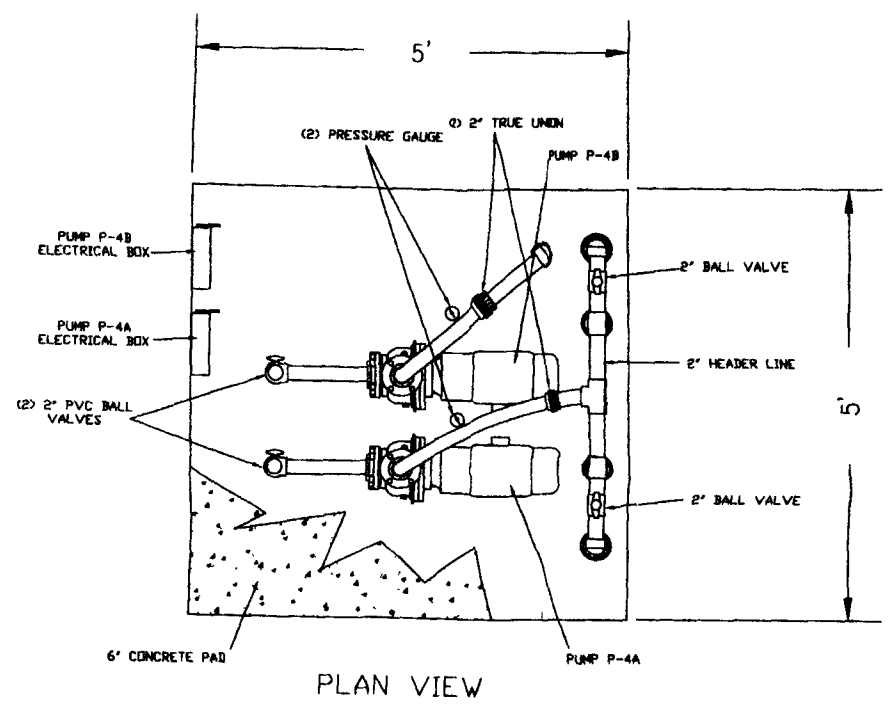
SEAL

REVISIONS			
NO.	DATE	BY	DESCRIPTION



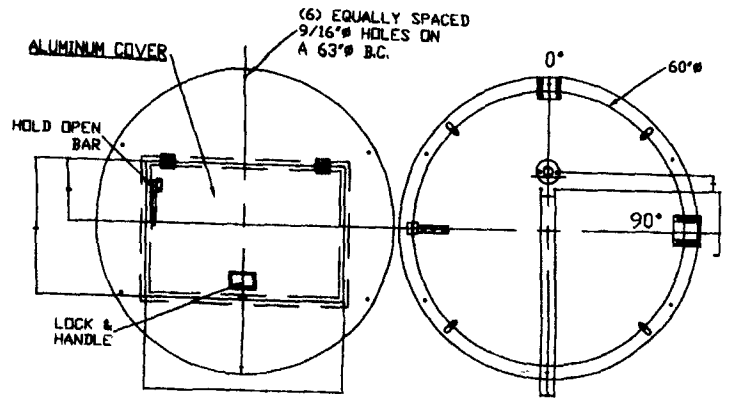
PUMP P-4B

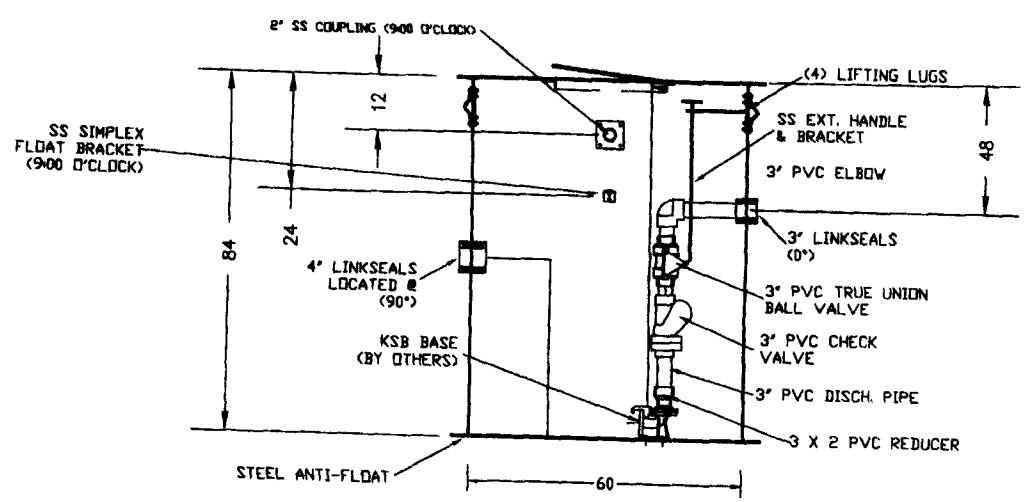
PUMP P-4A



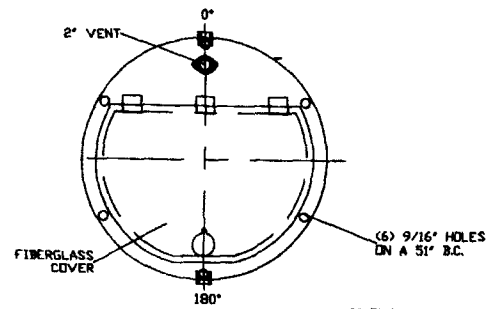
PLAN VIEW

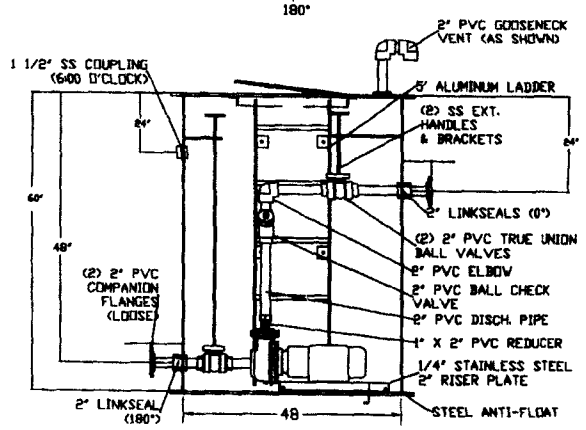
ZERO VALENCE IRON DUPLEX PUMP HOUSE





WETWELL PUMP STATION





ENGINEERED WETLAND EFFLUENT PUMP STATION

REVISIONS			
NO	DATE	BY	DESCRIPTION

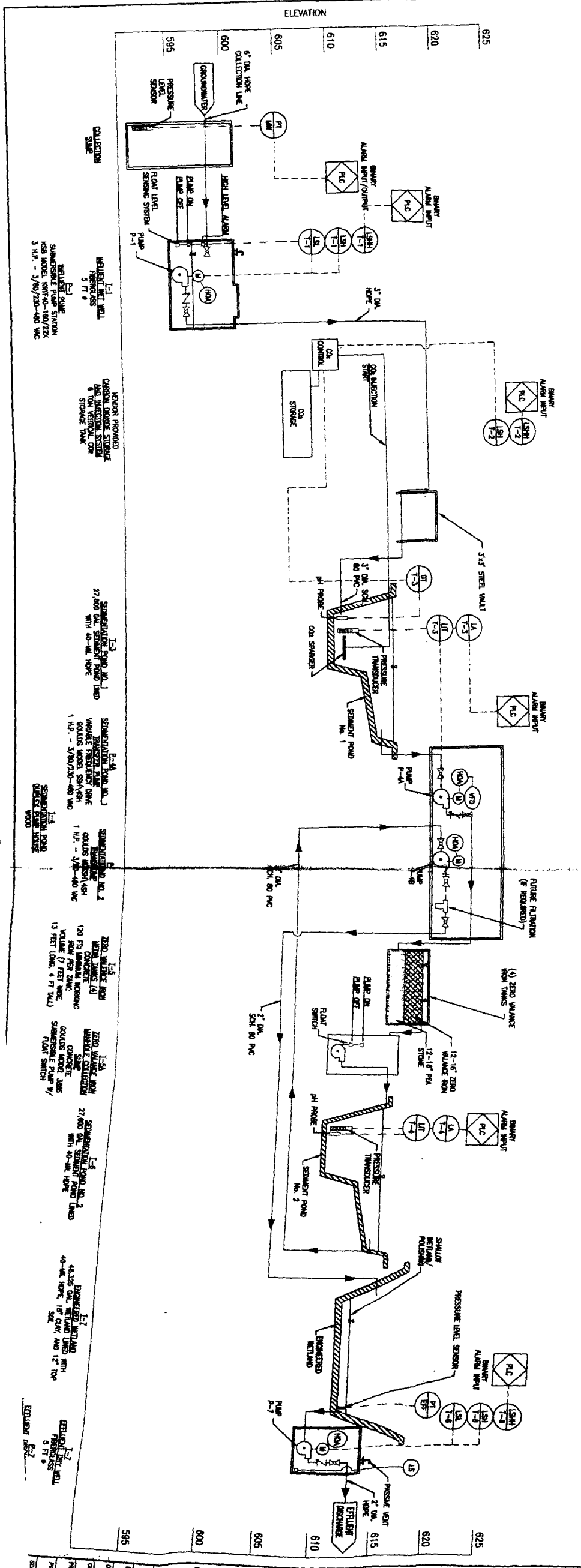
AIRCO PARCEL
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
NIAGARA FALLS, NEW YORK

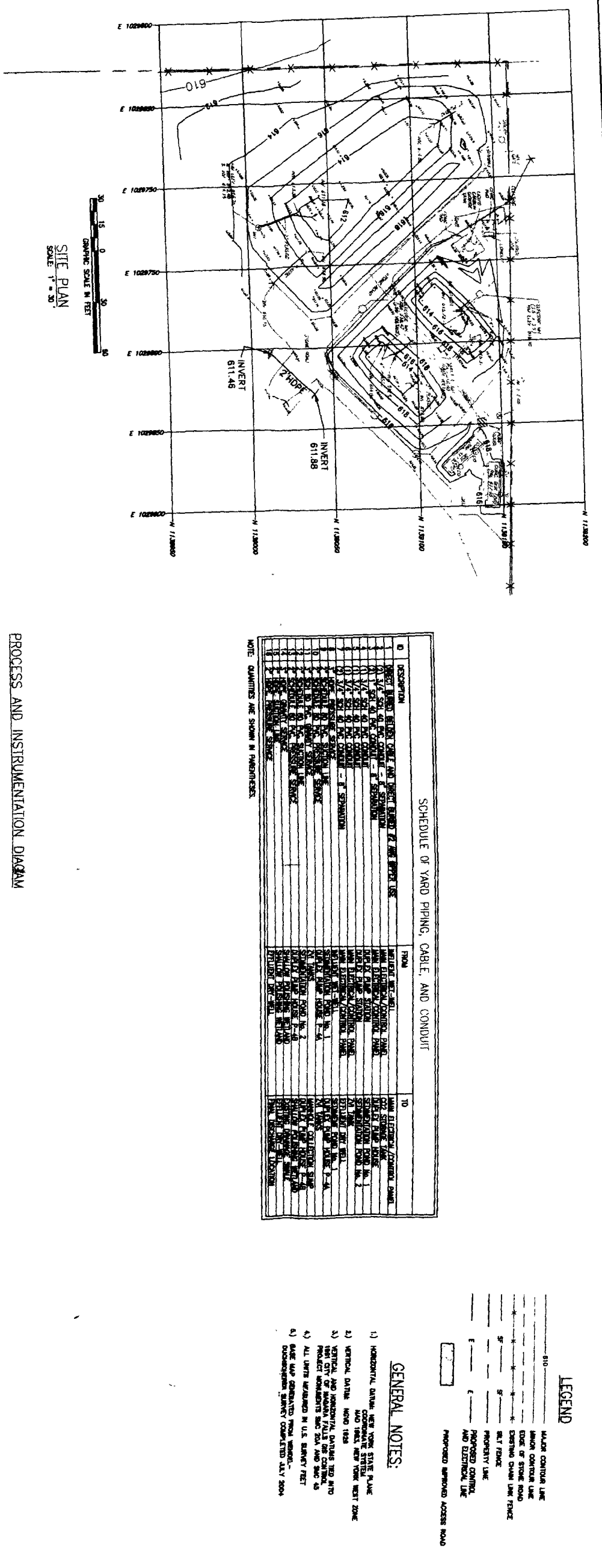
PUMP STATION DETAILS

EA ENGINEERING, P.C. AND ITS AFFILIATE EA SCIENCE AND TECHNOLOGY
3 Washington Center
Newburgh, New York 12550
(845) 565-8100

DATE	NOVEMBER 2004
DESIGNED BY	SJR
DRAWN BY	JAP
CHECKED BY	SER
PROJECT MANAGER	CEM
PROJECT NUMBER	12040.83
SCALE	AS SHOWN
FILE NAME	PUMPSTATIONDETAILS.DWG
DRAWING NUMBER	C-3
SHEET NUMBER	4 OF 5

PROCESS AND INSTRUMENTATION DIAGRAM





SITE PLAN
SCALE: 1" = 30'

SCHEDULE OF YARD PIPING, CABLE, AND CONDUIT

ID	DESCRIPTION	FROM	TO
1	DIRECT BURIED SOLDER CABLE AND DIRECT BURIED #2 AWG COPPER WIRE	INFLUENT WET WELL	MAIN ELECTRICAL CONTROL PANEL
2	(2) 3/4" SCH 40 PVC CONDUIT - 6" SEPARATION	MAIN ELECTRICAL CONTROL PANEL	CO2 STORAGE TANK
3	(2) 3/4" SCH 40 PVC CONDUIT - 6" SEPARATION	MAIN ELECTRICAL CONTROL PANEL	CO2 PUMP HOUSE
4	(2) 3/4" SCH 40 PVC CONDUIT	CO2 PUMP STATION	SEDIMENTATION POND No. 2
5	(2) 3/4" SCH 40 PVC CONDUIT	MAIN ELECTRICAL CONTROL PANEL	INFLUENT WET WELL
6	(2) 3/4" SCH 40 PVC CONDUIT - 6" SEPARATION	MAIN ELECTRICAL CONTROL PANEL	EFFLUENT WET WELL
7	4" PVC SCH 40 PRESSURE SENSOR LINE	INFLUENT WET WELL	SEDIMENTATION POND No. 1
8	2" PVC SCH 40 PRESSURE SENSOR LINE	SEDIMENTATION POND No. 1	CO2 PUMP HOUSE P-4A
9	2" PVC SCH 40 PRESSURE SENSOR LINE	CO2 PUMP HOUSE P-4A	CO2 TANKS
10	2" PVC SCH 40 PRESSURE SENSOR LINE	SEDIMENTATION POND No. 2	CO2 PUMP HOUSE P-4B
11	2" PVC SCH 40 PRESSURE SENSOR LINE	CO2 PUMP HOUSE P-4B	MANHOLE COLLECTION SUMP
12	(2) 3/4" SCH 40 PVC CONDUIT	CO2 PUMP HOUSE P-4A	SHALLOW POLISHING WETLAND
13	(2) 3/4" SCH 40 PVC CONDUIT	SHALLOW POLISHING WETLAND	EFFLUENT DRY WELL
14	2" PVC SCH 40 PRESSURE SENSOR	SHALLOW POLISHING WETLAND	EFFLUENT DRY WELL
15	3/4" PVC SCH 40 CONDUIT	EFFLUENT DRY WELL	FINAL DISCHARGE LOCATION

NOTE: QUANTITIES ARE SHOWN IN PARENTHESES.

LEGEND

- 610 — MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- EDGE OF STONE ROAD
- EXISTING CHAIN LINK FENCE
- SF — SILT FENCE
- PROPERTY LINE
- E — PROPOSED CONTROL AND ELECTRICAL LINE
- PROPOSED IMPROVED ACCESS ROAD

GENERAL NOTES:

1) HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM NAD 1983, NEW YORK WEST ZONE
2) VERTICAL DATUM: NGVD 1929
3) VERTICAL AND HORIZONTAL DATUMS TIED INTO 1991 CITY OF NIAGARA FALLS GIS CONTROL PROJECT MONUMENTS BMS 23A AND SMC 45
4) ALL UNITS MEASURED IN U.S. SURVEY FEET
5) BASE MAP GENERATED FROM WENDEL-DAGHSHEIKH SURVEY COMPLETED JULY 2004

REVISIONS			
NO	DATE	BY	DESCRIPTION

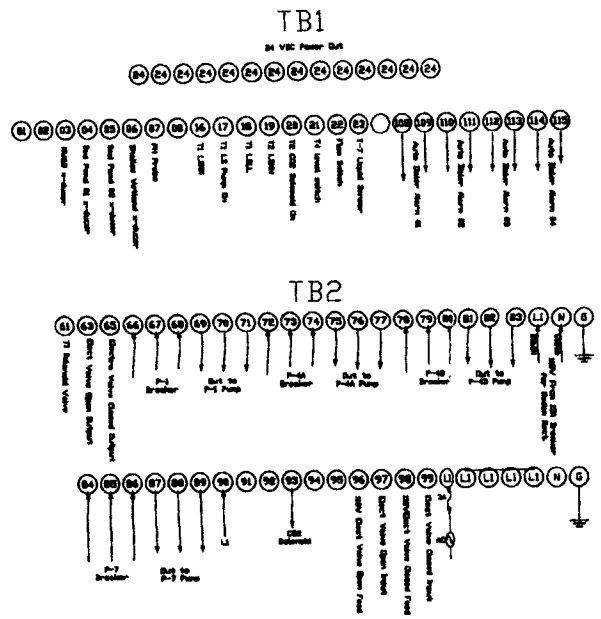
SEAL

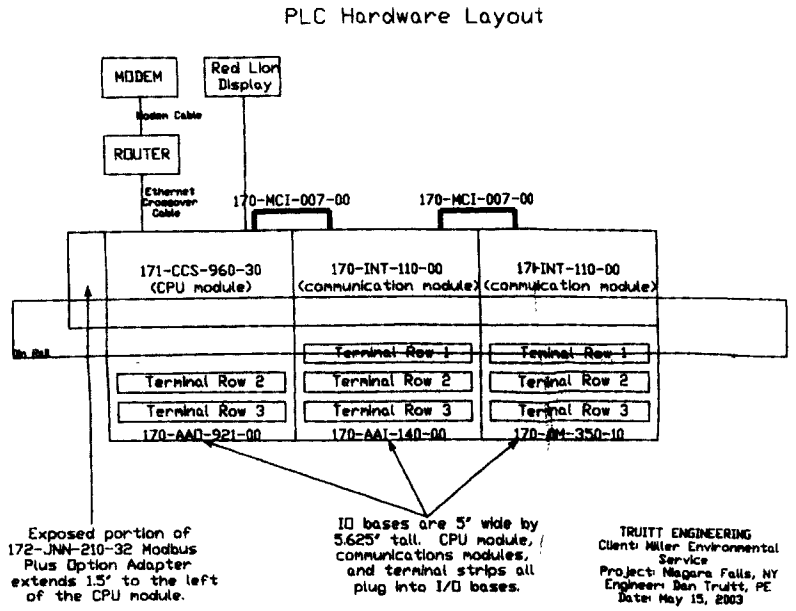
AIRCO PARCEL
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
NIAGARA FALLS, NEW YORK

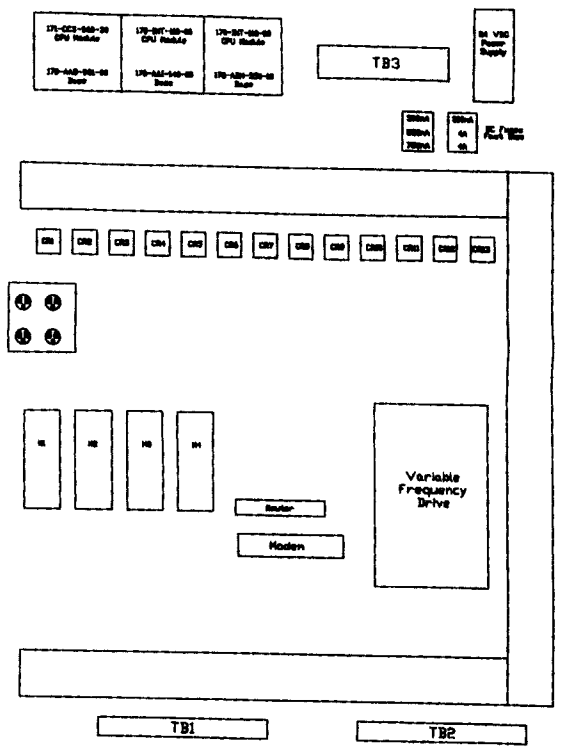
PROCESS DESIGN AS-BUILT

EA ENGINEERING, P.C. AND ITS AFFILIATE EA SCIENCE AND TECHNOLOGY
3 Washington Center
Newburgh, New York 12550
(845) 565-8100

DATE	NOVEMBER 2004
DESIGNED BY	SJR
DRAWN BY	JAP
CHECKED BY	SCR
PROJECT MANAGER	CEM
PROJECT NUMBER	12040.83
SCALE	







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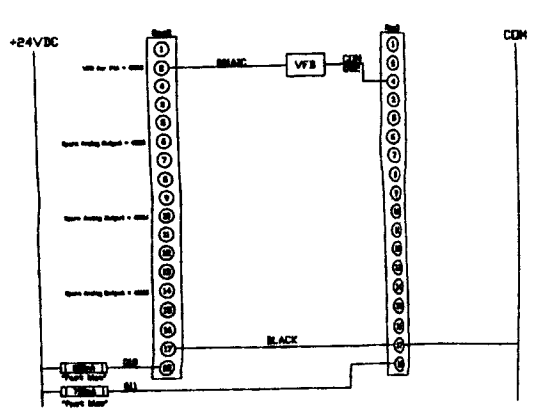

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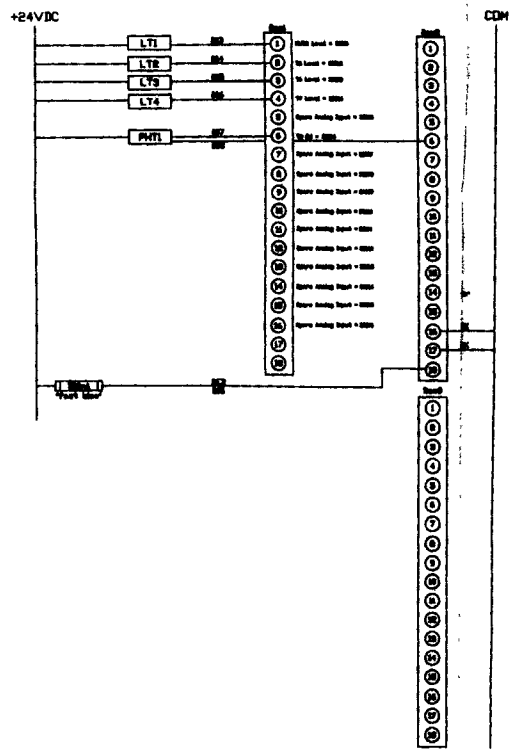

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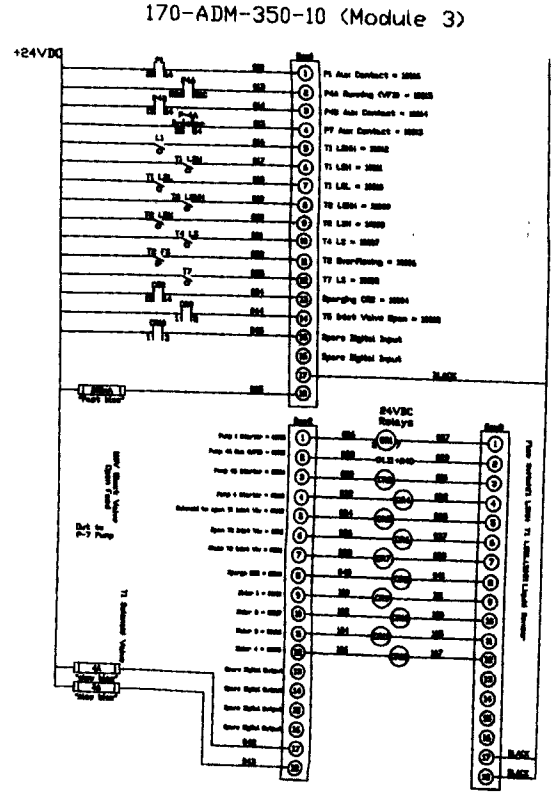

AIRCO PARCEL
GROUNDWATER TREATMENT SYSTEM
NIAGARA FALLS, NEW YORK

ELECTRICAL LAYOUT

EA ENGINEERING, P.C. AND ITS AFFILIATE EA SCIENCE AND TECHNOLOGY
3 Washington Center
Newburgh, New York 12550
(845) 565-8100

DATE	NOVEMBER 2004
DRAWN BY	KM
DESIGN BY	RSC
CHECKED BY	CDM
PROJECT MANAGER	CDM
PROJECT NUMBER	12040.83
SCALE	NONE
FILE NAME	ELECTRICAL.DWG
DRAWING NUMBER	E-1
SHEET NUMBER	5 OF 5

REVISIONS

NO.	DATE	BY	DESCRIPTION

Appendix B

Standard Operating Procedures for Low-Flow and Sampling Method

APPENDIX B

STANDARD OPERATING PROCEDURES FOR LOW-FLOW AND SAMPLING METHOD

B.1 SCOPE OF APPLICATION

The purpose of this Standard Operating Procedure is to establish the protocol for collecting ground-water samples with minimum turbidity, and is also intended to be used in conjunction with the analyses for the most common types of ground-water contaminants (semivolatile organic compounds and inorganic compounds).

B.2 EQUIPMENT/MATERIALS

- Operations and Maintenance Plan.
- Well construction data and location map.
- Field logbook and Field Record of Well Gauging, Purging, and Sampling forms.
- Water level measuring device, 0.01 ft accuracy (electronic preferred) for monitoring water level during pumping operations.
- Pumps: adjustable rate, variable displacement submersible centrifugal pumps constructed of stainless steel and Teflon® or peristaltic pump.
- Tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic analysis. For samples collected for inorganic analysis, Teflon or Teflon-lined polyethylene, polyvinyl chloride, Tygon, or polyethylene tubing may be used.
- Flow measurement supplies (e.g., graduated container and stopwatch).
- Power source (e.g., generator).
- Water quality indicator parameter monitoring instruments—pH, turbidity, specific conductances, temperature, oxidation-reduction potential, and dissolved oxygen. Water quality indicator parameters will be measured in the field in accordance with U.S. Environmental Protection Agency (EPA)-600/4-79-020 (1983) using the following methods: temperature (Method170.1), pH (Method 150.1), turbidity (Method 180.1), specific conductance (Method 120.1), and dissolved oxygen (Method 360.1).
- Decontamination supplies (for monitoring instruments).

- Sample bottles and sample preservation supplies (as required by the analytical method).
- Sample tags of labels.

B.3 PRELIMINARY ACTIVITIES

The following site activities are required prior to performing well purging and ground-water sampling. Field logbooks and sampling forms should be filled out as the procedure is being preformed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.
- Check well for damage or evidence of tampering; record pertinent observations in field logbook and on sample form.
- Lay out sheet of polyethylene for monitoring and sampling equipment.
- Unlock well and remove well cap (if applicable).
- If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one.
- Measure and record the height of the protective casing above the concrete pad or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.
- Measure and record the depth to water (to 0.01 ft) in each well to be sampled before purging begins. Care should be taken to minimize disturbance of any particulate attached to the side or at the bottom of the well. The depth to well bottom should not be measured because of the potential to stir up sediment at the bottom of the well.

B.4 SAMPLING PROCEDURE

The following general procedure will be followed to obtain representative ground-water samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and depth to water.

- Prepare the pump by checking electrical connections, discharge tubing, and motor. Locate the generator (if applicable) downwind of the well; connect the power converter to the generator.

- Connect the instrumentation header to the pump discharge and begin purging the well at 0.2-0.5 L/minute. Measure and record the water level and time with the pump in well before starting the pump. Continue pumping the well at 0.2-0.5 L/minute.

- Establish that the water level has not dropped significantly such that the pump is dry (bubbles in discharge) or water is heard cascading down the inside of the well. This may be accomplished by setting the sensor of the water level meter approximately 3-6 in. below the static water level and monitoring for a continuous audible alarm, which indicates the sensor is in water and the level has not dropped more than 6 in. Ideally, the pump rate should cause little or no water level drawdown in the well (>0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Care should be taken not to cause entrainment of air in the pump system. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 L/minute) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. The well will not be purged dry as this may affect analytical parameters.

- During purging of the well, monitor the water quality indicator parameters (turbidity, temperature, specific conductance, and pH) every 3-5 minutes. Record in the field logbook and on the Field Record of Well Gauging, Purging, and Sampling the pumping rate, drawdown, water quality indicator parameters values, and clock time at 3- to 5-minute intervals in the field logbook and sampling record. Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 nephelometric turbidity units (NTU) are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 NTU goal, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes. Measurements should be obtained using a flow-through cell.

- Reduce the pump flow rate to the lowest practical setting, usually about 0.1 L/minute. Remove the in-line sensor, if applicable. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing. Record pertinent observations in the field logbook and on sampling records.

- Begin filling sample containers from the pump discharge, allowing the water to fill the containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible. Collect the sample aliquots for the analytical parameter categories in the order below, as applicable:

  — Volatile organic compounds
  — Metals
  — All other analytes.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling Form after each well is sampled, including sample team members, sample date and time, total quantity of water removed, well sampling sequence and time of sample collection, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

Appendix C

Field Forms

EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Site Name:		Project Number:	
Well ID:		Well Lock Status:	
Well Condition:		Weather:	

Gauge Date:		Gauge Time:	
Sounding Method:		Measurement Ref:	
Stick Up/Down (ft):		Well Diameter (in.):	

Purge Date:		Purge Time:	
Purge Method:		Field Personnel:	
Ambient Air VOCs (ppm):		Well Mouth VOCs (ppm):	

WELL VOLUME

A. Well Depth (ft):		D. Well Volume/ft (L):	
B. Depth to Water (ft):		E. Well Volume (L) (C*D):	
C. Liquid Depth (ft) (A-B)		F. Three Well Volumes (L) (E*3):	

G. Measurable LNAPL? Yes _____ /ft No _____

Parameter	Beginning	1	2	3	4	5
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Total Quantity of Water Removed (L):			
Samplers:		Sampling Time (Start/End):	
Sampling Date:		Decontamination Fluids Used:	
Sample Type:		Sample Preservatives:	
Sample Bottle IDs:			
Sample Parameters:			

EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING (OVERFLOW PAGE)

Site Name:	Project Number:	Date:
Well ID:	Field Personnel:	

Parameter	6	7	8	9	10	11
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (EC)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Parameter	12	13	14	15	16	17
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (EC)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Comments and Observations:

LANDFILL CAP INSPECTION CHECKLIST
WITMER ROAD LANDFILL, NIAGARA FALLS, NEW YORK

EA Personnel: _____

Date: _____

Weather: _____

1. Inspection of ground surface for exposure of geotextile cover (cap erosion):

2. Inspection of ground surface for differential settlement resulting in soil cracking or ponded water:

3. Identification of stressed vegetation:

4. Identification of seeps, rooted vegetation (trees), and/or animal burrows:

5. Identification of deteriorating equipment (i.e., monitoring wells, fencing, or drainage structures):

6. Inspection of stormwater drainage swales for erosion, sloughing, or flow-through:

7. Inspection of east side of the landfill (Niagara Mohawk Power Corporation parcel) along the intermittent stream for the presence of erosion or sloughing:

8. Inspection of access roads:

TREATMENT SYSTEM CHECKLIST
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
AIRCO PARCEL, NIAGARA FALLS, NEW YORK

_____ CO_2 Storage Tank Pressure (Normal Range = 220–235 psi)

_____ CO_2 Storage Liquid Level (Normal Range = 2,000–12,000 lb)*

_____ P1 Running Status (on/off)

_____ P1 Running Status (on/off)

_____ T3 Water Elevation

_____ T3 pH

_____ T3 Temperature

_____ P4A Running Status (on/off)

_____ P4A Pressure Gauge (normal range = 10 psi)

_____ T6 Water Elevation

_____ P4B Running Status (on/off)

_____ T7 Water Elevation

_____ P7 Running Status (on/off)

Date: _____

Personnel: _____

* Call for refill at 2,000–3,000 lb.

FIELD SAMPLING REPORT FORM
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
AIRCO PARCEL, NIAGARA FALLS, NEW YORK

_____	P4A Hexavalent, Chromium Concentration (mg/L)	(0.011 mg/L)
_____	P4A Total Chromium Concentration (mg/L)	(0.05 mg/L)
_____	P4B Hexavalent, Chromium Concentration (mg/L)	(0.011 mg/L)
_____	P4B Total Chromium Concentration (mg/L)	(0.05 mg/L)
_____	P7 Hexavalent, Chromium Concentration (mg/L)	(0.011 mg/L)
_____	P7 Total Chromium Concentration (mg/L)	(0.05 mg/L)

Date: _____

Personnel: _____

CHECKLIST
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
AIRCO PARCEL, NIAGARA FALLS, NEW YORK

___ Yes ___ No Pump House Station Checked

___ Yes ___ No T3 Pressure Transducer Cleaned

___ Yes ___ No T3 pH Probe Cleaned

___ Yes ___ No P6 Pressure Transducer Cleaned

___ Yes ___ No P6 pH Probe Cleaned

___ Yes ___ No P7 Pressure Transducer Cleaned

P4A/ P4B Pump House Station

_____ P4A Pressure Gauge reading

_____ P4B Pressure Gauge reading

_____ ZVI Line 1 Flow Rate

_____ ZVI Line 2 Flow Rate

_____ ZVI Line 3 Flow Rate

_____ ZVI Line 4 Flow Rate

Zero Valance Iron Tanks

___ Yes ___ No Outlet Structures Checked

___ Yes ___ No Water Levels OK

Sed Pond Manifold

_____ Sed Pond A Flow (scfh)

_____ Sed Pond B Flow (scfh)

Date: _____

Personnel: _____

Appendix D

Well Construction Diagrams

EA Engineering Science, and Technology

LOG OF BORING: MW-1B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1139140.13
	Geologist: Jennifer Martin	Easting: 1030297.45
	Date Started: 8/23/00	Surface Elevation: 616.2 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/23/00	Total Depth of Boring: 25.2 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
2							Steel Protective Casing
							1" Clean Stone
0	0 - 2	24/11	2 4 3 4	CLAY: Brown clay, trace silt (soft, wet to moist)			
-2	2 - 4	24/18	10 11 31 43	FINE SAND: Light brown very fine to fine sand, trace silt (dry and loose) CLAY: Brown clay, trace very fine to fine sand and silt (dry, soft and tight)			Hydrated Bentonite
-4	4 - 6	18/18	15 30 50/0.4	WASTE			3' Diameter x 4' Deep Concrete Pad
-6				NOT LOGGED			Cement/Bentonite Grout
-8							
-10	10 - 12	24/18	1 7 8 10	WASTE			
-12				CLAY: Dark brown clay (soft, tight and slightly moist) NOT LOGGED			Ground-Water at 12 ft 00 Sand Pack
-14			4 8				Bentonite Seal
	15 - 17	24/24	6 10	CLAY: Gray to reddish brown clay, gray and red mottles (moist to wet, soft and tight)			
-16							2" PVC Casing

EA Engineering Science, and Technology

LOG OF BORING: MW-1B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1139140.13
	Geologist: Jennifer Martin	Easting: 1030297.45
	Date Started: 8/23/00	Surface Elevation: 616.2 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/23/00	Total Depth of Boring: 25.2 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
-18				NOT LOGGED			00 Sand Pack
-20	20 - 22	24/10	1 7 4 2	CLAY: Brown clay, little silt and sand, trace to little gravel (wet, loose to semi-cohesive)			2" PVC Screen from 18.5 to 23.5 ft
-22				NOT LOGGED			
-24							Bentonite
	25 - 25.2	2/0	50/0.2	DOLOMITE			End of Boring at 25.2 ft - Auger refusal, bedrock inferred

EA Engineering Science, and Technology

LOG OF BORING: MW-2B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138916.42
	Geologist: Jennifer Martin	Easting: 1030611.03
	Date Started: 8/23/00	Surface Elevation: 613.3 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/23/00	Total Depth of Boring: 27 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
2							Steel Protective Casing
							1" Clean Stone
0	0 - 2		8 6	SILT AND CLAY: Brown silt and clay with yellow and gray mottles (dry and tight)			
			6 7				
-2	2 - 4		10 15				Hydrated Bentonite
			17 20	WASTE			3' Diameter x 4' Deep Concrete Pad
-4	4 - 6		17 18				
			13 21				
-6	6 - 8		26 24				Cement/Bentonite Grout
			20 23				
-8	8 - 10		14 10				2" PVC Casing
			16 12				
-10	10 - 12		21 12	WASTE: (wet from 10 - 11 ft, slightly moist to dry from 11 - 12 ft)			
			17 50/0.3				
-12	12 - 14		18 50/0.3	WASTE: (slightly moist to wet)			Ground-Water at 11.9 ft
-14	14 - 16		4 4	SILT AND CLAY: Dark gray silt and clay (slightly moist, soft and tight)			00 Sand Pack
			8				

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LOG OF BORING: MW-2B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138916.42
	Geologist: Jennifer Martin	Easting: 1030611.03
	Date Started: 8/23/00	Surface Elevation: 613.3 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/23/00	Total Depth of Boring: 27 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
-16	16 - 18		7 15 13	SILT: Reddish brown silt, little clay (moist to wet and tight)			Bentonite Seal
-18	18 - 20		16 13 10 10				
-20	20 - 22		12 9 4 7 10	SILT AND CLAY: Reddish brown silt and clay (wet, soft and tight)			00 Sand Pack
-22	22 - 24		12 4 4 9	SILT: Reddish brown silt, little clay (moist to wet and tight)			2" PVC Screen from 20.5 to 25.5 ft
-24	24 - 26		5 18 7 5 7	SILT AND SAND: Brown silt and sand, little fine to medium gravel and clay (wet and loose)			Bentonite
-26				NOT LOGGED			End of Boring at 27 ft Auger refusal, bedrock inferred

EA Engineering Science, and Technology

LOG OF BORING: MW-3B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138461.58
	Geologist: Jennifer Martin	Easting: 1030885.32
	Date Started: 8/24/00	Surface Elevation: 610.95 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/24/00	Total Depth of Boring: 15.5 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
2						Steel Protective Casing	
						1" Clean Stone	
0	0 - 2	24/24	2 3 3 8	FINE SAND: Brownish red fine to very fine sand, trace silt (dry and loose) SILT AND CLAY: Brown silt and clay (dry and tight)		Hydrated Bentonite 3' Diameter x 2' Deep Concrete Pad	
-2	2 - 4	24/16	8 9 9 14			Cement/Bentonite Grout 00 Sand Pack	
-4	4 - 6	24/2	6 8 12 13	CLAY: Brown clay, trace gravel (wet and soft). Gravel is waste		Bentonite Seal 2" PVC Casing	
-6	6 - 8	24/0	6 8 7 32	NO RECOVERY: Waste inferred			
-8	8 - 10	24/24	8 4 14 32	SILT: Brown silt, trace clay, gray mottles (moist to dry at bottom, tight)		Ground-Water at 9.3 ft	
-10	10 - 12	24/24	27 29 23 18			00 Sand Pack 2" PVC Screen from 8.5 to 13.5 ft	
-12	12 - 14	24/15	2 4 3 10	SILT AND CLAY: Brown silt and clay (wet and soft) SILT AND SAND: Brown sand and silt, trace clay and gravel (wet and loose to semi-cohesive)			
-14	14 - 16	24/14	7 13 50/0.4			Bentonite End of Boring at 15.4 ft. Spoon refusal, bedrock inferred	

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LOG OF BORING: MW-4B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138079.24
	Geologist: Jennifer Martin	Easting: 1030982.86
	Date Started: 8/21/00	Surface Elevation: 605.7
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/21/00	Total Depth of Boring: 13.4 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
0	0 - 2	24/20	5 4 5 6	SAND AND SILT: Light brown very fine sand and silt (loose, dry and noncohesive) grading to brown clay, little silt (dry and tight) - fill			Steel Protective Casing 1" Clean Stone Hydrated Bentonite 3' Diameter x 1.5' Deep Concrete Pad 00 Sand Pack
-2	2 - 4	24/18.5	11 12 10 14				Bentonite Seal
-4	4 - 6	24/22	8 8 11 12	SILT AND CLAY: Brown silt and clay (dry and loose) - fill			2" PVC Casing
-6	6 - 8	24/12	15 14 13 16	CLAY: Brown clay, little silt (dry, tight and soft)			
-8	8 - 10	24/23	6 5 6 7	CLAY: Brown clay, trace silt (slightly moist to moist, soft and tight)			00 Sand Pack 2" PVC Screen from 7.5 to 12.5 ft
-10	10 - 12	24/15	3 4 5	CLAY: Brown to reddish brown clay, trace silt and gray mottles (slightly moist to moist, tight and soft)			
-12	12 - 14	24/9	5 17 13 50/0.4	SILT: Brown silt, little clay, trace fine to medium gravel (soft, moist to wet and semi-cohesive)			Ground-Water at 11.9 ft End of Boring at 13.4 ft Spoon refusal, bedrock inferred Bentonite

EA Engineering Science, and Technology

LOG OF BORING: MW-5B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138085.16
	Geologist: Jennifer Martin	Easting: 1030597.75
	Date Started: 8/21/00	Surface Elevation: 603.0 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/21/00	Total Depth of Boring: 11 Feet

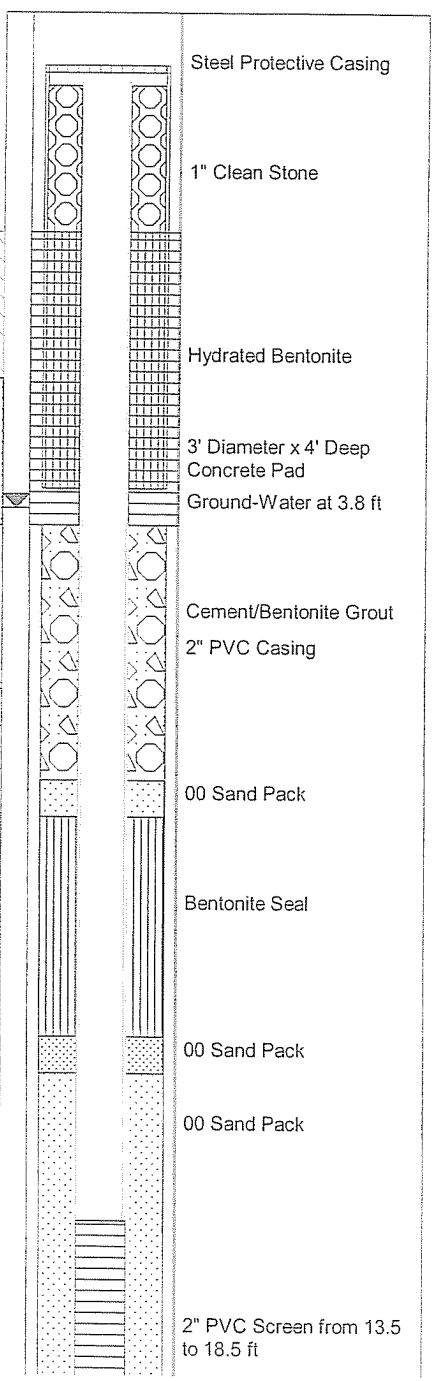
Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
2							Steel Protective Casing
							1" Clean Stone
0	0 - 2	24/19	4 8 6 8	CLAY: Brown clay, little silt, trace fine gravel (dry and tight)			Hydrated Bentonite 3' Diameter x 1.5' Deep Concrete Pad 00 Sand Pack
-2	2 - 4	24/10	8 16 18 22	SILT AND CLAY: Light brown silt and clay, trace orange and red mottles (dry and tight)			Bentonite Seal
-4	4 - 6	24/19	7 8	SILT AND CLAY: Brown silt and clay (dry to slightly moist, soft and tight)			2" PVC Casing
			7 9	CLAY: Brown clay, trace silt (moist, soft and tight)			
-6	6 - 8	24/24	9 7 6 11	CLAY: Brown to reddish brown clay, little silt (moist, soft and tight)			00 Sand Pack 2" PVC Screen from 5.25 to 10.25 ft
-8	8 - 10	24/14	23 16 15 8	SAND AND SILT: Brown very fine sand and silt, trace fine to medium gravel (moist to wet, loose and non-cohesive)			Ground-Water at 8.5 ft
-10	10 - 12	22/11	20 4	SAND AND SILT: Brown very fine sand and silt, little fine to medium gravel, trace clay (wet, loose to semi-cohesive)			End of Boring at 11 ft Auger refusal, bedrock inferred Bentonite

EA Engineering Science, and Technology

LOG OF BORING: MW-6B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138101.19
	Geologist: Jennifer Martin	Easting: 1030177.05
	Date Started: 8/21/00	Surface Elevation: 601.2 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/21/00	Total Depth of Boring: 20 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
2							
0	0 - 2	24/5	4 4 4 3	CLAY: Brown clay, trace silt (dry to slightly moist, soft and tight) - fill			
-2	2 - 4	24/2	5 2 2 2	FINE SAND: Brown very fine sand, little silt (dry to slightly moist, loose and non-cohesive) - fill			
-4	4 - 6	24/8	1 3 4 5	CLAY AND SILT: Brown clay and silt (slightly moist, soft and tight)			
-6	6 - 8	24/24	8 11 16 13	CLAY: Brown clay, trace fine to medium gravel (dry to slightly moist and soft)			
-8	8 - 10	24/20	8 8 10 5	SILT: Brown silt, trace to little clay (slightly moist to moist and semi-cohesive)			
-10	10 - 12	24/24	7 8 9 7				
-12	12 - 14	24/24	6 7 8 6	CLAY: Brown clay, little to trace silt - grading from top to bottom (moist, soft and cohesive)			
-14	14 - 16	24/24	3 2 4	CLAY: Brownish gray clay (soft, moist to wet and tight)			



EA Engineering Science, and Technology

LOG OF BORING: MW-6B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138101.19
	Geologist: Jennifer Martin	Easting: 1030177.05
	Date Started: 8/21/00	Surface Elevation: 601.2 Ft MSL
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/21/00	Total Depth of Boring: 20 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
-16	16 - 18	24/20	2 1 3 2 7				
-18	18 - 18.7	24/2	38 50/0.1	DOLOMITE: Weathered dolomite			Bentonite End of Boring at 20 ft Auger refusal, bedrock inferred
-20							

EA Engineering Science, and Technology

LOG OF BORING: MW-7B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138463.39
	Geologist: Jennifer Martin	Easting: 1029833.06
	Date Started: 8/22/00	Surface Elevation: 607.0
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/22/00	Total Depth of Boring: 17.5 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
2							Steel Protective Casing
							1" Clean Stone
0	0 - 2	24/2	7 4 5 6	CLAY: Brown clay (dry and hard) - fill			
-2	2 - 4	24/15	8 9 10 13				Hydrated Bentonite
-4	4 - 6	16/9.5	3 4 50/0.3	CLAY: Brown clay (slightly moist, soft and tight) FINE SAND: Gray very fine to fine sand, yellow and orange mottles, little silt and fine gravel (dry and loose)			3' Diameter x 4' Deep Concrete Pad Cement/Bentonite Grout 00 Sand Pack
-6	6 - 8	7/7	50/0.4	CLAY AND GRAVEL: Brown clay and fine to medium gravel (wet, loose to semi-cohesive)			Bentonite Seal
-8	8 - 10	24/21	4 4 7 5	GRAVEL AND SAND: Black fine to medium sand and gravel, trace course sand (wet and loose) CLAY: Brown clay, trace			2" PVC Casing Ground-Water at 8.8 ft 00 Sand Pack
-10	10 - 12	24/12	8 6 10 6				
-12	12 - 14	24/24	3 3 6 6	SILT AND CLAY: Brown to reddish brown silt and clay (wet, soft and tight)			2" PVC Screen from 11 to 16 ft
-14	14 - 16	24/24	7 5 5	CLAY AND GRAVEL: Brown clay and gravel (wet, loose to semi-cohesive)			

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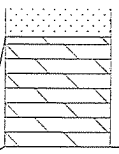
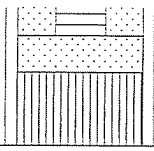
Technology

LOG OF BORING: MW-7B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138463.39
	Geologist: Jennifer Martin	Easting: 1029833.06
	Date Started: 8/22/00	Surface Elevation: 607.0
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/22/00	Total Depth of Boring: 17.5 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
-16	16 - 16.4	5/3	26 50/0.4	FINE SAND: Brown very fine to medium sand, little silt and gravel, trace clay (wet and loose) DOLOMITE: Weathered dolomite			Bentonite End of Boring at 17.5 ft Auger refusal, bedrock inferred

EA Engineering Science, and Technology

LOG OF BORING: MW-8B

BOC GASES WITMER ROAD LANDFILL CLOSURE	Project: BOC GASES	Equipment: 2-in Split-Spoon Sampler
	Project Number: 12040.68.0016	Northing: 1138901.46
	Geologist: Jennifer Martin	Easting: 1029642.84
	Date Started: 8/22/00	Surface Elevation: 609.4
Hammer Weight/Fall: 140lb/30"	Date Completed: 8/22/00	Total Depth of Boring: 13 Feet

Depth (fbg)	Split Spoon Interval (fbg)	Inches Drvn/In. Recvrd	Blow Counts per 0.5 ft	Soil Description	Graphic Log	Well Construction	Remarks
2						Steel Protective Casing	
						1" Clean Stone	
0	0 - 2	24/13	1 7 3 5	FINE SAND: Light brownish red very fine to fine sand, trace silt (dry to slightly moist and loose3) - fill		Hydrated Bentonite 3' Diameter x 1.5' Deep Concrete Pad	
-2	2 - 4	24/14	5 2 3 4			00 Sand Pack Bentonite Seal	
-4	4 - 6	24/22	5 8 8 10	SILT AND CLAY: Brown silt and clay, red and gray mottles (dry to slightly moist, hard and tight)		2" PVC Casing Ground-Water at 5.8 ft	
-6	6 - 8	24/24	17 11 10 10				
-8	8 - 10	24/16	2 10 6 7	SAND AND CLAY: Brown very fine sand and clay, little silt, trace to little fine to medium gravel (moist to wet and loose to semi-cohesive)		00 Sand Pack 2" PVC Screen from 7 to 12 ft	
-10	10 - 12	24/18	13 12 7 10			Split spoon refusal at 12.75 ft	
-12	12 - 12.75	8/0	17 50/0.2	DOLOMITE: Dolomite cobble in bottom of spoon		End of Boring at 13 ft Auger refusal, bedrock inferred Bentonite	