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Superfund - hw
Spills - sp
ERP - e
VCP - v
BCP - c

non-releasable - put .nf.pdf
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REPORT

# OPERATION AND MAINTENANCE PLAN
# REMEDIATION SYSTEM
# MOBIL BUFFALO TERMINAL

*Prepared for*
Mobil Business Resources Corp.
464 Doughty Boulevard
Inwood, New York 11096

May 14, 1998

Woodward-Clyde

Woodward-Clyde International-Americas
1400 Union Meeting Road
Suite 202
Blue Bell, Pennsylvania 19422
7E02600-3

**From:** Christopher Magee
**To:** REG90.Buffalo.tedieffe
**Date:** 5/28/98 4:41pm
**Subject:** Mobil / Buffalo Terminal

As promised, comments on the O&M plan for the Remedial System before 05/29.

I have received your fax with the field work schedule.
I am not going to be in the office on Friday (tomorrow?), call me on Monday (515-457-3891) and we can talk about what needs to be covered and who's best to do it.

**New York State Department of Environmental Conservation**
Division of Spills Management
50 Wolf Road, Albany, New York 12233-3750
Telephone: 518-457-9412
FAX: 518-457-9210

**MEMORANDUM**

To: T. Dieffenbach

From: C. Magee

Subject: O&M Plan
Remedial System
Mobil Buffalo Terminal

Date: 05/28/98

---

I have reviewed the above proposal prepared by Woodward-Clyde on the behalf of Mobil Business Resources Corporation and dated 05/14/98. In my opinion it may be implemented with the following minor modifications.

Comments:

1. **Page 2-1**
   **Section 2.1 Background**

   The last two sentences of the last paragraph in this section state that, AFigure 3 is a generalized process and instrumentation diagram for the systems. Detailed equipment information about individual system components is included in Appendix A.@

   An abbreviated review of Appendix A suggests that it includes equipment descriptions for the Dual Phase Recovery System and the Water Treatment System, but that the details of the Well Point System have been omitted. Appendix A should be modified to make it consistent with the statements in section 2.1.

2. **Page 3-1**
   **Section 3.1 Performance Goals**
   **Section 3.2 Scheduled Operations, Maintenance and Monitoring**

The first sentence of this section outlines the performance goal of this system's operation as to A... create and maintain hydraulic control of the product and dissolved plume on the site in order to prevent impact to the Buffalo River.@

The activities specified in the section titled Scheduled Operations, Maintenance and Monitoring (section 3.2) will not monitor the system's performance in achieving this goal. These activities make no allowance for the measurement or calculation of the horizontal and vertical capture curves (the zone of capture) of the extraction systems, or the monitoring of the quality of the ground water discharging into the Buffalo River down gradient of these systems.

The remedial goals should also include the attempt to return the areas impacted by the spill(s) to pre-spill conditions (as defined by criteria such as TOGS 1.1.1, STARS Memo #1 and TAGM 4046, or exposure based levels calculated specifically for the site). Mobil should determine the mass of contaminant present and the predicted rate of removal to develop a remediation schedule with targets at specific points in the future to allow the predicted performance of the system to be evaluated against real data.

**REPORT**

# OPERATION AND MAINTENANCE PLAN
# REMEDIATION SYSTEM
# MOBIL BUFFALO TERMINAL

RECEIVED

MAY 15 1998

NYSDEC - REG. 9
FOIL
__REL__UNREL

*Prepared for*
Mobil Business Resources Corp.
464 Doughty Boulevard
Inwood, New York 11096

May 14, 1998

**Woodward-Clyde**

Woodward-Clyde International-Americas
1400 Union Meeting Road
Suite 202
Blue Bell, Pennsylvania 19422
7E02600-3

# TABLE OF CONTENTS

## 1.1 LOCATION

The Mobil Buffalo Terminal #31-010 (the site) is located at 625 Elk Street in Buffalo, Erie County, New York, as shown on Figure 1.

## 1.2 ABOUT THIS MANUAL

This manual provides a plan for operation, maintenance, monitoring, and reporting for the groundwater and product recovery system, the storm water lift station and the water treatment systems at the site.

The operations and maintenance (O&M) program, defined in this manual reflects agreements between Mobil and the NYSDEC, per Order on Consent No. 95-08, dated April 29, 1997, and signed on May 21, 1997. The O&M plan will provide sufficient data to facilitate the ongoing evaluation of the pumping system efficiency, and a performance assessment of product containment and recovery.

## 1.3 GROUNDWATER, PRODUCT RECOVERY, AND TREATMENT SYSTEMS

Three independent, but interconnected systems collect water for treatment at the site; a Well Point System (WPS), a Dual-Phase Recovery System and a Storm Water Lift Station. These systems discharge their respective flows to the Water Treatment System through a common piping header, as generally depicted on the Flow Diagram, Figure 2. A generalized process and instrumentation diagram for the systems is depicted on Figure 3. The groundwater and recovery system layout at the site are shown on Figure 4.

The groundwater, product recovery, and water treatment systems at the site consist of the following components:

- **Well Point System (WPS)** - Two liquid-ring pump systems vacuum extract groundwater, product and soil vapor from a network of approximately 130 extraction wells across the southern boundary of the site adjacent to the Buffalo River. The extracted fluids are pumped to the water treatment system.

- **Dual-Phase Recovery System** - Six recovery wells are fitted with groundwater depression and product recovery pumps and controls. The product pumps discharge to 1,000-gallon product holding tanks adjacent to each recovery well. Recovered groundwater is discharged into a combined flow header to the water treatment system.

- **Storm Water Lift Station** - A concrete sump, which is approximately 10 feet in diameter and 12 feet deep, collects storm water from the former loading rack area, the biocell area (northeast section of the site), and the roadways around the current tank dikes (southeast portion of the site). A 5-horsepower vertical pump discharges the accumulated water to the water treatment system influent header.

- **Water Treatment System** - The water treatment system is housed within the "Remediation Building", which was previously known as the "Old Fire House". Water is transferred to the treatment system from the extraction and collection systems through a 6-inch carbon steel pipe header. The treatment system is comprised of a 400-gpm slant-rib type oil-water separator and an air sparge system with three parallel tank / blower units. The treated effluent is discharged under permit via gravity to the Buffalo Sewer Authority (BSA).

## 2.1 BACKGROUND

The collective effect of the groundwater and product recovery systems is hydraulic control of the product and groundwater plume, and significant product recovery.

The WPS consists of a series of approximately 130 interconnected well points located adjacent to the Buffalo River. The WPS has been in operation since 1971. In September, 1993, Mobil activated a Dual-Phase Recovery System that consists of six recovery wells to recover product and groundwater. The Storm Water Lift Station receives surface water from three areas on the site.

Each of these systems discharge through common piping to the Water Treatment System, which subsequently discharges to the BSA. Interconnection of these systems is depicted on Figure 2. Figure 3 is a generalized process and instrumentation diagram for the systems. Detailed equipment information about individual system components is included in Appendix A.

## 2.2 WELL POINT SYSTEM

The WPS has been operating since 1971. It consists of approximately 130 well points located parallel to the Buffalo river (see Figure 3). Each well point is approximately 25 feet deep and 2.5 inches in diameter with a drop tube assembly within the well. Each point has a riser to the surface so that the well can be accessed. Each well has a valve connecting it to the 6-inch header. The well points are connected in series to a horizontal header pipe that leads to a dual liquid ring pump (LRP) vacuum system. Vacuum gauges are located along the header at several locations.

X The LRPs provide vacuum that extracts fluid from all the well points tied into the header. Each has a 25Hp motor which drives the LRP and a centrifugal water pump. Water and any petroleum pulled from the WPS is pumped directly into the piping system and transmitted to the water treatment system prior to discharge to the Buffalo municipal sewer system. The WPS runs independently of the Dual-Phase Recovery system. The average groundwater recovery rate for the WPS is approximately 100 gpm. Flow from the WPS is measured by a totalizer-type flowmeter, and is typically recorded on a daily basis.

## 2.3 DUAL-PHASE RECOVERY SYSTEM

Six (6) Dual-Phase Recovery Systems have been installed at the site to recover product. The Dual-Phase Recovery Systems operate in conjunction with, but independent of WPS. The recovery wells were constructed of 8-inch, 20-slot continuous wrap PVC well screen. The recovery well locations are shown on Figure 2. Screen was placed from approximately 10 to 25 feel below grade, depending on the location of the first clay confining layer. A 2-foot long sump was placed at the bottom of each well for pump placement and sediment accumulation.

Dual-Phase Recovery Systems use the coordinated effects of two pumps to optimize the recovery of product. Each recovery well is equipped with a submersible groundwater pump and a separate product pump. A groundwater pump is located near the bottom of the well, and the product pump is located above it. By pumping water out of the recovery well, the water level is lowered in the surrounding area, creating a "cone of depression", which is used to capture floating product and maximize its recovery.

The pumps are controlled by groundwater and product-specific density- float type level sensors. The lower pump discharges groundwater through an above-ground piping header system to the Water Treatment System located in the Remediation Building. A Halliburton flow analyzer monitors flow at each recovery well. The total average groundwater recovery rate for the Two-Phase recovery wells is approximately 10 to 15 gpm.

When the product sensor activates the product pump, it recovers product from the well and discharges it through double-contained piping directly to a 1,000-gallon above-ground steel storage tank located at the recovery well. A 4-inch port on top of the tank allows stick reading of product levels and vacuuming out of recovered product. Each tank is vented with two-inch pressure/vacuum vent and an 8-inch emergency relief vent. A float will shut down product pump if the tank is full. Recovered product is transported off-site for disposal. Each product storage tank is surrounded by a 1,100-gallon capacity containment dike.

Recovery Wells RW-1 and RW-2 were installed in July 1991, and wells RW-3, 4, 5 and RW-6 were installed in 1992 to provide hydraulic control of the entire area known to contain product (based on pump test evaluation and computer modeling).

## 2.4 STORM WATER LIFT STATION

Storm water is collected in a concrete sump, which is approximately 10 feet in diameter and 12 feet deep. Surface storm water comes from three areas: the former loading rack, the road around the terminal office and Biotreatment Cell, and the roads around the storage tanks.

A 5-horsepower vertical Goulds sump pump discharges the accumulated water to the water treatment system influent header. The discharge flow is measured by an insertion-type turbine flow meter, with a local digital rate and totalizer display.

to date
not reported?

The sump is fitted with high and high-high level sensors, to alert operators about the potential for sump overflow and surcharge of upstream junction boxes. A high level condition activates a red warning light. A high-high level condition (pending overflow of the sump) will alert the operator for the need for supplemental manual pumping-out of the sump. When the alarm conditions subside, the pumped water can be returned to the sump for processing through the water treatment system, as normal.

There has been no apparent or significant accumulation of silt within the sump to date.

## 2.5 WATER TREATMENT SYSTEM

The water treatment system is housed within the "Remediation Building", which was previously known as "the old Fire House" (See Figure 3). Water is pumped to the water treatment system through a 6-inch steel pipe header, with combined flows from the WPS, Dual-Phase Recovery Systems, and the Storm Water Lift Station. The above-ground header piping is insulated and protected from freezing by heat tapes.

The water treatment system consists of an inlet strainer, a 400-gpm slant rib coalescing oil-water separator (OWS) and a three-tank air sparging unit, each with a dedicated regenerative blower and flow switch, and an 8,000-gallon product storage tank with secondary containment. The OWS removes any separate phase product which may be present in the influent stream. The air sparge tanks can be used to strip and reduce dissolved concentrations of contaminant, if necessary, to meet BSA permit limits. The air sparge tanks vent through a 50-foot tall stack. A bypass is included in the OWS discharge piping to allow direct discharge to the BSA after the OWS when necessary.

The water treatment system receives all groundwater and any product recovered by the WPS, groundwater from the Dual-Phase Recovery Systems, and storm water from the Storm Water Lift Station. The water treatment system receives water continuously from the WPS and intermittently from the Dual-Phase Recovery Systems and Storm Water Lift Station. Except for the pumped influent flow into the system, the water treatment system operates via gravity transfer of liquids throughout the process.

Any product recovered by the OWS is manually transferred to an 8,000-gallon product storage tank using a pneumatic double-diaphragm pump. A sludge pump is used to periodically remove sludge and solids from the bottom of the OWS.

The 8,000-gallon product storage tank also receives product transferred from the six 1000-gallon Dual-Phase recovery system tanks as it accumulates. This product is removed from the 1,000-gallon storage tanks and transferred to the 8,000-gallon product storage tank using a vacuum truck. Product is removed from the 8,000-gallon product storage tank to offsite recycling facilities on an as-needed basis. Product removal events are reported in the Quarterly Reports (see Section 4.4).

## 2.6 CRITICAL DEVICES

Critical devices are defined as those system components that provide a safety or protective function, and should be inspected and maintained on a regular basis to assure safe operations.

A Critical Devices List and inspection procedures and schedule is included in Appendix B.

## 3.1 PERFORMANCE GOALS

The groundwater and product recovery systems were installed and are operated to create and maintain hydraulic control of the product and dissolved plume on the site in order to prevent impact to the Buffalo river. The goal of this O&M program is to provide consistent oversight and attention to the systems through routine inspections, monitoring, operation and maintenance. It also provides methods to support consistent performance, optimal reliability, efficiency and cost-effective operation, while providing responsive procedures to address changes in operational needs and correct problems as they arise.

## 3.2 SCHEDULED OPERATIONS, MAINTENANCE AND MONITORING

The O&M program is defined by routine events and standard procedures and reports to address the long-term project needs. O&M falls into three basic categories:

- **Routine Maintenance and Monitoring:** Scheduled events periodic (daily, weekly, monthly, quarterly) to inspect, monitor, adjust, maintain, record, track and report proper system performance and maintain regulatory compliance.

- **Preventive Maintenance:** Less frequent events, designed to improve reliability, reduce downtime and corrective maintenance costs by addressing equipment and system operating needs before they compromise system performance, cause compliance exceedances and/or catastrophic failure of equipment.

- **Corrective Maintenance:** Repair, replacement and correction of system components that break or stop functioning properly.

Table 1 Summarizes the schedule for Inspection, O&M, Monitoring, and Reporting activities.

### 3.2.1 ROUTINE MAINTENANCE AND MONITORING:

#### *DAILY MAINTENANCE AND INSPECTIONS*

Forms and logs referred to in this section are included in Appendix C. On-site personnel will perform routine system checks and inspections on a daily basis as follows:

#### *WELL POINT SYSTEM (WPS)*

1. Use "WELL POINT SYSTEM AND LIFT STATION DAILY INSPECTION FORM"
2. Visually inspect the southern site boundary along the Buffalo River. Record and report any locations with a sheen or other sign of product release.
3. Check and record the WPS operational status.
4. Record which system(s) are operating (Unit A, Unit B, or both)
5. Record vacuum pump vacuum/pressure readings
6. Record water pump pressure readings
7. Record the WPS header vacuum gauge readings across system
8. Record flow totalizer values for system
9. Inspect piping for leakage. Record and report any observed leaks.

#### *STORM WATER LIFT STATION*

1. Use "WELL POINT SYSTEM AND LIFT STATION DAILY INSPECTION FORM"
2. Inspect the storm sewer sump and pump for proper operation, and record system status.
3. Record flow meter readings, rate and totalizer values.
4. Inspect piping for leakage. Record and report any observed leaks.

#### *DUAL-PHASE RECOVERY SYSTEMS*

1. Use "DUAL-PHASE RECOVERY SYSTEM DAILY INSPECTION FORM"

2. Inspect the systems at RW-1, RW-2, RW-3, RW-4, RW-5 and RW-6, including the product recovery tanks, interconnecting piping, heat trace and controls.
3. Inspect piping for leakage. Record and report any observed leaks.
4. Gauge and record levels of all product recovery tanks.
5. Indicate if tank is ready for pump-out.
6. Check and record the operational status of all pumps and controls. Check and record any fault status indications.
7. Record flow totalizer values for each system.

### *WATER TREATMENT SYSTEM*

1. Use "WATER TREATMENT SYSTEM DAILY INSPECTION FORM"
2. Inspect the oil-water separator (OWS) high level fault indicators.
3. Record the level in the 8,000-gal product recovery tank
4. Inspect OWS and air sparge tanks, interconnecting piping, heat trace and controls for leakage. Record and report any observed leaks.
5. Check and record the operational status of the blowers and controls. Check and record any fault status indications.

## *WEEKLY MAINTENANCE AND INSPECTIONS:*

Routine inspection and maintenance of the systems is typically performed on a weekly basis, as described in Table 1. Notes are recorded on the daily inspection form for each respective system.

### *WELL POINT SYSTEM*

1. Record flow totalizer values and check critical devices (see Appendix B)
2. Note abnormal conditions.

### *STORM WATER LIFT STATION*

1. Inspect the Storm sewer sump and pump for proper operation, and record system status.

2. Record pump pressure and flow meter readings (rate and totalizer values).
3. Make any necessary adjustments and perform any necessary corrective maintenance to put system in proper operating order.
4. Record any repairs that are made. Note any additional necessary repairs or recommended system modifications.

### *DUAL-PHASE RECOVERY SYSTEMS*

1. Inspect the systems at RW-1, RW-2, RW-3, RW-4, RW-5 and RW-6, including the product recovery tanks, interconnecting piping, heat trace and controls.
2. Inspect piping for leakage. Record and report any observed leaks.
3. Gauge and record levels of all (six) product recovery tanks and indicate if a tank pump-out is required.
4. Inspect tank containment dikes for integrity. Drain all accumulated rainwater water from each containment as necessary.
5. Check and record the operational status of all pumps and controls. Check and record any fault status indications.
6. Perform all necessary corrective maintenance to correct any system faults, and to make the system operational.
7. Record any repairs that are made. Note any additional necessary repairs or recommended system modifications.
8. Record flow totalizer values for each system.
9. Make any necessary adjustments and perform any necessary corrective maintenance to put system in proper operating order.
10. Record any repairs that are made. Note any additional necessary repairs or recommended system modifications.

### *WATER TREATMENT SYSTEM*

1. Inspect the inlet strainer pressure. If the inlet pressure exceeds 5 psig, shut down the systems, disassemble and clean the inlet strainer. And put it back into service.
2. Inspect the OWS high level fault indicators.
3. As required, manually pump the accumulated oil from the separator into the 8,000-gallon storage tank using the double-diaphragm pump.

4. Inspect the 8,000-gallon storage tank and containment dike. Drain any accumulated rain water from the containment.
5. Record the level in the 8,000-gal product recovery tank. Indicate if it requires pump-out.
6. Inspect OWS and air sparge tanks, interconnecting piping, heat trace and controls for leakage. Record and report any observed leaks.
7. Check and record the operational status of the blowers and controls.
8. Visually inspect the interior of the BSA storm water catch basin (about 4-feet square) which receives the treated water discharge. The presence of any product or sheen indicates the potential for product release through the treatment system. Investigate, report and resolve any such conditions.
9. Make any necessary adjustments and perform any necessary corrective maintenance to put system in proper operating order.
10. Record any repairs that are made. Note any additional necessary repairs or recommended system modifications.

## *QUARTERLY MAINTENANCE AND INSPECTIONS:*

### *SITE-WIDE MONITORING*

1. Gauge all monitoring and recovery wells and piezometers across the site.

### *WATER TREATMENT SYSTEM*

1. Sample the water treatment system influent and effluent to support the air discharge permit emissions calculations.
2. Properly fill out a chain of custody, and submit the samples to a certified laboratory in accordance with approved sampling protocol.

BSA monitoring & reporting requirements?

Results of quarterly maintenance activities are reported to the NYSDEC in the Site Monitoring Reports, an example of which is included in Appendix D.

### 3.2.2 PREVENTIVE MAINTENANCE:

## *MONTHLY PREVENTIVE MAINTENANCE:*

### *DUAL-PHASE RECOVERY SYSTEMS*

1. Pull and clean the level probes at each recovery well (RW-1, RW-2, RW-3, RW-4, RW-5, and RW-6), clean and inspect them.
2. Repair or replace any defective items.
3. Reinstall the probes, and adjust them to the proper levels. Reactivate the system and verify proper function.
4. Record any repairs that are made on the "GENERAL EQUIPMENT SERVICING SHEET" (Appendix C). Note any additional necessary repairs or recommended system modifications.

## *QUARTERLY PREVENTIVE MAINTENANCE*

### *WELL POINT SYSTEM*

1. The liquid ring vacuum pumps will be cleaned disassembled and inspected for wear. Internal cleaning, bearing and seal replacement will be performed as required. Record any repairs that are made on the "GENERAL EQUIPMENT SERVICING SHEET".

### *STORM SEWER LIFT STATION*

1. Inspect the lift station pump, and grease the bearings in accordance with the manufacturer's instructions. Record any repairs or servicing on the "GENERAL EQUIPMENT SERVICING SHEET".

### *DUAL-PHASE RECOVERY SYSTEMS*

1. Pull and clean the product and groundwater pumps at each recovery well (RW-1, RW-2, RW-3, RW-4, RW-5, and RW-6), clean and inspect them.
2. Repair or replace any defective items. Record any repairs that are made on the "GENERAL EQUIPMENT SERVICING SHEET".
3. Reinstall the pumps, and adjust them to the proper levels. Reactivate the system and verify proper function.

### *WATER TREATMENT SYSTEM*

1. Deactivate the water treatment system.
2. Transfer all accumulated oil into the 8,000-gallon product holding tank.
3. Pump all sludge out of the system using the manual control sludge auger, and a vac-truck.
4. Thoroughly steam clean the slant rib packing and the OWS tankage.
5. Drain the air sparge system tanks. Deactivate the blowers.
6. Open the air sparge tanks, vacuum them out and steam clean them.
7. Reassemble all systems and components, and reactivate the system.
8. Examine the systems and piping for leaks. Examine heat trace systems for proper operation.
9. Correct any faults, perform all necessary corrective maintenance as required. Record any repairs that are made on the "GENERAL EQUIPMENT SERVICING SHEET".

## *ANNUAL PREVENTIVE MAINTENANCE*

### *DUAL-PHASE RECOVERY SYSTEMS*

1. Clean and redevelop the (six) product recovery wells using an approved and accepted methodology, to restore well efficiency and yield. Record work done on the "GENERAL EQUIPMENT SERVICING SHEET".

What methodology

To our knowledge this has never yet been performed

### *WELL POINT SYSTEM*

1. The backflow preventer on the potable water supply will be cleaned, calibrated and tested in accordance with manufacturers instructions and certified by a licensed plumber. Record work done on the "GENERAL EQUIPMENT SERVICING SHEET".

## 3.2.3 CORRECTIVE MAINTENANCE:

Corrective maintenance will address the unplanned repair, replacement or modification of the system equipment. Reporting forms included in Appendix E are intended to allow reporting of the conditions described below to the NYSDEC via Fax:

1. Repairs will be performed in accordance with manufacturer's instructions and manuals and system design drawings provided in the appendices. All system repairs will be documented, so that recurring problems can be identified and resolved effectively.
2. A "SYSTEM DOWN NOTIFICATION FORM" (Appendix E) will be filled out and communicated to the NYSDEC if the Well Point System is down for more than a 24-hour period.
3. A "SYSTEM DOWN NOTIFICATION FORM" will be filled out and communicated to the NYSDEC if the Dual-Phase Recovery System is down for more than a consecutive 3-day period, or 5-days or more in any one month period.
4. Recurring problems will be tracked, reviewed, resolved and reported to the NYSDEC using the "RECURRING OPERATIONAL PROBLEM RESOLUTION FORM".
5. Any proposed or implemented system modifications will be documented and reported to the NYSDEC using a "SYSTEM MODIFICATION FORM".

No Reports made
to date

## 4.1 GENERAL

Logs will be kept of daily inspection forms. Summaries of the monitoring data are reported to the NYSDEC quarterly through the Site Monitoring Reports. Certain events are communicated to the NYSDEC via additional forms and/or reports, as described in Section 3.2.3, and are included in Appendix E. They are included in this section to thoroughly describe NYSDEC reporting requirements for the systems.

## 4.2 EVENT REPORTS

*System Down Reports*

The WPS, Dual-Phase Recovery System, and Storm Water Lift Station operation are inspected and recorded daily, and reported monthly on the "MONTHLY OPERATIONS STATUS REPORT", which is included in Appendix D. The daily inspection forms of Appendix C provide the basis for preparing and determining reportable 24-hour events for the WPS and 3-Day Consecutive Event and 5-Day-per-Month Event Report for the Dual-Phase Recovery System. The "SYSTEM DOWN NOTIFICATION FORM" (Appendix E) is used to communicate these down-time events to the NYSDEC in a timely fashion.

This system of data collection and reporting also supports the review and detection of recurring problems. The "RECURRING PROBLEM RESOLUTION FORM" is used to identify and address any problems which may be recurring.

## 4.3 SYSTEM MODIFICATIONS

The "SYSTEM MODIFICATION FORM" will be used to document, discuss, justify and track the effectiveness of proposed or implemented system modifications.

## 4.4 QUARTERLY REPORTING

Quarterly reporting to the NYSDEC will include:

- Project Status Report

- Operations Report
- Permit Compliance Report
- Laboratory Data
- Groundwater Gauging Data Tables
- Groundwater Contour Map
- Monitor Well Hydrographs and Product Thickness Graphs

An example Quarterly Report that contains this information, as reported to the NYSDEC, is attached as Appendix D. Also contained in Appendix D are two sample forms that can be used as part of the Quarterly Report format. These are:

- Monthly Operations Status Report, and
- Permit Compliance.

# Tables

# Table 1

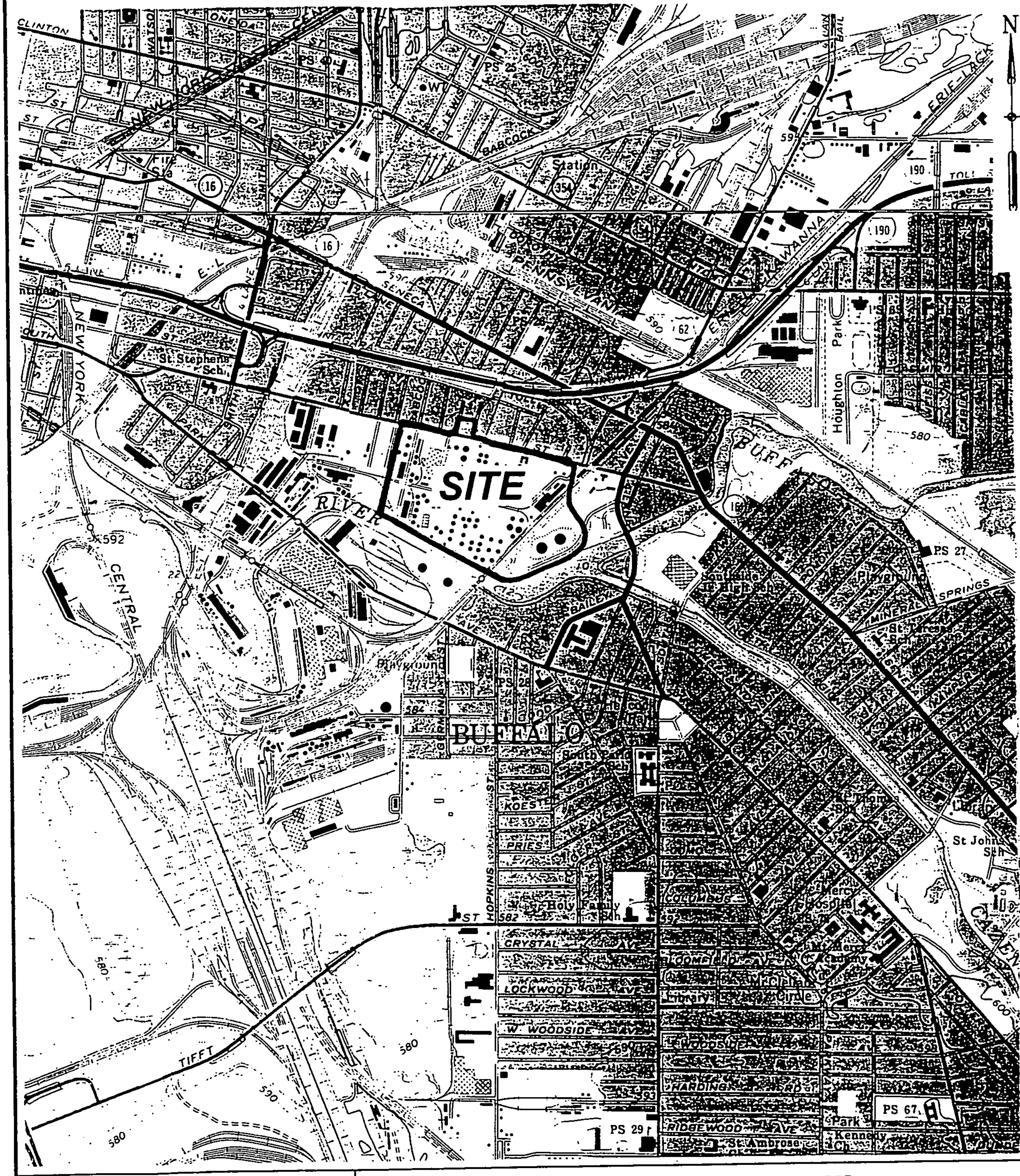
## Inspection, O&M, Monitoring, and Reporting Schedule

### Mobil Terminal # 31-010
### 625 Elk Street, Buffalo, NY

| | SYSTEM | ACTIVITY | REPORT |
|---|---|---|---|
| **DAILY** | Well Point System | Inspect, Record Readings | Well Point System And Lift Station Daily Inspection Form/LOG |
| | Storm Water Lift Station | Inspect, Record Readings | Well Point System And Lift Station Daily Inspection Form/LOG |
| | Dual-Phase Recovery System | Inspect, Record Readings | Dual-Phase Recovery System Daily Inspection Form/LOG |
| | Water Treatment System | Inspect, Record Readings | Water Treatment System Daily Inspection Form/LOG |
| **WEEKLY** | Well Point System | Inspect, Check All Critical Devices, Record Readings | Note Results on Daily Inspection Form |
| | Storm Water Lift Station | Inspect, Check All Critical Devices, Record Readings | Note Results on Daily Inspection Form |
| | Dual-Phase Recovery System | Gauge Tanks, Check Operation, Record Readings | Note Results on Daily Inspection Form |
| | Water Treatment System | Transfer Product to 8000-gallon tank, Inspect, Record Readings | Note Results on Daily Inspection Form |
| **MONTHLY** | Site-Wide | Check All Critical Devices, Notifications & Warning Signs.<br>Review System Downtime Data<br>Identify Recurring Operational Problems<br>Address and Resolve Recurring Problems | Monthly Operations Status Report<br>Monthly Operations Status Report<br>Monthly Operations Status Report<br>Recurring Operational Problem Resolution Form<br>System Modification Form<br>Permit Compliance (Report) Form |
| | Water Treatment System | Sample System Influent and Effluent | Results Reported to NYSDEC in Quarterly Reports |
| | Dual-Phase Recovery System | **Preventive Maintenance:**<br>Clean Level Probes | General Equipment Servicing Sheet |
| **QUARTERLY** | Site-Wide Event | **Quarterly Monitoring Event:**<br>Gauge Groundwater Levels at all Monitoring, Recovery Wells and Piezometers | Results Reported to NYSDEC in Quarterly Reports |
| | Water Treatment System | **Preventive Maintenance:**<br>Sludge Removal & Steam Clean OWS and Air Sparge Units | General Equipment Servicing Sheet |
| **ANNUAL** | Dual-Phase Recovery System | Clean and Redevelop Recovery Wells | General Equipment Servicing Sheet |

# Figures

**Woodward-Clyde**



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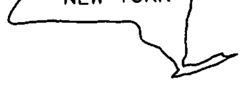
0 2000 4000

MAP SOURCE

BUFFALO-SE, NY QUADRANGLE,
U.S. GEOLOGICAL SURVEY, 1965



QUADRANGLE LOCATION

Job No. 7E02600

Prepared by: TP

Date: 07/11/1997

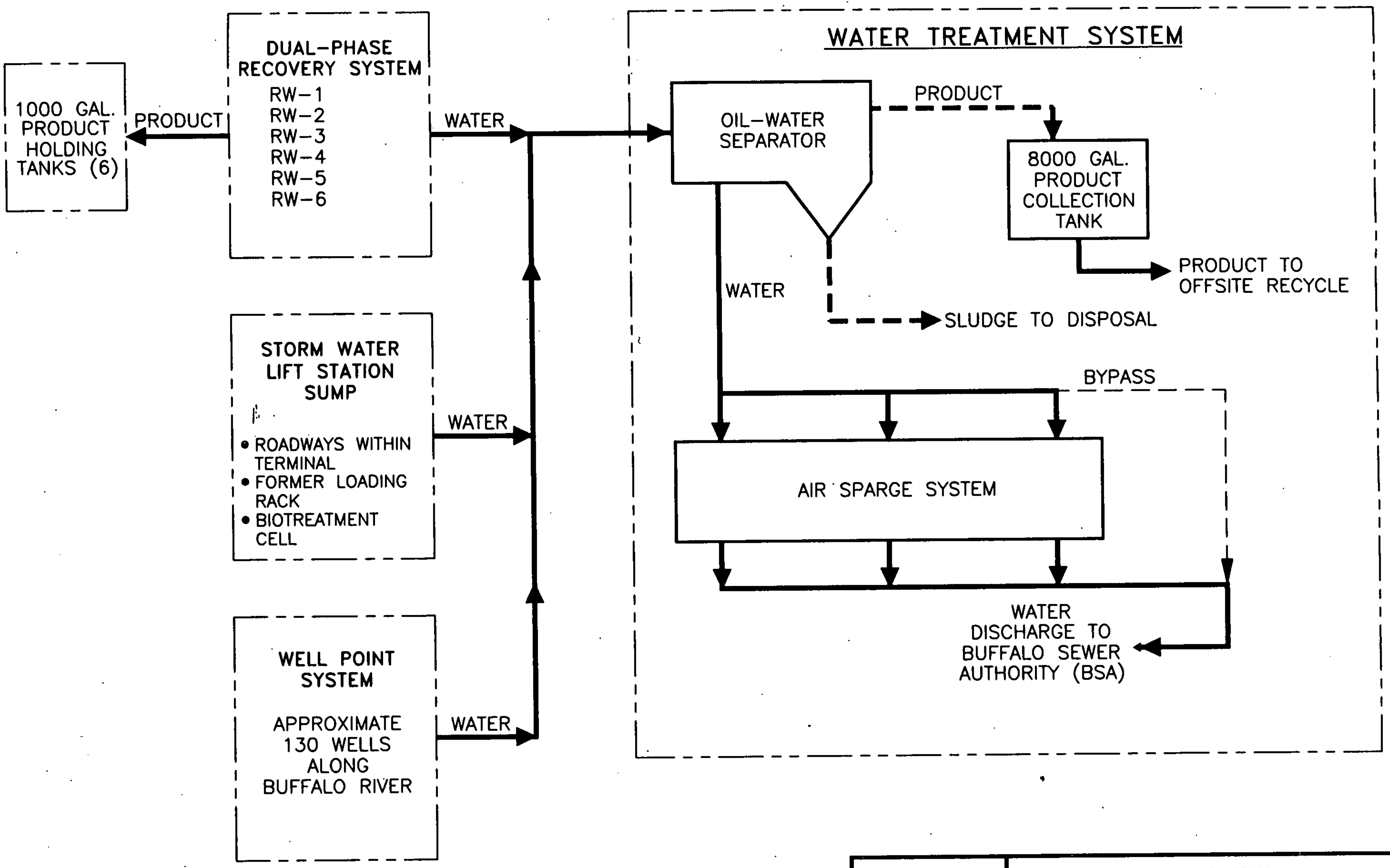
REGIONAL LOCATION MAP
MOBIL BUFFALO TERMINAL
BUFFALO, NEW YORK

FIGURE 1

E:\DRAFT\7E02600\FIG1

76002014.dwg

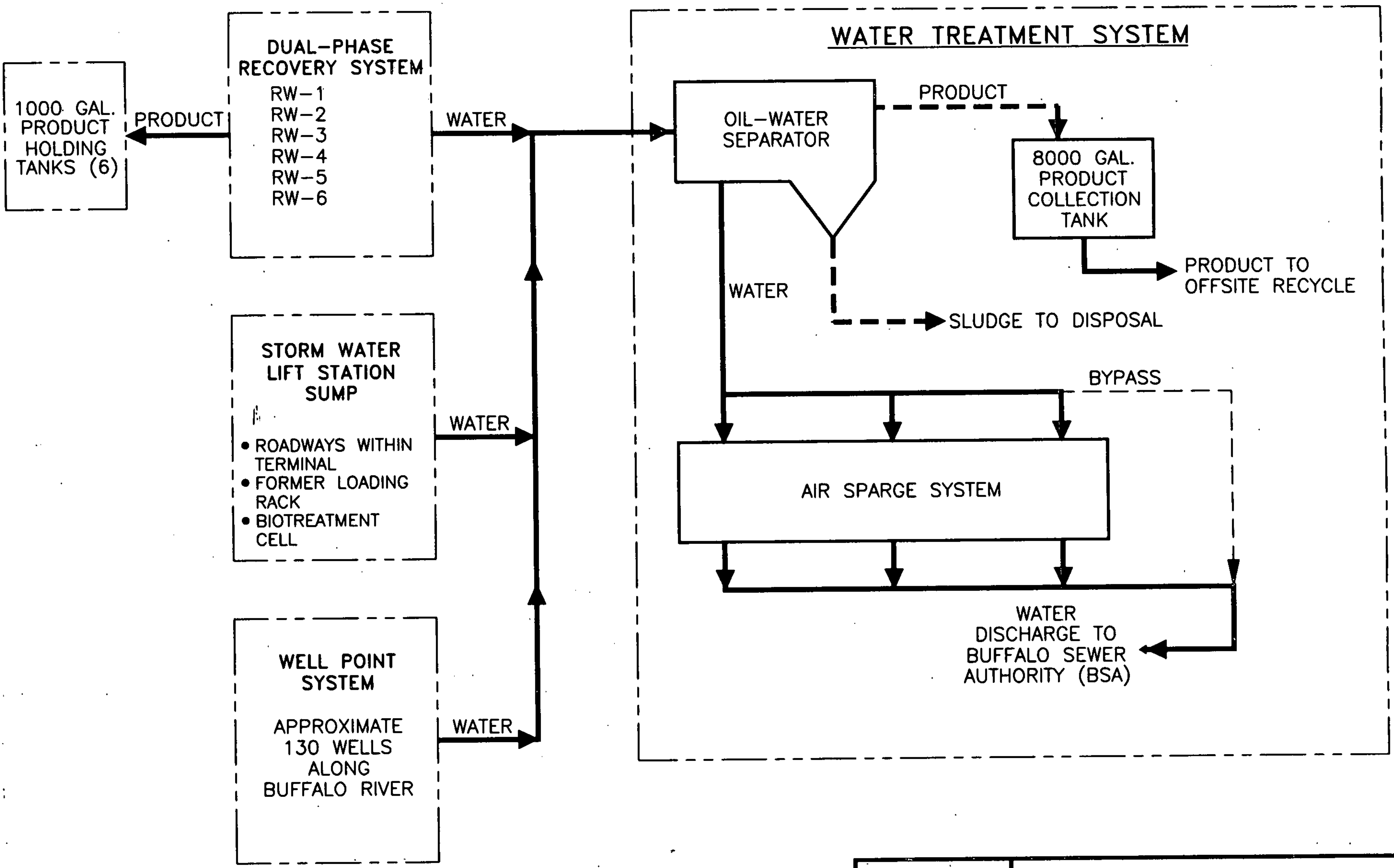
**Woodward-Clyde**



Job No. 7E02600
Prepared by: TFP
Date: 05/14/1998

FLOW DIAGRAM
WATER & PRODUCT RECOVERY & TREATMENT SYSTEMS
MOBIL – BUFFALO TERMINAL
BUFFALO, NEW YORK

FIGURE 2



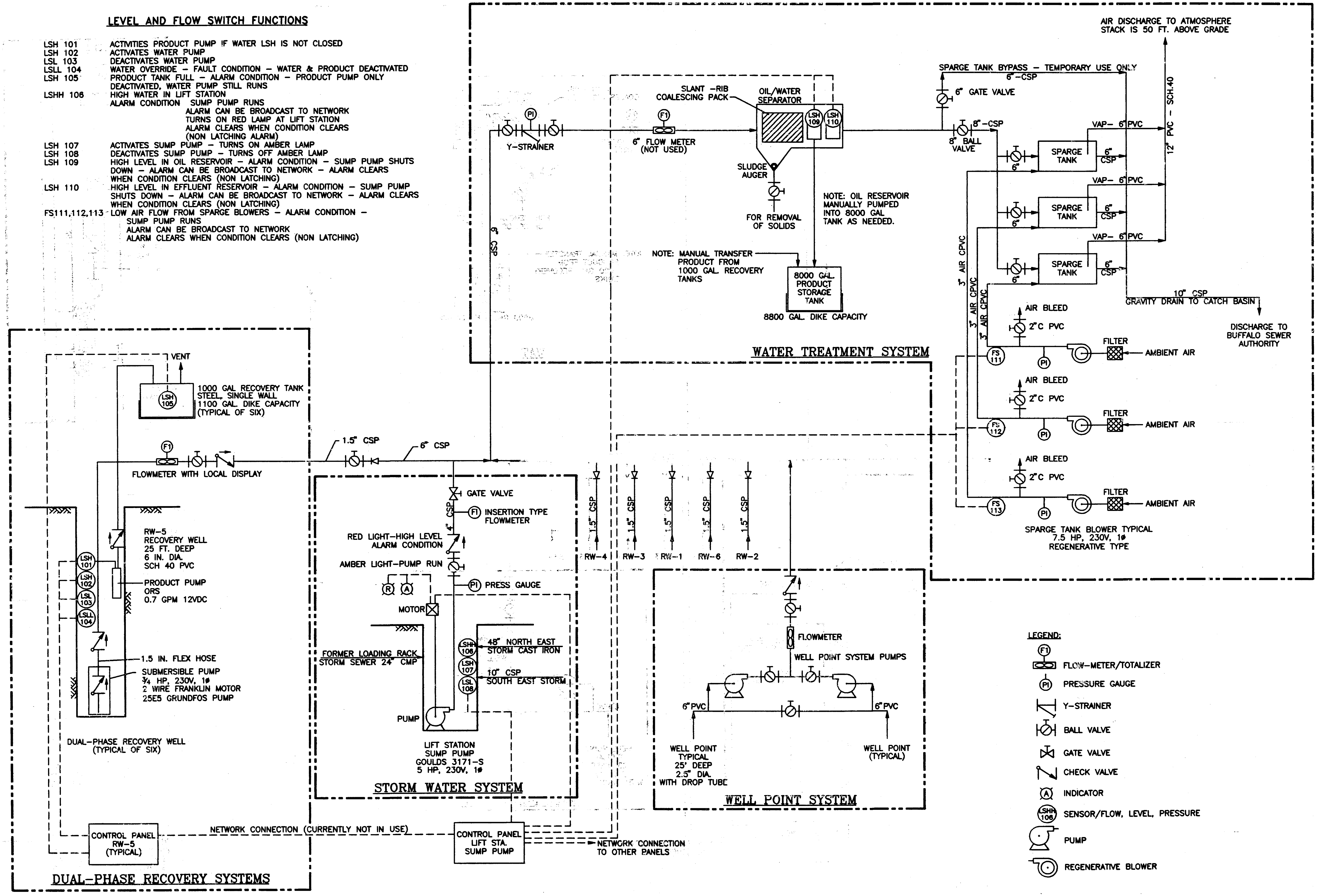
Job No. 7E02600
Prepared by: TFP
Date: 05/14/1998

FLOW DIAGRAM
WATER & PRODUCT RECOVERY & TREATMENT SYSTEMS
MOBIL – BUFFALO TERMINAL
BUFFALO, NEW YORK

FIGURE 2

## LEVEL AND FLOW SWITCH FUNCTIONS

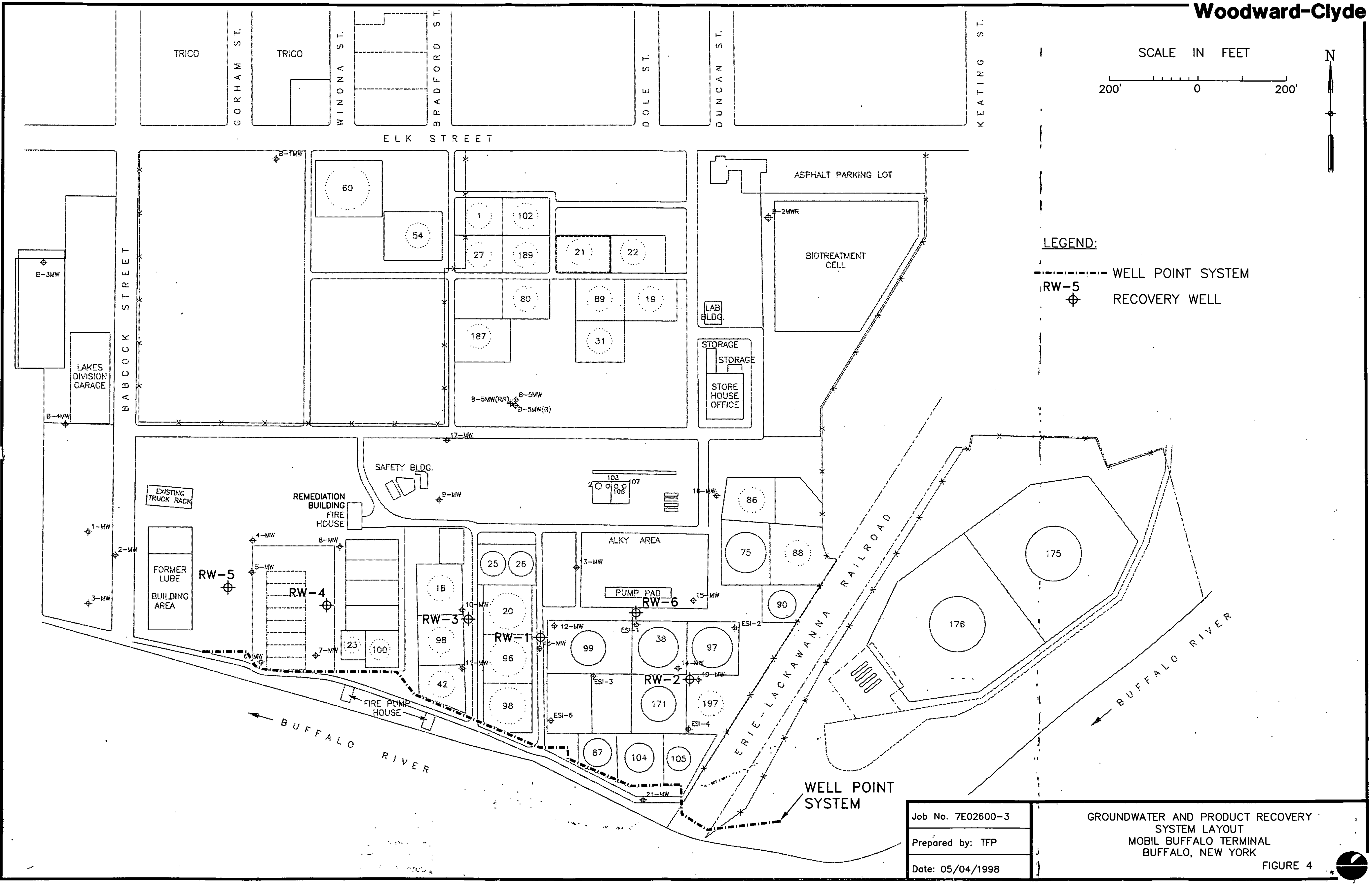
| | |
|---|---|
| LSH 101 | ACTIVITIES PRODUCT PUMP IF WATER LSH IS NOT CLOSED |
| LSH 102 | ACTIVATES WATER PUMP |
| LSL 103 | DEACTIVATES WATER PUMP |
| LSLL 104 | WATER OVERRIDE – FAULT CONDITION – WATER & PRODUCT DEACTIVATED |
| LSH 105 | PRODUCT TANK FULL – ALARM CONDITION – PRODUCT PUMP ONLY DEACTIVATED, WATER PUMP STILL RUNS |
| LSHH 106 | HIGH WATER IN LIFT STATION<br>ALARM CONDITION SUMP PUMP RUNS<br>ALARM CAN BE BROADCAST TO NETWORK<br>TURNS ON RED LAMP AT LIFT STATION<br>ALARM CLEARS WHEN CONDITION CLEARS<br>(NON LATCHING ALARM) |
| LSH 107 | ACTIVATES SUMP PUMP – TURNS ON AMBER LAMP |
| LSH 108 | DEACTIVATES SUMP PUMP – TURNS OFF AMBER LAMP |
| LSH 109 | HIGH LEVEL IN OIL RESERVOIR – ALARM CONDITION – SUMP PUMP SHUTS DOWN – ALARM CAN BE BROADCAST TO NETWORK – ALARM CLEARS WHEN CONDITION CLEARS (NON LATCHING) |
| LSH 110 | HIGH LEVEL IN EFFLUENT RESERVOIR – ALARM CONDITION – SUMP PUMP SHUTS DOWN – ALARM CAN BE BROADCAST TO NETWORK – ALARM CLEARS WHEN CONDITION CLEARS (NON LATCHING) |
| FS111,112,113 | LOW AIR FLOW FROM SPARGE BLOWERS – ALARM CONDITION –<br>SUMP PUMP RUNS<br>ALARM CAN BE BROADCAST TO NETWORK<br>ALARM CLEARS WHEN CONDITION CLEARS (NON LATCHING) |



| | |
|---|---|
| Job No. 7E02600-3 | GENERALIZED PROCESS AND INSTRUMENTATION DIAGRAM<br>GROUNDWATER REMEDIATION SYSTEM<br>BUFFALO TERMINAL<br>MOBIL BUSINESS RESOURCES CORPORATION<br>FIGURE 3 |
| Prepared by: TFP | |
| Date: 05/04/1998 | |

76002015.dwg

**Woodward-Clyde**



Job No. 7E02600-3

Prepared by: TFP

Date: 05/04/1998

GROUNDWATER AND PRODUCT RECOVERY
SYSTEM LAYOUT
MOBIL BUFFALO TERMINAL
BUFFALO, NEW YORK

FIGURE 4

76002016.dwg

# Appendix A

**ORS** ENVIRONMENTAL EQUIPMENT
A DIV. OF GROUNDWATER TECHNOLOGY, INC.

# BULK TERMINAL REMEDIATION SYSTEM

## EQUIPMENT/DOCUMENTATION DESCRIPTION

8/27/93
#40126

32 Mill St., Greenville, NH 03048
Phone (800) 228-2310/ (603) 878-2500
FAX (603) 878-3866

## INTRODUCTION

This manual provides an overview of the equipment and documentation supplied by ORS Environmental Equipment for the Mobil Oil Bulk Terminal Remediation project.

## CONTENTS

This manual contains the following information:

1. Documentation List - a list of all equipment manuals and drawings provided with the system.
2. System Description - includes the following sections:
    - I. System Overview
    - II. System Description, Remote Extraction Points
    - III. System Description, Central Water Treatment Location
    - IV. Sensor Specifications

## DOCUMENTATION LIST

Documentation provided with the Mobil Bulk Terminal Remediation System includes (1) this Equipment/Documentation Description manual (2) documentation packages for each of the 6 remote recovery wells and (3) a documentation package for the central water treatment/transfer facility.

1. Recovery Well Documentation includes;

    (1) SITEPRO 2000 Probe Scavenger/Water Pump Control Panel manual

    (1) Quick Start Installation & Configuration Supplement containing;

        (1) Field Wiring Diagram for SITEPRO 2000
        (1) Panel Configuration Guide drawing for SITEPRO 2000

    (1) Water Table Depression Pump manual

    (1) Probe Scavenger manual

    (1) Product and Water Pump Installation Instructions drawing

2. Central Water Treatment/Transfer System Documentation includes;

- (1) SITEPRO 2000 Water Table Depression Pump Control Panel manual
- (1) Quick Start Installation & Configuration Supplement containing;
  - (1) Field Wiring Diagram for SITEPRO 2000
  - (1) Panel Configuration Guide drawing for SITEPRO 2000
- (1) Water Table Depression Pump manual

## 2. SYSTEM DESCRIPTION

### I. System Overview

**Note: This section is written to serve as an overview of the complete remediation system. Its specific purpose is to identify ORS supplied components. ORS has provided only the parts identified below, as requested by the system designer, Groundwater Technology, Inc. ORS warranties the performance of ORS-supplied components only, as specified in ORS proposal # 93-0034R1, the operator's manual, and the ORS Standard Limited Warranty.**

The remediation system consists of 6 remote recovery wells, and one central water treatment/transfer system. Each well contains 2 submersible pumps, (1) multistage submersible water pump, and (1) positive displacement pump specified to pump non-aqueous, phase separated liquid. All process equipment and sensors have been specified to tolerate prolonged exposure to products known to be present at the Mobil Buffalo Terminal, specifically, refined petroleum products including gasoline and aviation and jet fuels.

Water extracted from each recovery well will be transferred through permanently installed steel piping (installed by customer-specified contractors) to an above-ground oil/water separator, supplied by others (Great Lakes Environmental). After processing through the oil/water separator, it will passively drain into one of three customer-specified sanitary sewer hookups.

The system is designed to extract and process a combined total of approximately 100 gallons per minute of groundwater from the 6 extraction points. The extraction and transfer of all water and product through this system will be controlled by ORS Sitepro 2000 control systems, designed to be connected in a communication system allowing the units to respond to common interlock signals, and to be accessed from remote offsite communication points. Off-site communication is performed through the use of a 2400 baud modem and proprietary software (supplied).

ORS-supplied System Components:

| | Description | ORS Part # | Quan. |
|---|---|---|---|
| 1. | Sitepro 2000 Controller, Dual Pump System | 1392200 | 6 |
| 2. | Sitepro 2000 Controller, Water/Transfer Pump | 1392000 | 1 |
| 3. | Water Probe Assembly (25' cable) | 2390062 | 6 |
| 4. | Product Probe Assembly (25' cable) | 2020067 | 6 |
| 5. | 3/4 H.P. Water Pumps, w/25' Start Cable | 2032226 | 6 |

ORS-supplied System Components (cont.):

| | Description | ORS Part # | Quan. |
|---|---|---|---|
| 6. | Telemetry Package, Sitepro | 2390068 | |
| 7. | 4" Dia. Product Pump, w/25' Power Cable | 2022039 | 6 |
| 8. | 3 function float switch (for transfer sump) | Non-invent. | 1 |
| 9. | 1" water totalizer w/pulse generator | Non-invent. | 6 |
| 10. | 0-30 Amp inductive current monitor units | Non-invent. | 18 |
| 11. | 4-20 mA power supply units | Non-invent. | 7 |
| 12. | Temperature sensor for oil/water separator | Non-invent. | 1 |
| 13. | Tankfull level sensors (for product tanks) 50' | 2390069 | 6 |

## II. System description, remote extraction points

The extraction points consist of six recovery systems, with all controls for downwell pumps mounted at or near each wellhead. With the exception of slight variations in physical location of wellhead equipment from well to well, all six extraction systems are identical.

### 1. Electrical classification:

a. Wellheads: all areas below grade, specifically the well vaults are classified as Class 1, Division 1, Group C/D atmospheres, and all ORS-supplied electrical assemblies have been specified accordingly.

b. Controls: all equipment mounted above grade will be located in an unclassified atmosphere. This location is defined as 18" or more above grade. All equipment installed in outdoor areas will be rated for exposure at a minimum of NEMA 3X (weatherproof). All enclosures mounted above grade will require conduit seals or other approved vapor barrier if entering a classified location.

### 2. Controls:

The pumps (two per well) will be controlled by a single controller (at each well), mounted in a NEMA 3R enclosure. The controls consist of an ORS Sitepro 2000 Dual Pump Probe Scavenger controller, and peripheral sensors. Please see attached drawing for graphic depiction of a typical wellhead deployment.

The controllers include the short-circuit protection for both motors, and also serve as a lockable disconnect, in compliance with OSHA Lockout-Tagout standards.

In addition to controlling both downhole pumps, the controls will monitor status on the following system parameters:

a. Total gallons of water pumped, via pulsed output turbine-type, totalizing flowmeter (ORS-supplied).

b. Current draw on heat trace circuits, via inductive 0-5 volt analog sensor (ORS supplied). Note: Heat trace supplied by others.

c. Tankfull shutdown circuit, via hi-level float switch. This circuit is intrinsically safe. A tankfull alarm will shut down the product recovery pump, but allow the water table depression pump to continue to run normally. Each wellhead controller is equipped with a dedicated tankfull level switch, designed to be deployed on each dedicated product recovery tank.

Each local wellhead control system is connected through a two conductor, shielded wire to all other controls on the site. This enables the entire system to be monitored, and for the system to share common alarm interlocks.

### 3. Pumps:

a. Product recovery pump: This pump is a submersible, magnetically coupled, positive displacement type pump, capable of discharge pressure as high as 70 psi, and flow rates ranging from .25 to 0.9 gpm. This pump operates on a 12 Volt DC power supply. The transformer/rectifier assembly is located in a NEMA 7 enclosure in the below-grade recovery vault.

b. Water Table Depression Pump: This is a stainless steel multistage submersible pump. It employs a 1/2 HP 230 VAC motor. It is a "2-wire" type, containing its start components internally. Overcurrent protection is internal, and is automatically resetting.

## III. System description, central water treatment location

Three storm drain collection points (located at various locations in the terminal facility) will feed a subsurface concrete sump. This water will then be transferred into the central oil/water separator fed by the 6 extraction pumps located within the terminal facility. Water leaving the oil/water separator will then gravity drain into one of three customer-specified sanitary sewer connection points. Water extracted from the 6 recovery wells will be pumped directly into the oil/water separator. The central water treatment location, referred to as "firehouse" in construction drawings, will house the single-function Sitepro 2000 controller tasked with controlling the flow of water and monitoring system status.

Firehouse Controller: This unit is a single pump controlling Sitepro 2000. It is responsible for operating the 5 HP centrifugal transfer pump (customer supplied) which transfers storm water from the collection sump to the oil/water separator. (ORS will supply the motor starter for this pump). This Sitepro unit will also serve as the "master" controller which acts as the central controller in the network, and contain the modem through which the system will be accessed remotely.

The firehouse controller will service the following interlocks and monitoring functions:

a. High product and high water alarms in the oil/water separator. The level sensors (supplied and installed by others), will generate a high level signal on either alarm, which the firehouse controller will transmit to all 6 remote wellhead controllers, and shut them down in the event of either alarm.

b. Oil/water separator submersible heater (3) status. This channel will monitor on/off status of the three submersible resistive heaters. There is no alarm interlock associated with their control. The heaters are supplied with, and controlled by, the oil water separator (supplied by others).

c. Water temperature in the oil/water separator. An ORS-supplied thermocouple, sheath, and power supply will continuously monitor water temperature within the oil/water separator. This is a monitoring function only, and will not control any site functions. The controller can, however, be configured to generate a remote fax dialout at a given temperature set point.

d. Current (amperage) consumption on the heat trace circuits (3) (supplied by others). The system will be monitored with ORS supplied inductive current sensors for electrical consumption. This data does not control any process, and is included for monitoring purposes only

The Sitepro and peripheral equipment described immediately above will be deployed in the firehouse building. The area which is to house the control equipment is unclassified electrically. The transfer pump will be mounted remotely in a Class 1, Division 2 hazardous atmosphere area (although its ORS-supplied motor starter will be mounted next to the Sitepro in the firehouse.)

All Sitepro systems are "standard" equipment. All modifications, such as additions of sensor power supplies, motor starters, etc. will be installed once on site. All configuration of alarm channels, monitoring channels, probe signals, etc is done on site.

ORS' Standard Limited Warranty applies to all equipment supplied on this equipment order. A copy of the warranty is attached for customer reference.

40126-03

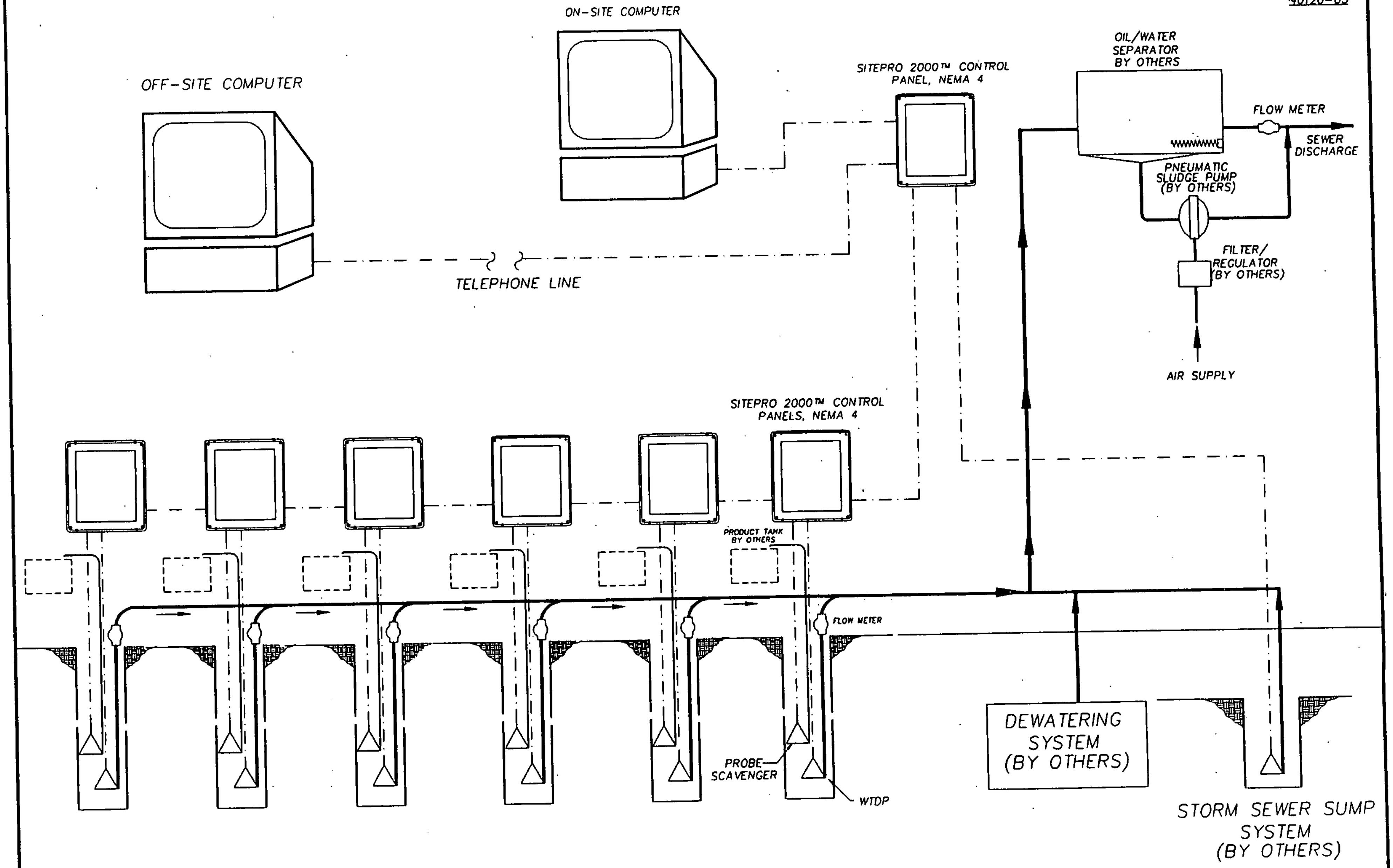


FIGURE 1

MOBIL BULK TERMINAL, BUFFALO, NY

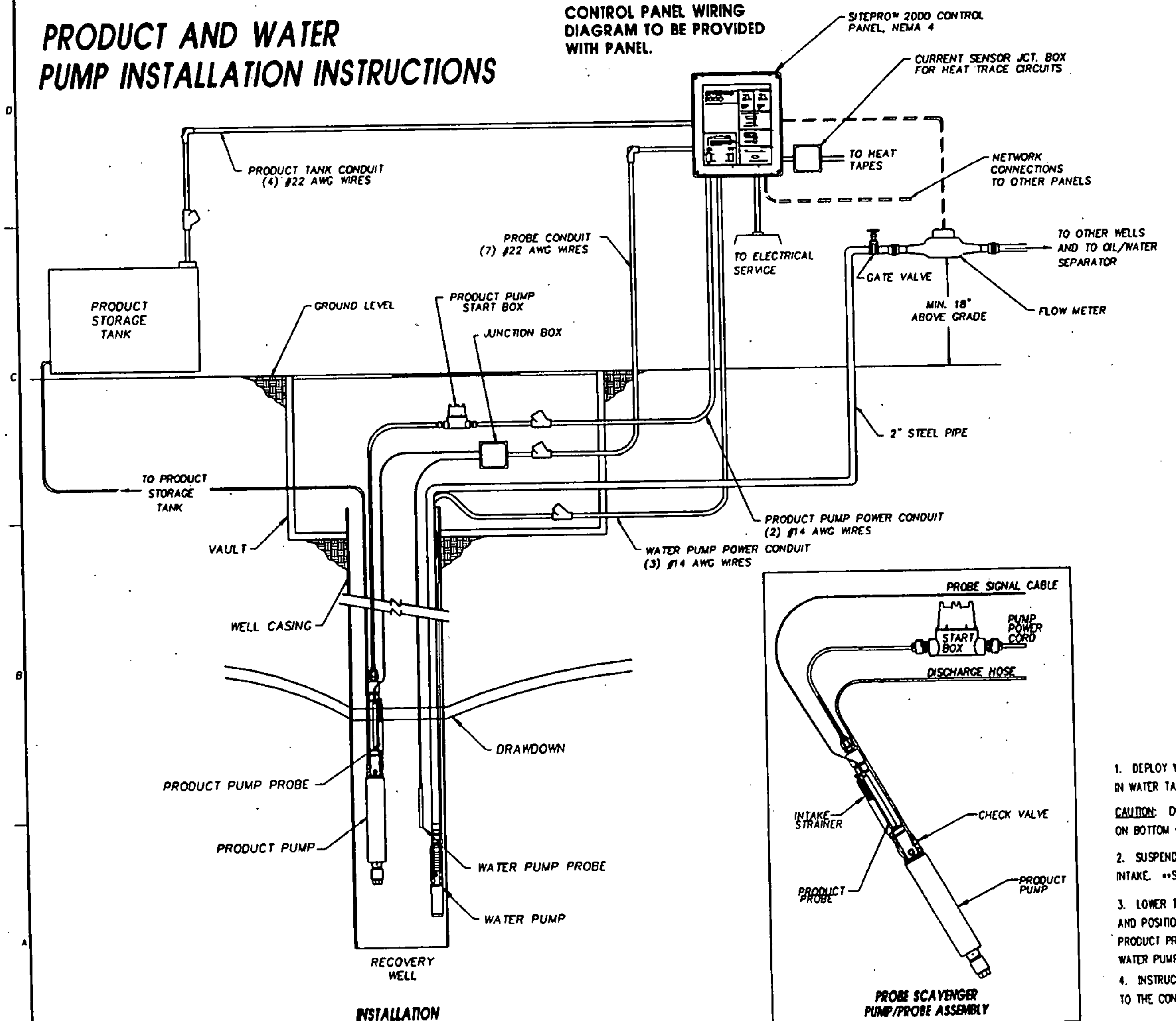
PROCESS FLOW DIAGRAM

ORS
ENVIRONMENTAL
EQUIPMENT
A DIV. OF GROUNDWATER TECHNOLOGY, INC.

# PRODUCT AND WATER PUMP INSTALLATION INSTRUCTIONS

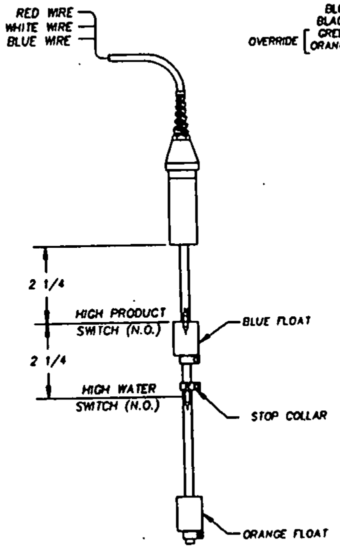
| | | | | | |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| — | [illegible] | [illegible] | [illegible] | [illegible] | |
| — | [illegible] | [illegible] | [illegible] | [illegible] | |
| | | | | | |
| | | | | | |

**CONTROL PANEL WIRING DIAGRAM TO BE PROVIDED WITH PANEL.**

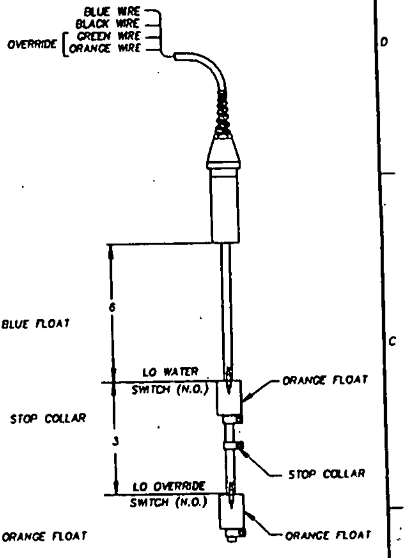


**INSTALLATION DIAGRAM**

**PROBE SCAVENGER PUMP/PROBE ASSEMBLY**



**PRODUCT PUMP PROBE ASSEMBLY**



**WATER PUMP PROBE ASSEMBLY**

****NOTE:****
THE WATER PUMP PROBE SUPPLIED WITH THIS SYSTEM IS CUSTOM. DISREGARD PROBE WIRING WHICH IS SHOWN IN THE WATER TABLE DEPRESSION PUMP MANUAL.

## INSTALLATION INSTRUCTIONS

1. DEPLOY WATER PUMP ACCORDING TO INSTRUCTIONS IN WATER TABLE DEPRESSION PUMP MANUAL.

<u>CAUTION:</u> DO NOT PLACE WATER TABLE DEPRESSION PUMP ON BOTTOM OF WELL DUE TO POSSIBLE DAMAGE FROM DEBRIS.

2. SUSPEND THE WATER PUMP PROBE ABOVE THE PUMP'S INTAKE. **SEE NOTE.

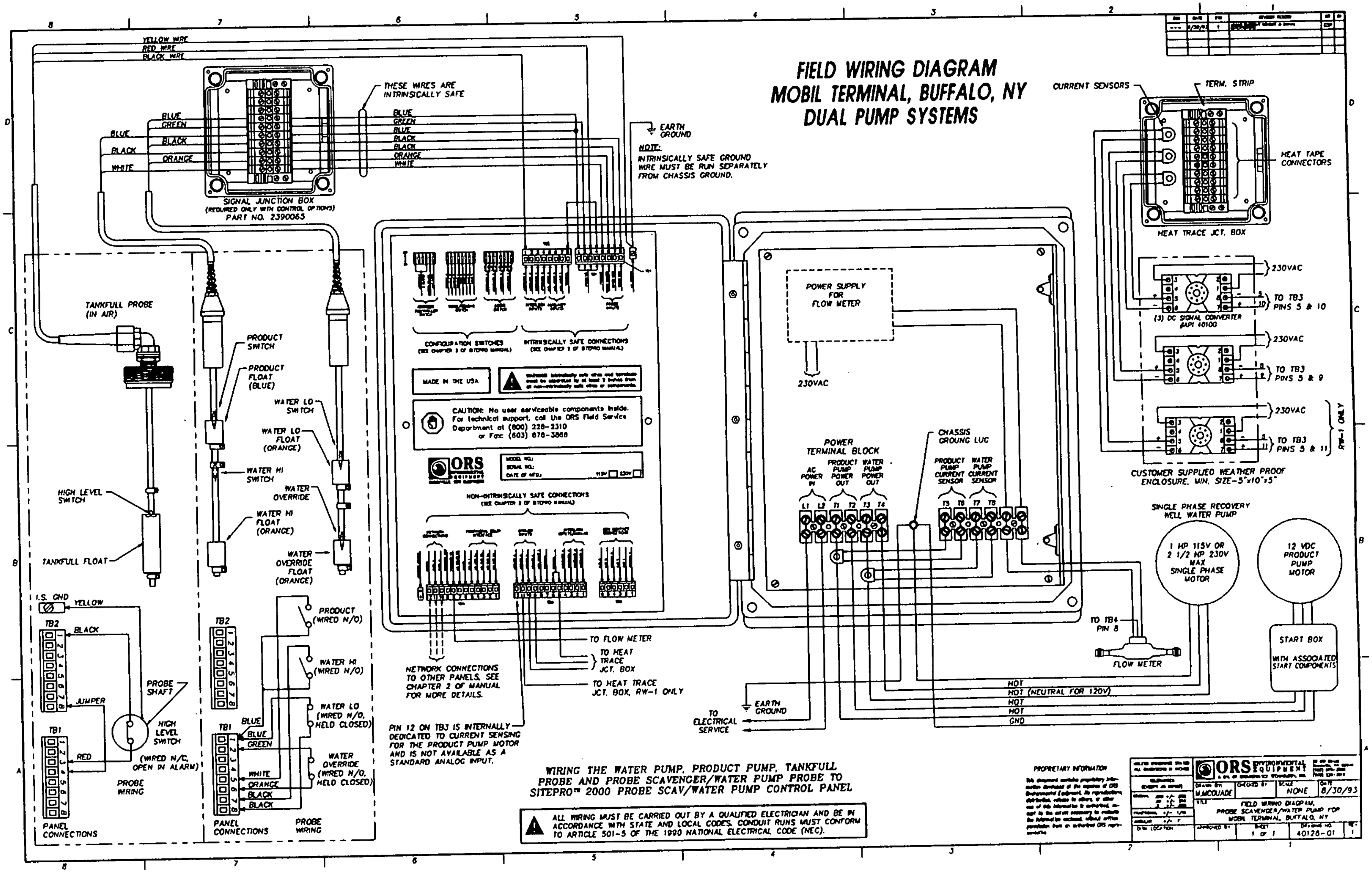
3. LOWER THE PRODUCT PUMP ASSEMBLY INTO THE WELL AND POSITION SO THAT THE HI WATER SWITCH ON THE PRODUCT PROBE IS <u>ABOVE</u> THE LO WATER SWITCH ON THE WATER PUMP PROBE.

4. INSTRUCTIONS FOR WIRING THE PUMPS AND PROBES TO THE CONTROL PANEL WILL BE SHIPPED WITH THE PANEL.

ORS ENVIRONMENTAL EQUIPMENT

| | | | |
|---|---|---|---|
| DRAWN BY: E.PIERCE | CHECKED BY: | SCALE NONE | DATE 8/27/93 |
| TITLE INSTALLATION INSTRUCTION AND FIELD HOOKUP DIAGRAM FOR MCBK TERMINAL, BUFFALO, NY | | | |
| APPROVED BY: | SHEET 1 OF 1 | DRAWING NO. 40126-02 | REV 2 |

# FIELD WIRING DIAGRAM
# MOBIL TERMINAL, BUFFALO, NY
# DUAL PUMP SYSTEMS



CAUTION: No user serviceable components inside. For technical support, call the ORS Field Service Department at (800) 228-2310 or Fax (603) 878-3866

**NOTE:**
INTRINSICALLY SAFE GROUND WIRE MUST BE RUN SEPARATELY FROM CHASSIS GROUND.

PIN 12 ON TBJ IS INTERNALLY DEDICATED TO CURRENT SENSING FOR THE PRODUCT PUMP MOTOR AND IS NOT AVAILABLE AS A STANDARD ANALOG INPUT.

WIRING THE WATER PUMP, PRODUCT PUMP, TANKFULL PROBE AND PROBE SCAVENGER/WATER PUMP PROBE TO SITEPRO™ 2000 PROBE SCAV/WATER PUMP CONTROL PANEL

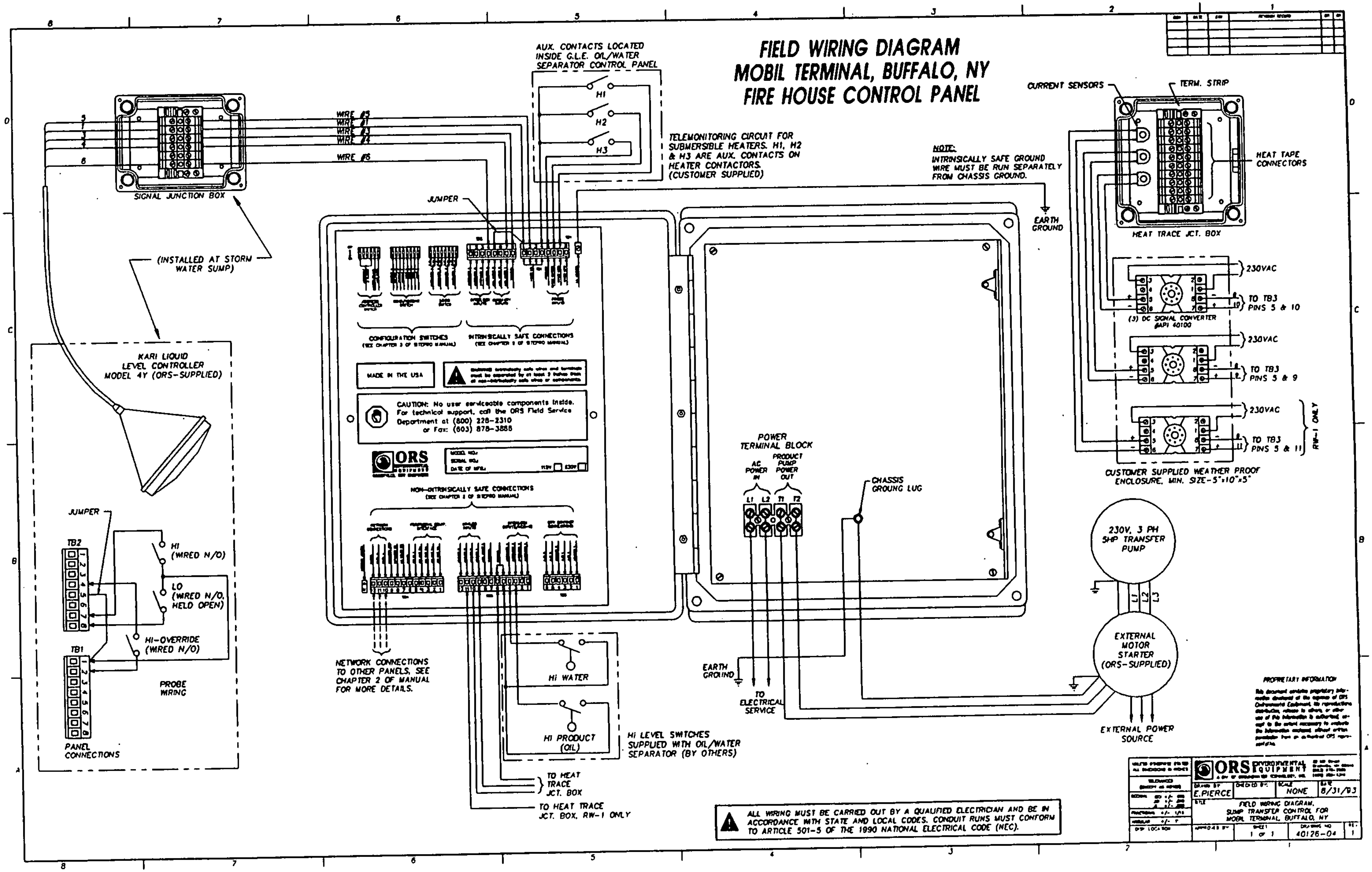
ALL WIRING MUST BE CARRIED OUT BY A QUALIFIED ELECTRICIAN AND BE IN ACCORDANCE WITH STATE AND LOCAL CODES. CONDUIT RUNS MUST CONFORM TO ARTICLE 501-5 OF THE 1990 NATIONAL ELECTRICAL CODE (NEC).

PROPRIETARY INFORMATION

ORS ENVIRONMENTAL EQUIPMENT

| | | | |
|---|---|---|---|
| DRAWN BY<br>M.MCQUADE | CHECKED BY | SCALE<br>NONE | DATE<br>8/30/93 |
| TITLE<br>FIELD WIRING DIAGRAM, PROBE SCAVENGER/WATER PUMP FOR MOBIL TERMINAL, BUFFALO, NY | | | |
| APPROVED BY | SHEET<br>1 OF 1 | DRAWING NO.<br>40126-01 | REV<br>1 |

# FIELD WIRING DIAGRAM
# MOBIL TERMINAL, BUFFALO, NY
# FIRE HOUSE CONTROL PANEL



ALL WIRING MUST BE CARRIED OUT BY A QUALIFIED ELECTRICIAN AND BE IN ACCORDANCE WITH STATE AND LOCAL CODES. CONDUIT RUNS MUST CONFORM TO ARTICLE 501-5 OF THE 1990 NATIONAL ELECTRICAL CODE (NEC).

PROPRIETARY INFORMATION

[illegible]

ORS ENVIRONMENTAL EQUIPMENT

| DRAWN BY | CHECKED BY | SCALE | DATE |
|---|---|---|---|
| E.PIERCE | | NONE | 8/31/93 |

TITLE
FIELD WIRING DIAGRAM,
SUMP TRANSFER CONTROL FOR
MOBIL TERMINAL, BUFFALO, NY

| APPROVED BY | SHEET | DRAWING NO | REV. |
|---|---|---|---|
| | 1 of 1 | 40126-04 | 1 |

## IV. Sensor Specifications

### Sensor #1: Current Sensor

**Quantity:** 18

**Deployment:** 18 current monitors will be installed total. Three in the firehouse, three at RW-1, and two each at MW 2 through MW-6. They will attach to each local Sitepro control panel (on the analog input busses), and monitor the current draw through the heat tape circuits.

The sensors are inductive, and generate a 0-5 volt signal which will be received by the Sitepro panel. A separate power supply will not be required for these items, although the signal rill require conditioning before processing by the Sitepro.

They will need to be installed in a small (4"x4"x6") NEMA 4 (weatherproof) junction box next to the sitepro panels. One lead from each heat tape power circuit will need to be run through this box in order to be monitored. Per discussions on site, Ferguson Electric will supply these boxes.

The sensors are scheduled to be delivered to ORS on or about 8/4/93. they will be shipped to GT Cheektowaga approximately one week later.

**Note: Product literature attached.**

The Sitepro controllers are not capable of accepting an "unconditioned" 0-5 VDC input. The 0-5 volt signal will require conditioning to 4-20 mA current signal before sending to the Sitepro panel. This is accomplished through the use of a DC to DC transmitter. The one specified is manufactured by API, and is a model 4010G. It is powered with a 230 VAC power supply, and can be located in the same enclosure as the current sensors. Please see the attached equipment specification sheet for a complete description of the unit(s).

SMITH RESEARCH & TECHNOLOGY, INC.

## PRICING POLICY

The variations available of these sensors are almost infinite. Units are not stocked, and SRT, Inc. supplies samples when request is submitted with a valid company purchase order complete with data on the application, quantity, and specifications desired.

With reference to Output Voltage (i.e., standard AC Output units), per unit prices quoted are based on the customer accepting normal production tolerance of units at plus or minus 15%. Closer tolerance prices will be based upon yield for that sensor model at the tolerance specified. **Be specific on required tolerance when asking for price quotes.* Minimum order $50.00. *Proper output voltage guaranteed for your application as specified. If not satisfied, RETURN in EXCHANGE for another unit within 30 days.*

SET UP & TEST FEES : $5 for each set of test data included with test of prototype sensors, where more than one sensor, or group of sensors can be tested at one time. $10 for each set of test data for one sensor only. For tests requiring special set-ups and/or requiring special material or equipment there is an additional time and cost charge. Please call the factory. *All prices are subject to change without notice.*

SHIPPING: F.O.B. Factory: Colorado Springs, CO., 80907, U.S.A. All shipping charges are paid by customer. No order will be taken unless acknowledgement of shipping charge acceptance is noted on company purchase order. Shipped as specified, or UPS Ground. *(Provide your company FedEx # for Next Day Air).* Usually prepaid and billed with invoice. All orders are shipped from the factory to the customer. **Shipping other than U.S.A.:** Payment in advance. Check with International Sales Department at SRT. This is a licensable commodity when exported.

DELIVERY: Three days to three weeks after ordering; depending on complexity of specifications and quantity ordered. With the exception of test units available, production quantities are not stocked in advance of orders.

**New Accounts Please Note:** To qualify for discounted rates for quantity orders of 100 or more units, a pre-payment with written Purchase Order of 20% of total due per each shipment will be required prior to shipping date.

PAYMENT OF INVOICES: All orders are billed to the customer from, and shall be paid to the factory as noted on the invoice. Payment to be made in U.S. dollars.

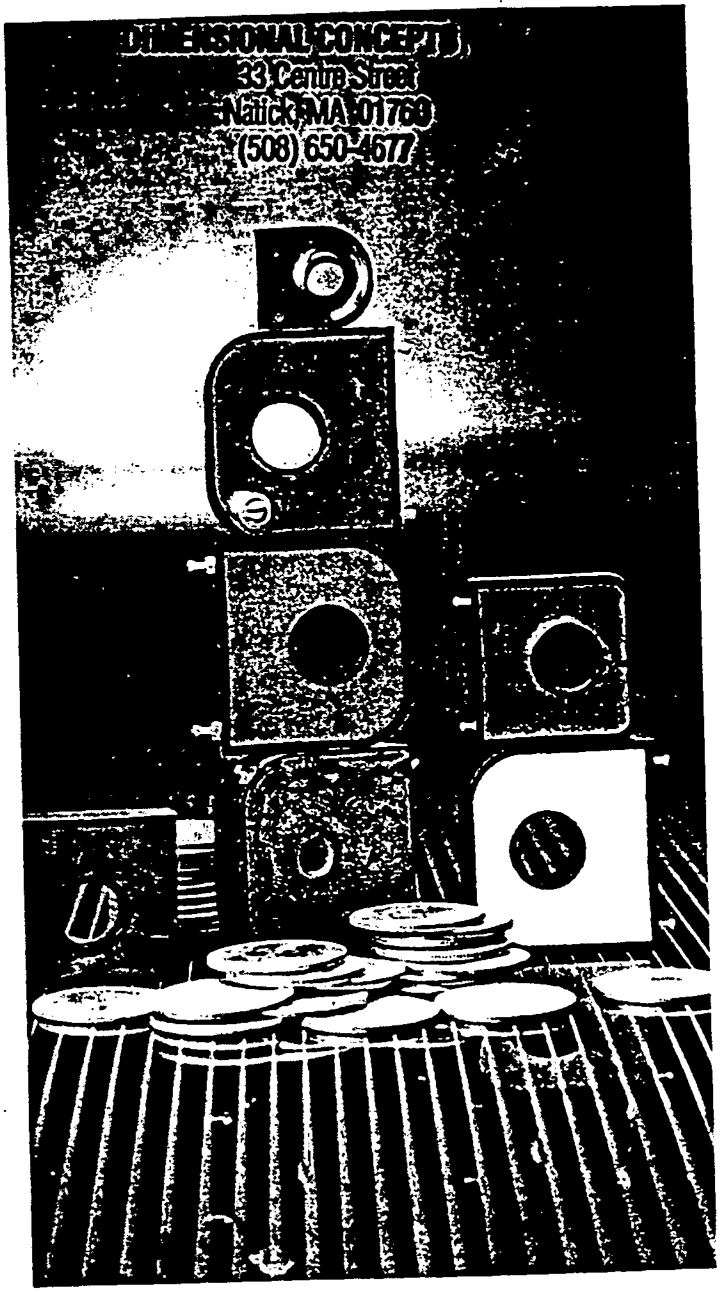
TERMS: Payment due on delivery. **Credit approved accounts:** Net 30 days from shipping date on invoice. Credit references required. Telephone orders accepted from credit approved accounts. However, no orders will be processed without a customer purchase order number and no orders will be shipped without a written purchase order.

**Non-refundable:** Units will be exchanged for credit on purchase of another sensor if NO SOLDER has been used on the terminals and sensor(s) are returned within 30 days. If units are not returned, the invoice is due and payable.

Smith Research & Technology, Inc.
(719) 634-2259 • 800-447-6805 • FAX: 719-634-2601

# PRICE LIST

JANUARY 1992



srt Smith Research & Technology, Inc.

205 Sutton Lane
Colorado Springs, CO 80907
(719) 634-2259 • 800-447-6805
FAX: 719-634-2601

## INSTRUMENTATION INDUCTIVE A.C. SENSORS

## STANDARD UNIT PRICE LIST

*Prices are quoted for standard 60 Hz. units. For frequencies above or below 60 Hz. a nominal charge will be added. Call S.R.T., Inc. for specifics. Some sensors called out as specials are not covered by this price list.*

## A GUIDE TO ORDERING STANDARD CAS UNITS:

*EXAMPLE:* AC CAS: AC Switch Control

CAS 2 Y- V- .1- 1A- N.O. -120V ac -1A- RW

Sensor Connection: W=*Wire Leads*
Type Load: R= *Resistive;* L= *Inductive*
MAX Load Current; from 1-15A
Output Circuit Voltage Rating
Contact configuration: N.O.= *Normally Open*
N.C.= *Normally Closed*
Current Range
Operation: V= *Variable Switch Point;* F= *Fixed Switching Point*
Model Series

*Further example:*

CAS 2XV .01- .1A N.O. 120Vac 1A RW (Current sensor is piggybacked on a CAS unit. Switching point is variable and can be set in the field between 10 and 20 Amps. The switch is Normally Open and is rated at 120Vac 1A resistive load.)

FOR AC CONTROL CIRCUITS

| MODEL *Packaged in C Case* | SWITCH | CURRENT RANGE | OPERATION | QUANTITY | | |
|---|---|---|---|---|---|---|
| | | | | 1-24 | 25-249 | 250-499 |
| | | Multiple Primary Turns Required | | | | |
| CAS 2X | N.O. | .01 to .1 A | Variable | 79.50 | 74.00 | 69.56 |
| CAS 2Y | N.O. | .1 to 1 A | Variable | 75.00 | 70.00 | 65.80 |
| CAS 2Z | N.O. | .01 to .1 A | Fixed | 78.00 | 72.50 | 68.15 |
| CAS 2T | N.O. | .1 to 1 A | Fixed | 75.00 | 70.00 | 65.80 |
| CAS 3 | N.O. | Single Pass-thru wire 1- 10 A | Variable | 72.00 | 67.00 | 62.98 |
| CAS 4 | N.O. | 10-100 A | Variable | 77.00 | 71.65 | 67.35 |
| ***SPECIALS* - D Case** | | | | | | |
| CAS 5 | N.C. | 1-10 A | Variable | 90.00 | 83.70 | 78.68 |
| CAS 6 | N.C. | 10-100 A | Variable | 90.00 | 83.70 | 78.68 |
| | | | | 500 & up - CALL FACTORY | | |

NOTE: *Please specify voltage to be switched.*
**CAS 2 through 4: Switch rated for up to .5A, switching current to 60V**

TO ORDER: Example: CAS-2- N.O.- .1 to 1A-V

[illegible] AC CONTROL CIRCUITS - [illegible]

| MODEL | OPER-ATION | SWITCH | CURRENT RANGE | QUANTITY | | |
|---|---|---|---|---|---|---|
| | | | | 1-24 | 25-249 | 250-499 |
| | | | Mulitple Primary Turns Required | | | |
| CAS-2X | V | NO | 0.01 A- 0.1 A | 98.00 | 91.14 | 85.65 |
| CAS-2Y | V | NO | 0.1 A- 1.0 A | 95.00 | 88.35 | 83.04 |
| CAS-2Z | F | NO | 0.01 A- 0.1 A | 96.00 | 89.28 | 83.92 |
| CAS-2T | F | NO | 0.1 A- 1.0 A | 93.00 | 86.49 | 81.30 |
| | | | Single Pass-thru wire | | | |
| CAS-3 | V | NO | 1A-10A | 90.00 | 83.70 | 78.68 |
| CAS-4 | V | NO | 10A- 100A | 90.00 | 83.70 | 78.68 |

500 & UP: CALL FACTORY

NOTE: Deleting use of this model for inductive loads. See *Relay Switch* below.

## *SPECIAL* CATEGORIES
### For Fixed A.C. Current Actuated Switches
### For A.C. Control Circuits - For OEM'S

Special A.C. CAS are mixed and matched using switch SMT electronics with A, B, or C Sensor Cases mounted on top. The simplest combination is used to obtain switching at customers current in order to keep costs down. Call factory for quantity price quote.

*Available in the following packages and current ranges:*

CAS A 1.2 to 35 Amps Single Wire (0.286 Dia.)
CAS B 1.0 to 50 Amps Single Wire (0.500 Dia.), 0.1 A Multiple Turns
CAS C 0.6 to 165 Amps Single Wire (0.500 Dia.), .01 A Multiple Turns

[illegible] ACTUATED RELAY SWITCH - [illegible]

| MODEL | OPER-ATION | SWITCH | CURRENT RANGE | QUANTITY | | |
|---|---|---|---|---|---|---|
| | | | | 1-24 | 25-249 | 250 -499 |
| CARS-2X | V | NO/NC | Mulitple Primary Turns Required<br>0.01A-0.1A | 233.00 | 208.00 | 194.00 |
| CARS-2Y | V | NO/NC | Multiple or Single<br>0.1A-1.0A | 217.85 | 194.47 | 181.38 |
| CARS-3 | V | NO/NC | Single Pass-thru wire<br>1A-10A | 204.00 | 182.00 | 170.00 |
| CARS-4 | V | NO/NC | 10-200A | 204.00 | 182.00 | 170.00 |

NOTE: This model designed for delayed activation of relay after motor start up.
Adjustable time constant. LED shows status of relay.

| | | | | | Line Driver- Including Sensor | |
|---|---|---|---|---|---|---|
| [illegible] | | MODEL [illegible] SERIES | | | MODEL [illegible] SERIES | |
| **QUANTITY** | Thru-hole size | Case Size | 1-99 | 100-999 | 1-99 | 100-999 |
| **2.5 AMPS**<br>Model CQ 45 -2.5A- 5V DC- 060 Hz<br>Production run linearity | .500 | 1.5" W<br>1.4"H<br>.50"D | 100.00 | 92.50 | 245.90 | 230.00 |
| **5 AMPS**<br>Model: CQ 35- 5A- 5V DC- 60 Hz<br>Production run linearity | " | " | 90.00 | 85.50 | 233.90 | 220.00 |
| **10 AMPS**<br>Model: CQ 35-10 A- 5V DC- 60 Hz<br>Production run linearity | " | " | 85.00 | 80.75 | 228.90 | 215.00 |
| **15 AMPS** (15- 20 A Same price)<br>Model: CQ 32- 15 A- 5 V DC- 60 Hz<br>Production run linearity | " | " | 80.00 | 74.00 | 223.90 | 210.00 |
| **30 AMPS** (25- 50 A Same price)<br>Model: CQ 25- 30 A- 5 V DC- 60 Hz<br>Production run linearity | " | " | 80.00 | 74.00 | 223.90 | 210.00 |
| **60 AMPS** (60- 75 A Same price)<br>Model: CQ 25-60A-5V DC-60 Hz | " | " | 80.00 | 74.00 | 223.90 | 210.00 |
| **100 AMPS** (80- 125 A Same price)<br>Model: CQ 25- 100 A- 5 V DC- 60 Hz<br>Production run linearity | " | " | 80.00 | 74.00 | 223.90 | 210.00 |
| **150 AMPS** (130- 150 A Same price)<br>Model: CM 20- 150 A- 5 V DC- 60 Hz<br>Production run linearity | " | " | 80.00 | 74.00 | 223.90 | 210.00 |
| | | **MODEL D SERIES** | | | | |
| **100-250 AMPS**<br>Model: DR 20- 200A-5V DC-60 Hz | .700 | 2.2" W<br>2.0" H<br>.80 D | 135.00 | 125.55 | 230.00 | 213.90 |
| **200-300 AMPS**<br>Model: DO- 20-200A- 5V DC- 60 Hz | .800 | 2.2" W<br>2.0" H<br>.80 D | 150.00 | 139.50 | 230.00 | 213.90 |
| | | **MODEL E SERIES** | | | | |
| **200-400 AMPS**<br>Model: EP 20- 300 A- 5V DC-60 Hz | .955 | 2.3" W<br>2.5" H<br>1.0" D | 170.00 | 158.10 | 240.00 | 223.20 |

## A.C. VOLTAGE SENSORS - 5.0 V D.C. OUTPUT - 60 Hz.

A.C. Output: Nominal transfer function is 40 MV/ Volts. Order by line voltage and output voltage desired. Example: VC- 480- 6V, 60 Hz. (RMS volts)

D.C. Output: Based on output of 5.00 Volts at median or maximum monitoring voltage. Special units: 10 volts output (consult factory for price).
Example: VC- 240- 5V D.C., 60 Hz. (Other frequencies available).
Line to Line; Line to Ground

| QUANTITY | A.C. OUTPUT | D.C. OUTPUT |
|---|---|---|
| 1 - 25 | 80.00 | 105.00 |
| 26 - 99 | 74.00 | 97.13 |
| 100 - 999 | 68.00 | 89.25 |
| 1000 & up | Call Factory | |

**STANDARD UNITS: C CASE**

* *NOTE:* SPECIAL ORDER; The AC Input-AC Output model is available for real time on-line (RMS) measurement with 20' of TSP cable, 400V. See AC/AC Units in this price list.

## STANDARD UNIT PRICE LIST:

*Prices quoted are for standard 60 Hz.units. For frequencies above or below 60 Hz.a nominal charge will be added. Call SRT, Inc. for specifics. Some sensors called out as specials are not covered by this price list.*

### 10 Volt D.C. Output available by special order.

**Production Run:** Linearity tolerance spread of maximum deviation of 1% to 4% theoretical straight line (T.S.L.), linearity.
Other linearities: Deviation from T.S.L. to 1%, 2%, 3% available for some units. Call the factory.

**For frequencies of 100 Hz to 1000 Hz:** Add 25% per standard unit cost.

**For frequencies of 1000 Hz to 20K Hz:** Add 50% per standard unit cost. All of the above High Linearity sensors are temperature compensated for a range of 5° to 45° C; for other temperature requirements, call the factory.

Note: Calibration test data for each sensor is available for $10.00 per single unit order, or $5.00 for two or more sensors.

### DESIGN AID FOR HIGH LINEARITY 5 V D.C. OUTPUT SENSORS

Typical output magnitude deviation from Theoretical Straight Line versus percent of Full Scale.

PER CENT OF FULL SCALE CURRENT

% OF FULL SCALE ERROR

| MODEL | AMPERES | 20% | 40% | 60% | 80% | 100% | 120% |
|---|---|---|---|---|---|---|---|
| CQ 45 | 2.5 Amperes | - 4.0 | - 3.5 | - 2.40 | +1.8 | 0 | +1.8 |
| CQ 35 | 5 Amperes | - 4.2 | - 3.5 | - 2.40 | +1.8 | 0 | +1.8 |
| CQ 32 | 15 Amperes | - 2.0 | -1.7 | -1.0 | - .4 | 0 | -.2 |
| CQ 25 | 30 Amperes | -.8 | .4 | +.4 | +.3 | 0 | -.5 |
| CQ 25 | 60 Amperes | +.4 | +1.2 | +1.6 | +1.2 | 0 | -.2 |
| CM 20 | 100 Amperes | -1.00 | 0 | +.6 | +.4 | 0 | -1.0 |
| CM 25 | Refer to price list | — | — | — | — | — | — |

*NOTE: Non-calibrated version has been discontinued. All high linearity series now potted in 94VO epoxy, black, self-extinguishing.

### LED DRIVER CQ SPECIAL SERIES TO 200A

| QUANTITY | 1- 99 | 100 - 999 |
|---|---|---|
| MODEL | | |
| CQ - 01 | 24.00 | Call Factory |
| CQ - 015 | 25.00 | |
| CQ - 02 | 26.00 | |

*These LED drivers limit the current to below 30 milliamperes for currents to 200 A. Also, the small zeners may be used as clippers to hold the LED current easily to a value which will allow close to theoretical projected LED lifetime.*

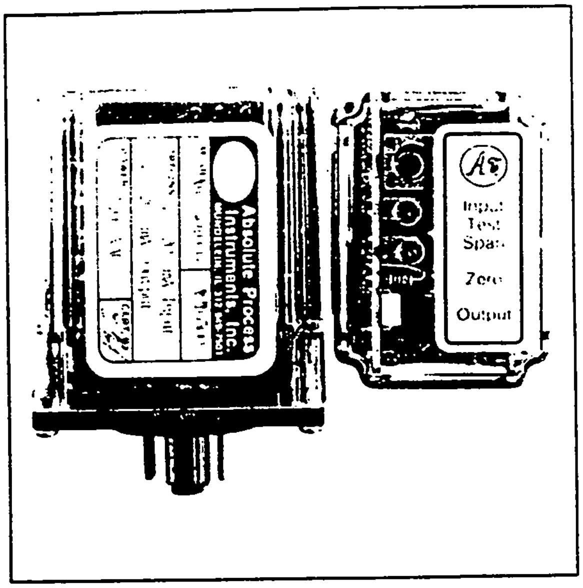
This special series allows LEDs to be used where needed for signalling without the burn-out rate experienced from other drivers, and still hold a competitive price. Call us for further information or data on these unique products.

ABSOLUTE PROCESS INSTRUMENTS, INC.

# PLUG-IN SIGNAL CONDITIONERS
## Api 4010G Non-Isolated DC to DC Transmitter

*FEATURES*

- * Wide Range of Input/Output Parameters
- * Input/Output Loop Tracker LED's
- * Functional Test Pushbutton
- * Voltage or Current Output



### FUNCTIONAL DESCRIPTION

The Api 4010G Plug-In accepts a DC Voltage or Current Input and provides a linearly-transferred DC Voltage or Current Output. The Api 4010G is useful for signal scaling, or translation from current to voltage or vice-versa in applications that do not require isolation (e.g., 4-20mA In/1-5VDC Out; 0-10VDC In/4-20mA Out; +/-10VDC In/0-20mA Out, etc.). If Input/Output isolation is required, use the Api 4300. The Api 4010G is designed to function effectively in "Electrically-Noisy" environments such as steel mills, foundries, refineries, paper mills, pharmaceutical plants, electric generating plants, gas utilities, and similar installations. The Api 4010G Plug-In is compatible with, and can interface with Recorders, Data Loggers, Personal Computers, Programmable Controllers, and other Process Monitoring and Control Systems. An Api Exclusive Feature, the LoopTracker LED is standard on 4/20mA Input/ Output Models and is optional on certain other Input/Output ranges. The LoopTracker "tracks" or varies its intensity as the process variable changes. The LoopTracker aids in setup and troubleshooting of the Control Loop by indicating loop current flow and process fluctuations, and also acts as a "power-on" indicator. Standard Features include an 8-pin Industry-standard plug-in base; a high-impact, clear polycarbonate cover; efficient modular internal construction; +/-10VDC or 50mA output capability; PLUS Api's 5-Year Limited Warranty. Optional Features include an internal connection to power one external 4/20mA Loop Powered Transmitting Device; LoopTracker for DC voltage or current outputs other than 4/20mA; 230VAC or 12/24 VDC/VAC module power; conformal coating for moisture resistance.

### OPERATION

The Api 4010G contains a power supply which provides dual-polarity regulated outputs. Input conditioning circuitry scales and filters the DC input. The output side scales and/or converts to voltage or current, if necessary, to meet the customer's requirement. The Output stage can be factory calibrated for Voltage outputs of up to +/-10VDC or Currents up to 50mA.

### CALIBRATION

The unit comes from the factory calibrated to customer specifications. However, Span and Zero controls are available thru the top cover for those wishing to change or re-calibrate the unit. Calibration requires an accurate signal source and measuring equipment, such as an accurate Digital Voltmeter and should be done only by Factory Authorized Personnel in order to maintain Warranty of the Plug-Ins. The Functional Test Pushbutton sets the output to 50% when depressed, independent of the input.

## Api 4010G ELECTRICAL SPECIFICATIONS

**Input Impedance (Voltage)**
200K Ohm min.

**Input Voltage Burden (Current)**
1.25VDC max.

**Output Capability**
(Voltage) +/- 10VDC, +/- 10mA max.
(Current) 50mADC, 12V compliance.
(Current) 25mADC, 12V compliance (with option for external Transmitter power).

**Linearity**
Better than .01% of Span.

**Response Time**
70mS typ.

**Temperature Stability**
Better than .02% of Span per °C.

**Zero/Span Control Range**
+/-15% typ.

**Functional Test Pushbutton**
50% (+/-1.5%) of Span when pressed.

**Ambient Temperature Range**
10 to +60 °C (Operating).

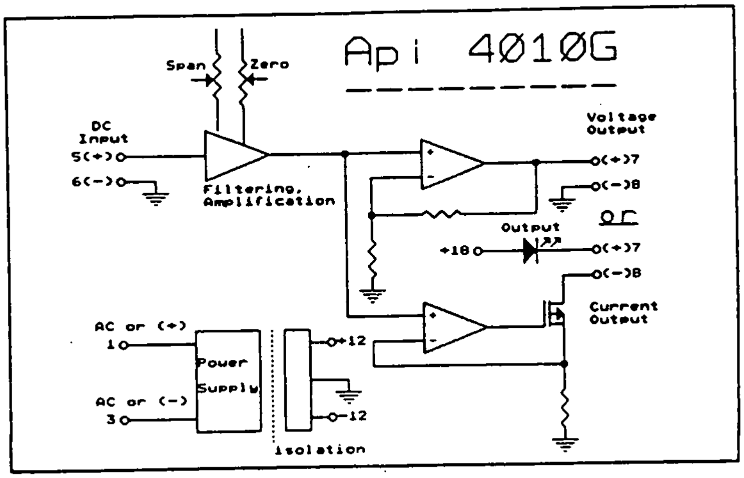
**Power**
(Standard) 115 VAC +/-10% 50/60Hz 2.5W max
(Optional) 230 VAC +/-10% 50/60Hz 2.5W max.
12 VDC +/-5% 125mA max.
24 VDC +/-5% 65mA max.
12 VAC +/-10% 2.5W max.
24 VAC +/-10% 2.5W max.

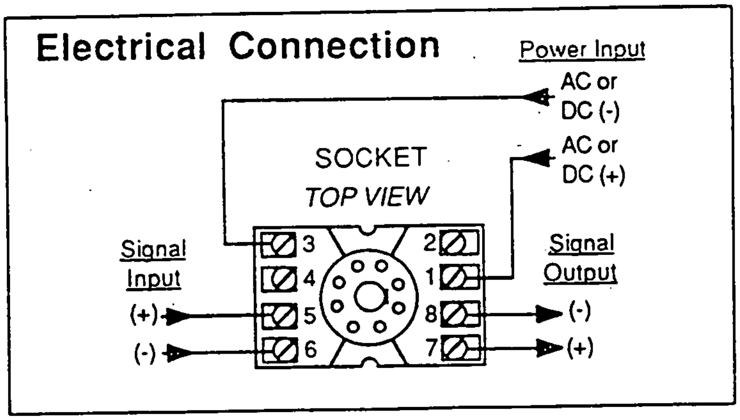
Api maintains a constant effort to upgrade and improve its products. Therefore, Specifications are subject to change without notice.

**Standard Ranges**

| Input | | | Output | |
|---|---|---|---|---|
| Voltage | | Current | Voltage | Current |
| 0 to 100mV | 0 to 50V | 0 to 1mA | 0 to 1V | 0 to 20mA |
| 0 to 200mV | 0 to 100V | 0 to 10mA | 0 to 5V | 4 to 20mA |
| 0 to 500mV | +/-100mV | 0 to 20mA | 1 to 5V | |
| 0 to 1V | +/-200mV | 4 to 20mA | 0 to 10V | |
| 0 to 2V | +/-500mV | 10 to 50mA | +/-5V | |
| 0 to 5V | +/-1V | 0 to 100mA | +/-10V | |
| 1 to 5V | +/-2V | 0 to 200mA | | |
| 0 to 10V | +/-5V | 0 to 500mA | | |
| 0 to 20V | +/-10V | 0 to 1A | | |

Consult Factory for Special or Non-Standard Ranges





*General Offices:*

Absolute Process Instruments, Inc.
942-B Turret Ct.
Mundelein, IL 60060
☎ TEL (708) 949-7501
FAX (708) 949-7502
Outside Illinois 1-800-942-0315

*Proudly Represented By:*

**Sensor #2: Signal-generating Flowmeters**

**Quantity:** 6.

**Deployment:** 6 Flowmeters will be installed, one located at each wellhead. The meters will need to be mounted in an electrically unclassified area, as the signals servicing each meter are not intrinsically safe. Plans presently call for the mounting of the meters at least 18" above grade immediately next to the control panel location.

Each flowmeter is a 1" model mechanical turbine type, equipped with a local digital readout, and having an pulse generator mounted atop the meter. The meter is equipped with 1 1/4" MNPT threads at each end. Atop each meter will be a Halliburton Model MC-II Flow Analyzer. In addition to providing the local digital readout, this device also provides the signal pulse for the Sitepro. Please see the attached cut sheets for additional information.

The Flow Analyzer device is equipped with a weatherproof cord grip connector to attach the meter to the electrical circuit using 3 16 AWG or larger greater wires, which will need to be routed to a nearby mounted (+/- 6" away) NEMA 4 junction box. The wires can then be routed to the Sitepro via watertight conduit, and 3 #16 AWG wires.

This meter assembly requires a 24-30 volt power supply to function. This power supply will be located in the back of the Sitepro panel(s). (These power supplies are also detailed in this package.)

**Note: Product literature attached.**

# INSTALLATION AND MAINTENANCE INSTRUCTIONS
# HALLIBURTON TURBINE TYPE FLOW METER

**Part No. 458.80001**

The calibration tag for each flow meter designating pulses per gallon observed during factory calibration, is attached to the magnetic pickup conduit adapter. This factor is also listed on the packing list (MT). In the event this information is lost or misplaced, the original calibration factor can be obtained from Halliburton Services, Special Products Division, Duncan, Oklahoma. Please supply the flow meter serial number when requesting this information.

**HALLIBURTON SERVICES**
**SPECIAL PRODUCTS DIVISION**
**DUNCAN, OKLAHOMA**

**405-251-3442**
**FAX# 405-251-2154**

## PRINCIPLE OF OPERATION:

The Halliburton Turbine Flow Meter is a rugged versatile instrument capable of handling a wide variety of liquids including many types of slurries and suspensions. The Flow Meter contains a rotor secured to a tungsten carbide shaft. The shaft is supported at each end in tungsten carbide bearings. The rotor is made of a magnetic material, while the flow meter body is non-magnetic. A magnetic pickup consisting of a magnet and coil is mounted externally in the body in the same plane as the rotor. Fluid moving through the Flow Meter causes the rotor to rotate at a speed proportional to the fluid velocity. The rotor blades cutting the magnetic field in the vicinity of the magnetic pickup generate a frequency signal proportional to the fluid velocity. This signal is used to represent flow rate and can be accumulated to totalize the volume of liquid passing through the Flow Meter.

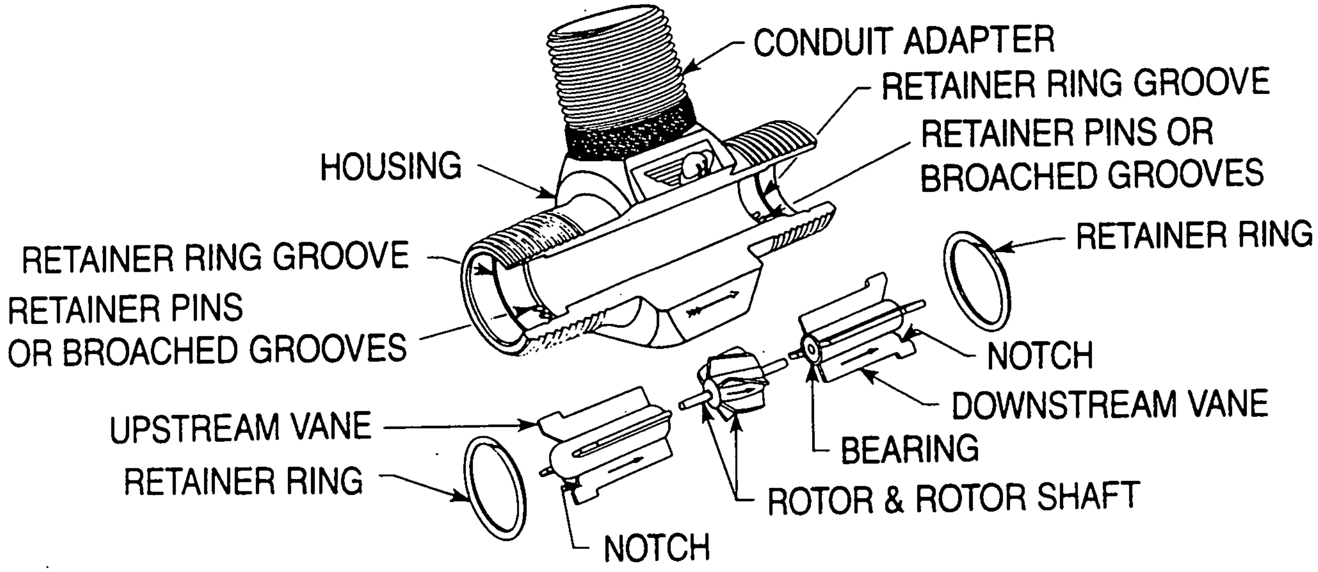
Each Flow Meter is calibrated to insure accuracy over the entire recommended flow rate range. Meters are furnished with a calibration factor representing the number of pulses per gallon produced. This information is supplied with the precalibrated rotor and vane kits available for field replacement. Meter and kits are available in either industrial grade with an accuracy of ±0.5% or standard grade with an accuracy of ±1.0%.

## INSTALLATION:

The Halliburton Turbine Flow Meter may be installed either vertically or horizontally. The direction of flow should correspond to the arrow that appears on the outside of the housing. A minimum straight section with a length of five pipe diameters of the same size as the flow meter is required both upstream and downstream of the meter.

The following precautions should be observed during the installation and operation of the Flow Meter:

1. Clean all upstream lines before installing the Flow Meter.
2. Do not blow out lines with compressed air or gas.
3. Do not slug the Flow Meter with fluid. Initial filling of line with fluid should be done with care.
4. Do not exceed maximum recommended flow rate through the Flow Meter.
5. Avoid hammer blows or other sharp impacts on the Flow Meter; it may break the shaft.
6. The magnetic pickup should be installed per drawing SPI-2B-1830 (Fig. 2). If vibration is present, the locknut should be tightened. A ¾" 12 point deep socket wrench is required. (Part No. 70.80902)



CAUTION:
ALWAYS REASSEMBLE VANE WITH
THE REFERENCE NOTCH IN GROOVE

Figure 1

## MAINTENANCE:

Figure 1 illustrates a typical Flow Meter. The following instructions are applicable to all meter sizes except as noted.

The Flow Meters may be disassembled for inspection, cleaning or repair in the following manner:

1. Screw the magnetic pickup out of the housing to avoid breaking during handling of the meter.
2. Remove the retainer ring from one end of the housing.
3. Slide the vane from the housing. (If the vane should be stuck, insert a brass rod through the opposite vane and through the rotor and drive the vane out by tapping on alternate blades of the vane.)
4. In 3″ and smaller size meters, the rotor may now be removed. In 4″, 6″ and 8″ meters, it is necessary to remove the inner retainer ring before the rotor can be taken out. The rotor should be handled with care to prevent damage to the rotor shaft.
5. Remove the retainer ring from the other end of the housing.
6. Remove the other vane.
7. Do not attempt to remove the bearings and thrust balls from the vanes.
8. Clean all parts with a suitable solvent for the material that has been pumped through the meter. A cotton swab is very useful for cleaning the inside diameter of the bearings.

The meter is assembled in the following manner:

1. Lubricate the bearings with a few drops of light machine oil or 5 centistoke silicone oil. During operation, the meter is lubricated by the fluid that is being pumped. The purpose of this initial lubrication is to enable the meter to be tested after assembly without running the bearings dry.
2. Before assembling, note that an arrow is cast or engraved on each part. These arrows indicate the direction of flow. The meter must be assembled so that all arrowheads point the same way and the direction of flow must coincide with the direction of flow indicated on the housing.
3. In all sizes, observe that one of the blades on each vane has a mark or notch on it and that retainer pins, welds or notches are provided in each end of the housing. The marked or notched blade must be inserted between these retainer pins, weld spots or notches. The meters are calibrated in this position, and should be reassembled in this position for the greatest accuracy. (See Figure 1.)
4. Insert one of the vane assemblies in the housing bore being careful that the direction arrow is correctly oriented. The vane should fit snugly but should not require excessive force to install.
5. Install the rotor and rotor shaft assembly being careful to properly orient the direction arrow on the rotor. Care should be taken to avoid chipping the rotor shaft. Tungsten carbide is very brittle.
6. Insert the other vane assembly. If this vane does not fall into position when placed in the housing, rotate the rotor to align the bearing and the rotor shaft. Do not attempt to drive the vane in, as this will result in a broken rotor shaft.
7. Check the meter by blowing air through it. The rotor should turn freely and come to a smooth stop. If the rotor will not turn or stops abruptly, the meter should be disassembled and checked.
8. Screw the magnetic pickup into the housing according to the procedures indicated by drawing SPI-2B-1830 (Fig. 2). Tighten finger tight and set lock nut. Do not tighten with pliers or wrench.

## REPLACEMENT PARTS:

| *MAGNETIC PICKUPS | |
|---|---|
| 70.73941 | M-155 pickup for 3/8″, 1/2″ and 3/4″ meters,<br>−65°F to +225°F. |
| 70.35638 | 3030AN pickup for 7/8″ and larger meters,<br>−100°F to +225°F. |
| 70.35637 | 3030HTB pickup for 7/8″ and larger meters,<br>−100°F to +450°F. |
| 458.88833 | PC28 pickup for 7/8″ and larger meters,<br>0°F to +850°F. |

| *ROTOR AND VANE KITS | | |
|---|---|---|
| Standard Grade | | Industrial Grade |
| 458.85045 | Kit - 3/8″ meter | 458.00014 |
| 458.85538 | Kit - 1/2″ meter | 458.00021 |
| 458.45063 | Kit - 3/4″ meter | 458.00022 |
| 991.43516 | Kit - 7/8″ meter | 458.00030 |
| 458.85229 | Kit - 1″ meter | 458.00023 |
| 458.70076 | Kit - 1 1/2″ meter | 458.00024 |
| 458.70084 | Kit - 2″ meter | 458.00025 |
| 458.70077 | Kit - 3″ meter | 458.00026 |
| 458.70083 | Kit - 4″ meter | 458.00027 |
| 458.70079 | Kit - 6″ meter | 458.00028 |
| 458.70081 | Kit - 8″ meter | 458.00029 |

*Normal replacement parts consist of 1 kit and 1 pickup per meter.

# INSTALLATION PROCEDURE

STEP 1. INSTALL FLOW METER Ⓐ IN ACCORDANCE WITH NOTE BELOW.

STEP 2. LOOSEN GLAND NUT Ⓘ SO THAT WEATHERPROOF PICKUP ADAPTER Ⓖ IS FREE TO ROTATE WITHOUT TWISTING SIGNAL CABLE Ⓙ.

STEP 3. SCREW MAGNETIC PICKUP Ⓒ CLOCKWISE INTO CONDUIT ADAPTER Ⓑ UNTIL "FINGER TIGHT", THEN ROTATE PICKUP COUNTER-CLOCKWISE ONE QUARTER TURN. DO NOT TIGHTEN WITH PLIERS.

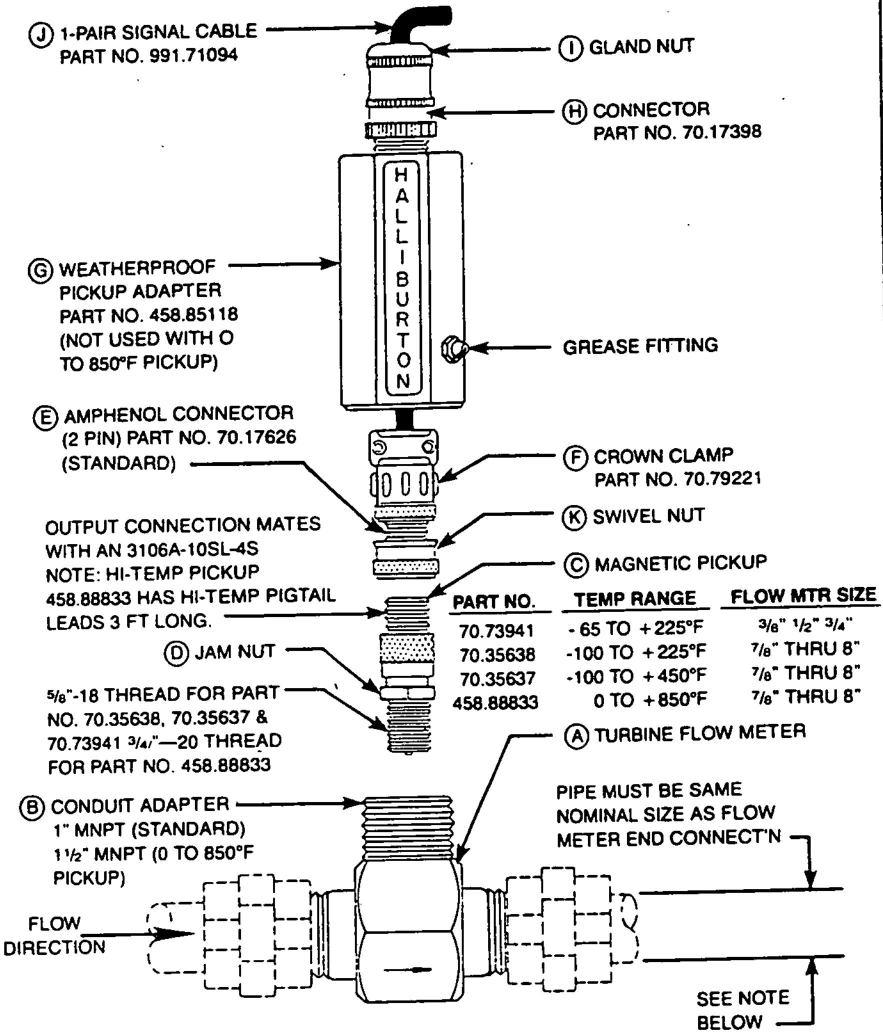
STEP 4. SCREW JAM NUT Ⓓ CLOCKWISE UNTIL MAGNETIC PICKUP Ⓒ IS SECURE.

STEP 5. PLUG AMPHENOL CONNECTOR Ⓔ INTO PICKUP Ⓒ AND TURN SWIVEL NUT Ⓚ UNTIL SECURE.

STEP 6. SLIP WEATHERPROOF PICKUP ADAPTER Ⓖ OVER PICKUP Ⓒ AND TIGHTEN ONTO CONDUIT ADAPTER Ⓑ.

STEP 7. PUMP GREASE INTO GREASE FITTING UNTIL IT **SQUEEZES OUT** AROUND CONNECTOR Ⓗ &GLAND NUT Ⓘ. USE ANY GOOD QUALITY, NON-CONDUCTIVE, MULTI-PURPOSE GREASE.

STEP 8. TIGHTEN GLAND NUT Ⓘ UNTIL RUBBER GROMMET SEALS AROUND SIGNAL CABLE.



| PART NO. | TEMP RANGE | FLOW MTR SIZE |
|---|---|---|
| 70.73941 | - 65 TO + 225°F | 3/8" 1/2" 3/4" |
| 70.35638 | -100 TO + 225°F | 7/8" THRU 8" |
| 70.35637 | -100 TO + 450°F | 7/8" THRU 8" |
| 458.88833 | 0 TO + 850°F | 7/8" THRU 8" |

NOTE:

THERE MUST BE A MINIMUM OF FIVE PIPE DIAMETERS OF UNRESTRICTED FLOW IMMEDIATELY UPSTREAM AND DOWNSTREAM FROM THE FLOW METER.

EXAMPLES: FOR 1" END CONNECTION - 1" PIPE FIVE INCHES LONG.
FOR 2" END CONNECTION - 2" PIPE TEN INCHES LONG.

THROTTLING VALVES **MUST NOT** BE INSTALLED UPSTREAM FROM THE FLOW METER.

DESCRIPTION — STOCK

INSTALLATION
MAGNETIC PICKUP AND
WEATHERPROOF ADAPTER
W/GREASE FITTING

| | | |
|---|---|---|
| APPROVED | WFL | 7-21 |
| CHECKED | WFL | 7-21 |
| DESIGNED | BFL | 7-29 76 |
| DRAWN | OE | 7-28 76 |

HALLIBURTON
SERVICES
DUNCAN OKLAHOMA

SCALE | SHEET 1 OF 1 | CHG B | SPI - 2B - 1830

| LOC. NO. | PART NO. | QUAN. REQ'D. |
|---|---|---|
| | | |

UNLESS OTHERWISE SPECIFIED:
1. REMOVE ALL BURRS AND SHARP CORNERS
2. COR. RADII .03
3. DO NOT SCALE DRAWING
4. ALL DIMENSIONS ARE IN INCHES
5. MACHINE FIN.

TOLERANCES

| 6. FABRICATION | 7. MACHINE |
|---|---|
| .X = ± 1.0 | .X = ± .030 |
| .XX = ± .5 | .XX = ± .015 |
| XXX = ± .25 | .XXX = ± .005 |
| ANGLES ± 3° | ANGLES ± ½° |
| | CONCENTRICITY WITHIN .010 TIR |

NEXT ASSEMBLY

SUPERSEDES

ARTICLES MANUFACTURED IN ACCORDANCE WITH THESE DRAWINGS SHALL BE CONSIDERED HALLIBURTON'S DESIGN AND MANUFACTURER AGREES NOT TO MANUFACTURE FOR THE USE OR SALE BY ANY OTHER PERSON OR CONCERN OR FOR MANUFACTURER'S USE OR SALE IDENTICAL ARTICLES OR PARTS THEREOF WITHOUT HALLIBURTON'S WRITTEN PERMISSION.

PROTECTIVE FINISH

| CHG. | DESCRIPTION | CH. BY | DATE |
|---|---|---|---|
| A | ADDED 70.73941 PICKUP | | 1-2 |
| | CORRECTED HI-TEMP TO 450°F | | 1980 |
| B | CROWN CLAMP PT. NO. 70.79221 WAS AMPHENOL CLAMP PT. NO. 70.16036. | ME | 5-20 82 |

HEAT TREAT — TAKE READING AT

Part No. 458.80001

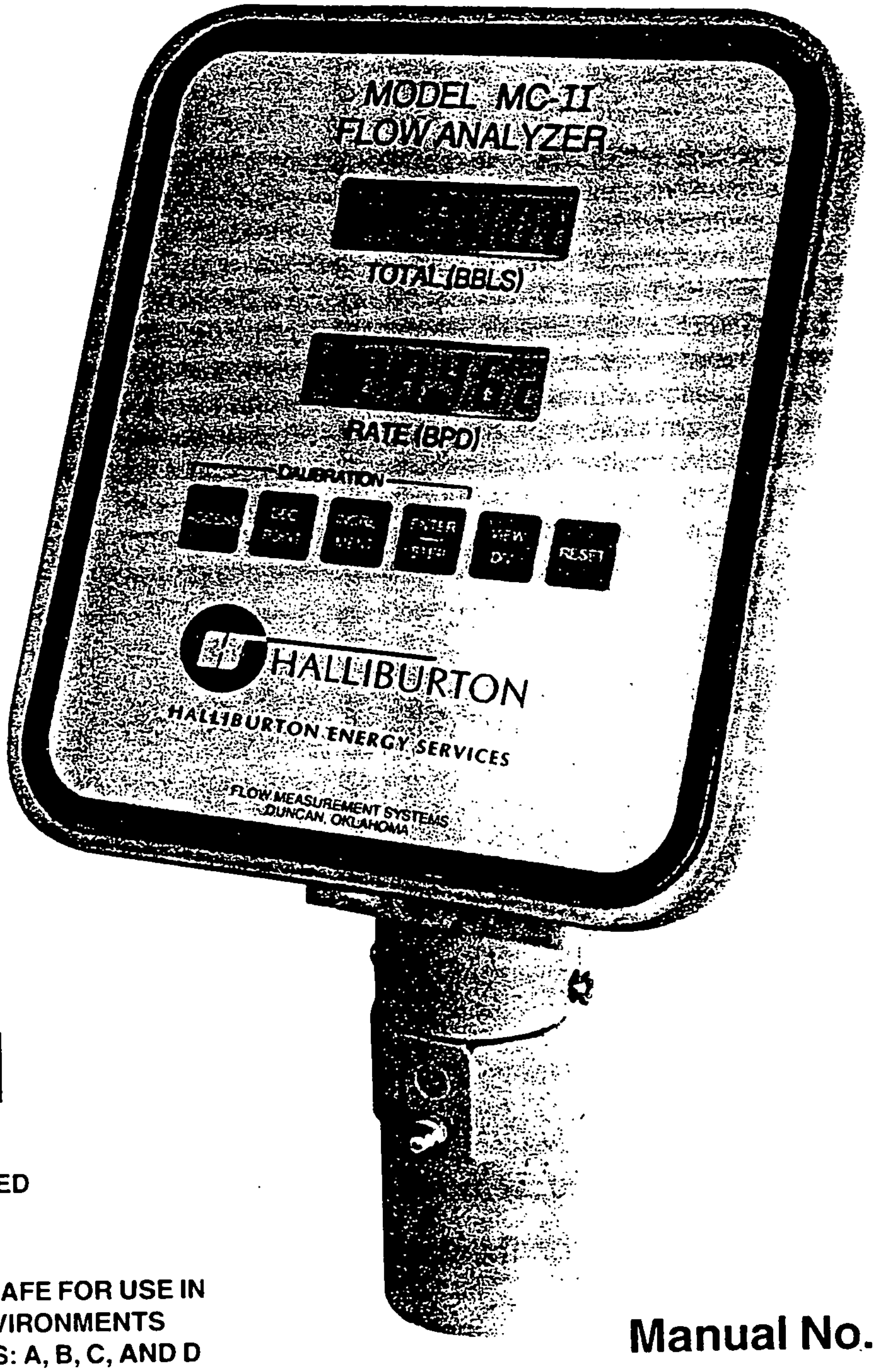
Figure 2

HALLIBURTON

**FLOW MEASUREMENT SYSTEMS**

# FLOW ANALYZER
# Model MC-II

## INSTRUCTION MANUAL



UL LISTED

SP ® CERTIFIED

INTRINSICALLY SAFE FOR USE IN
HAZARDOUS ENVIRONMENTS
CLASS I, GROUPS: A, B, C, AND D

Manual No. 991.43407

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**This Instruction Manual was prepared by**

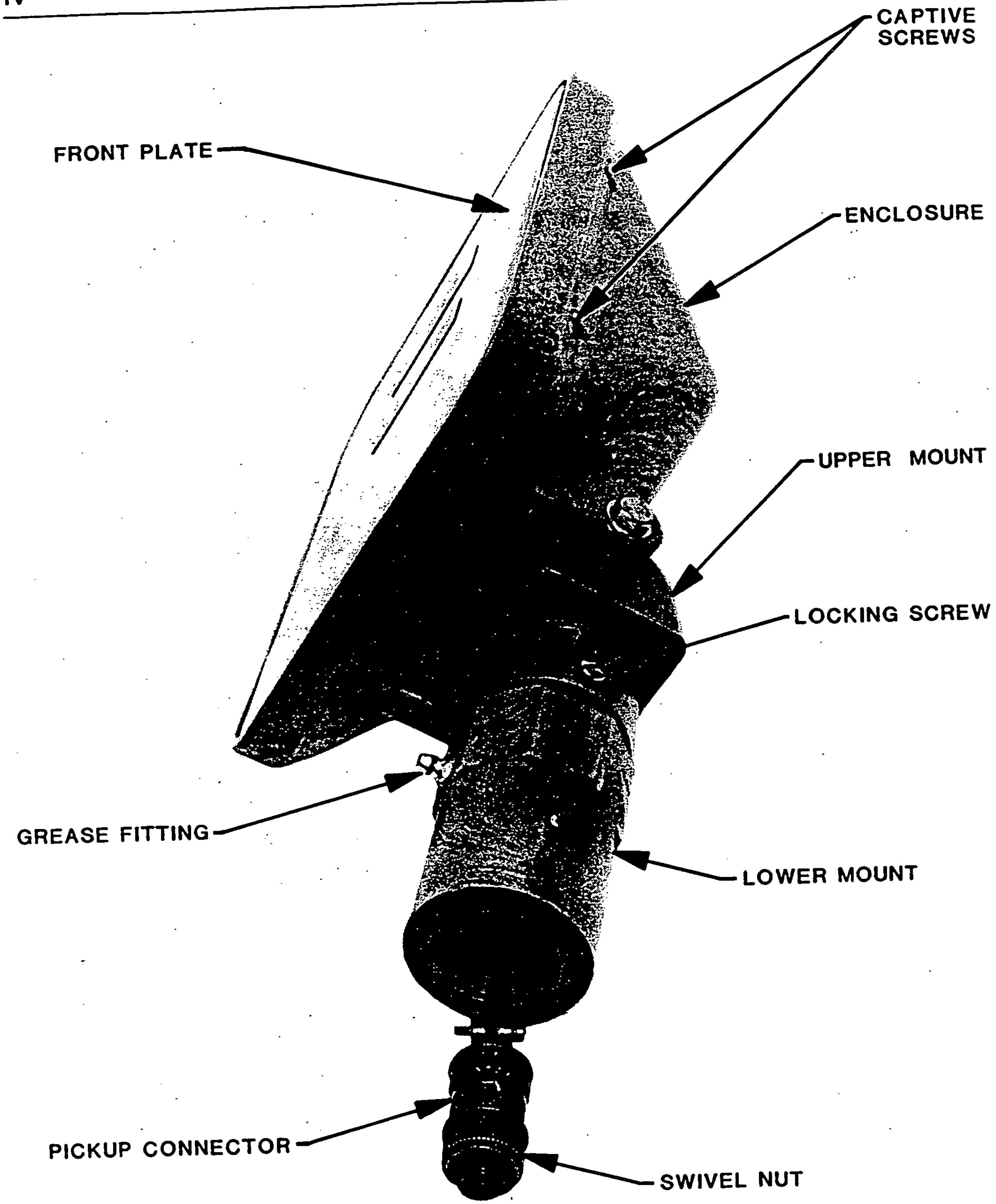
**Flow Measurement Systems (Instrument Section).**

# TABLE OF CONTENTS

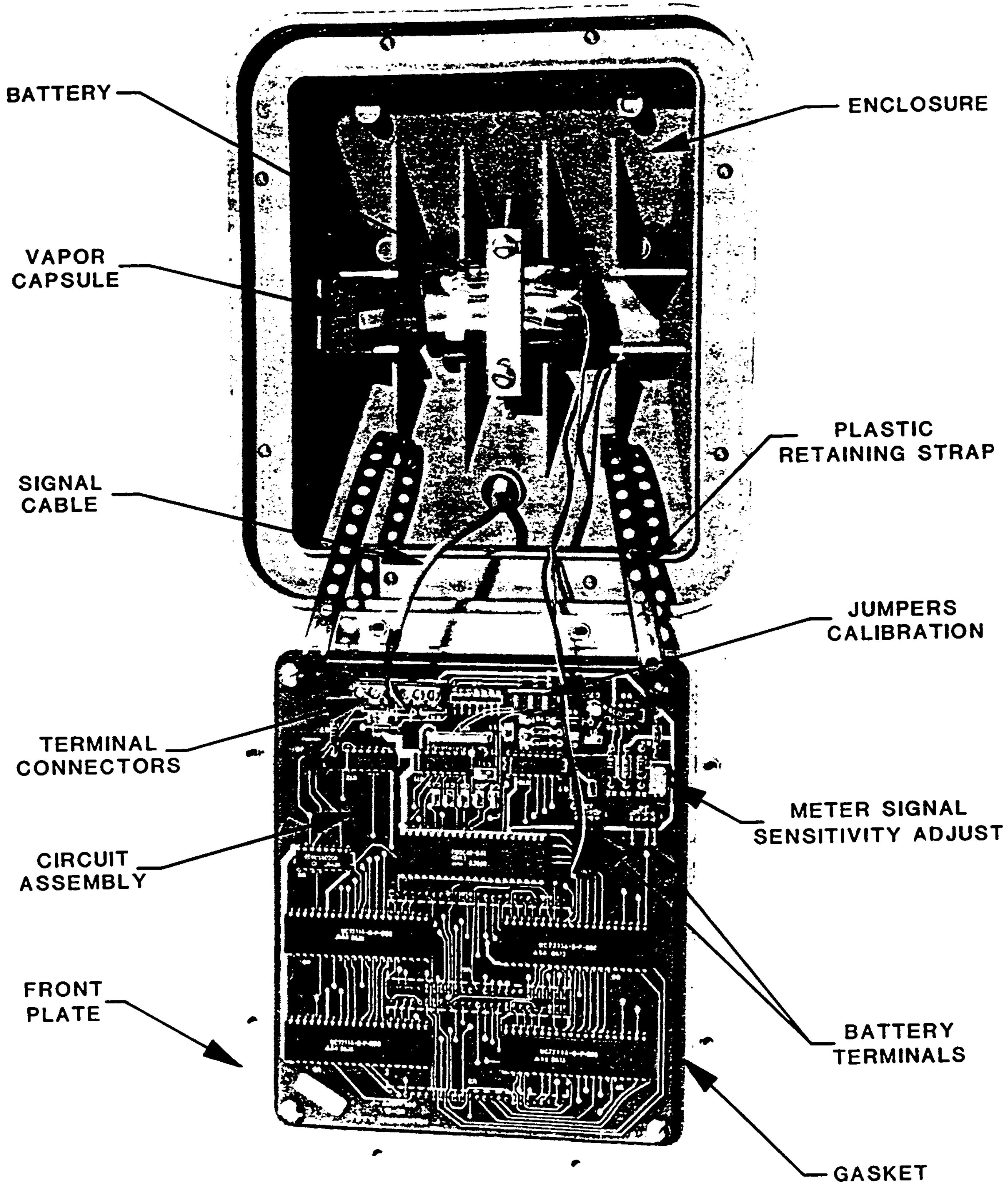
# TABLE OF CONTENTS (CONTINUED)

* NOTE: Appendix 1 & 2 furnished as separate instructions.

## TABLE OF ILLUSTRATIONS



NOMENCLATURE I



NOMENCLATURE II

# GENERAL DESCRIPTION

The Halliburton Model MC-II Flow Analyzer receives an electronic pulse train from a flow meter and provides a registration of totalized flow and an indication of flow rate by utilization of its microprocesser-based circuitry. The totalized flow and flow rate are displayed on two six digit liquid crystal displays (LCD'S). Both displays are properly labeled with respective units of measurement.

The low current draw of its CMOS circuitry enables the MC-II to run for three to five years on a single battery.

The MC-II has the advantage of being battery powered and enclosed in a noncorrosive weatherproof housing, an ideal combination for use in remote locations.

# INSTALLATION INSTRUCTIONS

## A. GENERAL

The Model MC-II Flow Analyzer was designed to be mounted either directly atop its companion flow meter or, with optional hardware, on vertical or horizontal 2" pipe. Either type mount should be free of vibration. (See Figure 2 and 3.) Each MC-II is calibrated for operation with a particular flow meter at the factory, but it can be recalibrated for any compatible flow meter on site. Refer to calibration section of this manual if recalibration is needed. The serial numbers of companion flow meters and readouts may be determined from the shipping and/or packing information. The serial number for the MC-II is located on the back of the housing. The serial number also appears on the outside of the shipping carton. The serial number for the flow meter is stamped on the flow meter body and also appears on its shipping carton.

It is good practice to orient MC-II's such that the liquid crystal displays are not exposed to direct sunlight.

## B. MOUNTING ON FLOW METER

The MC-II is shipped completely assembled. After the flow meter has been installed in the flow line according to the instructions furnished with it, the pickup should be installed, also according to the flow meter instruction manual. If remote mounting option was ordered along with the instrument, see Option Section 3. It is advisable to grease the pickup threads before screwing them into the flow meter body to facilitate easy removal in the future. For the same reason grease the pickup threads which mate with the connector. Plug the connector on the end of the MC-II signal cable into the pickup and turn the swivel nut until the connector is fully inserted into the pickup and the swivel nut is hand tight. Loosen the locking screws which hold the base MC-II mount secure.

Position the MC-II on the flow meter, carefully pulling excess signal cable through the strain relief cord connector on the side of the upper mount. (Refer to Nomenclature I & Figure 4.) Thread the base of the mount onto the conduit adapter of the turbine meter and tighten two extra rounds after it is hand tight. It is important that the upper mount and MC-II readout be kept from turning while the base is being tightened in order to prevent the signal cable from being damaged by twisting. Tighten the outside nut if the strain relief cord connector on the upper mount with a 15mm open end wrench to prevent cord slippage. Adjust the MC-II readout for best viewing position and tighten the locking screws in the upper mount. The viewing angle may be adjusted by loosening the nut on the bolt which holds the MC-II readout on the upper mount, tilting to the desired angle and retightening. Pump grease into the fitting located on the side of the base of the mount until grease comes out of the pressure relief hole which is located opposite the grease fitting.

### C. REMOTE MOUNTING

The MC-II Flow Analyzer is designed to be installed directly atop the flow meter; but if the flow meter is in a line which has vibration or if the location of the meter makes it undesirable to mount the MC-II directly on the meter, remote mounting hardware is available to allow the MC-II to be mounted on a 2 inch pipe. Refer to Option Section 3.

## OPERATION

After proper installation and calibration, the MC-II is ready for operation. If the MC-II was not ordered with a companion flow meter and needs to be calibrated for the meter it is to be used with, see Calibration Section.

When fluid begins to pass through the flow meter, the MC-II displays should register total accumulated flow volume and instantaneous flow rate.

The decimal points will appear in their proper position in the displays when the units are properly calibrated.

If the flow rate exceeds the capabilities of the display, an "E" will appear in the far left hand digit of the rate display, followed by the lower five digits of the rate display. The total display will remain accurate as long as the 35 counts per second rate is not exceeded.

The divisor and rate multiplier which are set into the MC-II will be displayed on the total and rate displays respectively when the "VIEW DIV" button is pressed. (See Figure 1.) This button must be pressed for a few seconds in order to obtain this display. The divisor display may have a decimal point appearing in the display. This decimal point does not reflect the position of a decimal point in the divisor as the divisor is always a whole number. The appearance of a decimal point means that the total display has been calibrated to show parts of a volume, such as 1/10 gallons or 1/100 barrels. The decimal point is determined by the limitation on the maximum number that can be used for a divisor (maximum number for whole units is 32767) (See calibration section). When the Totals divisor is viewed, the appearance of a decimal point & numbers in the top display is expressing two pieces of information at the same time. First the number's are the divisor entered in whole numbers and the position of the decimal point which were determined during the calibration procedure. However, the decimal point appearing in the rate multiplier display is in the actual position occupied by a decimal point in the multiplier.

The accumulated flow total may be reset to zero by pressing the "RESET" button if the reset function is enabled. (Refer to Calibration Section for information concerning enabling and disabling this function.) This button may have to be pressed for a few seconds in order to implement a reset.

## MAINTENANCE

* To gain access to the internal portion of the MC-II, loosen the eight captive screws around the outer edge on the back of the enclosure. Once all of these screws are loose, the front plate of the MC-II should fold down, hinging on the plastic retaining straps at the bottom of the enclosure. It may be necessary to use a thin screwdriver blade to pry the front plate free, but do not use excessive force. The battery and circuit board should now be exposed for servicing.

* CAUTION

> Under normal operating conditions the MC-II poses no hazard when the enclosure is opened. The lithium battery which powers the MC-II is a sealed unit; but if one of these units leaks, there is a possibility of toxic fumes being present when the enclosure is opened. Select a well-ventilated area in which to open the enclosure and avoid breathing fumes that may be trapped inside. Care must be taken in handling and disposing of a damaged battery. See additional Safety Information in the appendix section of the manual.

## A. BATTERY REPLACEMENT

The battery used in the MC-II has a life expectancy of about three to five years. This battery has a very flat discharge curve, making it difficult to measure the battery voltage to determine the remaining battery life at any point in time. When the battery is replaced, the new battery must be connected to the unused battery terminals first before the old battery is disconnected in order to prevent the loss of counts and calibration information. It is advisable to record the date of installation of replacement batteries to help ascertain when the next replacement may be required.

## B. CIRCUIT ASSEMBLY

The circuit assembly 991.43179 contains all of the electronic components. To remove this circuit card, remove the four screws located in the corners of the card, and disconnect the battery, signal cable, and the switch plate.

## C. RECALIBRATION

In order to provide maximum accuracy, the MC-II should be recalibrated whenever its associated flow meter has a new rotor and vane kit installed, or whenever the MC-II is used with a flow meter with a different calibration factor. (Refer to Calibration Section.) Changing the calibration of an MC-II will not destroy the total accumulation flow to that time. Additional flow will be added to that total based on the new calibration information.

# CALIBRATION

The MC-II Flow Analyzer is capable of several different operating modes. Each MC-II shipped is set to the mode of operation specified on the order. It is possible to change the mode of operation in the field if necessary. The MC-II Flow Analyzer comes factory calibrated to match its companion flow meter which should make field calibration unnecessary; however, if calibration adjustment is required, it can be performed at the job site. (See Figure 7.)

## A. MODE OF OPERATION

Three different functions are controlled by jumper plugs on the MC-II circuit board. These functions are the ability to calibrate, the ability to reset, and the ability to enter a rate multiplier. Refer to Figure 7 for the location of each of these jumpers.

### 1. CALIBRATE

The calibrate jumper enables or disables the ability to calibrate the MC-II from the front panel without opening the enclosure. If the operator wants to be able to calibrate the MC-II from the front panel at all times, the jumper should be placed in the ENABLE position. If the operator does not want to have calibration abilities available via the front panel, the jumper should be placed in the DISABLE position. If the jumper is in the DISABLE position, the MC-II must be opened and the jumper plug placed in the ENABLE position in order to calibrate the unit. The jumper can be returned to the DISABLE position after calibration is complete. (See Figure 7.)

### 2. RESET

The reset jumper enables or disables the ability to reset the MC-II totals display to zero from the front panel without opening the enclosure. If the operator wishes to be able to reset the MC-II from the front panel, the jumper should be placed in the ENABLE position. If the operator does not want to have reset capabilities continuously available at the front panel, the jumper should be placed in the DISABLE position. The MC-II must be opened and the jumper plug placed in the ENABLE position in order to reset the totals display. (See Figure 7.)

### 3. RATE MULTIPLIER

The MC-II can calculate a rate multiplier for use in determining flow rate if the time base reflects units per day. It is possible to enter another multiplier if other units of measure are required or if a more accurate multiplier for units per day is desired. If the operator wants the MC-II to calculate the rate multiplier, the one number calibration (O.N.C.) jumper should be placed in the ENABLE position. If the operator prefers to enter the rate multiplier, the O.N.C. jumper should be placed in the DISABLE position (See Figure 7). Refer to the Rate Multiplier Calculation Section for more information.

## B. DIVISOR CALCULATION

The signal from the flow meter used with the MC-II is amplified and squared by the electronic circuitry. The divisor, which is the number of flow meter pulses per unit of volume, is programmed into the MC-II. By making continuous calculations based on the number of stored pulses and the divisor, the MC-II generates total volume readings.

### 1. LIQUID FLOW METERS

The divisor for a liquid meter is determined by the flow meter calibration factor and the appropriate conversion factor for the desired units of registration.

***Example # 1***

Suppose we have a 1½" turbine meter with a calibration factor of 331.35 pulses per gallon. Assume the desired units of registration are barrels. The divisor would then be:

331.35 P/GAL x 42 GAL/BBL = 13,916.7 P/BBL =13,917 P/BBL

The divisor must be rounded to the nearest whole number. In this example, 331.35 pulses per gallon is the calibration factor, 42 gallons per barrel is the appropriate conversion factor for the desired unit of measurement, and 13,917 is the resultant divisor. A divisor for other units of measure must be calculated in a similar manner.

If the desire units of registration had been tenths of barrels, (.1 BBL) the conversion factor would have been 4.2 gallons per tenth barrel and the divisor would have been 1,392. (A decimal point would have to be inserted.)

***Example # 2***

Suppose we have a 1" turbine meter with a calibration factor of 893.37 pulses per gallon. The desired unit of registration are tenths of barrels. The maximum divisor which may be entered via the keyboard is 32,767. The MC-II will not accept a divisor larger than 32,767, nor will it accept a divisor of 0. The divisor would than be:

893.37 P/GAL x 4.2 GAL/.1 BBL = 3752.154 P/.1 BBL = 3,752 P/.1 BBL

The divisor must be rounded to the nearest whole number. In this example, 893.37 pulses per gallon is the calibration factor, 4.2 gallons per tenth barrel is the appropriate conversion factor for the desired unit of measurement, and 3,752 is the resultant divisor. A divisor for other units of measure must be calculated in a similar manner.

If the desired units of registration had been hundreds of barrels, the conversion factor would have been .42 gallons per hundredth of barrel and the divisor would have been 375. (A decimal point would have to be inserted in both examples.)

## 2. GAS FLOW METERS

The divisor for a gas meter is determined by the flow meter calibration factor and the appropriate conversion factor for the desired units of registration . It is also generally desirable to compensate the divisor in order to measure gas in terms of standard unit volumes instead of actual unit volumes. Volumes measured by gas meters are affected by temperature and pressure. If the flowing temperature and pressure are constant, it is possible to adjust the divisor for registration of standard unit volumes by using the following equation.

$$\text{Divisor} = \frac{CF \text{ X } PS \text{ X } TF}{PF \text{ X } TS}$$

Where CF = Flow Meter Calibration Factor (Pulses/ACF)

PS = Standard Pressure = 14.73 PSIA

PF = Flowing Pressure (PSIA)

TF = Flowing Temperature (Degrees Rankine)

TS = Standard Temperature = 519.69 Degrees Rankine (60°F)

NOTE: Degrees Rankine = Degrees Fahrenheit + 459.69

PSIA = PSIG + atmospheric pressure at metering site (14.73 at sea level)

***Example:***

Suppose we have a 2" gas turbine meter with a calibration factor of 124.36 pulses/ACF installed in a flow line operating at 70 PSIG and 80 degrees Fahrenheit. The desired unit of registration is MCF. The divisor would be:

$$\frac{124.36 \times 14.73 \times (80 + 459.69)}{(70 + 14.73) \times 519.69} \times \frac{1{,}000 \text{ CF}}{1 \text{ MCF}} = 22{,}451.55 \text{ P/MCF} = 22{,}452 \text{ P/MCF}$$

The divisor must be rounded to the nearest whole number. A divisor for other units of measure may be calculated in a similar manner.

The maximum divisor which may be entered via the keyboard is 32,767. The MC-II will not accept a divisor larger than 32,767 nor will it accept a divisor of 0.

## C. DIVISOR ENTRY

Once the proper divisor has been calculated it may be entered into the MC-II by use of the membrane switches on the front of the unit. To begin the divisor entry routine, simultaneously press the "ACCESS" and "ENTER/STEP" buttons. (Calibrate jumper must be in "enable" position. Refer to Calibration Section A,1.) Both displays will clear except for a single zero in the right hand side of the total display. Press the "INCREMENT" button repeatedly until the number in that position equals the number in the right most digit of the divisor. (Divisor must be entered from right to left.) Press the "ENTER/STEP" button. A zero will appear in the next higher digit of the display. Again use the "INCREMENT" button to obtain a number in this position corresponding to that in the divisor. Repeat this process until all of the digits of the divisor are entered. Note that it may be necessary to enter zeroes to the left in the case of smaller divisors.

When the five digit positions of the divisor display have been entered and the "ENTER/STEP" button pressed after the fifth entry, an "L" will appear in the total display. This is a prompt asking for the decimal point to be set. Pressing the "DEC. POINT" button repeatedly will cause the decimal point to loop through positions for tenths, hundredths, thousandths, and whole numbers. When the decimal point is in the position corresponding to that required for the units of registration determined by the divisor, press the "ENTER/STEP" button.

After the decimal point has been entered, the MC-II will begin operation if it has been programmed for a one number calibration. If it has been programmed for a two number calibration, a zero will appear in the right hand digit of the rate display, indicating the need to enter a rate multiplier. (See Calibration Sections D and E)

## D. RATE MULTIPLIER CALCULATION

The rate multiplier is the number which will yield the desired flow rate reading when multiplied by the flow meter frequency. This number will be automatically calculated for the selected volumetric units (barrels) per day when the MC-II is in the one number calibration mode (NOTE: Some instances exist in which it would not be desirable to use the one number calibration mode. Refer to Table I, page 8.) When rate readings other than volume per day are required, or when greater accuracy is required, the one number calibration should be disabled in order that the multiplier may be entered by the user. The rate multiplier is calculated as follows:

$$\text{Rate Multiplier} = \frac{\text{TC}}{(\text{CF} \times \text{CON})^*}$$

Where TC = Time Conversion (Second/Unit Time)

CF = Flow Meter Calibration Factor (Pulses/Gallon)

CON = Conversion Factor (Gallon/Unit Volume)

*This figure will be the number or pulses per <u>whole</u> unit volume and thus will not necessarily be the same as the divisor. For example an MC-II used with a 1" turbine meter and indicating barrels and barrels per day could have a divisor of 3752 (i.e. each count is .1 barrel, see example 2 on page 4) and a rate multiplier of

$$\frac{\text{86,400 SECONDS/DAY}}{\text{893.37 PUL/GAL} \times \text{42 GAL/BBL}} = 2.303$$

Note that even though the divisor is set for .1 barrels, the rate multiplier is still calculated based on pulses per whole barrel.

***Example:***

Suppose we have a 1" flow meter with a calibration factor of 891.54 pulses per gallon. We want to read rate in barrels per day. The rate multiplier would be:

$$\frac{\text{86,400 SECONDS/DAY}}{\text{893.37 PUL/GAL} \times \text{42 GAL/BBL}} = 2.303$$

***Example:***

Suppose we have a ¾" flow meter with a calibration factor of 2891.83 pulses per gallon. We want to read rate in gallons per minute. The rate multiplier would be:

$$\frac{\text{60 SECONDS/MINUTE}}{\text{2891.83 PUL/GAL} \times \text{1 GAL/GAL}} = 0.021$$

The smallest rate multiplier allowed is .001. In order to keep from exceeding the rate display capabilities, the rate multiplier should be selected such that the digits entered correspond to the digits shown in Table I. Multipliers may be required for the rate display label, such as BPD x 10.

## Maximum Size of Rate Multiplier Entry

| Meter | GPM | GPH | GPD | BPM | BPH | BPD | M3/Min | M3/H | M3/D |
|---|---|---|---|---|---|---|---|---|---|
| 3/8" | .XXX* | .XXX* | X.XXX | + * | .XXX* | .XXX | + * | + * | .XXX* |
| 1/2" | .XXX* | .XXX* | X.XXX | + * | .XXX* | .XXX | + * | + * | .XXX* |
| 3/4" | .XXX* | X.XXX* | XX.XX | + * | .XXX* | .XXX | + * | .XXX* | .XXX |
| 1" | .XXX* | X.XXX* | XX.XX | .XXX* | .XXX* | X.XXX | + * | .XXX* | .XXX |
| 1 1/2" | .XXX* | XX.XXX* | XX. * | .XXX* | .XXX* | X.XXX | + * | .XXX* | .XXX |
| 2" | X.XXX* | XX.XXX* | XXX. * | .XXX* | X.XXX* | XX.XXX | .XXX* | .XXX* | X.XXX |
| 3" | X.XXX* | XX.XXX* | XXX. * | .XXX* | X.XXX* | XX.XX | .XXX* | .XXX* | X.XXX |
| 4" | X.XXX* | XXX.XX * | XX. * | .XXX* | X.XXX* | XX.XX | .XXX* | .XXX* | XX.XXX |
| 6" | X.XXX* | XX. * | XXX. * | .XXX* | XX.XXX* | XX. * | .XXX* | X.XXX* | XX.XXX |
| 8" | XX.XXX* | XXX. * | XXX. * | .XXX* | XX.XXX* | XX. * | .XXX* | X.XXX* | XXX.XX |

+ Due to very small size of rate multiplier (Less than .001), reading rate in these units is not recommended with this meter.

* One number calibration should not be used.

**TABLE I**

### E. RATE MULTIPLIER ENTRY

Once the rate multiplier has been calculated it may be entered into the MC-II by using the membrane switches on the front of the unit in a manner very similar to that used to enter the divisor. The divisor must always be entered before the rate multiplier may be entered or changed. (Refer to the Divisor Entry Section.)

The rate multiplier entry begins with a zero in the right hand digit of the rate display. Press the "INCREMENT" button repeatedly until the number in that position equals the number in the corresponding digit of the rate multiplier. Press the "ENTER/STEP" button. A zero will appear in the next higher digit of the display. Again use the "INCREMENT" button to obtain a number in this position corresponding to that in the rate multiplier. Repeat this process until all digits of the rate multiplier are entered. Note that it may be necessary to enter zeroes in the upper positions in the case of small rate multipliers, because only 3 places to the right of the decimal point may be entered.

When the five digit rate multiplier has been entered and the "ENTER/STEP" button pressed after the fifth entry, an "L" will appear in the rate display. This is a prompt asking for the decimal point to be set. The purpose of decimal point positioning for the rate multiplier is different than that of the divisor. The decimal point in the divisor routine was placed in the position that it was to appear in the total display. The decimal point in this routine is to be positioned where it actually occurs in the rate multiplier. Press the "DEC. POINT" button repeatedly to loop the decimal point through the positions for tenths, hundredths, thousandths, and whole numbers. When the decimal point is in the position corresponding to that of the decimal point in the rate multiplier, press the "ENTER/STEP" button. After this entry, the MC-II will begin operation.

## SENSITIVITY ADJUSTMENT-FLOW METER SIGNAL

The circuit assembly for the MC-II has the additional feature of being able to adjust the input sensitivity for the flow meter input signal.

Provided on the circuit assembly is a 25-turn, 5000 ohm potentiometer. Adjustment of this "pot" varies the sensitivity range from approximately 950mV p-p down to 15mV p-p. Instruments are factory set at 20 mV p-p. See "NOMENCLATURE II", page V, for location of this potentiometer.

A clockwise adjustment will increase the sensitivity, allowing a signal with less amplitude to operate the unit. Caution should be used here in order that the sensitivity not be adjusted so low that electrical noise would be counted along with the signal pulses.

A counter-clockwise adjustment will decrease the sensitivity. In other words, a larger input signal would be required to operate the unit. Some electrically "noisy" areas may require that this adjustment be done, in order that the noise be eliminated from the signal processing.

## RECOMMENDED SPARE PARTS LIST

| Quantity | Part Number | Description |
|---|---|---|
| 1 | 991.43179 | Circuit Assembly, Totalizer/Rate Indicator LCD |
| 1 | 991.43283 | Battery |
| 1 | 70.96304 | Vapor Capsule |
| 1 | 991.43385 | 1 ft. Cable Assembly |
| 1 | 991.43395 | Front panel with keypad switch |
| 1 | 991.43564 | Rubber Sponge Gasket |
| *1 | 991.43394 | 10 ft. Cable Assembly |
| **1 | 991.43450 | Circuit - Pulse Output |
| ***1 | 991.44828 | Circuit - Pulse Output - Intrinsically Safe |
| ****1 | 70.90690 | Relay - Pulse Output - 5V |
| ****1 | 70.76662 | Relay - Pulse Output - 12V |
| ****1 | 70.90691 | Relay - Pulse Output - 24V |
| ****1 | 991.43534 | Module - Open Collector Pulse Output |
| ****1 | 991.43533 | Module - Opto-Isolated Pulse Output |

*Required with remote mounting option.

**Required with pulse output option.

***Required with intrinsically safe pulse output option.

****Check specific MC-II assembly to determine which pulse out relay or module is required.

# OPTIONS

## 1. TOTALIZER AND FLOW RATE UNITS

The MC-II Flow Analyzer's standard configuration is for increments of barrels (BBL) and barrels per day (BPD). Other totalizer units and flow rate units are available and should be specified when ordering. It is possible to change the units of measurement in the field. See Calibration Section for instructions.

## 2. TOTALIZER RESET

The MC-II Flow Analyzer is furnished with the totalizer reset switch on the front panel, disabled such that pressing this switch will not reset the totals display, unless the "RESET" option is specified at the time the instrument is ordered. This feature may be enabled in the field to allow the totals display to be reset from the front panel. Refer to Calibration Section for instructions.

## 3. REMOTE MOUNTING

The MC-II Flow Analyzer is normally furnished for flow meter mounting. Optional hardware including additional signal cable is available for pipe mounting. (Refer to Figure 3) The remote mounting option kit consists of a mounting bracket, "U" bolts, nuts and lock washers, weatherproof adapter and 10 foot signal cable assembly. Additional signal cable length is available if required.

A. If remote mounting option was specified at the time the instrument was ordered, follow step 1 below only.

B. If the remote mounting option was not specified when the MC-II Flow Analyzer was originally ordered, skip step 1 below and proceed directly to Steps 2, 3, and 4.

**STEP 1:** Place the "U" bolts around the pipe the MC-II is to be mounted on, then through the mounting bracket. Note that the holes in the mounting bracket are arranged such that it may be used with horizontal or vertical pipe. (Note: Disregard the center hole in the mounting bracket.) Fasten the bracket with the lock washers and nuts. Use the bolts, lock washers and nuts to attach the MC-II to the bracket. Position the MC-II to the viewing angle desired before tightening the nut. (See Figure 3.) Follow the installation procedure of the weatherproof pickup housing furnished with the flow meter.

**STEP 2:** To remove old cable connector, loosen the eight captive screws around the outer edge on the back of the enclosure.* Once all of these screws are loose, the front plate of the MC-II folds down, hinging on the plastic retaining straps at the bottom of the enclosure. The cable feeds through the rubber grommet to the inside of the enclosure where it is connected to the terminal connector. (See Nomenclature II) Unscrew terminal connector number 3 and pull off the black cable lead, then unscrew terminal connector number 4 and pull off the red or white cable lead. Cut "cable tie" on the cable and pull the cable through the housing.

*** CAUTION:**

Under normal operating conditions the MC-II poses no hazard when the enclosure is opened. The lithium battery which powers the MC-II is a sealed unit; but if one of these units leaks, there is a possibility of toxic fumes being present when the enclosure is opened. Select a well-ventilated area in which to open the enclosure and avoid breathing fumes that may be trapped inside. Care must be taken in handling and disposing of a damaged battery. See additional Safety Information in the appendix section of the manual.

**STEP 3:** To install new cable connector; feed cable through rubber grommet and make a knot or install a cable tie inside housing, but allow enough free length to connect wires to the terminal connector. Feed black lead and shield into terminal connector number 3 and screw retainer down tight. Feed red or white lead into terminal connector number 4 and screw retainer down tight. Close the enclosure and retighten all eight screws. Follow the installation procedure of the weatherproof pickup housing furnished with the flow meter.

**STEP 4:** Mounting the bracket; place the "U" bolts around the pipe the MC-II is to be mounted on, then through the mounting bracket. Note that the holes in the mounting bracket are arranged such that it may be used with horizontal or vertical pipe. (Disregard the center hole in the mounting bracket.) Fasten the bracket with the lock washers and nuts. Remove the nut and bolt which holds the MC-II housing to the upper mount. Discard the mount but use the bolt, lock washer, and nut to attach the MC-II to the bracket. Position the MC-II to the viewing angle desired before tightening the nut.

## 4. TWO NUMBER CALIBRATION

The MC-II Flow Analyzer is furnished with O.N.C. (one number calibration), unless the two number calibration option is specified at the time the instrument is ordered. The two number calibration feature permits the operator to enter the totalizer divisor and the rate multiplier for the selected units per day. Refer to Calibration Section for additional details about this option.

## 5. CALIBRATION FROM FRONT PANEL

The MC-II Flow Analyzer is furnished with calibration from the front panel disabled, unless this feature is requested to be enabled at the time the instrument is ordered. Having this feature enabled allows the operator to calibrate the MC-II via the front panel without having to open the instrument and move the calibration jumper to the "enable" position. Refer to Calibration Section for additional details about this option.

## 6. MC-II PULSE OUTPUT CIRCUIT ASSEMBLY - 991.43450

This circuit assembly was designed for use with the MC-II Flow Analyzer to provide optional pulse output. It is mounted inside the unit between the totalizer board and the battery cavity. A 6 pin terminal strip and two mounting holes allow for easy installation.

The following paragraphs describe the circuit assembly's operation.

### A. PULSE INPUT:

The pulse input to this card is obtained from the "Pulse Out" of the totalizer card. It will appear in the form of a single square wave pulse or a "burst" of several pulses, according to the flow meter input frequency and divisor setting on the totalizer board.

### B. PULSE OUTPUT:

The pulse output from this card is provided in the form of a dry contact from a relay, transistor open-collector, or an emitter/collector opto-isolated output. A 14 pin socket on the card is provided to install either the relay or component plug "module", whichever is specified.

## C. DIVIDE-BY CIRCUIT:

The "W1" jumper is used to select whether the output is to occur with each increment of the totalizer volume, for every 10 increments, or for every 100 increments of the display total. In most cases, either "÷1", "÷10" or "÷100" can be selected with no problem of losing pulse output counts. However, due to the totalizer display update time being approximately 2.8 seconds and its "burst" potential of pulses, there may be times when the ÷10 or ÷100 mode is mandatory to maintain proper pulse out to incremental volume ratio. In order to determine whether this is necessary, divide the calculated "divisor" by the flow meter's maximum frequency. This value can then be looked up in Table 2 below to determine which jumper position can be selected.

TABLE 2

| DIVISOR/FREQUENCY | PULSE OUTPUT ("W1" JUMPER) |
|---|---|
| .028 to .27 | Use ÷100 only |
| .28 to 2.7 | Use ÷10 or ÷100 |
| 2.8 & up | Use ÷1, ÷10 or ÷100 |

## D. EXTERNAL POWER INPUT:

The DC power input to this card can range from a fixed 5v to 28v. However, 12v or 24v is preferred. 5v, 12v and 24v relays are standard and available for this circuit.

Any other voltage may require that the "W2" jumper be replaced with a resister. This would serve to limit current through the relay coil should a "non-standard" input voltage be selected. If 5 volts were selected as the supply voltage, the circuit card would have to be modified as follows:

(1) Remove CR3 and VR1.

(2) Install jumper wire in CR3 position.

(3) Install jumper wire from 1st to 3rd pins of VR1 position.

(4) Install 5V relay.

## E. EXTERNAL POWER OF TOTALIZER BOARD:

Normally, the Lithium battery within the MC-II provides power to the totalizer board whether a pulse output board has been installed or not. However, if desired, the battery can be removed and the totalizer board be powered from the pulse output board. To do so would require the following circuit assembly wiring modifications.

(1) Refer to Installation Drawing 991.43532, Figure 9, Page 24.

(2) Install R7 (220 ohm), C6 (10 mfd), and CR1 (1N5227) on circuit 991.43450, Figure 8, Page 23.

(3) Remove Lithium battery.

(4) Install wiring assembly (99.43532, from pulse output board J2 to totalizer board J3/J4.

A disadvantage to the above configuration would be that during a power outage, the display totals would be lost and the unit would have to be recalibrated when power was restored.

## F. INPUT/OUTPUT CONNECTIONS:

(Refer to Figure 10, Page 25)

| | |
|---|---|
| DC Power (12V or 24V preferred) | J1 Pin 6 |
| Ground | J1 Pin 5 |
| Pulse Input & Common | J1 Pin 2,1 |
| Pulse Output - Relay Contact | J1 Pin 4,3 |
| - Transistor or Opto-Isolated | J1 Pin 4,3 |

## G. ELECTRICAL SPECIFICATIONS:

| | |
|---|---|
| Current Draw - standard | 3 ma |
| - with Zener circuit to power totalizer board | 10 ma |
| Relay Contact Rating | 0.5, 30VDC, 10W max (resistive) |
| Open Collector Module | 0.3A max., 30VDC max |
| Opto-Isolated Module | 0.1A max, 30VDC max |
| Pulse Output Duration | 60 msec (approx.) |

## 7. MC-II PULSE OUTPUT CIRCUIT ASSEMBLY - INTRINSICALLY SAFE - 991.44828

This circuit assembly was designed for use with the MC-II Flow Analyzer to provide an optional pulse output. It is mounted inside the unit between the totalizer board and the battery cavity. A 6 pin terminal strip and two mounting holes allow for easy installation. When this circuit assembly is installed according to drawing 991.44737 (Figure 12), the MC-II with pulse output is rated by Underwriters Laboratory and Canadian Standards Association as Intrinsically Safe for Class I, Groups A, B, C and D, Division 1.

The following paragraphs describe the circuit assembly's operation.

### A. PULSE INPUT - INTRINSICALLY SAFE:

The pulse input to this card is obtained from the "Pulse Out" of the totalizer card. It will appear in the form of a single square wave pulse or a "burst" of several pulses, according to the flow meter input frequency and divisor setting on the totalizer board.

### B. PULSE OUTPUT - INTRINSICALLY SAFE:

The pulse output from this card is provided in the form of a dry contact from a relay, transistor open-collector, or an emitter/collector opto-isolated output. A 14 pin socket on the card is provided to install either the relay or component plug "module", whichever is specified.

## C. DIVIDE-BY CIRCUIT - INTRINSICALLY SAFE:

The "W1" jumper is used to select whether the output is to occur with each increment of the totalizer volume, for every 10 increments, or for every 100 increments of the display total. In most cases, either "÷1", "÷10" or "÷100" can be selected with no problem of losing pulse output counts. However, due to the totalizer display update time being approximately 2.8 seconds and its "burst" potential of pulses, there may be times when the ÷10 or ÷100 mode is mandatory to maintain proper pulse out to incremental volume ratio. In order to determine whether this is necessary, divide the calculated "divisor" by the flow meter's maximum frequency. This value can then be looked up in Table 2 (page 13) to determine which jumper position can be selected.

## D. EXTERNAL POWER INPUT - INTRINSICALLY SAFE:

The DC power input to this card is 6V.

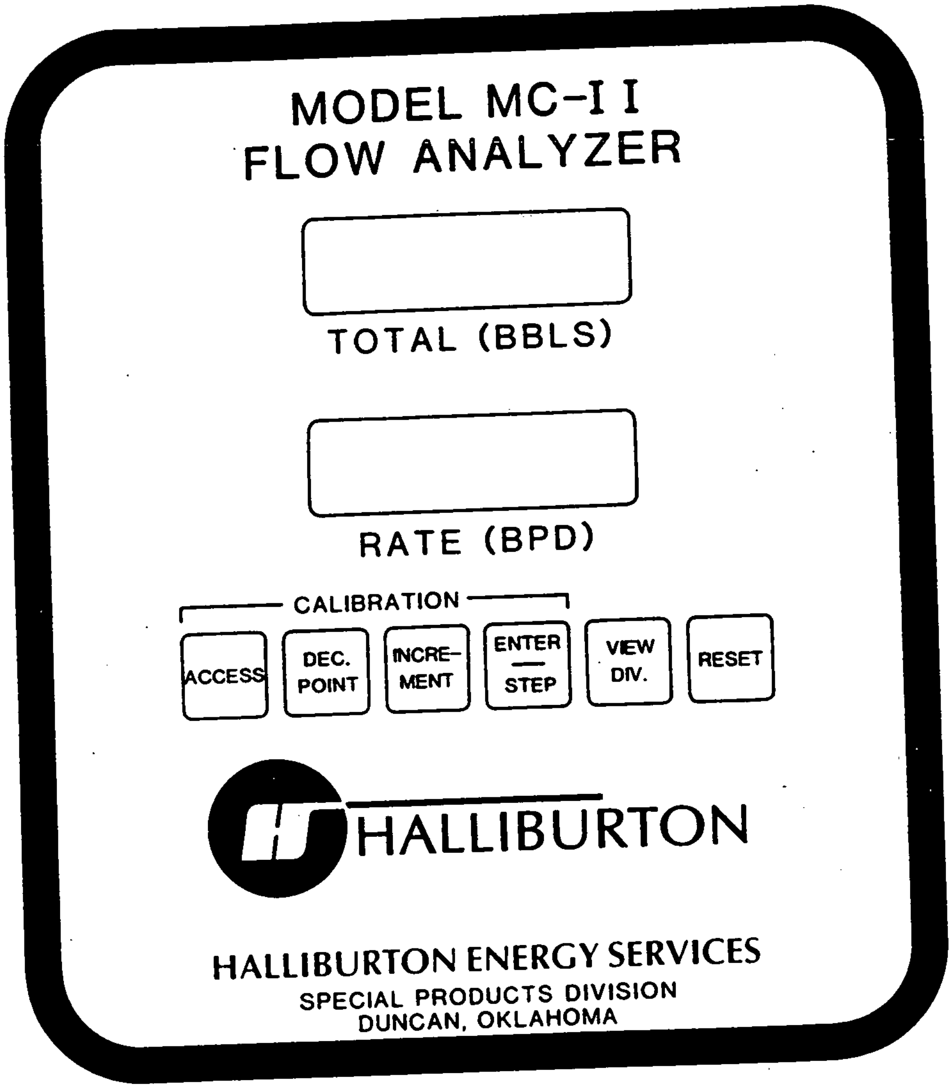
## E. INPUT/OUTPUT CONNECTIONS - INTRINSICALLY SAFE:

(Refer to Figure 12, Page27)

| | |
|---|---|
| DC Power | J1 Pin 6 |
| Ground | J1 Pin 5 |
| Pulse Input & Common | J1 Pin 2,1 |
| Pulse Output - Relay Contact | J1 Pin 4,3 |
| - Transistor or Opto-Isolated | J1 Pin 4,3 |

## F. ELECTRICAL SPECIFICATIONS - INTRINSICALLY SAFE:

| | |
|---|---|
| Current Draw | 3 ma |
| Relay Contact Rating | 0.5, 30VDC, 10W max (resistive) |
| Open Collector Module | 0.3A max., 30VDC max |
| Opto-Isolated Module | 0.1A max, 30VDC max |
| Pulse Output Duration | 60 msec (approx.) |

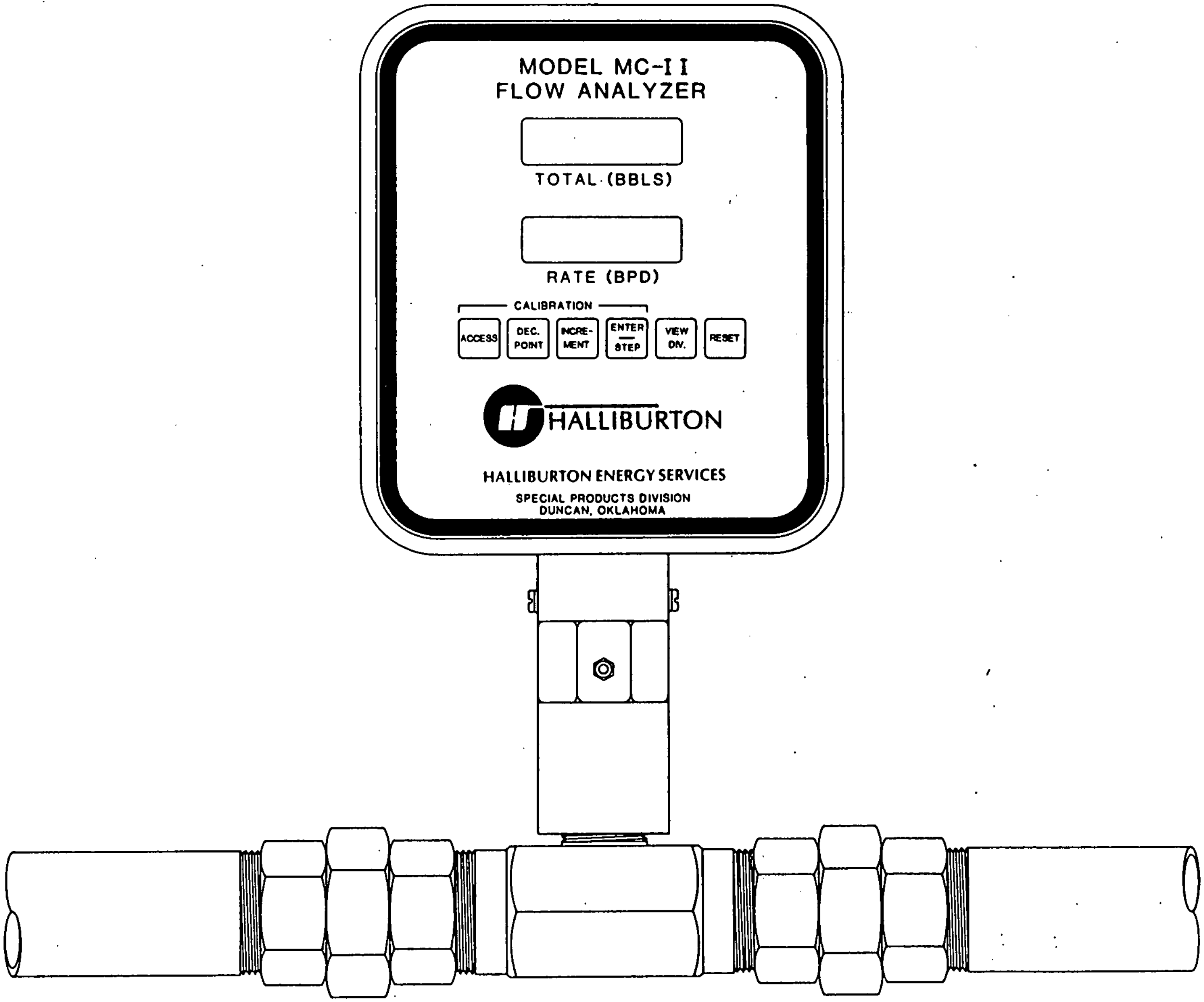


FRONT PANEL

SPI-1C-1178

Figure 1

Figure 2

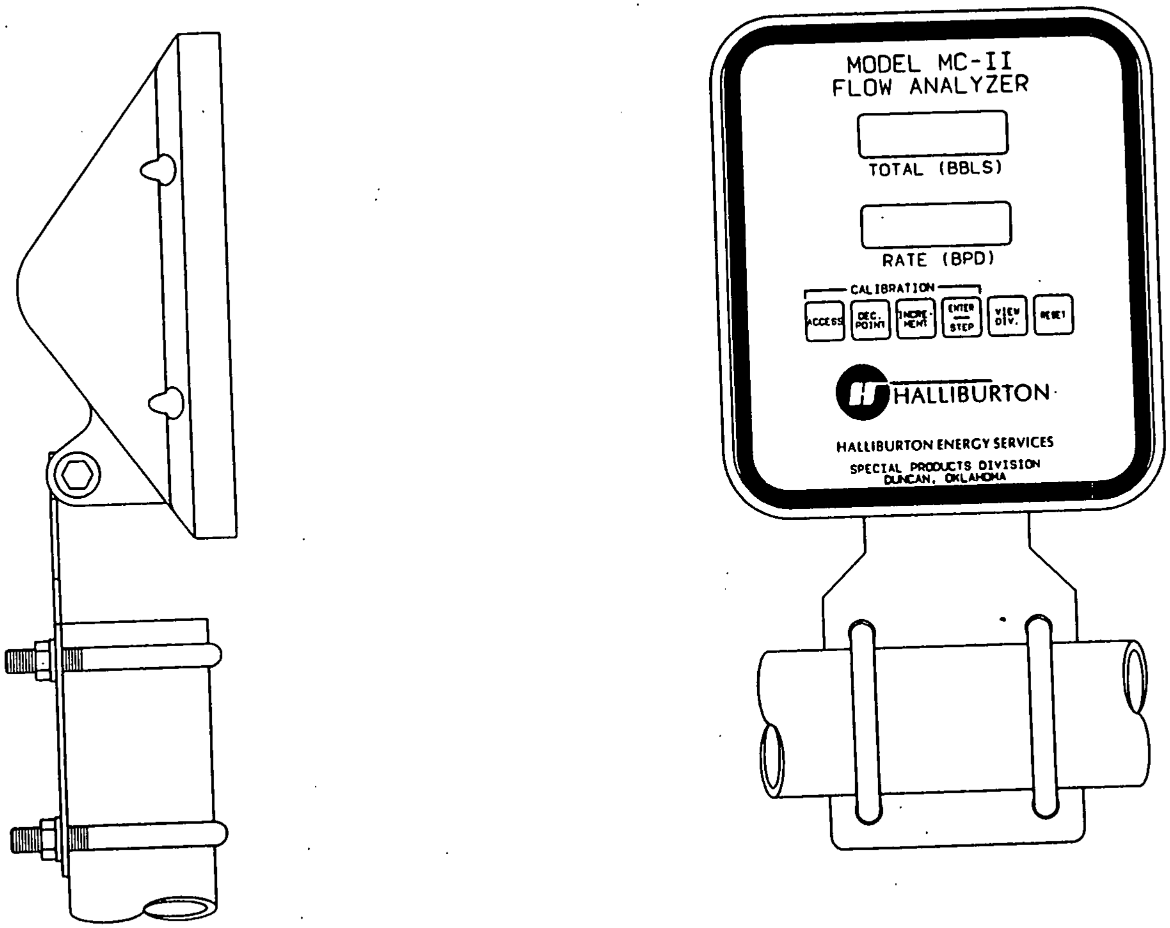


TYPICAL INSTALLATION - DIRECT MOUNT

TYPICAL INSTALLATION — DIRECT MOUNT

SPI-1D-1423

SPI-1D-1423

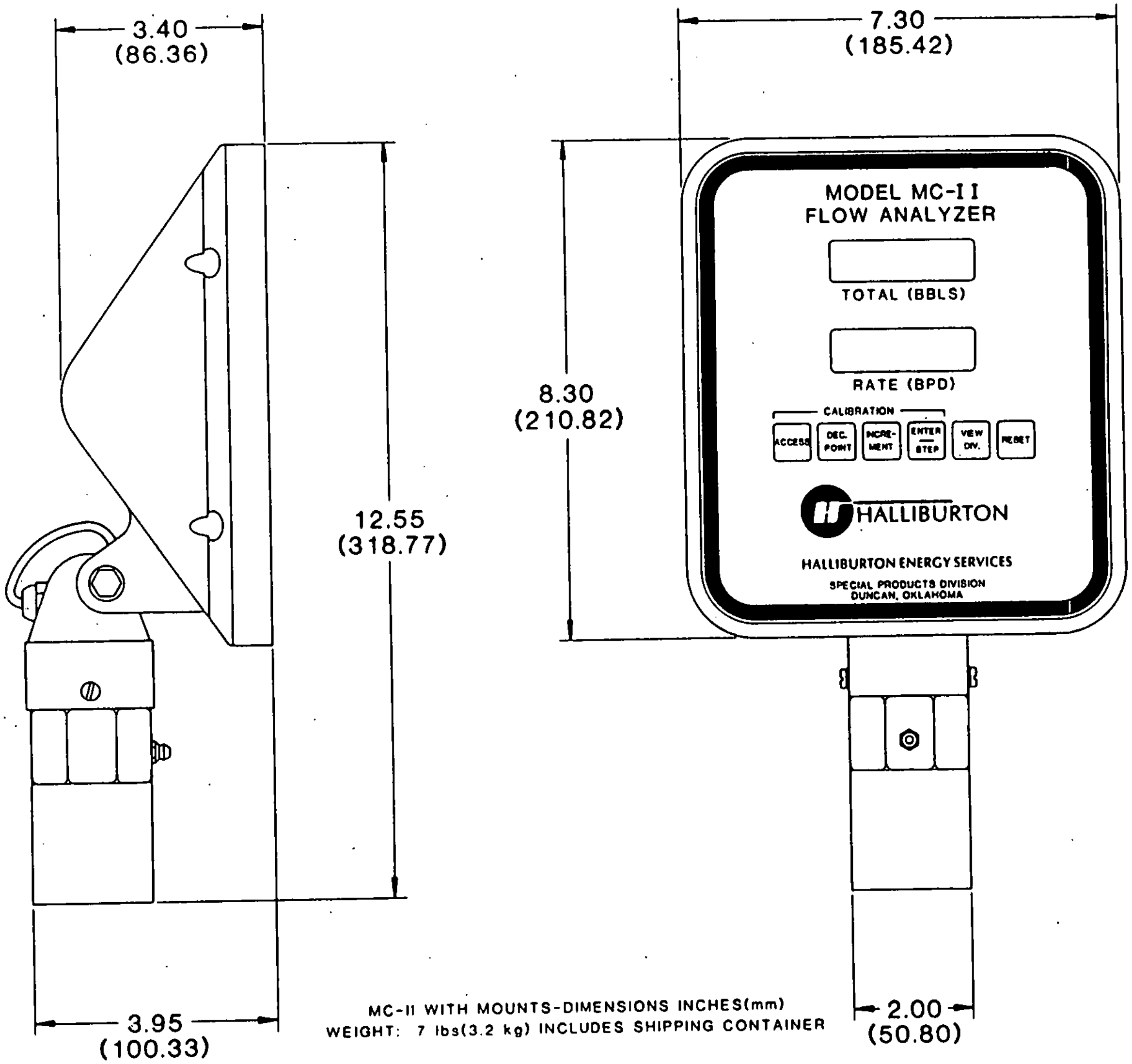


SPI-2D-1459

TYPICAL INSTALLATION — REMOTE MOUNT

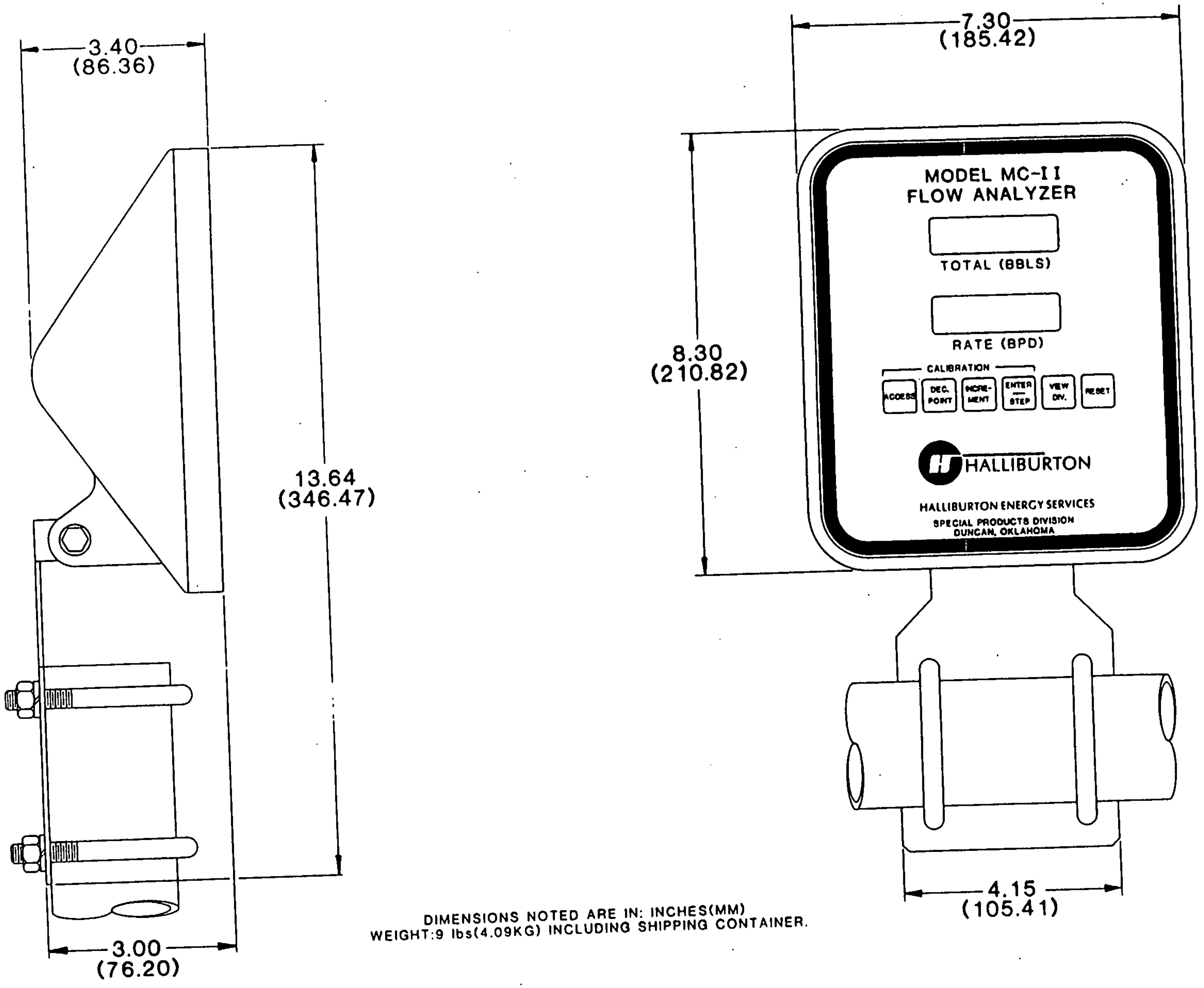
Figure 3

Figure 4



MC-II WITH MOUNTS-DIMENSIONS INCHES(mm)
WEIGHT: 7 lbs(3.2 kg) INCLUDES SHIPPING CONTAINER

DIMENSIONAL DRAWING — MC-II WITH DIRECT MOUNT



DIMENSIONS NOTED ARE IN: INCHES(MM)
WEIGHT:9 lbs(4.09KG) INCLUDING SHIPPING CONTAINER.

VERTICAL PIPE

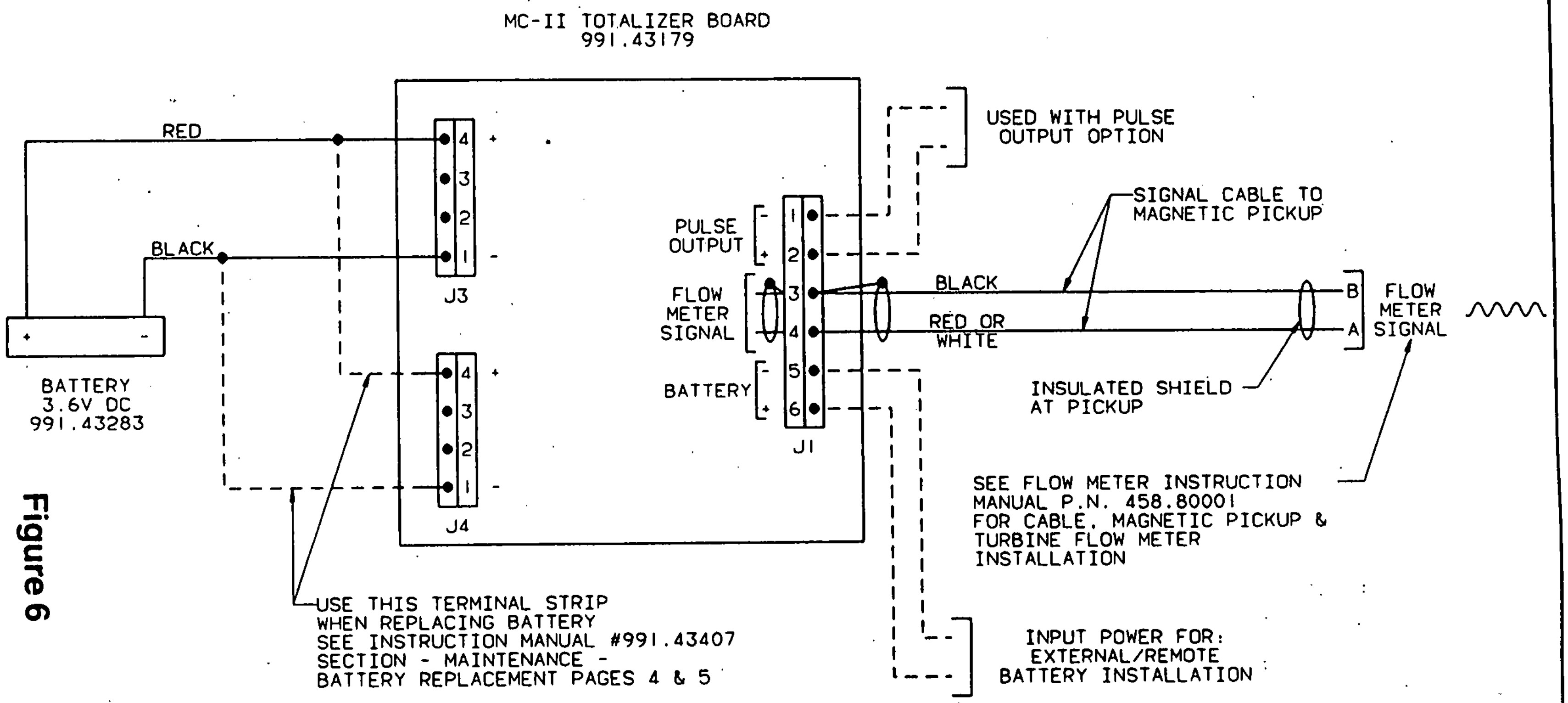
HORIZONTAL PIPE

SPI-1D-1422

DIMENSIONAL DRAWING - MC-II WITH REMOTE MOUNT

Figure 5

Figure 6



WIRING DIAGRAM

991.43857

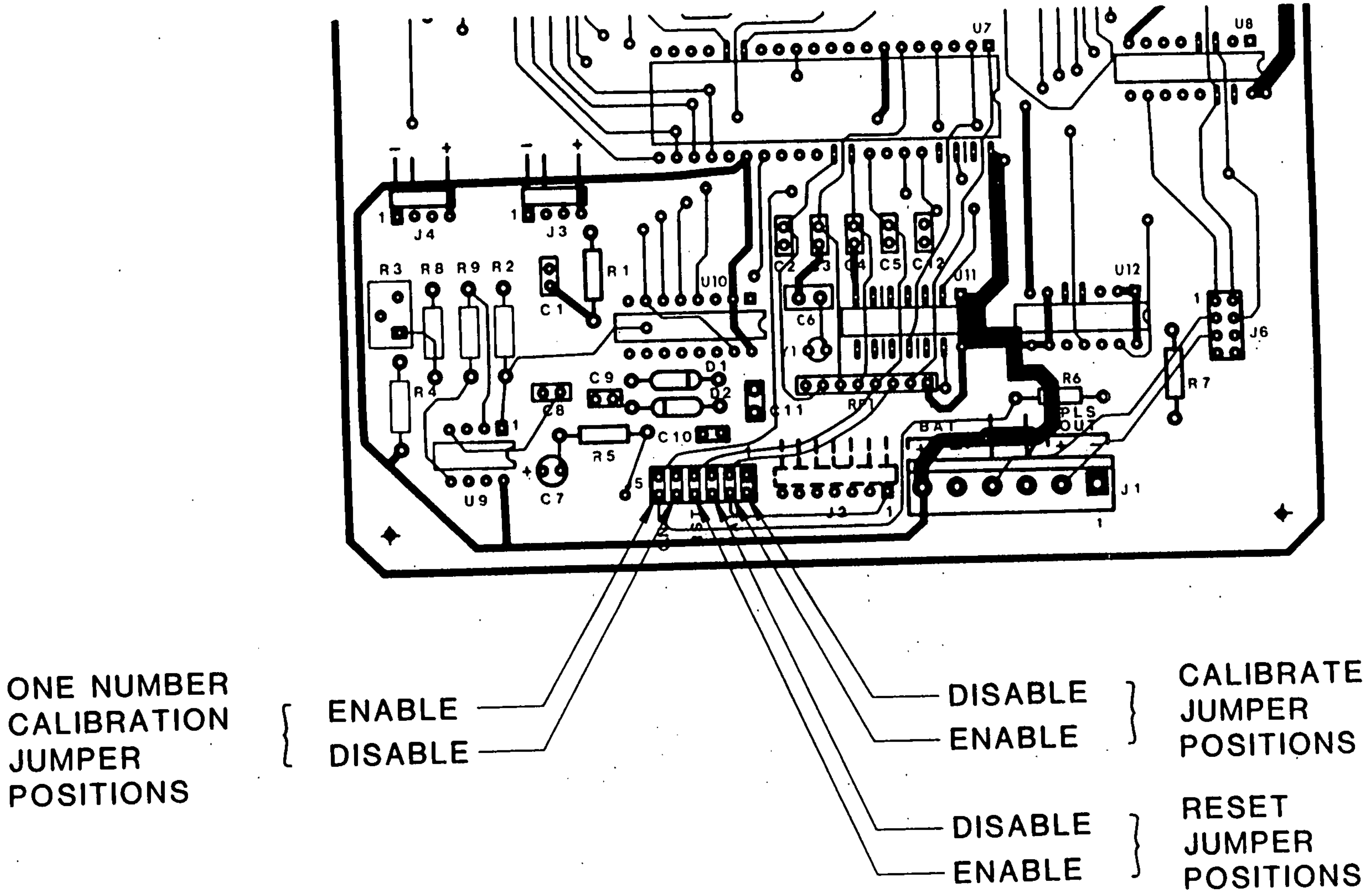
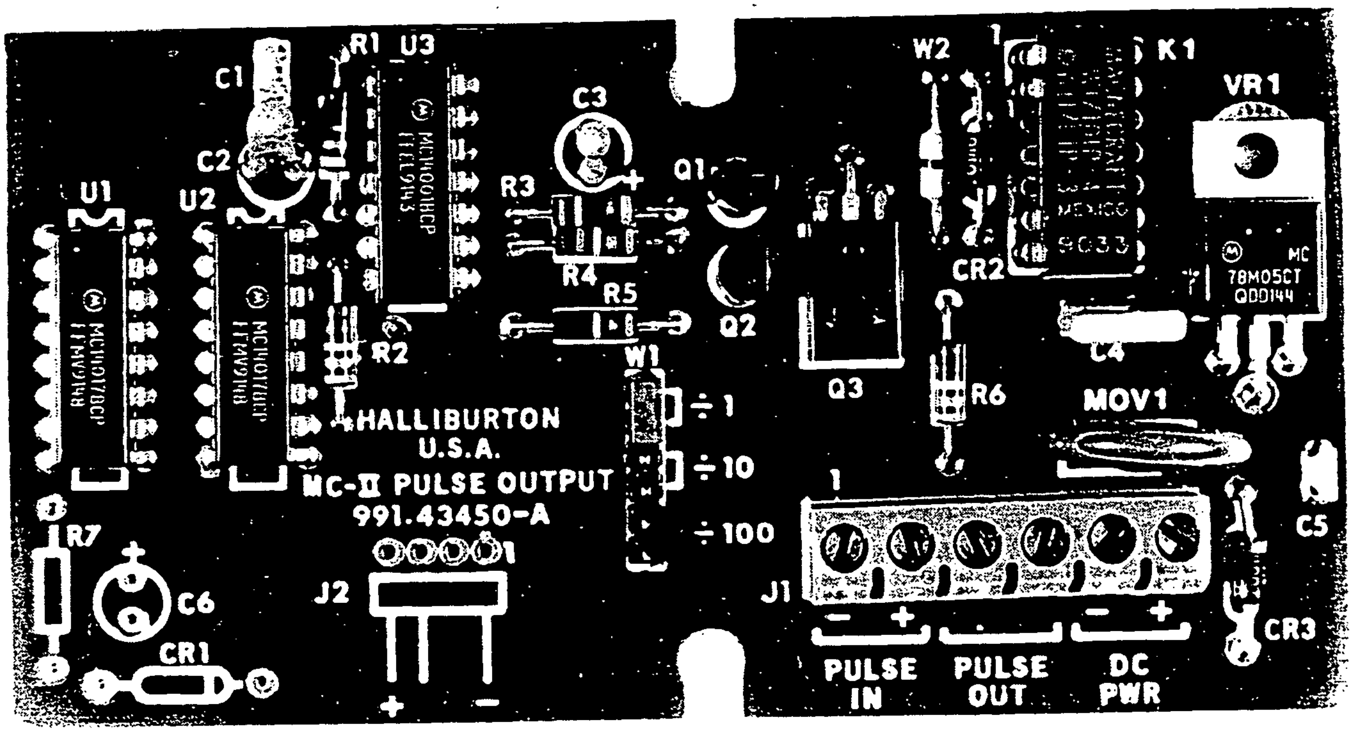


Figure 7

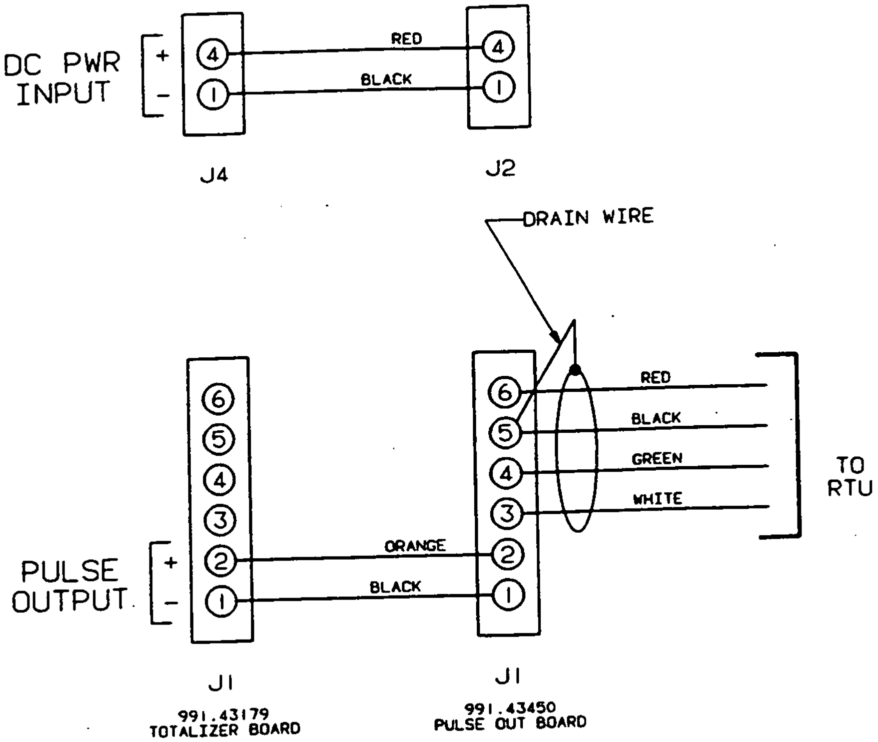
CALIBRATION JUMPER POSITION



PULSE OUTPUT CIRCUIT ASSEMBLY 991.43450

Figure 8

## PULSE OUTPUT OPTION–WIRING & CORD INSTALLATION



## WIRING DIAGRAM – 991.43532

## CORD CONNECTOR INSTALLATION

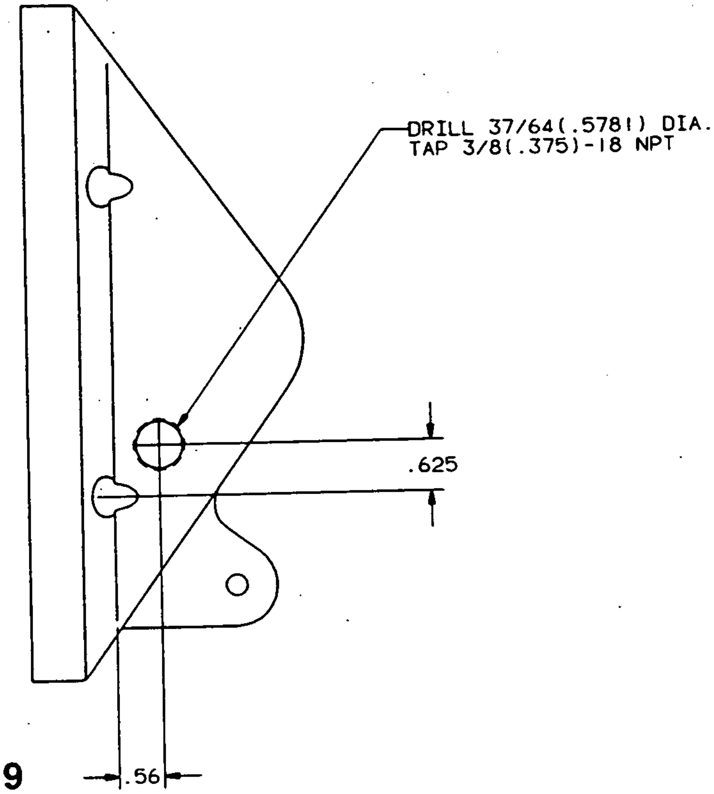
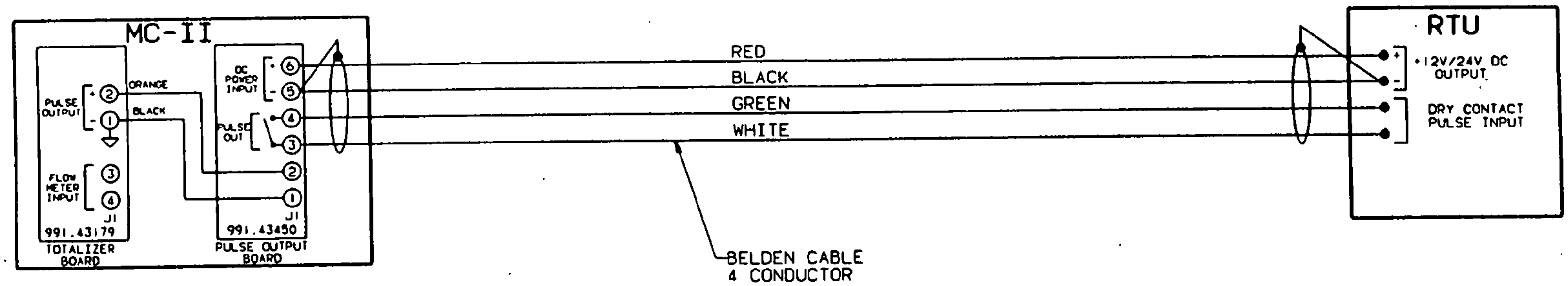
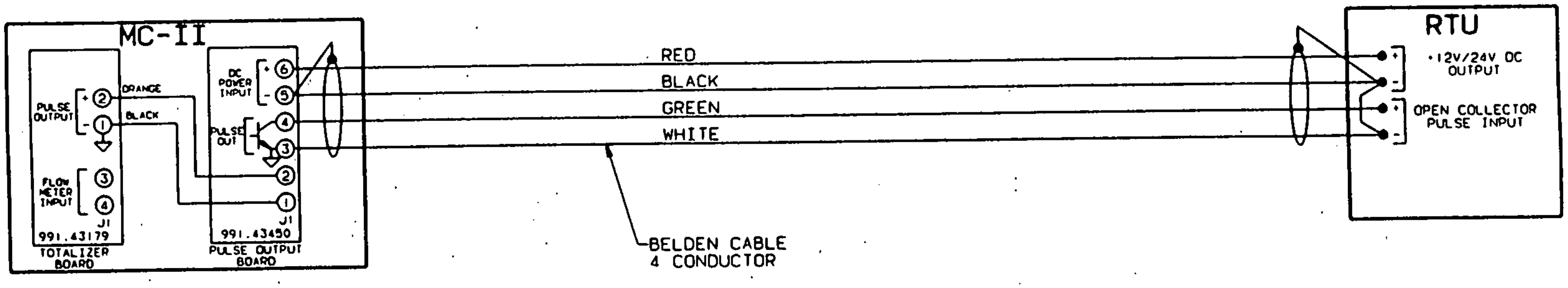


Figure 9

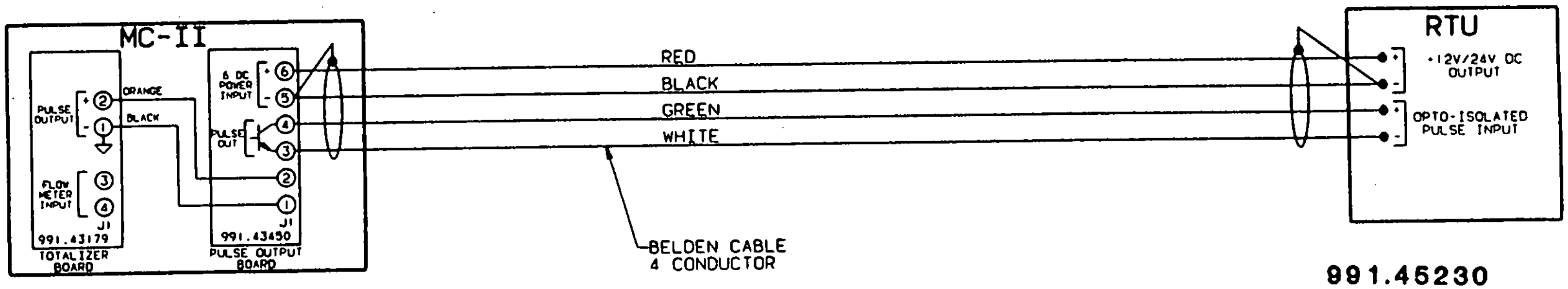
## MC-II W/DRY CONTACT PULSE OUTPUT



## M C-II W /OPEN COLLECTOR PULSE OUTPUT



## MC- II W/OPTO-ISOLATED PULSE OUTPUT



991.45230

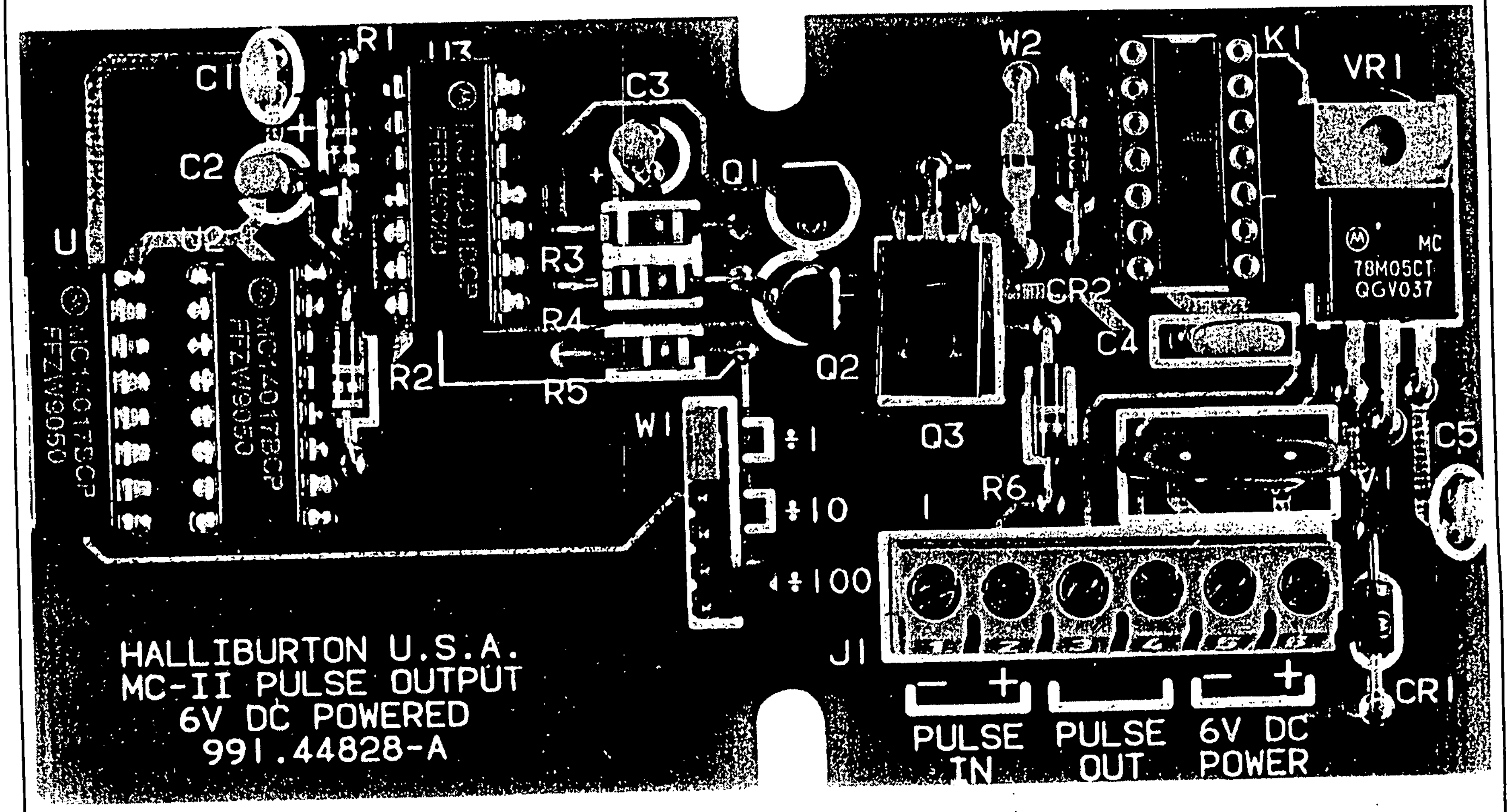
PULSE OUTPUT-INSTALLATION-FIELD WIRING DIAGRAMS:

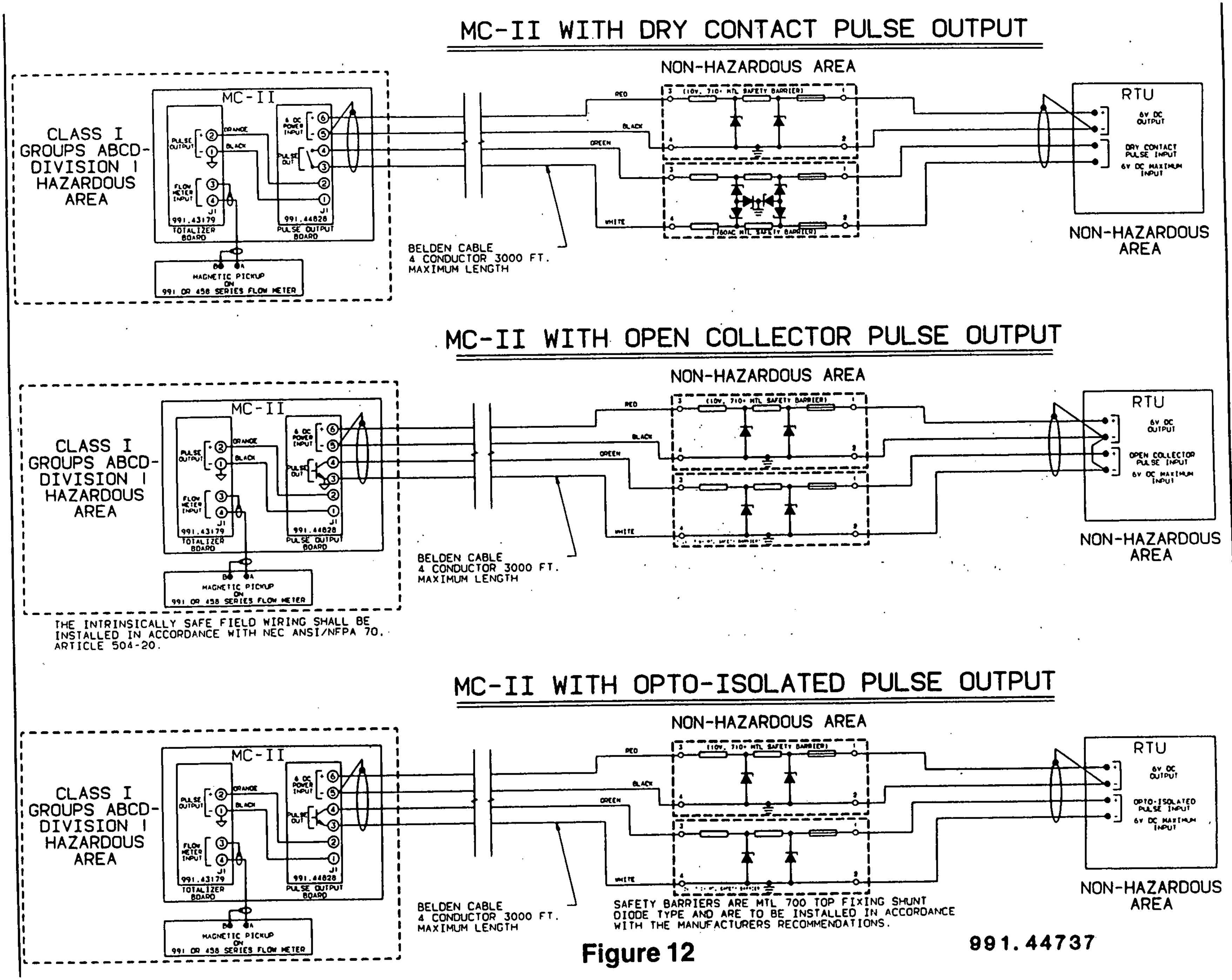
Figure 10

## PULSE OUTPUT CIRCUIT ASSEMBLY
## INTRINSICALLY SAFE

991.44828

Figure 11





MC-II WITH DRY CONTACT PULSE OUTPUT

MC-II WITH OPEN COLLECTOR PULSE OUTPUT

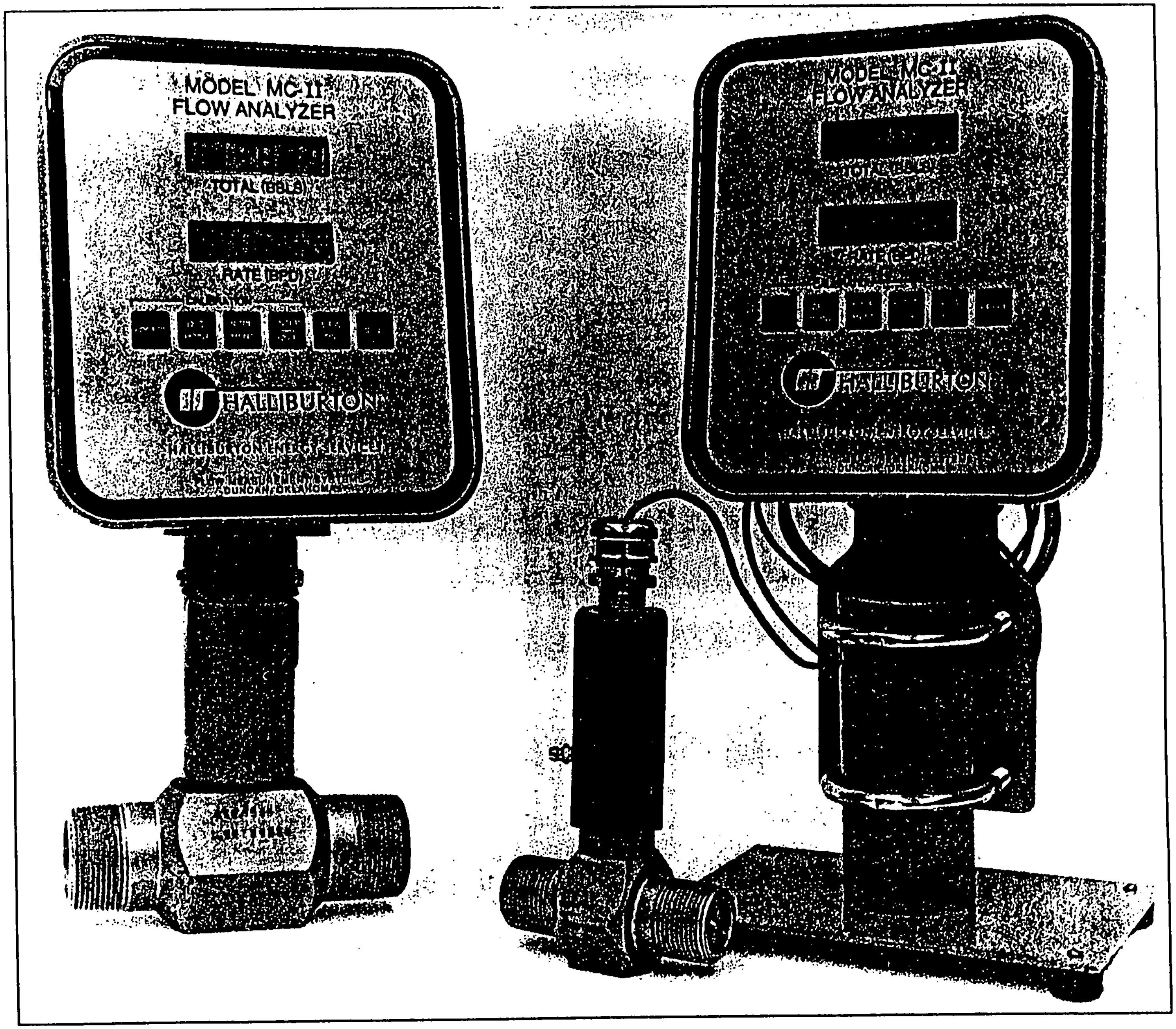
MC-II WITH OPTO-ISOLATED PULSE OUTPUT

THE INTRINSICALLY SAFE FIELD WIRING SHALL BE INSTALLED IN ACCORDANCE WITH NEC ANSI/NFPA 70, ARTICLE 504-20.

SAFETY BARRIERS ARE MTL 700 TOP FIXING SHUNT DIODE TYPE AND ARE TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

Figure 12

991.44737



METER MOUNT
Part No. 991.43676

REMOTE MOUNT
Part No. 991.43675

HALLIBURTON

# HALLIBURTON ENERGY SERVICES

Flow Measurement Systems
P.O. Drawer 1431, Duncan, OK 73536-0602
Cable: HALLIBURTON DUNCAN
Telex: 796348 or 4637054 (HOW CO DUNN)
Telephone:
Inside Oklahoma 405-251-3442
Outside Oklahoma 1-800-654-3760
Telefax: (405) 251-2154

Prepared by Flow Measurement Systems (Instrument Section)

LAST REV. 7/20/93

CLM/MAR 1-85

MANUAL NO. 991.43407

**Sensor #3: Thermocouple and peripheral equipment**

**Quantity:** 1

**Deployment:** 1 Thermocouple will be installed, located in the oil/water separator, immediately below the normal water operating level. The components involved in this installation include (1) one T-type ungrounded thermocouple, (2) one sheath for installation into pressurized liquid vessels, (3) one zener barrier assembly panel location, (4) 50 feet of Type T thermocouple connector wire, and (5) a 30 volt DC power supply (addressed separately).

**Itemized list:**

1. Thermocouple: It is a conduit mount Type E ungrounded thermocouple. The conduit attaching it to the Sitepro utilizes a 1/2" NPT knockout.

2. Sheath: This item is required to mount the thermocouple into a pressurized liquid vessel such as the O/W separator. A 3/4" FNPT thread is required to be installed at the appropriate location in the separator, and the sheath threaded into the knockout. The thermocouple is then threaded into the sheath for a liquid tight installation.

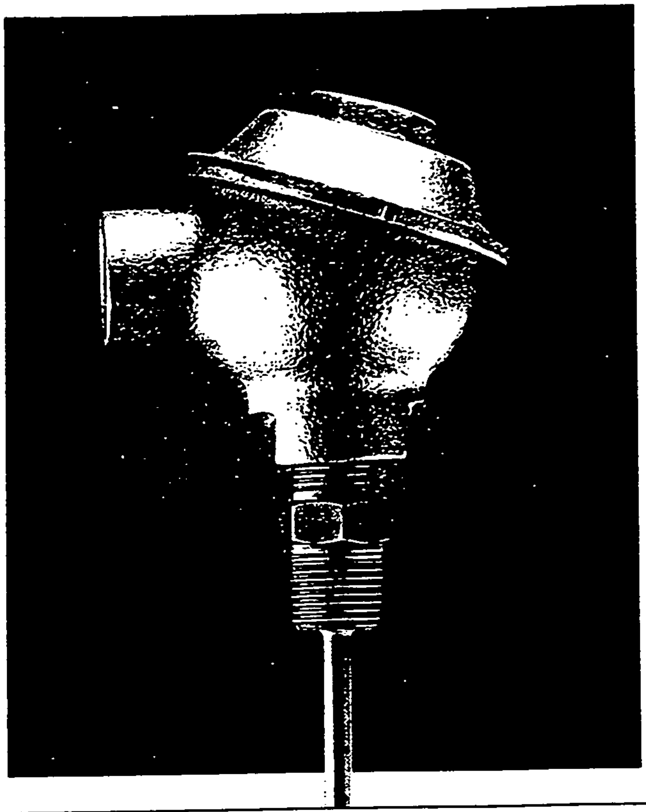
3. Zener barrier: this item is required in order to install the thermocouple in an electrically classified location. It will be mounted in a junction box placed in line between the Sitepro in the firehouse and the final thermocouple location. Classification requires it to be installed in an electrically unclassified location. It will require a j-box approximately 4"x6", and about 6 inches deep. Since the junction box will be located in the firehouse, a NEMA 1 or equivalent box should suffice.

4. Wire: when connecting the power supply of the Sitepro to the thermocouple, the ORS-provided thermocouple wire should be used. Use of any other type of wire can adversely affect the accuracy and scaling of the thermocouple signal.

5. Power supply: See power supply section.

The thermocouple and peripheral equipment are scheduled to be delivered to ORS at various dates during mid August, and will ship to the site with the Sitepro controls. It cannot ship earlier due to the necessity to test it with the entire system.

**Note: Product literature attached.**



# Cast Iron Protection Head

The NB1 style assemblies are available in J, K, T or E calibrations, with either 304SS or Inconel sheathing. Standard lengths are 12" including ½" for the pipe thread, with other lengths available. Both the thread on the probe, and the extension wire opening are ½"NPT. An internal terminal block is standard.

**OMEGALLOY™ TYPE N**
**NOW AVAILABLE!**
**Consult Factory for Pricing and Delivery**

***ALL OMEGA® PROBES ARE ALSO AVAILABLE WITH PFA TEFLON® COATING. CONSULT SALES FOR ORDERING INFORMATION.***

## How To Order

| THERMOCOUPLE ALLOY | SHEATH DIAMETER | GROUNDED JUNCTION | PRICE | UNGROUNDED JUNCTION | PRICE | EXPOSED JUNCTION | PRICE | PRICE PER ADD'L. FT. |
|---|---|---|---|---|---|---|---|---|
| IRON-CONSTANTAN Inconel Sheath | 1/16" | NB1-ICIN-116G-12 | $42 | NB1-ICIN-116U-12 | $44 | NB1-ICIN-116E-12 | $42 | $1.55 |
| | 1/8" | NB1-ICIN-18G-12 | 42 | NB1-ICIN-18U-12 | 44 | NB1-ICIN-18E-12 | 42 | 3.15 |
| | 3/16" | NB1-ICIN-316G-12 | 43 | NB1-ICIN-316U-12 | 45 | NB1-ICIN-316E-12 | 43 | 4.35 |
| | 1/4" | NB1-ICIN-14G-12 | 47 | NB1-ICIN-14U-12 | 49 | NB1-ICIN-14E-12 | 47 | 7.50 |
| IRON-CONSTANTAN 304 SS Sheath | 1/16" | NB1-ICSS-116G-12 | $42 | NB1-ICSS-116U-12 | $44 | NB1-ICSS-116E-12 | $42 | $1.55 |
| | 1/8" | NB1-ICSS-18G-12 | 42 | NB1-ICSS-18U-12 | 44 | NB1-ICSS-18E-12 | 42 | 1.85 |
| | 3/16" | NB1-ICSS-316G-12 | 43 | NB1-ICSS-316U-12 | 45 | NB1-ICSS-316E-12 | 43 | 3.15 |
| | 1/4" | NB1-ICSS-14G-12 | 47 | NB1-ICSS-14U-12 | 49 | NB1-ICSS-14E-12 | 47 | 5.00 |
| CHROMEL-ALUMEL Inconel Sheath | 1/16" | NB1-CAIN-116G-12 | $42 | NB1-CAIN-116U-12 | $44 | NB1-CAIN-116E-12 | $42 | $1.55 |
| | 1/8" | NB1-CAIN-18G-12 | 42 | NB1-CAIN-18U-12 | 44 | NB1-CAIN-18E-12 | 42 | 3.15 |
| | 3/16" | NB1-CAIN-316G-12 | 43 | NB1-CAIN-316U-12 | 45 | NB1-CAIN-316E-12 | 43 | 4.35 |
| | 1/4" | NB1-CAIN-14G-12 | 47 | NB1-CAIN-14U-12 | 49 | NB1-CAIN-14E-12 | 47 | 7.50 |
| CHROMEL-ALUMEL 304 SS Sheath | 1/16" | NB1-CASS-116G-12 | $42 | NB1-CASS-116U-12 | $44 | NB1-CASS-116E-12 | $42 | $1.55 |
| | 1/8" | NB1-CASS-18G-12 | 42 | NB1-CASS-18U-12 | 44 | NB1-CASS-18E-12 | 42 | 1.85 |
| | 3/16" | NB1-CASS-316G-12 | 43 | NB1-CASS-316U-12 | 45 | NB1-CASS-316E-12 | 43 | 3.15 |
| | 1/4" | NB1-CASS-14G-12 | 47 | NB1-CASS-14U-12 | 49 | NB1-CASS-14E-12 | 47 | 5.00 |
| CHROMEL-CONSTANTAN Inconel Sheath | 1/16" | NB1-CXIN-116G-12 | $42 | NB1-CXIN-116U-12 | $44 | NB1-CXIN-116E-12 | $42 | $1.85 |
| | 1/8" | NB1-CXIN-18G-12 | 42 | NB1-CXIN-18U-12 | 44 | NB1-CXIN-18E-12 | 42 | 3.75 |
| | 3/16" | NB1-CXIN-316G-12 | 43 | NB1-CXIN-316U-12 | 45 | NB1-CXIN-316E-12 | 43 | 5.00 |
| | 1/4" | NB1-CXIN-14G-12 | 50 | NB1-CXIN-14U-12 | 52 | NB1-CXIN-14E-12 | 50 | 7.50 |
| CHROMEL-CONSTANTAN 304 SS Sheath | 1/16" | NB1-CXSS-116G-12 | $42 | NB1-CXSS-116U-12 | $44 | NB1-CXSS-116E-12 | $42 | $1.55 |
| | 1/8" | NB1-CXSS-18G-12 | 42 | NB1-CXSS-18U-12 | 44 | NB1-CXSS-18E-12 | 42 | 2.50 |
| | 3/16" | NB1-CXSS-316G-12 | 43 | NB1-CXSS-316U-12 | 45 | NB1-CXSS-316E-12 | 43 | 3.15 |
| | 1/4" | NB1-CXSS-14G-12 | 47 | NB1-CXSS-14U-12 | 49 | NB1-CXSS-14E-12 | 47 | 5.00 |
| COPPER-CONSTANTAN Inconel Sheath | 1/16" | NB1-CPIN-116G-12 | $42 | NB1-CPIN-116U-12 | $44 | NB1-CPIN-116E-12 | $42 | $1.85 |
| | 1/8" | NB1-CPIN-18G-12 | 42 | NB1-CPIN-18U-12 | 44 | NB1-CPIN-18E-12 | 42 | 3.75 |
| | 3/16" | NB1-CPIN-316G-12 | 43 | NB1-CPIN-316U-12 | 45 | NB1-CPIN-316E-12 | 43 | 5.00 |
| | 1/4" | NB1-CPIN-14G-12 | 50 | NB1-CPIN-14U-12 | 52 | NB1-CPIN-14E-12 | 50 | 7.50 |
| COPPER-CONSTANTAN 304 SS Sheath | 1/16" | NB1-CPSS-116G-12 | $42 | NB1-CPSS-116U-12 | $44 | NB1-CPSS-116E-12 | $42 | $1.55 |
| | 1/8" | NB1-CPSS-18G-12 | 42 | NB1-CPSS-18U-12 | 44 | NB1-CPSS-18E-12 | 42 | 2.50 |
| | 3/16" | NB1-CPSS-316G-12 | 43 | NB1-CPSS-316U-12 | 45 | NB1-CPSS-316E-12 | 43 | 3.15 |
| | 1/4" | NB1-CPSS-14G-12 | 47 | NB1-CPSS-14U-12 | 49 | NB1-CPSS-14E-12 | 47 | 5.00 |

*Note: Probe length includes approx. ½" allowance for threads.*

*To order probes with lengths other than 12", change the last two digits of the part no. from 12 to the desired length in inches, and add the appropriate price per additional foot from the last column.*

# Series 260H

## Heavy Duty Threaded Well for ¼" Diameter Elements

**Application:**
Standard length, ¼" bimetal thermometers. #20 gage thermocouple elements. Unarmored liquid-in-glass test thermometers. Other temperature sensing elements having .252 in. maximum diameter.

**Connection Size:**
¾" NPT and 1" NPT are standard. Other thread sizes are available upon request.

**Protective Coatings For Thermowells:**

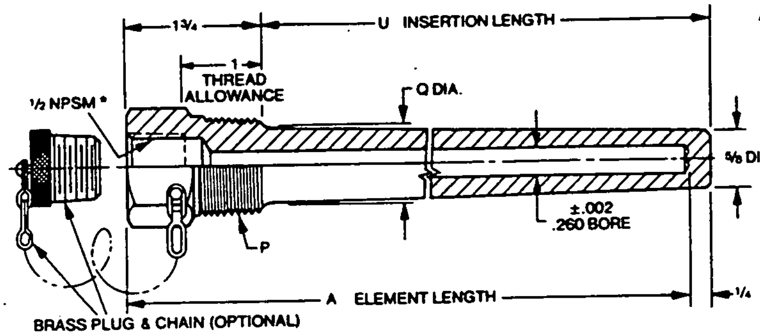
- Resist Corrosion • For Chemical Baths
- Color-Coded Sensors for Process Control
- Available in PFA Teflon®, Epoxy and other materials

Please consult our Sales Department for complete information.

**Materials:**
Brass (ASTM B-16); Carbon Steel (C-1018); Stainless Steel A.I.S.I. 304 & A.I.S.I. - 316; Monel. Wells are available also in special materials, prices on request.

**Cap and Chain Options:** For Brass cap, add $4 to price and add suffix—CC (Brass) to the end of the catalog number.
For 304SS cap, add $7 to price and add suffix—CC (304SS) to the end of the catalog number.

### Series 260H — General Use



All dimensions are in inches.

**When ordering probes with NPT Fittings specify this stem length.**

| External Thread P | Type Number | Elem Lgth A | Insert Lgth U | Shank Dia Q | Material & Prices Stainless St 304 | Stainless St 316 | Carbon Steel | Brass |
|---|---|---|---|---|---|---|---|---|
| | ¾"-260H-U 2½☐ | 4 | 2½ | ⅞ | $ 29.00 | $ 38.50 | $ 21.00 | $ 21.00 |
| Most Popular Sizes ▶ | -U 4½☐ | 6 | 4½ | " | 34.00 | 46.00 | 27.50 | 27.50 |
| | -U 7½☐ | 9 | 7½ | " | 50.50 | 68.00 | 42.00 | 42.00 |
| ¾" NPT | -U10½☐ | 12 | 10½ | " | 63.50 | 85.50 | 53.50 | 53.50 |
| | -U13½☐ | 15 | 13½ | " | 84.50 | 113.50 | 69.00 | 69.00 |
| | -U16½☐ | 18 | 16½ | " | 102.50 | 138.00 | 83.50 | 83.50 |
| | -U22½☐ | 24 | 22½ | " | 143.50 | 193.00 | 101.00 | 101.00 |
| | 1"-260H-U 2½☐ | 4 | 2½ | 1¹⁄₁₆ | 33.00 | 44.50 | 25.00 | 25.00 |
| | -U 4½☐ | 6 | 4½ | " | 42.00 | 56.50 | 29.50 | 29.50 |
| | -U 7½☐ | 9 | 7½ | " | 55.50 | 74.50 | 45.50 | 45.50 |
| 1" NPT | -U10½☐ | 12 | 10½ | " | 68.50 | 92.00 | 58.50 | 58.50 |
| | -U13½☐ | 15 | 13½ | " | 95.50 | 128.50 | 73.00 | 73.00 |
| | -U16½☐ | 18 | 16½ | " | 112.00 | 150.50 | 87.00 | 87.00 |
| | -U22½☐ | 24 | 22½ | " | 149.00 | 200.50 | 120.00 | 120.00 |

Material - 304 S.S., Carbon Steel, etc.
Insertion length dimension
Bore size - inch
External thread - NPT

***HIGHLIGHTED MODELS STOCKED FOR FAST DELIVERY.***

**Pressure - Temperature rating — lbs. per sq. inch**

| Material | Temperature — °F 70° | 200° | 400° | 600° | 800° | 1000° | 1200° |
|---|---|---|---|---|---|---|---|
| Brass | 5300 | 4750 | 1100 | — | — | — | — |
| Carbon Steel | 5950 | 5750 | 5450 | 5250 | 4000 | 1750 | — |
| A.I.S.I. - 304 | 7800 | 7050 | 6400 | 6150 | 6000 | 5190 | 1875 |
| A.I.S.I. - 316 | 7800 | 7800 | 7250 | 7100 | 6950 | 5800 | 2720 |
| Monel | 7450 | 6850 | 6150 | 6100 | 5940 | 1750 | — |

See Page B-29 for Maximum Fluid Velocity.

These wells are compatible with OMEGA® NB1, NB2 (pgs. B-3 & B-4), PR12, PR14 (pg. E-6), and NPT style probes (pg. B-5), as well as DialTemp™ Thermometers (Section S).

**To order, please specify:**

1. Complete Type Number
2. Material
3. Cap & Chain - If Desired

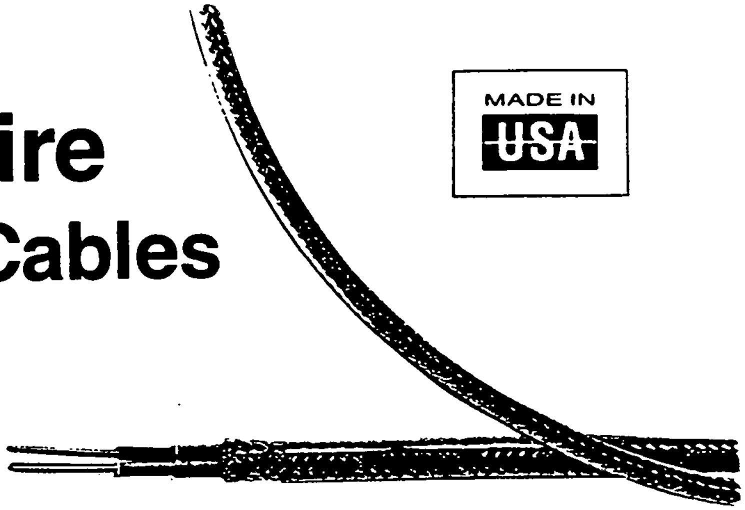
**Increase Response Rate!**
**Use OT-201 Conductive Silicon Paste**
**(See page J-6)**

| Discount Schedule | |
|---|---|
| 1-10 | Net |
| 11-24 | 10% |
| 25-100 | 20% |
| 101 and up | Consult Sales |

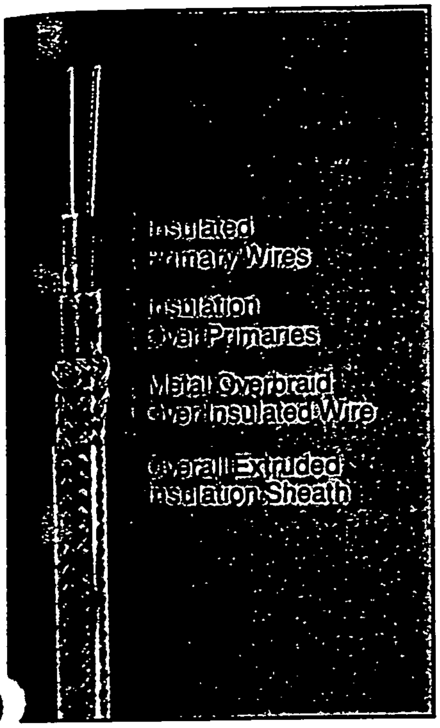
Discounts apply to similar thermowell types

# Extension Grade Thermocouple Wire

## Shielded Extension Cables



MADE IN USA



Omega extension cables are designed for use connecting the thermocouple probe to a readout or indicator. Made from extension grade thermocouple wire, J, K and E wire types, are rated from 0-105°C (32 to 221°F) for the insulation. The range of type T extension wire is −60 to 100°C (−76 to 212°F). For a wide variety of applications, these cables are constructed with color-coded extruded PVC or PFA applied to each wire leg. Another color-coded sheath of the same material is then extruded over the two primary legs. A metal overbraid is then applied over the insulated wire: tinned copper over PVC wire, stainless steel over PFA wire. This overbraid adds durability, flexibility and long-term abrasion protection to the wire, in addition to providing electrical shielding for use in noisy environments. Finally, a third layer of PVC or PFA is extruded over the entire assembly to protect the metal overbraid.

***IN STOCK FOR FAST DELIVERY!***

### Polyvinyl Coated Wire with Tinned Copper Overbraid

| Part No. | Price per M ft | Calibration | AWG No. |
|---|---|---|---|
| EXPP-J-14-TCB-P | $ 880 | **J**<br>Iron-Constantan | 14 Solid |
| EXPP-J-16-TCB-P | 720 | | 16 Solid |
| EXPP-J-16S-TCB-P | 880 | | 16 Stranded |
| EXPP-J-20-TCB-P | 500 | | 20 Solid |
| EXPP-J-20S-TCB-P | 640 | | 20 Stranded |
| EXPP-J-24S-TCB-P | 560 | | 24 Stranded |
| EXPP-T-14-TCB-P | 940 | **T**<br>Copper Constantan | 14 Solid |
| EXPP-T-16-TCB-P | 740 | | 16 Solid |
| EXPP-T-20-TCB-P | 510 | | 20 Solid |
| EXPP-T-20S-TCB-P | 660 | | 20 Stranded |
| EXPP-K-14-TCB-P | 1110 | **K**<br>Chromel-Alumel | 14 Solid |
| EXPP-K-16-TCB-P | 900 | | 16 Solid |
| EXPP-K-16S-TCB-P | 1100 | | 16 Stranded |
| EXPP-K-20-TCB-P | 550 | | 20 Solid |
| EXPP-K-20S-TCB-P | 740 | | 20 Stranded |
| EXPP-K-24S-TCB-P | 640 | | 24 Stranded |
| EXPP-E-16-TCB-P | 940 | **E**<br>Chromel-Constantan | 16 Solid |
| EXPP-E-20-TCB-P | 580 | | 20 Solid |
| EXPP-E-24S-TCB-P | 620 | | 24 Stranded |

### PFA Teflon® Coated Wire with 304SS Overbraid

| Part No. | Price per M ft | Calibration | AWG No. |
|---|---|---|---|
| EXTT-J-16-SB-T | $1260 | **J**<br>Iron-Constantan | 16 solid |
| EXTT-J-20-SB-T | 825 | | 20 Solid |
| EXTT-J-24-SB-T | 615 | | 24 Solid |
| EXTT-T-16-SB-T | 1245 | **T**<br>Copper Constantan | 16 Solid |
| EXTT-T-20-SB-T | 825 | | 20 Solid |
| EXTT-T-24-SB-T | 600 | | 24 Solid |
| EXTT-K-16-SB-T | 1500 | **K**<br>Chromel-Alumel | 16 Solid |
| EXTT-K-20-SB-T | 945 | | 20 Solid |
| EXTT-K-24-SB-T | 675 | | 24 Solid |
| EXTT-E-16-SB-T | 1530 | **E**<br>Chromel-Constantan | 16 Solid |
| EXTT-E-20-SB-T | 945 | | 20 Solid |
| EXTT-E-24-SB-T | 675 | | 24 Solid |

*To order quantities other than 1000 ft., see page H-20 for pricing information.*

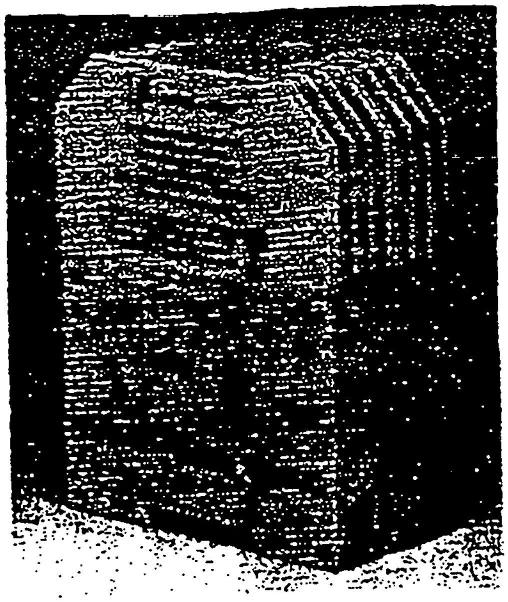
# Hazardous Area Devices:

☐ Thermocouples

## Model

**KHD3-ITT/Ex1**

Millivolt Input/0-20mA or 4-20mA Output



## Description

This model may be used to convert a signal from a thermocouple (millivolt) to 0-20mA or 4-20mA.

## Approvals

☐ All European Approvals

Factory Mutual System
Approved

## General Specifications

| | |
|---|---|
| **HOUSING STYLE** | 8 (See Dimension Pages) |
| **OPERATING TEMP. RANGE** | -4°F to +140°F |
| **MAXIMUM WIRE SIZE** | (2) #14 AWG |
| **HOUSING MATERIAL** | MAKROLON #6485 |
| **WEIGHT** | 5.5 oz. |
| **APPROVED FOR** | Class I, II, III; Division 1 and 2; Groups A-G Hazardous Location |

## Technical Data

| | |
|---|---|
| **SUPPLY VOLTAGE (Terminals 23 and 24)**<br>*The supply is isolated from the input and output circuits.* | 20-35VDC |
| **POWER CONSUMPTION** | 1.5W |
| **INPUT CIRCUIT (Terminals 7 and 8)**<br>*The input is isolated from the supply and output circuits.* | |
| | Intrinsically-Safe follows FM Approval Standard No. 3610 and all European Standards |
| *BURNOUT DETECTION CURRENT* | approx. 50nA upscale or downscale |
| **OUTPUT CIRCUIT (Terminals 17 and 18)**<br>*The output is isolated from the supply and input circuits.* | 0-20mA or 4-20mA up to 1kΩ load resistance |

*(technical data continued on next page)*

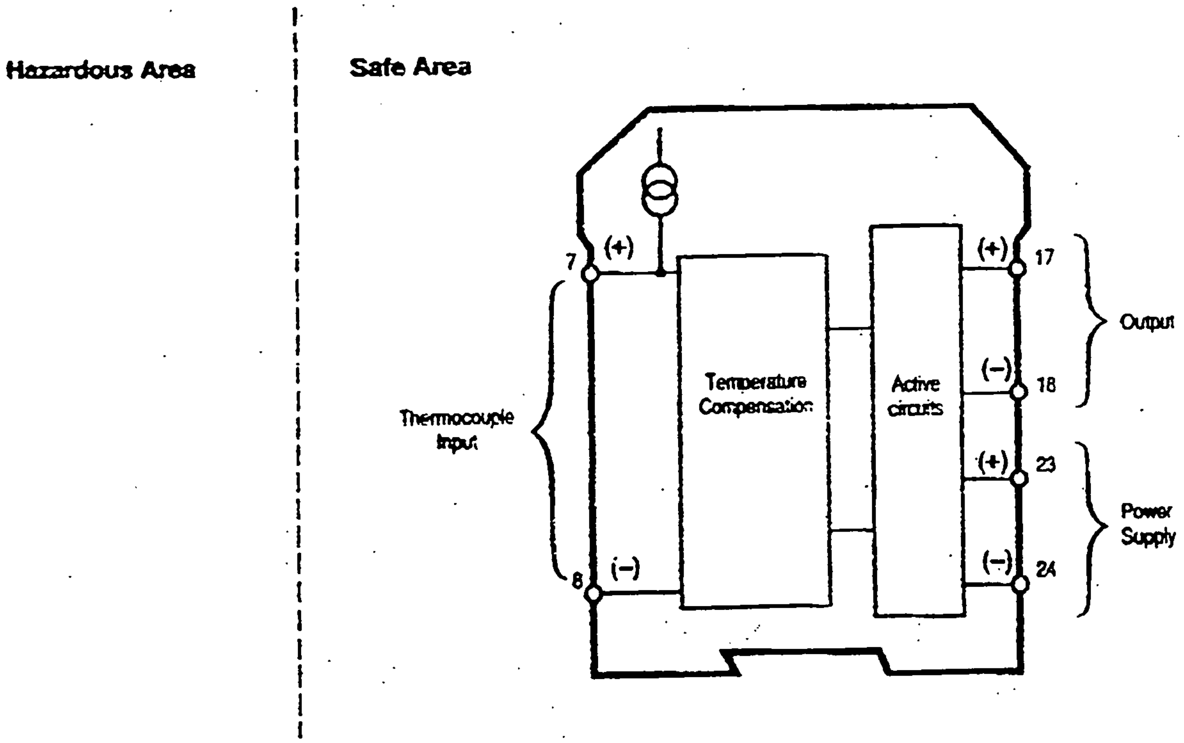
## Technical Data *(continued)*

| | |
|---|---|
| **TRANSFER CHARACTERISTICS** | |
| *CALIBRATED ACCURACY @ 68°F* | ±0.1% of span<br>±32.9°F or better |
| **TEMPERATURE EFFECT** | |
| *ZERO* | (±0.036°F ±0.1μV)/1.8°F |
| *SUPPRESSED/ELEVATED ZERO* | 0.008% of suppression/elevation/1.8°F (current and voltage) |
| **SPAN** | |
| *CURRENT OUTPUT* | ±0.0085% of span/1.8°F |
| *VOLTAGE OUTPUT* | ±0.01% of span/1.8°F |
| *EFFECT OF SUPPLY VOLTAGE VARIATION* | <0.01% |
| *EFFECT OF LOAD RESISTANCE CURRENT OUTPUT* | <0.001% of output per 100Ω |
| *OUTPUT RIPPLE* | <0.1% of Max. output, R.M.S. |
| *ERROR DUE TO INPUT CURRENT* | +5.5μV/100Ω of source resistance |
| *BURNOUT SENSING TIME* | <2.5 seconds for 20mV input span and 0.5μF capacitance in wiring, when adjusted for max. sensing current |
| *LINEAR ACCURACY* | <0.1% of span |

## Operation

The KHD3-ITT/Ex1 contains a micro-processor which converts the millivolt signal from the thermocouple into an output signal which is directly proportional to temperature. The temperature of the input terminals is measured by a built-in sensor, this measurement is used by the micro-processor for cold junction compensation. The KHD3-ITT/Ex1 puts out a small current (50nA) into the thermocouple loop to check for thermocouple burnout. The temperature span and minimum, upscale or downscale on burnout, type of thermocouple and thermocouple output range (0-20mA or 4-20mA) are programmed through switches on the unit by the user.

## Connection Diagram

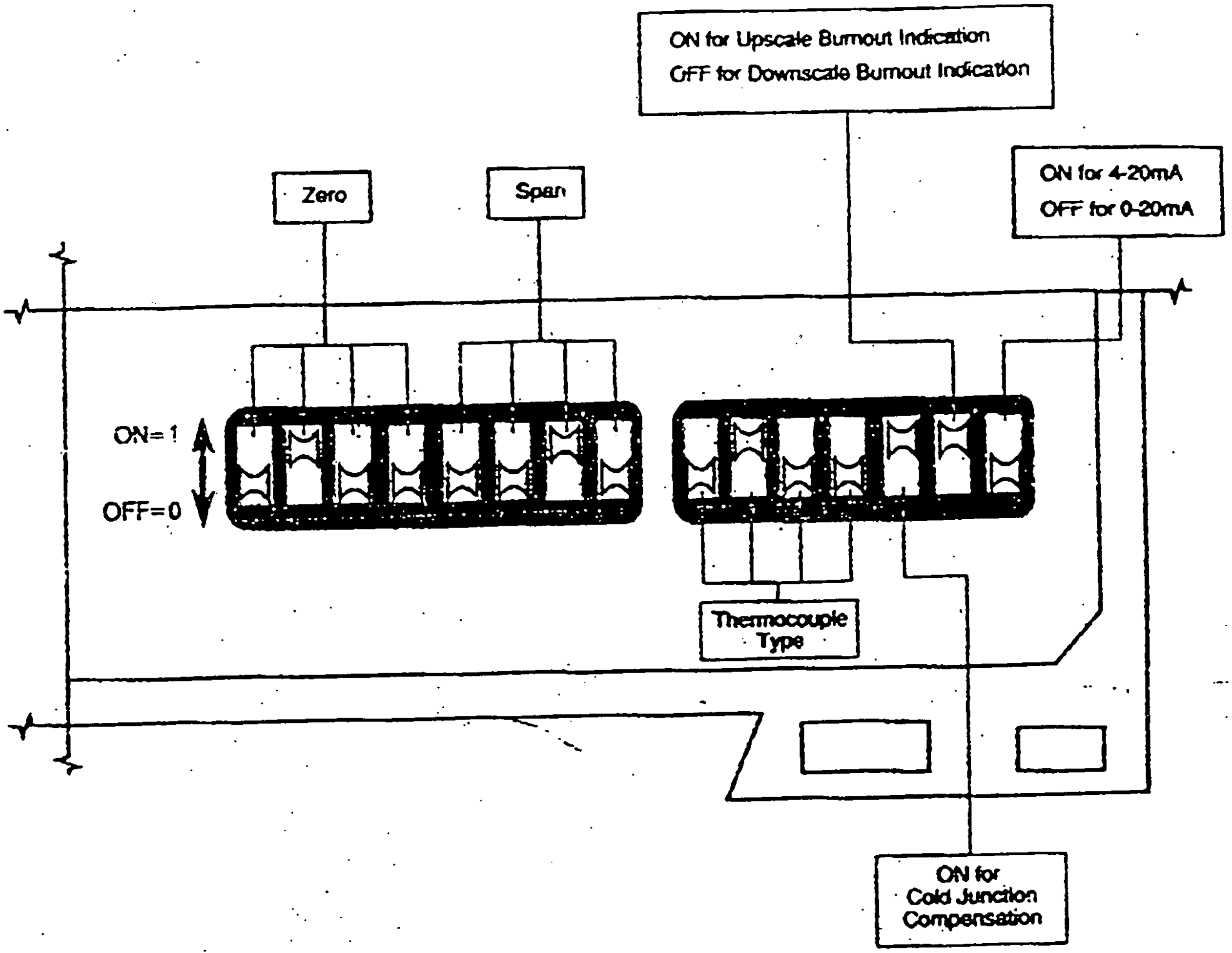


# Switch Settings for Ranges and Thermocouple Type

| | | Thermocouple Type | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | E | J | J | K | K | N | R | S | T | mV |
| | Switch Position | 1011 | 0010 | 0100 | 0101 | 0000 | 0001 | 1000 | 1001 | 1010 | 0011 | 1111 |
| ZERO | 0000 | — | −100 | −200 | −200 | −100 | −100 | −100 | 0 | 0 | −270 | −25 |
| | 0001 | 100 | −50 | −150 | −150 | −50 | −50 | 0 | 100 | 100 | −250 | −20 |
| | 0010 | 200 | 0 | −100 | −100 | 0 | 0 | 100 | 200 | 200 | −200 | −15 |
| | 0011 | 300 | 50 | −50 | −50 | 50 | 50 | 200 | 300 | 300 | −150 | −10 |
| | 0100 | 400 | 100 | 0 | 0 | 100 | 100 | 300 | 400 | 400 | −100 | −5 |
| | 0101 | 500 | 150 | 50 | 50 | 150 | 150 | 400 | 500 | 500 | −50 | 0 |
| | 0110 | 600 | 200 | 100 | 100 | 200 | 200 | 500 | 600 | 600 | 0 | 5 |
| | 0111 | 700 | 250 | 150 | 150 | 250 | 250 | 600 | 700 | 700 | 50 | 10 |
| | 1000 | 800 | 300 | 200 | 200 | 300 | 300 | 700 | 800 | 800 | 100 | 15 |
| | 1001 | 900 | 550 | 250 | 250 | 350 | 350 | 800 | 900 | 900 | 150 | 20 |
| | 1010 | 1000 | 400 | 300 | 300 | 400 | 400 | 900 | 1000 | 1000 | 200 | 26 |
| | 1011 | 1100 | 450 | 350 | 350 | 450 | 450 | 1000 | 1100 | 1100 | 250 | 30 |
| | 1100 | 1200 | 500 | 400 | 400 | 500 | 500 | 1100 | 1200 | 1200 | 300 | 35 |
| | 1101 | 1300 | 550 | 450 | 450 | 550 | —650 | 1200 | 1300 | 1300 | — | 40 |
| | 1110 | 1400 | 600 | 500 | 590 | 600 | 600 | — | 1400 | 1400 | — | 45 |
| | 1111 | 1500 | 650 | 550 | 550 | 650 | 650 | — | 1500 | 1600 | — | 50 |
| SPAN | 0000 | 300 | 100 | 100 | 800 | 100 | 800 | 100 | 100* | 100* | 100 | 5 |
| | 0001 | 400 | 150 | 150 | 850 | 150 | 850 | 200 | 200 | 200 | 150 | 10 |
| | 0010 | 500 | 200 | 200 | 900 | 200 | 900 | 300 | 300 | 300 | 200 | 15 |
| | 0011 | 600 | 250 | 250 | 950 | 250 | 950 | 400 | 400 | 400 | 250 | 20 |
| | 0100 | 700 | 300 | 300 | 1000 | 300 | 1000 | 500 | 500 | 600 | 300 | 25 |
| | 0101 | 800 | 350 | 350 | 1050 | 350 | 1050 | 600 | 600 | 600 | 350 | 30 |
| | 0110 | 900 | 400 | 400 | 1100 | 400 | 1100 | 700 | 700 | 700 | 400 | 35 |
| | 0111 | 1000 | 450 | 450 | 1150 | 450 | 1150 | 800 | 800 | 800 | — | 40 |
| | 1000 | 1100 | 500 | 500 | 1200 | 500 | 1200 | 900 | 900 | 900 | — | 45 |
| | 1001 | 1200 | 550 | 550 | — | 550 | 1250 | 1000 | 1000 | 1000 | — | 50 |
| | 1010 | 1300 | 600 | 600 | — | 600 | 1300 | 1100 | 1100 | 1100 | — | 55 |
| | 1011 | 1400 | 650 | 650 | — | 650 | — | 1200 | 1200 | 1200 | — | 80 |
| | 1100 | 1500 | 700 | 700 | — | 700 | — | 1300 | 1300 | 1300 | — | 65 |
| | 1101 | 1600 | 750 | 750 | — | 750 | — | — | 1400 | 1400 | — | 70 |
| | 1110 | 1700 | 800 | 800 | — | 800 | — | — | 1500 | 1500 | — | 76 |
| | 1111 | — | 850 | 850 | — | 850 | — | — | 1600 | 1600 | — | 80 |
| | Maximum Value | 1800 | 1000 | 1200 | 1200 | 1300 | 1300 | 1300 | 1600 | 1600 | 400 | 80 |
| | Units | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | mV |

KHD3-ITT/Ex1

## Housing — Side View



**Sensor #4: 30 VDC Power Supply**

**Quantity:** 7

**Deployment:** One 30 volt power supply will be mounted in each Sitepro at each wellhead. These units are to provide a signal to power the pulsing flowmeters. It is approximately 5" x 5" in size, and approx. 1" high. It will need to be mounted in the back of each Sitepro panel, and given 230 volt single phase power. They will be shipped separately from the controllers, and require installation once on site. The signal generated by these units is **not** intrinsically safe, so it requires conduit or barriers if entering an electrically classified location.

A 30VDC power supply will also be mounted in the Sitepro servicing the thermocouple installed in the o/w separator.

6 of these units will be shipping on 8/16, with the other available sensors. As with the others, at least one will be held at ORS until 8/27 for testing purposes.

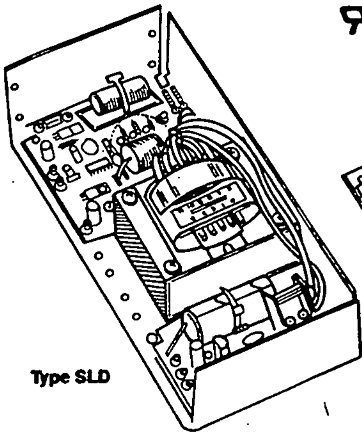
**Note: Product literature attached.**

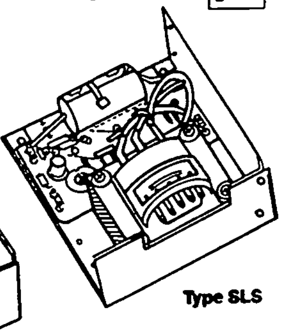
# DC POWER SUPPLIES

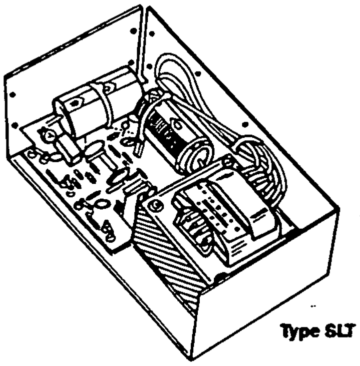
A UNIT OF GENERAL SIGNAL GS

SOLA

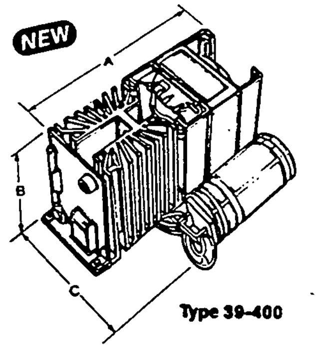
## SILVER LINE LINEARS


Type SLD


Type SLS


Type SLT

NEW



Type 39-400

- **Input Voltage: 100/120/220/230/240**
- **Input Frequency: 47-63Hz**
- **100 Percent Burn-in**
- **Line and Load Regulation Combined 0.1%**
- **Ripple 3.0mv max. P-P**
- **Automatic Current Limiting**
- **DC Output Adjustable 10% minimum**

Designed for bench and rack use, Silver Line Linears range from 15 to 90 watts. These units feature the split-bobbin transformer design for maximum isolation of outputs from primary. Built-in overvoltage protection, which provides both transient and power supply malfunction protection, is standard on 5 volt models and optional for other models (*order separately below*). UL recognized, CSA certified, and TUV certified. Maximum output ratings to +50°C.

## SINGLE OUTPUT SERIES POWER SUPPLIES

1.62″

| Stock No. | Type | Output 1 Rating | Output 2 Rating | Output 3 Rating | H | W | D | Each |
|---|---|---|---|---|---|---|---|---|
| 89F1266 | SLS-05-030-1 | 5V/3.0 A | N/A | N/A | 1.62″ | 4.83″ | 3.99″ | 40.00 |
| 89F1267 | SLS-05-060-1 | 5V/6.0 A | N/A | N/A | 2.50″ | 5.62″ | 4.87″ | 62.00 |
| 89F1268 | SLS-05-090-1 | 5V/9.0 A | N/A | N/A | 2.75″ | 7.00″ | 4.87″ | 96.00 |
| 89F1269 | SLS-05-120-1 | 5V/12 A | N/A | N/A | 2.75″ | 9.00″ | 4.87″ | 112.00 |
| 89F1270 | SLS-12-017 | 12V/1.7 A | N/A | N/A | 1.62″ | 4.83″ | 3.99″ | 40.00 |
| 89F1271 | SLS-12-034 | 12V/3.4 A | N/A | N/A | 2.50″ | 5.62″ | 4.87″ | 58.00 |
| 89F1272 | SLS-12-051 | 12V/5.1 A | N/A | N/A | 2.75″ | 7.00″ | 4.87″ | 85.00 |
| 89F1265 | SLS-12-068 | 12V/6.8 A | N/A | N/A | 2.75″ | 9.00″ | 4.87″ | 126.00 |
| 89F1259 | SLS-15-015 | 15V/1.5 A | N/A | N/A | 1.62″ | 4.83″ | 3.99″ | 40.00 |
| 89F1260 | SLS-15-045 | 15V/4.5 A | N/A | N/A | 2.75″ | 7.00″ | 4.87″ | 85.00 |
| 89F1261 | SLS-15-060 | 15V/6.0 A | N/A | N/A | 2.75″ | 9.00″ | 4.87″ | 120.00 |
| 89F1262 | SLS-24-012 | 24V/1.2 A | N/A | N/A | 1.62″ | 4.83″ | 3.99″ | 40.00 |
| 89F1263 | SLS-24-024 | 24V/2.4 A | N/A | N/A | 2.50″ | 5.62″ | 4.87″ | 58.00 |
| 89F1264 | SLS-24-036 | 24V/3.6 A | N/A | N/A | 2.75″ | 7.00″ | 4.87″ | 85.00 |

## DUAL OUTPUT SERIES POWER SUPPLIES

| Stock No. | Type | Output 1 Rating | Output 2 Rating | Output 3 Rating | H | W | D | Each |
|---|---|---|---|---|---|---|---|---|
| 89F1252 | SLD-12-1010-12 | +12V/1.0 A | −12V/1.0 A | N/A | 1.62″ | 6.50″ | 4.00″ | 50.00 |
| 89F1253 | SLD-12-1818-12 | +12V/1.8 A | −12V/1.8 A | N/A | 2.50″ | 7.00″ | 4.87″ | 69.00 |
| 89F1254 | SLD-15-808-15 | +15V/0.8 A | −15V/0.8 A | N/A | 1.62″ | 6.50″ | 4.00″ | 50.00 |
| 89F1255 | SLD-15-1515-15 | +15V/1.5 A | −15V/1.5 A | N/A | 2.50″ | 7.00″ | 4.87″ | 69.00 |
| 89F1256 | SLD-12-3434-12 | +12V/3.4 A | +12V/3.4 A | N/A | 2.75″ | 9.00″ | 4.87″ | 98.00 |
| 89F1257 | SLD-15-3030-15 | +15V/3.0 A | +15V/3.0 A | N/A | 2.75″ | 9.00″ | 4.87″ | 98.00 |
| 89F1258 | SLD-12-6034-05 | +5V/6.0 A | +12V/3.4 A | N/A | 2.75″ | 9.00″ | 4.87″ | 104.00 |
| 89F1273 | SLD-12-3015-05 | +5V/3.0 A | +12V/1.5 A | N/A | 2.75″ | 7.00″ | 4.87″ | 73.00 |

## TRIPLE OUTPUT SERIES POWER SUPPLIES

| Stock No. | Type | Output 1 Rating | Output 2 Rating | Output 3 Rating | H | W | D | Each |
|---|---|---|---|---|---|---|---|---|
| 89F1274 | SLT-12-31010-12 | +5V/3.0 A | +12V/1.0 A | −12V/1.0 A | 2.50″ | 10.25″ | 4.00″ | 82.00 |
| 89F1275 | SLT-12-61818-12 | +5V/6.0 A | +12V/1.8 A | −12V/1.8 A | 2.75″ | 11.00″ | 4.87″ | 112.00 |
| 89F1276 | SLT-24-30530-05 | +5V/3.0 A | −5V/0.5 A | +24V/3.0 A | 2.75″ | 11.00″ | 4.87″ | 129.00 |
| 89F1277 | SLT-12-20404-12 | +5V/2.0 A | +12V/0.4 A | +12V/0.4 A | 1.62″ | 6.50″ | 4.00″ | 62.00 |
| 89F1278 | SLT-12-61010-12 | +5V/6.0 A | +12V/1.0 A | −12V/1.0 A | 2.75″ | 9.00″ | 4.87″ | 104.00 |

## OVER VOLTAGE PROTECTION KIT

| Stock No. | Type | Description | H | W | D | Each |
|---|---|---|---|---|---|---|
| 89F1279 | SLO-12-000-1 | 6.2V - 34V/12 A intermittent; 8 A continuous | 0.56″ | 1.55″ | 1.50″ | 9.00 |

## SINGLE OUTPUT HIGH POWER POWER SUPPLIES

Brute force power supplies provide high current DC that is continuously adjustable over either 2 to 25 or 5 to 50 volt ranges. Can be set to constant voltage or con- nt current operation. Can be used as battery charger in the constant mode. justable damping for inductive loads enable units to drive relays, solenoids and motors. Maximum power efficiency: 75%. Regulation: ±0.1%. Input: 105-130/210-260 VAC, 47-63 Hz. Controls include: limit adjust (0-100%), output voltage adjust (10-100%).

| Stock No. | Type | Watts | DC Output | | Dimensions | | | Each |
|---|---|---|---|---|---|---|---|---|
| | | | Volts | Amps | A | B | C | |
| 84F1068 | 39-407 | 300 | 5-50/2-25 | 6/16 | 11.00″ | 6.75″ | 7.66″ | 498.00 |
| 84F1069 | 39-408 | 600 | 5-50/2-25 | 12/24 | 12.00″ | 6.75″ | 7.66″ | 634.00 |
| 84F1070 | 39-409 | 1200 | 5-50/2-25 | 25/50 | 14.00″ | 10.00″ | 11.1″ | 1068.00 |

**Sensor #5: Four Function Sump Level Control Float**

**Quantity:** 1

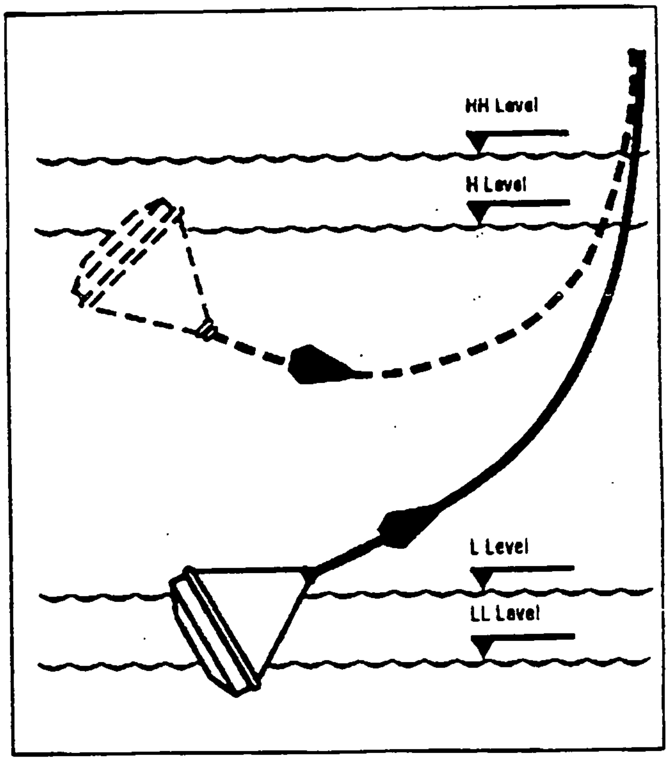
**Deployment:** One level control float will be deployed in the storm water sump. It is rated for continuous immersion in hydrocarbon contaminated water, and will accomodate a maximum switching level of 50 inches of travel in the sump. It will attach to the Sitepro as illustrated in the attached manufacturer's information sheet and as illustrated in the operation and maintenance manual

The controller is a KARI model 4Y multi-position level controller.

Please see the attached literature for any additional technical information.

# MULTIPLE POINT LEVEL SENSING WITH A SINGLE FLOAT

- Usable in most liquids
- Simple to install
- Installation does not require penetration of tank wall
- Adjustable switch-point levels
- Choice of 16 standard models
- Highly chemical resistant
- Proven reliability in operation
- No maintenance required
- Cost effective



## INTRODUCTION

KARI float switches are unique cable-suspended liquid level sensors offering unusual convenience and reliability for a wide range of pump control and alarm applications. Their most important feature is the ability to sense multiple levels using only one float. This results in an elegantly simple device that can be used in many different level sensing situations. The dependability of KARI float switches has been proven in many thousands of installations, worldwide, for over a quarter of a century.

These sensors come in many different switching configurations to suit various applications. The more common uses are illustrated in this brochure and details of the various models are given in the specifications section.

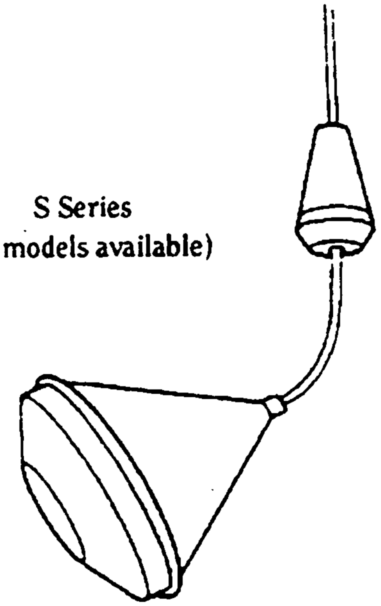
## DESCRIPTION

KARI sensors consist of a free-floating switch enclosure with an attached jacketed multiconductor cable. Inside the float up to three heavy-duty microswitches are cast at different angles. A control weight is fixed at a point along the cable. As the liquid level rises and falls, the weight on the cable causes the inclination of the float to change.

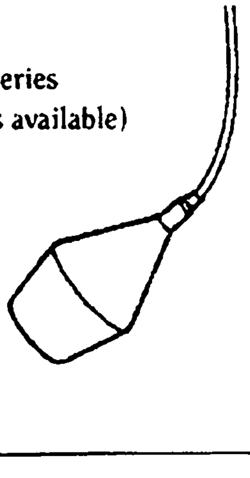
This tilting action causes the micro-switches to open and close at different liquid levels. The switch operating levels are easily adjusted by moving the weight along the cable and/or altering the length of the cable.

The hermetically-sealed switch enclosure is conical in shape, filled with plastic foam and weighted on one side. The rugged float and the weight are made of chemically resistant polypropylene. The standard cable is PVC-covered.

There are two versions of the KARI sensor. The S Series units are larger and have greater capabilities than the smaller M Series. There are a number of different standard switch configurations available in both versions.



S Series
(16 models available)



M Series
(6 models available)

## APPLICATIONS

There are many possible uses for these sensors since they can operate in practically any liquid. They are unaffected by floating material or by fluid characteristics (density, color, suspensions, mixtures, coating properties, etc.). They work well in slurries and viscous media. By having a separation between the switching levels, problems caused by turbulence are overcome. The switches are protected against the effects of adverse external environments by the rugged polypropylene enclosure.

The different configurations available simplify the related control circuitry. Normally a "make" (closure) is used to activate an alarm or start an action and a "break" (opening) is used to stop the action. Installation is extremely simple because KARI level sensors are designed to hang freely in the tank from a single fixing point. Operating levels are easily adjusted. The sensors require absolutely no maintenance and their reliability is well-proven in many demanding applications.

## SINGLE VERSUS DUAL POINT CONTROL

The simplest single point KARI level sensors (Types 1L or 1H) have no "deadband" ("differential" or "hysteresis"). They switch on and off at one level. Such sensors work well as alarm point indicators but are unsuitable for automatic maintenance of liquid levels in a container.

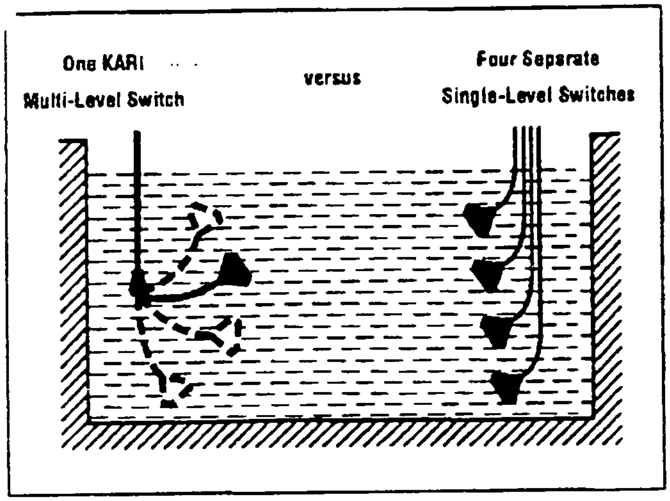
Tank levels are usually maintained by pumps or electrically-controlled solenoid valves in the supply or drain lines. Holding the level exactly at one point is difficult if there is flow in and out of the container, because it would involve the control switch going on and off constantly. This leads to excessive component wear. Thus, the normal practice is to have two control levels involved. At one level the pump or valve is turned on, and at the other level it is turned off.

These situations can take advantage of the unique capabilities of the KARI float level sensors. Rather than using two separate single level float switches, one float switch (Type 2L or 2H) can provide a latching circuit between the "on" and "off" levels. This differential (deadband) can be easily adjusted. Other KARI level sensors provide additional facilities for high and low alarms as well as control of duplex pump systems.

## CHEMICAL COMPATIBILITY — CORROSION RESISTANCE OF MATERIALS

With a standard KARI level sensor, the only materials in contact with the liquid are the polypropylene float and weight, the polyethylene wedge, and the heavy-duty PVC-covered cable. Consequently, these switches are unaffected by a wide range of liquids. However, there are some liquids and temperatures that are not compatible with these materials. For such applications, optional cable materials, (PTFE and urethane) are available. In assessing corrosion, key factors are the liquid's temperature and concentration, and the amount of time the float is immersed. Even if periodic replacement of KARI float switches is necessary, they still may be the most economical choice.

Neoprene cables are preferred for applications where freezing conditions can occur because PVC-covered cables tend to stiffen in low temperatures.



## CABLE LENGTH

The standard cable length is 16 feet (5 meters). Longer cables can be provided by special order. It is not possible to modify the cable length (nor repair damaged cables) on existing units. Once the cable is outside the liquid, it can, however, be easily extended through a waterproof junction box or liquid-tight connector.

## SELECTING THE RIGHT SWITCH

1. Determine number of level control points needed; for example, one point for alarm and two points for empty/fill operations.

2. Select required model from the Model Selection Table on page 5.

3. If there are no suspended solids present, the specific gravity of the liquid is greater than 0.95 and no more than two separate switch points are needed, the smaller, lower cost M Series switches may be used.

4. Note that if a special situation exists (material compatibility, special operating levels, etc.), a number of options are available as indicated in the specifications.

5. For more detailed applications information and installation advice on KARI float switches ask for a copy of the Owner's Manual.

Sometimes combinations of switches may be needed to meet critical switching point elevations or multiple pump situations. Our Application Engineers will be pleased to assist users in selecting the best models/versions for their particular needs.

## IMPORTANCE OF CONTROL RELAYS

The contacts used in KARI float switches are high-performance micro-switches. Although they are capable of carrying moderate currents at up to 250V AC, it is not a good practice to put pump motor currents directly through these contacts because they are immersed in a liquid. Therefore, it is usually just low currents for relay coil operation that are applied to the float switch contacts. The contact rating of the KARI switches should never be exceded.

Relays with heavy duty contacts are known as contactors. Pump motor manufacturers often provide suitable contactors with the control circuits on their motors. These allow the KARI float switches to be connected directly. If contactors are not provided, the contact ratings needed to start and stop a pump should be thoroughly understood. When pump motors start and stop, they can produce momentary surge currents several times greater than the steady running current. Suppliers of relays and contactors usually provide maximum ratings for their contacts in terms of allowable pump motor horsepower figures. If there are any concerns in this regard, consult our Application Engineers for advice.

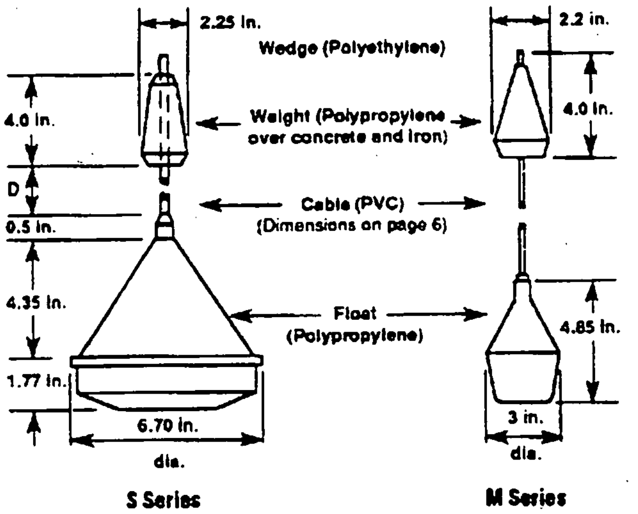
## STANDARD SPECIFICATIONS

| | | S SERIES | M SERIES |
|---|---|---|---|
| Contact Rating: | | | |
| Max. voltage | | 250V AC or DC | 250V AC or DC |
| Max. AC current (resistive) | | 6A | 6A |
| (inductive) | | 3A | 3A |
| Max. DC power | | 75VA(0.3A@250V) | 75VA(0.3A@250V) |
| Maximum liquid temperature* | | 140°F (60°C) | 140°F (60°C) |
| Maximum pressure (at 20°C) | | 28 psi | 28 psi |
| Minimum fluid specific gravity | | 0.7 | 0.95 |
| Standard cable length * | | 16 feet | 16 feet |
| Switching differential*: | Min. | 10 inches | 10 inches |
| | Max. | 50 inches | 40 inches |
| Max. No. of switching levels | | 4 | 2 |
| Max. No. of wires in cable | | 5 | 2 |
| Standard weight type ** | | G (black-0.75LB) | E (red/black-0.5LB) |

*See options available.

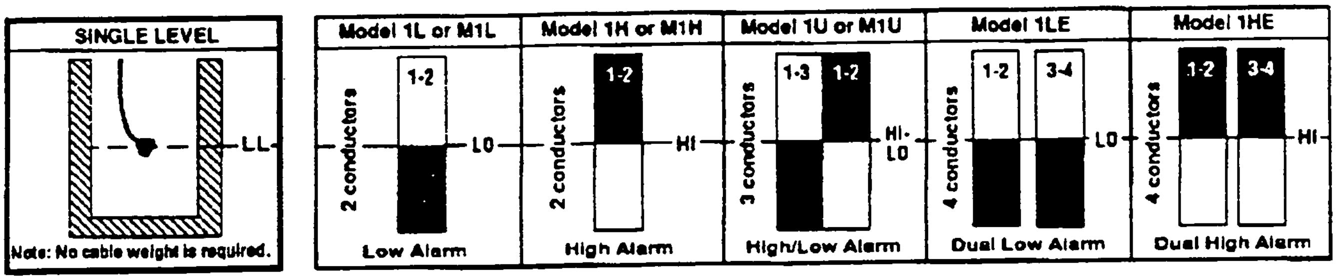
**On floats with more than one switch point.

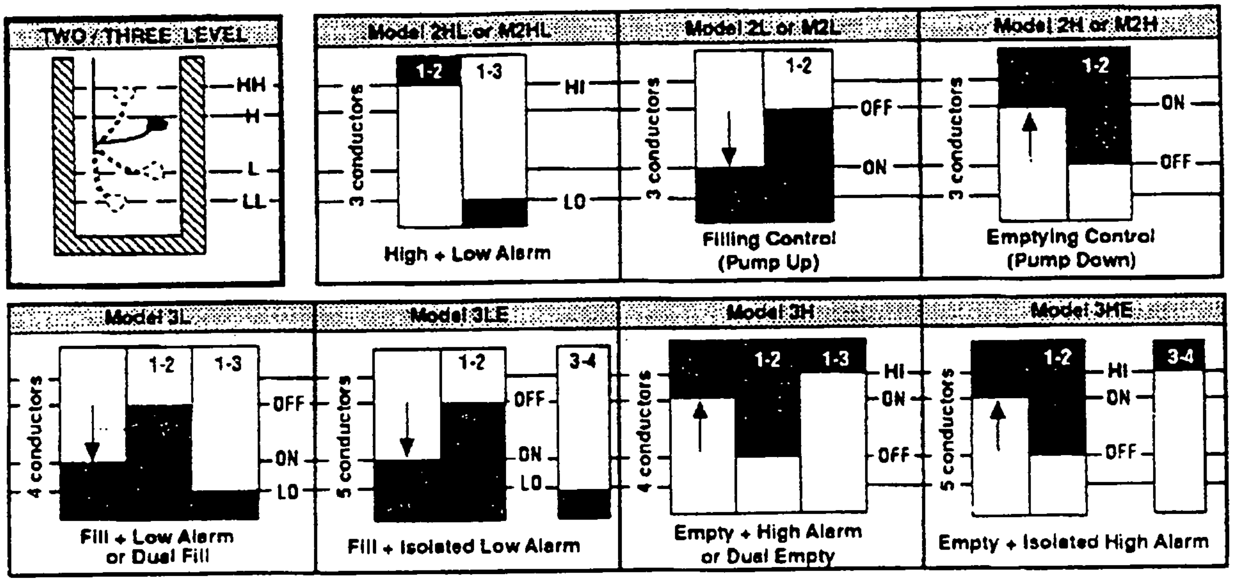
### SPECIFICATIONS DIAGRAM

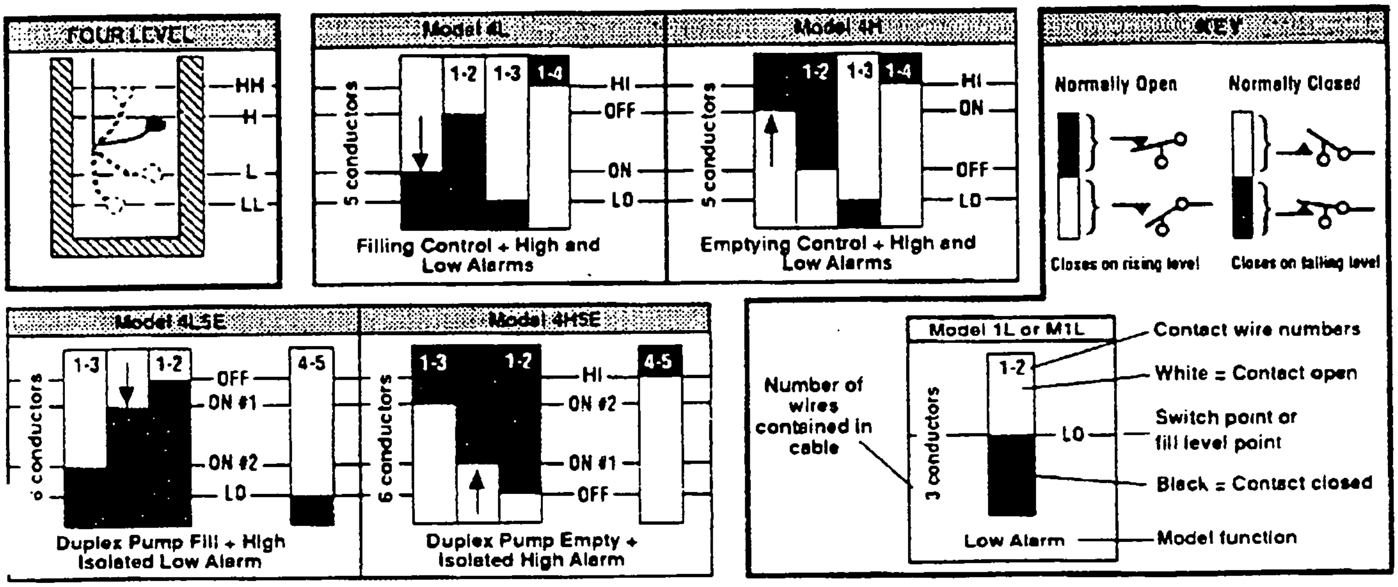


## MODEL SELECTION TABLE

KARI float switches provide up to four separate switching levels in one conically shaped float. A weight on the cable is used to adjust the difference between switching points. Full details of the different standard configurations are given in the table below. For installation and additional application details ask for our KARI Owner's Manual.



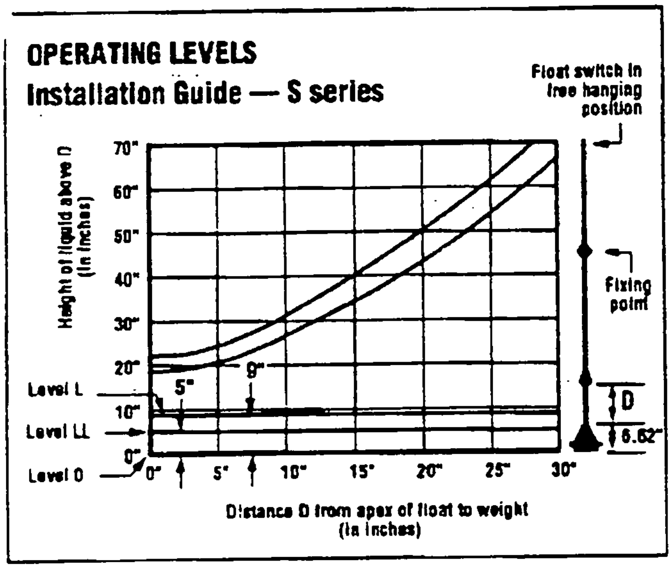




## OPERATING LEVELS

The diagram below shows the relationship between the switching levels, the spacing of the weight along the cable and the height of the fixing point. For multi-level switches, there are some restrictions on the different elevations that can be selected.

First, there is a minimum standard switching-difference level of 10 inches for the basic two-level (empty/fill) switch. This differential (between points H and L in diagram) can be increased (to a maximum of 50 inches) by moving the weight farther away from the float. Then, the level of these switching points can be altered by changing the height at which the float hangs in the empty tank. The other two levels (HH and LL) of a four-level switch bear a fixed relationship to the above adjustments. If these need to be adjustable or the normal elevation ranges are unsuitable, a combination of switches can be used or a special switch can be ordered. For example, a 3HE can be replaced by a 2H plus a 1H. A more detailed discussion of these points is provided in the Owner's Manual.



## OPTIONS AVAILABLE

- Higher working temperature to 175°F (80°C)
- Longer cables to specified lengths
- Smaller switching differentials down to 1.25 inches
- Greater switching differentials to 75 inches (S Series) or 60 inches (M Series)
- Alternative logic at switching points (normally open vs. normally closed)
- Alternative cables in neoprene and urethane
- Alternative cables in PTFE (max. 4 conductors for 3 or less switch points)
- Lead weight in place of polypropylene-covered weight

## CABLE WEIGHTS

Single level switches (high or low alarm) are not supplied with weights. All multiple level switches are supplied with standard weights. Heavier weights may be needed if there is a danger of caking, thick crusts developing and/or the liquid being very dense and viscous. Alternative weights available are:

Type B (red) 1.5 pound
Type C (grey) 2.5 pound
Type L (lead) 0.75 pound

## CABLE DIMENSIONS

Standard units have heavy-duty cables with PVC covering. Typical diameters of the cables are:

| | |
|---|---|
| 2-Wires : | 0.25 inch |
| 3-Wires : | 0.27 inch |
| 4-Wires : | 0.31 inch |
| 5-Wires : | 0.34 inch |

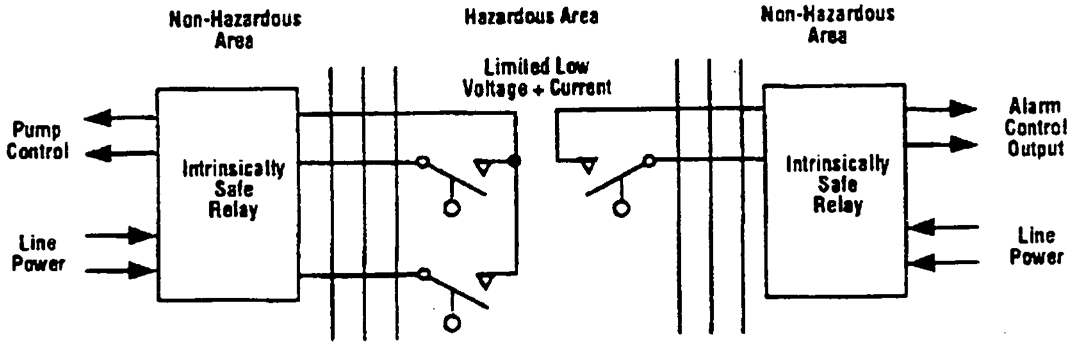
(Dimensions may vary ±10%)

## HAZARDOUS LOCATIONS/INTRINSIC SAFETY

KARI switches do not carry any explosion-proof ratings. Since they are simple switches with no other components, they can be used in hazardous locations *provided* they are operated in conjunction with appropriate intrinsically safe relays *and* correct installation procedures are followed.

The technique of intrinsic safety is an alternative approach to explosion-proofing. The traditional method of preventing explosions in hazardous environments is based on placing all electrical circuits and components in heavy boxes and conduit so that if an explosion is sparked by the electrical circuit, it would be contained and not escape into the hazardous area. With intrinsic safety, special circuits and barriers are built into the external equipment so that any wires running into the explosive area do not have sufficient voltage and current (hence power) to cause an explosion. Typical intrinsically safe configurations for KARI switches are illustrated below.

Customers desiring additional information on electrical requirements for hazardous locations should contact their local electrical, fire and building authorities.

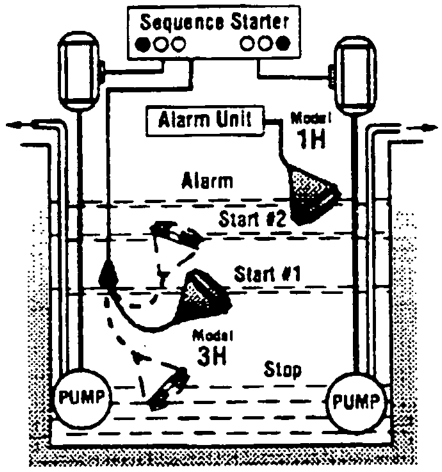


Dual Level (Empty/Fill)

Single Level (Alarm)

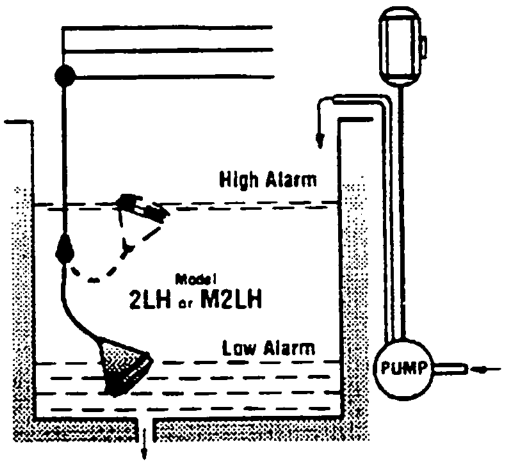
## ILLUSTRATIONS OF SOME TYPICAL APPLICATIONS FOR KARI LIQUID LEVEL SENSORS

MODEL 1H and 3H



Control of alternating emptying pumps with high level alarm.

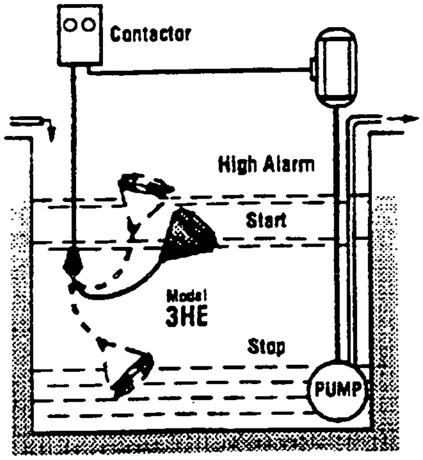
MODEL 2LH or M2LH



Both high and low limit alarms.

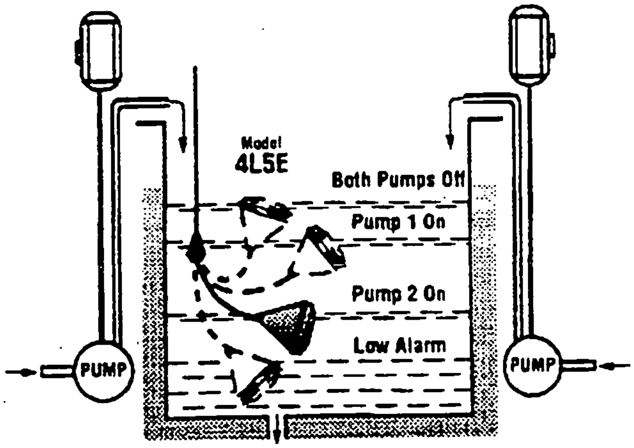
## ILLUSTRATIONS OF SOME TYPICAL APPLICATIONS FOR KARI LIQUID LEVEL SENSORS, contd.

### MODEL 3HE



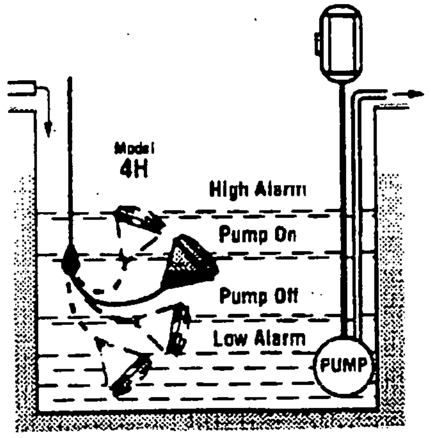
Empty pump control with high level alarm

### MODEL 4L5E



Control of two alternating filling pumps with low level alarm.

### MODEL 4H



Control of emptying pump with high and low level alarms.

## WARRANTY

All STI products supplied are warranted to be free from defects in material or workmanship and STI will, without charge, replace or repair any STI product found to be defective upon inspection at our offices, provided the equipment has been returned, transportation prepaid, within one year from date of delivery to the original purchaser. This express warranty is in lieu of and excludes all other warranties of merchantability or of fitness for a particular purpose. In no event shall STI be liable for any consequential damages or for expenses occasioned by the use of defective products or by improper installation/application. This warranty is void if the product has been modified or subject to misuse or abuse.

**SCIENTIFIC TECHNOLOGY INCORPORATED**
**ENVIRONECS DIVISION — Level Control Products**
31069 Genstar Road, Hayward, CA 94544-7831 USA
Phone 1/800-221-7060, 510/471-9717, Fax 510/471-9752

**ORS** ENVIRONMENTAL EQUIPMENT
A DIV. OF GROUNDWATER TECHNOLOGY, INC.

# PROBE SCAVENGER ™ PUMPING SYSTEM

## INSTALLATION AND OPERATION MANUAL

JOB #1940126
8/17/93

32 Mill St., Greenville, NH 03048
Phone (800) 228-2310/ (603) 878-2500
FAX (603) 878-3866

0300-85C

# PREFACE

## ABOUT THIS MANUAL

This manual contains all the information required to install and operate the Probe Scavenger™ System. It also contains specifications, performance data and maintenance procedures for the Probe Scavenger pumping system. A separate field hookup diagram is provided.

## ADDITIONAL DOCUMENTATION REQUIRED

- SITEPRO™ 2000 Probe Scavenger™/Water Pump Control Panel

In addition to this Probe Scavenger manual, you will need the manual supplied with the SITEPRO™ 2000 Control Panel.

## WHO SHOULD READ THIS MANUAL

This manual is intended for field technicians, project engineers or anyone responsible for installing, operating or maintaining site remediation equipment.

## WHAT THIS MANUAL COVERS

Here is what you will find in this manual:

**CHAPTER 1:** System Description includes:

- Overview of the system
- Specifications
- Performance Data

**CHAPTER 2:** System Installation includes:

- Installation instructions

**CHAPTER 3:** System Operation:

- Refer to SITEPRO™ Probe Scavenger/Water Pump Control Panel manual.

**CHAPTER 4:** System Maintenance includes:

- Maintenance procedures for the ORS Probe Scavenger pumping system.

**CHAPTER 5:** System Troubleshooting:

- Refer to SITEPRO manual.

# CHAPTER 1: SYSTEM DESCRIPTION

## SYSTEM OVERVIEW

The ORS Environmental Equipment Probe Scavenger System is an automatic oil/water separator and hydrocarbon recovery system. It uses a submersible, self-priming pump that withstands corrosion from both hydrocarbons and halogenated organics. A specially designed sensor differentiates between hydrocarbon contaminants and water, allowing for retrieval of virtually 100% water-free oil. The recovered contaminants are then automatically pumped from the well into a recovery tank. When the recovery tank becomes full, a tankfull sensor shuts down the pump to prevent overflow.

When used with a Water Table Depression Pump, the water pump creates a "cone of depression" in the well, drawing in the hydrocarbons that contaminate the surrounding groundwater. The Probe Scavenger then recovers the product floating on the water, pumping it out to a collection container.

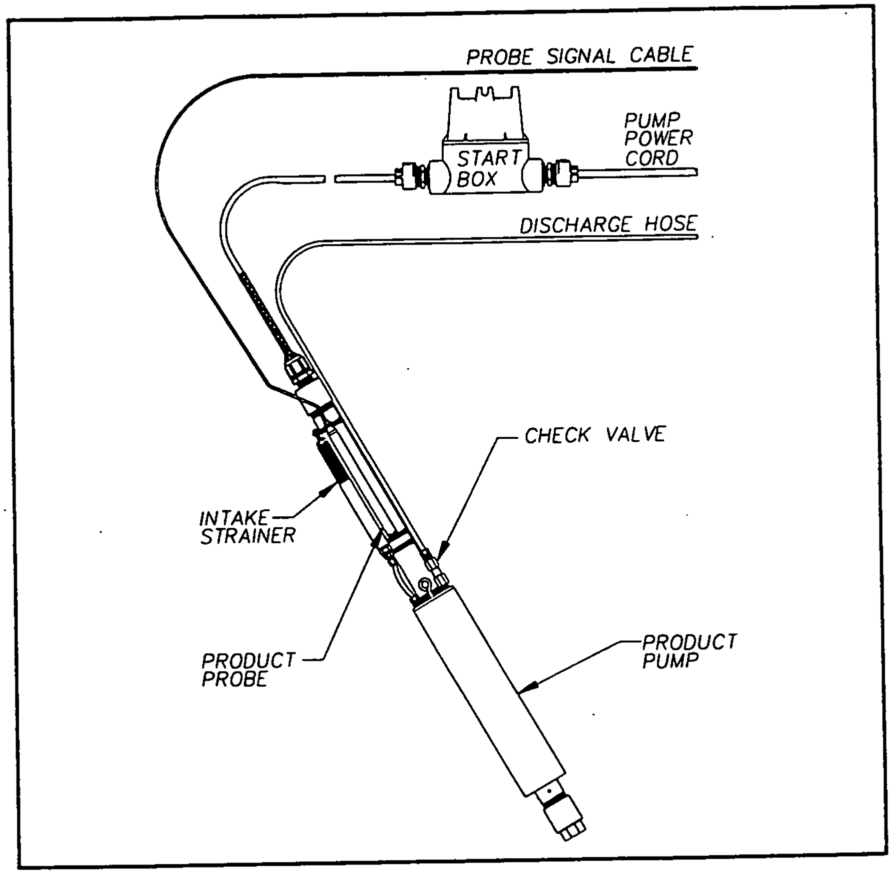


Figure 1. Probe Scavenger Pump/Probe Assembly

## SPECIFICATIONS

### PUMP

- Diameter: 3/34"(9.5cm)
- Height: 48"(121.9cm)
- Discharge Pressure up to 70 PSI
- Flow Rates: .25-0.9gpm
- Power Cord Length: 25'(7.5m)

### SENSOR

- Diameter:
- Length: 12" (30.5cm)
- Cable Length: 25' (7.5m)

### MOTOR

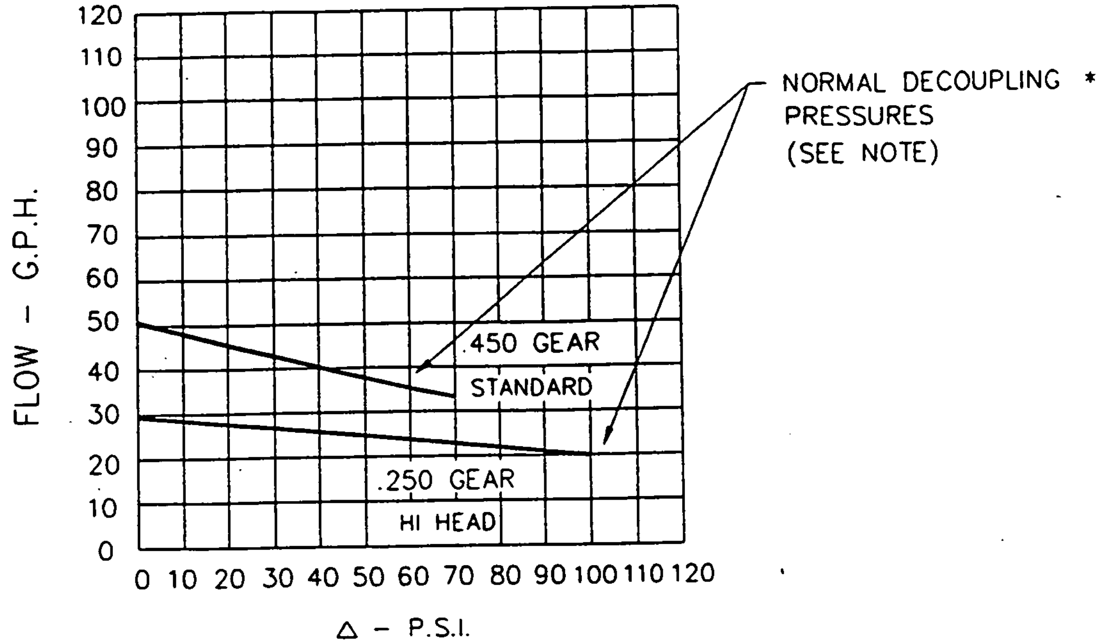
- HP: 1/13 (60watt)
- Voltage: 230 VAC
- HZ: 60

## PERFORMANCE DATA

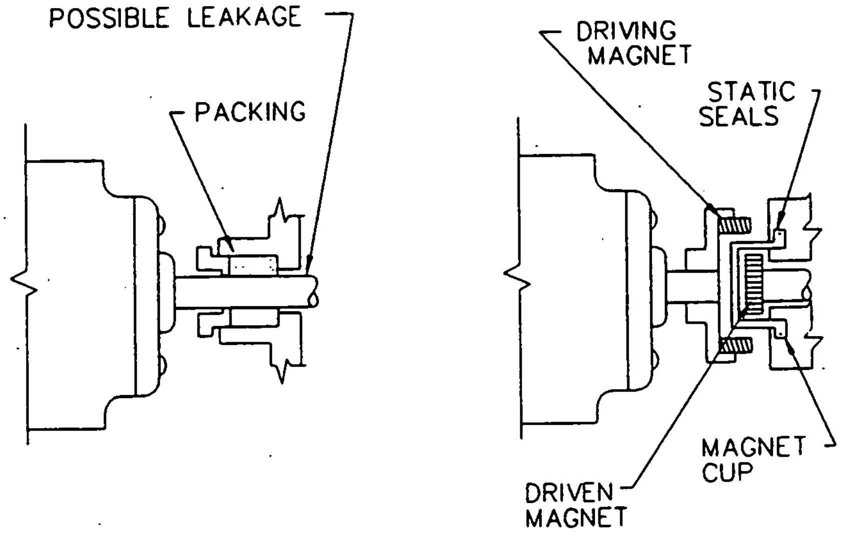
See next page for performance curve.

# SMALL DIA. FILTER SCAV AND PROBE SCAV.

PUMP PERFORMANCE CURVES
70°F WATER



NOTES: SOME FACTORS WHICH TEND TO REDUCE THE DECOUPLING * PRESSURE ARE HIGHER VISCOSITIES, HIGHER TEMPERATURES, ABRASIVE FLUIDS, PUMP WEAR, ETC.



COMMON CONSTRUCTION

MAGNETIC COUPLING *

DETAIL OF MAGNETIC COUPLING
VERSUS COMMON CONSTRUCTION

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# CHAPTER 2: SYSTEM INSTALLATION

## INSTALLATION INSTRUCTIONS

1. Deploy water pump according to instructions in Water Table Depression Pump manual.

**Caution:** Do not deploy the pump so close to the bottom of the well that debris can enter the pump.

2. Suspend the water pump probe above the pump's intake.

3. Lower the Product Pump assembly into the well and position so that the high water switch on the Product Probe is above the low water switch on the water pump probe.

4. Instructions for wiring the pumps and probes to the control panel are provided in the field wiring diagram shipped with each control panel.

# CHAPTER 3: SYSTEM OPERATION

Refer to the SITEPRO™ Probe Scavenger/Water Pump Control Panel manual.

# CHAPTER 4: SYSTEM MAINTENANCE

## CLEAN PROBE

It is essential that the probe shaft and floats be cleaned on a regular basis. Use Alconox detergent, warm water and a soft brush. The required frequency of cleanings is highly site specific and must be determined by the user.

Failure to clean the probe will result in fouling that could cause system malfunction.

## CLEAN STRAINER

The two stage strainer can be esily disassembled for cleaning. This should be done periodically to insure that the pump will not run dry. Time elapsed between strainer cleanings will depend on well conditions. In the event that frequent strainer cleanings are not considered a cost effective maintenance procedure, another option is available.

The inner 100 mesh strainer can be removed. By using the threaded reducer bushing provided, the 60 mesh outer strainer can be used alone. However, the long term effects to the pump must be considered when the 100 mesh inner strainer is not used. Pumping damaging debris will quickly diminish the gear pumps performance, lead to pump rebuilding and/or replacement, and overall down time of the system.

With proper usage and servicing the two stage intake strainer should substantially increase the life of the pump.

# CHAPTER 5: SYSTEM TROUBLESHOOTING

*Problem:* Pump not running.

*Remedy:* Confirm that power is reaching pump. To do this check power at the PUMP POWER OUT terminal block on the SITEPRO chasis.

- If no power is present, refer to the SITEPRO™ 2000 Probe Scavenger™/Water Pump Control Panel manual and troubleshoot the panel.
- If power is present, check the 6 1/4 Amp fuse in the product pump start box. Replace the fuse if blown. (see replacement parts list below). If the fuse is NOT blown, remove the pump from the well and check for damage or excessive wear. Call ORS for asistance.

*Problem:* Pump runs but product runs back into well when pump stops.

*Remedy:* Remove the pump from the well and examine the check valve on top of the pump assembly. Clean or replace the valve (see parts list on next page)

## REPLACEMENT PARTS LIST

| | |
|---|---|
| Bridge Rectifier | PPE-011-053 |
| Capacitor | PPE-008-065 |
| Check Valve | PPP-006-032 |
| Fuse | PPE-011-053 |
| Fuse Holder Assembly | 2010029 |
| Motor | PPE-018-087 |
| Pump | PPP-005-104 |
| Transformer Assembly | 2292003 |

**ORS** ENVIRONMENTAL
EQUIPMENT

# Water Table Depression Pump
For Use With
## SITEPRO™ 2000 Control Panel

5/3/93
Rev. 0
PN. 10297

32 Mill St., Greenville, NH 03048
Phone (800) 228-2310/ (603) 878-2500
FAX (603) 878-3866

# WATER TABLE DEPRESSION PUMP: SYSTEM SPECIFICATION SHEET

This page lists all the standard components and optional accessories included with your ORS Water Table Depression Pump. Numbers in parentheses are ORS part numbers.

**Standard Components:**

*System Type*

✓ Deep Well Submersible _____ Shallow Well Submersible _____ Surface Mounted

*Pump*

[illegible] Model No., 3/4 HP, 230 Voltage, 1 Phase, 60 Hz

✓ 2-Wire, _____ 3-Wire

**Optional Components:**

*Power Cords*

_____ 115VAC, 2-Wire (00244) _____ 115VAC, 3-Wire (ORS728001)

✓ 230VAC, 2-Wire (10071) _____ 230VAC, 3-Wire (10016)

*Hoses*

_____ 1" Hose (PPP001016) _____ 1-1/2" Hose (PPP001013)

_____ 2" Hose (PPP001019) _____ 3" Hose (PPP001030)

*Hose Barb x Male Quick Disconnect Fittings*

_____ 1" (PPP007038) _____ 1-1/2" (PPP007043) _____ 2" (PPP007008) _____ 3" (PPP 007011)

*Hose Barb x Female Quick Disconnect Fittings*

_____ 1" (PPP004034) _____ 1-1/2" (PPP004016) _____ 2" (PPP004007) _____ 3" (PPP004057)

*Hose Barb x MNPT*

_____ 1" (PPP002048) _____ 1-1/2" (PPP002032) _____ 2" (PPP002031) _____ 3" (PPP002038)

*Winch Assembly*

_____ Standard 1000 lb. capacity (2020005) _____ Heavy Duty 2500 lb. capacity (2030001)

*Probes*

_____ Small Diameter w/ 25' cable (2390055) _✓_ Large Diameter w/ 25' cable (2390062)

_____ Small Diameter w/ 50' cable (2390056) _____ Large Diameter w/ 50' cable (2390061)

_____ Small Diameter w/ 100' cable (2390057) _____ Large Diameter w/ 100' cable (2390060)

_____ Small Diameter w/ 150' cable (2390058) _____ Large Diameter w/ 150' cable (2390059)

_____ Probe Hanger (2020004) _____ Probe Adapter (2390063)

*Globe Valve*

_____ 1" (2340009) _____ 1-1/2" (2030036) _____ 2" (2030043) _____ 3" (2030037)

*Digital Flow Meter*

_____ 1-1/2" (1030912) _____ 2" (1030913) _____ 3" (1030914)

*Analog Flow Meter*

_____ 1" (PPP060028) _____ 1-1/2" (PPP060029) _____ 2" (PPP060030) _____ 3" (PPP060011)

*Male Quick Disconnect x MNPT*

_____ 1" (PPP007050) _____ 1-1/2" (PPP007017) _____ 2" (PPP007009) _____ 3" (PPP007034)

*Male Quick Disconnect x FNPT*

_____ 1" (PPP007041) _____ 1-1/2" (PPP007016) _____ 2" (PPP007007) _____ 3" (PPP007011)

*Female Quick Disconnect x FNPT*

_____ 1" (PPP004018) _____ 1-1/2" (PPP004040) _____ 2" (PPP004010) _____ 3" (PPP004009)

*Female Quick Disconnect x MNPT*

_____ 1" (PPP004048) _____ 1-1/2" (PPP004004) _____ 2" (PPP004008) _____ 3" (PPP004022)

*Flow Inducer*

_____ (2030914)

*Junction Boxes*

_____ XP Power (2390066) _✓_ NEMA 4 Signal (2390065)

_____ XP Power with receptacle.115VAC (1011907) _____ XP Power with receptacle. 230VAC (1022903)

## TABLE OF CONTENTS

# PREFACE

## ABOUT THIS MANUAL

This manual contains all the information required to deploy an ORS Water Table Depression Pump and connect it to an ORS SITEPRO 2000 control panel. The manual also contains procedures for maintaining and troubleshooting the pump and level sensing probe.

## ADDITIONAL DOCUMENTATION REQUIRED

- SITEPRO 2000 Water Table Depression Pump Control Panel manual.

In addition to this Water Table Depression Pump manual. you will need the manual supplied with the SITEPRO 2000 control panel. The SITEPRO manual provides detailed procedures for mounting and wiring the panel. and includes important information on pump operation.

## WHO SHOULD READ THIS MANUAL

This manual is intended for field technicians, project engineers or anyone responsible for installing, operating or maintaining site remediation equipment.

## WHAT THIS MANUAL COVERS

Here is what you will find in this manual:

**Chapter 1: System Description includes:**

- Equipment description
- Features and Specifications
- Available options

**Chapter 2: System Installation includes;**

- Pump deployment instructions
- Procedures for wiring to control panel
- Probe wiring and deployment

**Chapter 3: System Operation includes;**

- System precheck procedures
- System startup
- System operation

**Chapter 4: System Maintenance includes;**

- Maintenance schedule for pump and probe

**Chapter 5: System Troubleshooting includes;**

- Basic system troubleshooting procedures

**Appendix A: Deep Well Submersible Pumps includes;**

- Pump performance curves
- Pump specifications
- Pump troubleshooting procedures

**Appendix B: Shallow Well Submersible Pumps includes;**

- Pump performance curves
- Pump specifications
- Maintenance tips

**Appendix C: Surface Mounted Pumps includes;**

- Pump performance curves
- Pump specifications
- Pump troubleshooting procedures

**Appendix D: Winch Assembly includes:**

- Winch operating procedures

## WHAT YOU SHOULD KNOW BEFORE STARTING

If you are installing your Water Table Depression Pump with a SITEPRO control panel. be sure to read the entire SITEPRO manual before installing or attempting to operate the pump.

## DOCUMENTATION CONVENTIONS

This manual uses the following conventions to present information:

An exclamation point icon indicates a WARNING of a situation or condition that could lead to personal injury or death. You should not proceed until you read and thoroughly understand the WARNING message.

A raised hand icon indicates CAUTION information that relates to a situation or condition that could lead to equipment malfunction or damage. You should not proceed until you read and thoroughly understand the CAUTION message.

A note icon indicates NOTE information. Notes provide additional or supplementary information about an activity or concept.

## FOR MORE INFORMATION

If you need additional information on this or any other ORS product, you can contact our Sales or Technical Support staff at:

ORS Environmental Equipment
32 Mill St.
Greenville, NH 03048
Phone: (800) 228-2310
Fax: (603) 878-3866

# CHAPTER 1: SYSTEM DESCRIPTION

*Chapter Summary*

*This chapter contains the following information:*

- ***Introduction*** *- An overview of the system.*
- ***System Components*** *- A description of pump, probe and other system components.*

## INTRODUCTION

The ORS Water Table Depression Pump (WTDP) is designed to pump water containing dissolved contaminants, control groundwater conditions or facilitate the concentration and recovery of hydrocarbon.

When intended for use with the ORS SITEPRO 2000 Water Table Depression Pump Control Panel, the standard WTDP system consists of a submersible or surface mounted pump. All other components, including density actuated level sensing probe, hoses, cables, junction boxes and special fittings, are sold separately as options. For a list of the standard and optional components included with your system, refer to the System Specification sheet at the front of this manual. The major system components are described in the sections below.

## SYSTEM COMPONENTS

### Pumps

Water pumps are available in deep well submersible, shallow well submersible and surface mounted configurations. The type of pump being used is indicated on the System Specification sheet at the front of the manual. Specifications and performance curves for each type of pump are provided in appendices A, B & C at the back of the manual.

## Deep Well Submersible Pumps (Appendix A)

Deep well submersible pumps (Figure 1-1. below) are designed for use in wells that are more than 20' (5m) in depth. require high output pressure and are as small as 4" (10cm) in diameter.

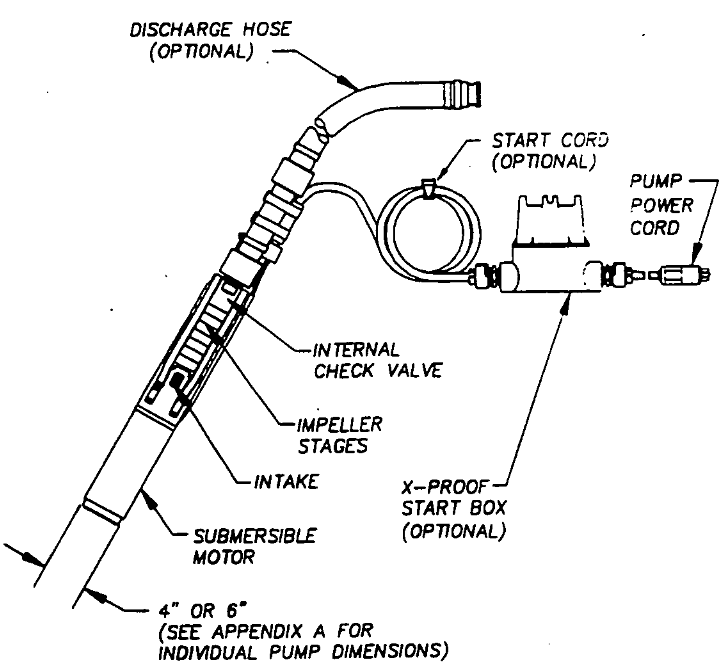


**FIGURE 1-1.** Deep Well Submersible Pump showing optional hose, cords and start box.

Some pumps require 6" (15cm) wells. See Appendix A for pump dimensions.

The pump is a multi-stage turbine unit constructed of corrosion resistant stainless steel with Teflon seals and bearings.

Deep well submersible pumps are available with either 2-wire or 3-wire pump motors and range in power from 1/3 to 20 horsepower. Two-wire motors are available in single-phase only, and feature built-in start components and thermal overload protection. Three-wire motors can be single-phase or three-phase. Single-phase, 3-wire motors (through 1 HP) include built-in thermal overload protection. All single-phase, three-wire deep well submersible pump motors require external start components and are provided with start boxes as a standard feature. Three-phase, three-wire motors require motor starters that can be supplied by ORS as an option.

Pumps up to 2-1/2 HP are supported by the standard SITEPRO 2000 control panel. Larger pumps can be controlled by the SITEPRO if a motor starter is installed in the enclosure (pumps up to 5 HP) or wired between the enclosure and the pump (pumps larger than 5 HP).

## Shallow Well Submersible Pumps (Appendix B)

Shallow well submersible pumps (Figure 1-2, p. 1-4) are designed for use in wells less than 35' (9m) in depth and at least 8" (20cm) in diameter. The pump is a single-stage aluminum centrifugal unit with Viton seals, gaskets and suction head. The abrasion resistant impellers used on these pumps are especially appropriate in applications where water may contain silts and sands. The motor is protected by oil lubricated mechanical seals.

Shallow well submersible pumps all use 3-wire motors and are supplied with start boxes that incorporate thermal overload protection. These pumps are available in models that range in size from 3/4 to 2 HP. Refer to Appendix B for further specifications and performance curves.

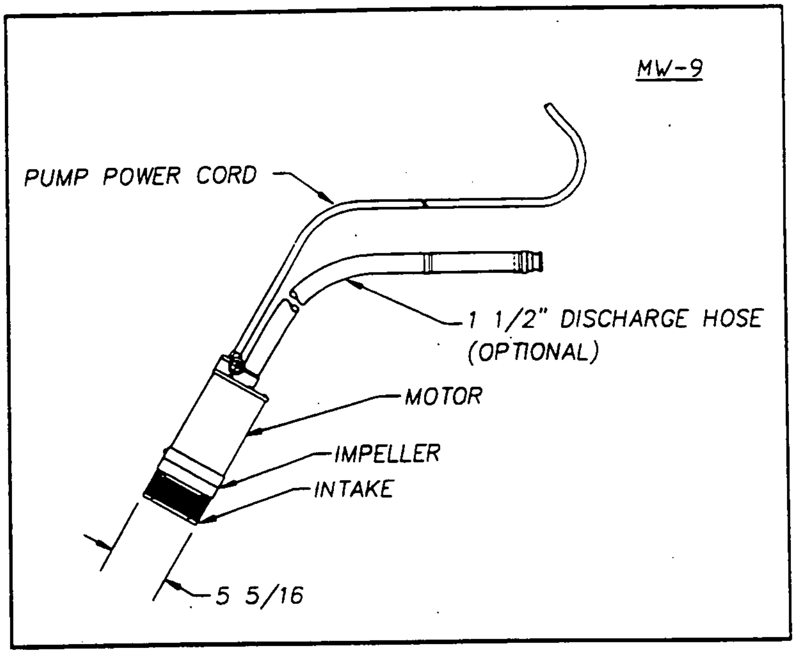


**FIGURE 1-2.** Shallow Well Submersible Pump showing optional hose and power cord.

## Shallow Well Surface Mounted Pumps (Appendix C)

Shallow well surface mounted pumps (Figure 1-3, p. 1-5) are self priming and are designed for use in shallow narrow gauge wells. These cast iron single-stage centrifugal pumps use a downwell intake hose that measures only 3" (76mm) in diameter, and the pump can be used in wells up to 20' (9m) in depth. The pump uses Viton seals and is resistant to damage from silt and sand. The standard ORS surface mounted pump uses a 1 HP motor with built-in start components and thermal overload protection.

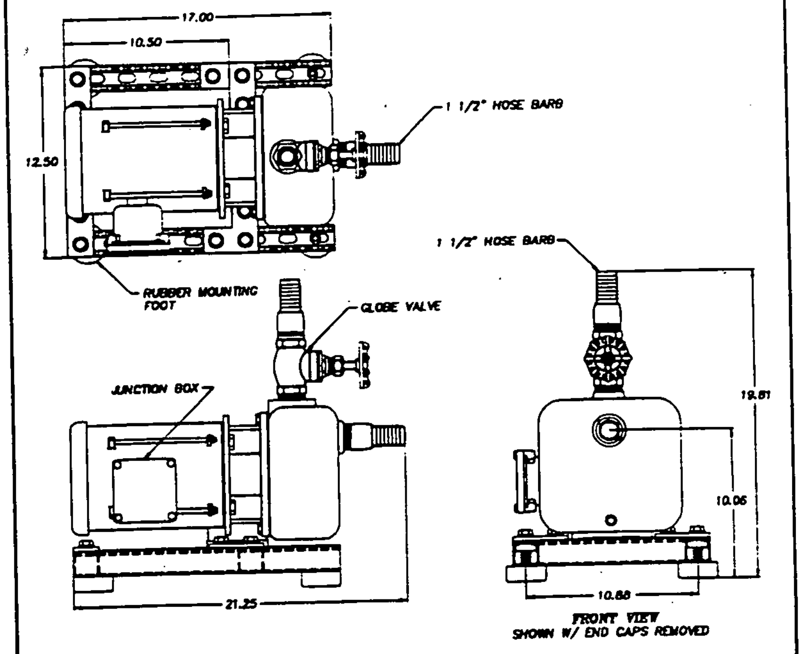


**FIGURE 1-3.** Surface Mounted Water Table Depression Pump showing optional globe valve and hose barbs.

## PROBE

When used with a SITEPRO control panel, ORS Water Table Depression Pumps employ a density actuated probe (Figure 1-4, p. 1-6) for level control. Use of conductivity actuated probes requires circuit modification and additional components.

The density actuated probe contains three separate switches referred to as HI, LO and OVERRIDE. The HI and LO switches are actuated by a single HI/LO float, while the OVERRIDE switch is actuated by a separate OVERRIDE float. The pump starts when the water level in the well lifts the HI/LO float to the HI switch. The pump continues to run until the float falls to the LO switch. The HI and LO sensors

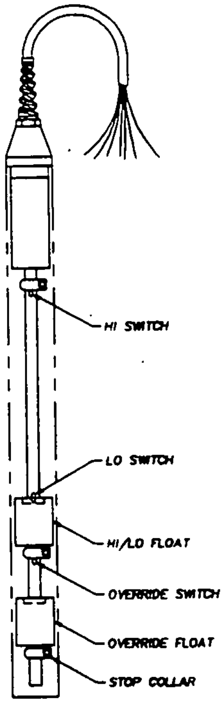


**FIGURE 1-4.** Water Table Depression Pump level sensing probe.

are used to start and stop the pump at two different levels. This differential level system prevents the rapid on and off cycling of the pump that would occur if the pump was started and stopped at the same level. This rapid cycling would destroy the pump motor in a short time.

If the LO switch should fail to stop the pump, the water level will continue to fall until the OVERRIDE float drops and disables the pump control circuit.

Probes designed for use with the SITEPRO panel are supplied without a connector and are wired in such a way that the pump will stop should the probe cable become broken or disconnected. Old style probes (with connectors) can be adapted for use with the SITEPRO, but will not shut off the pump in the event of a cable failure. Refer to Chapter 3 for probe hookup instructions.

**Junction Boxes**

To facilitate the wiring of Water Table Depression Pump systems, ORS offers ready to install power and signal junction boxes (Figure 1-5, below). The optional junction boxes contain terminal strips that allow the pump power cord and the probe cable to be joined to customer installed, conduited

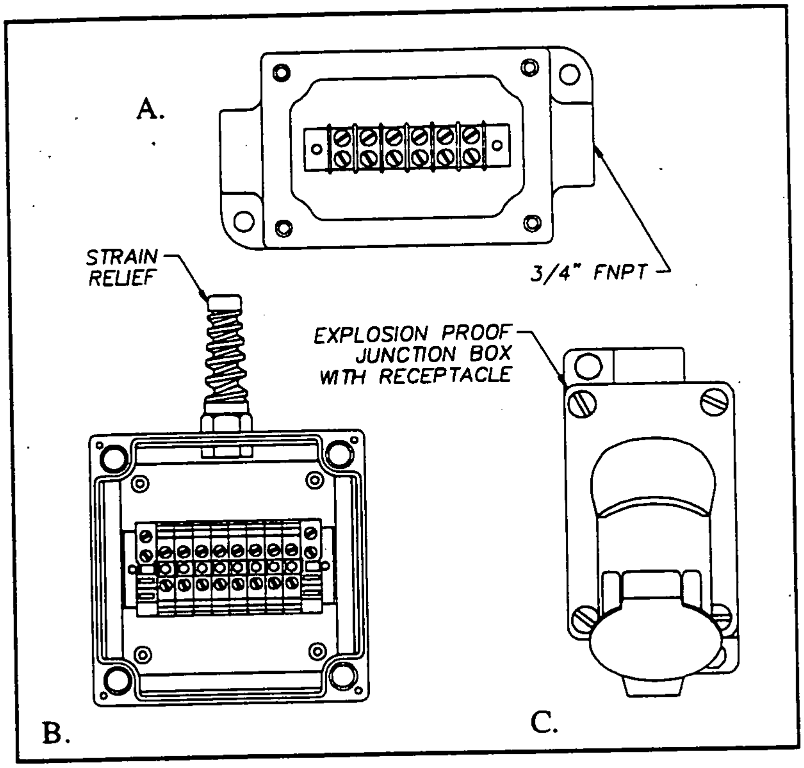


**FIGURE 1-5.** Junction boxes available for use with the Water Table Depression Pump. (A) Explosion proof power junction box. (B) NEMA 4 signal junction box. (C) Explosion proof junction box with receptacle. Refer to System Checklist for part numbers.

wire runs from the well head to the panel. Signal junction boxes are rated NEMA 4 while power junction boxes are explosion proof. See Figure 2-1 for a site installation drawing showing power and signal junction boxes.

**Pump Hoses**

Discharge hoses (for submersible pumps) and intake hoses (for surface mounted pumps) are sold as options with the Water Table Depression Pump. Hose length is specified by the customer. The hoses and fittings included with your system are listed in the System Specification sheet at the front of this manual.

**Accessories**

Also available for use with your Water Table Depression Pump is a selection of optional accessories including globe valves and flow meters. Refer to the System Specification sheet for the accessories ordered with your system.

# CHAPTER 2: SYSTEM INSTALLATION

*Chapter Summary*
*This chapter contains the following installation instructions:*

- ***Warnings and Cautions*** *- How to safely install your pumping system.*
- ***Inspection*** *- How to determine if you received what you ordered.*
- ***Wiring*** *- Procedures for wiring the pump and the probe to the panel.*
- ***Precheck*** *- Procedures for checking pump function.*
- ***Deployment*** *- Procedures for deploying and plumbing the pump.*

The Water Table Depression Pump must be installed, operated and maintained according to the procedures described in this manual. Failure to follow these procedures or to observe the Warnings and Cautions included in this manual may result in personal injury and will void the Standard Equipment Limited Warranty.

- Do not deploy the pump until the well has been developed by qualified personnel. Excessive silt and grit can damage the pump and degrade its performance.

- Never run the pump dry for more than 5 seconds at a time.

- Position the pump intake no closer than 1' (30cm) from the bottom of the well.

- Position the probe above the pump intake and below the desired level of drawdown.

## INSPECTION

Inspect all equipment upon arrival. Check the contents of the packing crate against the System Specification sheet at the front of this manual. If any items are missing or damaged, make note of this on the shipping papers and immediately notify ORS Environmental Equipment at (800) 228-2310.

## SYSTEM WIRING

Throughout the wiring procedures described below, refer to the site installation drawing in Figure 2-1 (p. 2-3), and to the separate Field Wiring Diagram blueprint provided with the system.

⚠ All wiring must be carried out by a qualified electrician and be in accordance with state and local codes. Conduit runs must conform to Article 501-5 of the 1990 National Electrical Code (NEC).

### Install Control Panel

Refer to the SITEPRO 2000 Water Table Depression Pump Control Panel manual and carry out panel mounting and power wiring procedures.

⚠ Power must be disconnected and locked out at the panel or service before any installation procedures are attempted.

### Wire Pump To Panel

1. Deploy the pump at the well head but do not lower into the well until precheck procedures have been completed.

2. Wire from the pump to the control panel as shown on pages 2-4, 2-6 and 2-7 for the various types of pump motors available.

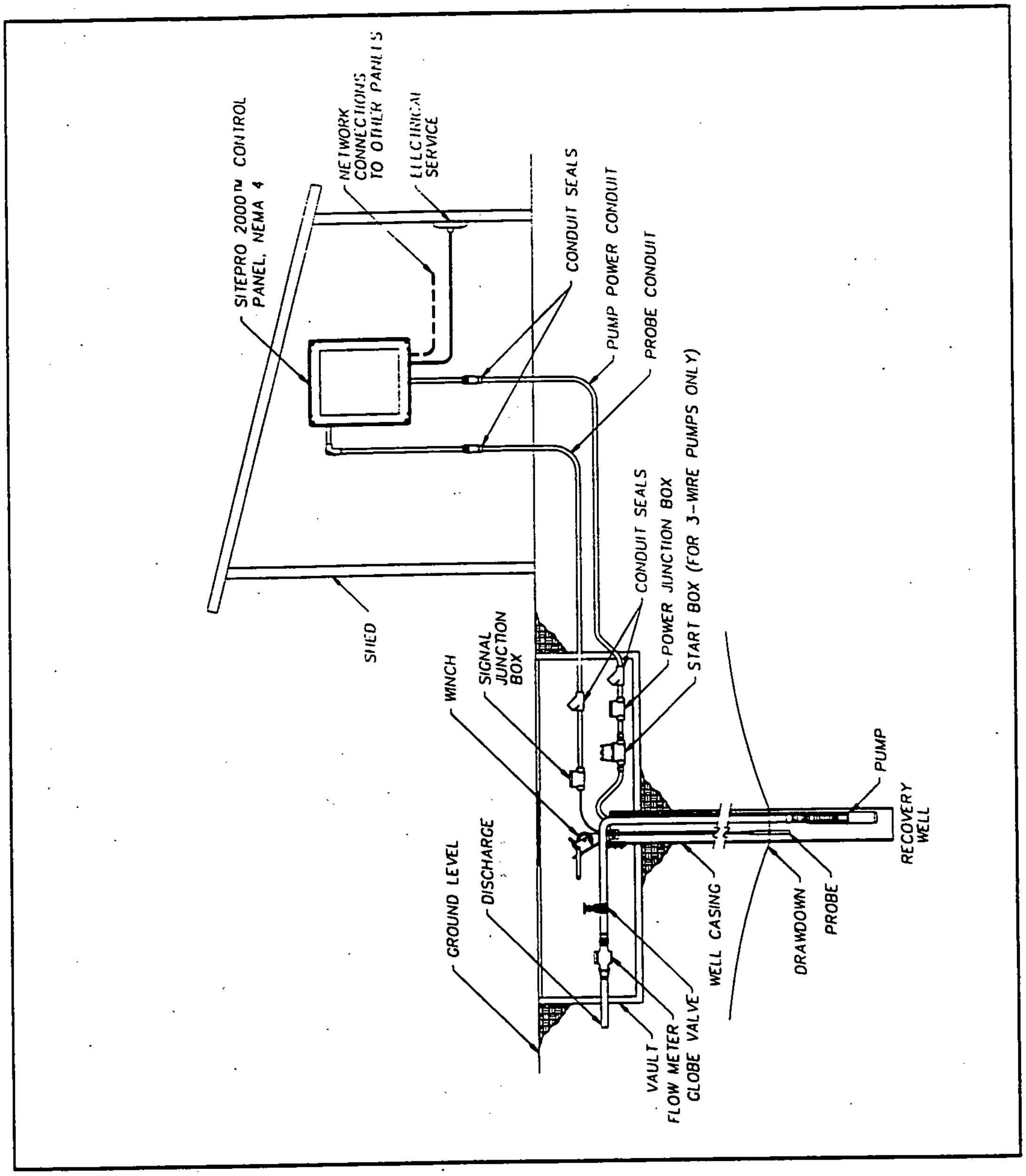


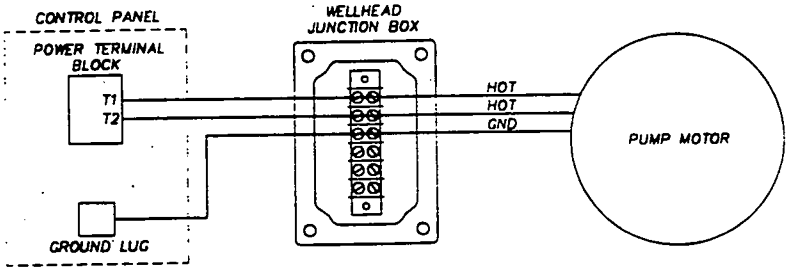
**FIGURE 2-1.** Deep Well Water Table Depression Pump deployed with SITEPRO™ 2000 Control Panel. A typical application showing optional probe, hose, valve, flow meter and junction boxes.

Refer to Figure 2-2 (p. 2-5) for location of the PUMP POWER terminal blocks and ground lug on the SITEPRO chassis.

## Wiring 230VAC 2-Wire Pump Motors

Wire the pump motor wires through a wellhead junction box and attach the hot leads to terminals T1 and T2 on the single phase terminal block. Attach the green Ground wire to the chassis ground lug on the control panel. See below for wiring diagram.

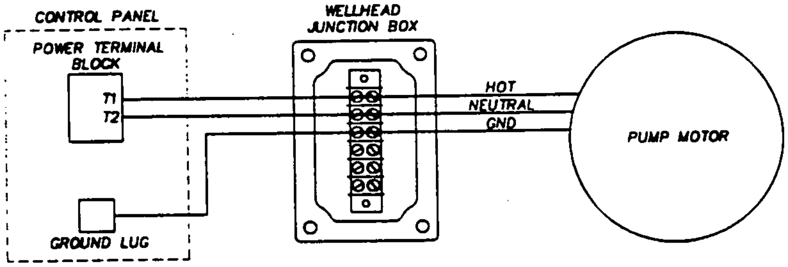
**230VAC**
**2-Wire**



## Wiring 115VAC 2-Wire Pump Motors

Wire the pump motor wires to a wellhead junction box. Then run the hot lead to T1 and the Neutral lead to T2 on the single phase terminal block in the control panel. Attach the green Ground wire to the chassis ground lug on the control panel. See below for wiring diagram.

**115VAC**
**2-Wire**



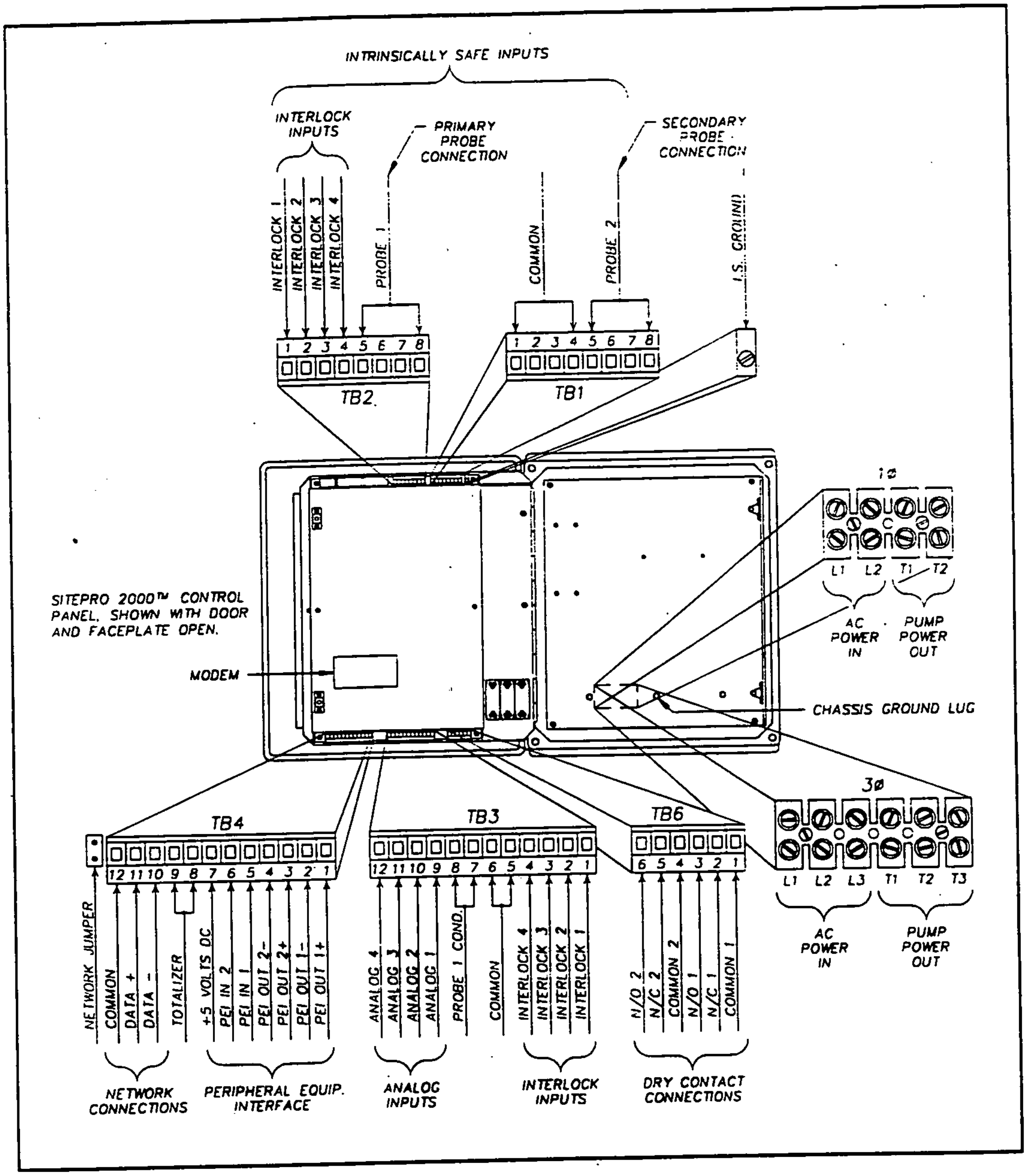
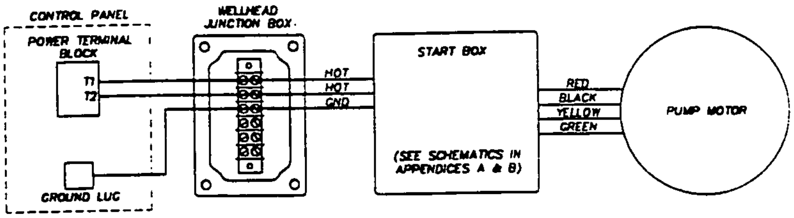


**FIGURE 2-2.** SITEPRO™ 2000 Control Panel showing terminal blocks for pump and power connections. See also chassis ground lug next to pump power terminals.

## Wiring Single Phase 230VAC 3-Wire Pump Motors

Wire from the pump start box to a wellhead junction box. Then run the hot leads from the junction box to terminals T1 and T2 on the single phase terminal block in the control panel. Attach the green Ground wire to the chassis ground lug on the control panel. See below for wiring diagram.

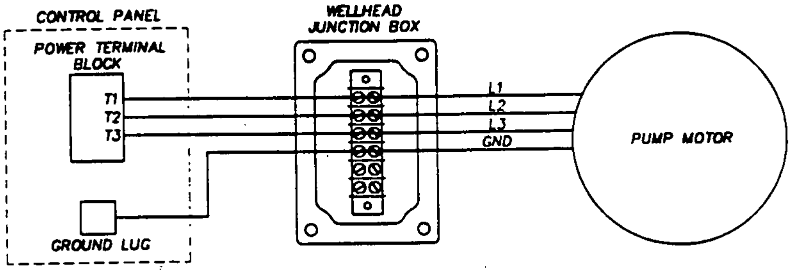
**1-Phase**
**230VAC**
**3-Wire**



## Wiring Three Phase Pump Motors (< 5 HP)

Wire from the pump motor to a wellhead junction box. Then run the three hot leads to terminals T1, T2 and T3 on the three phase terminal block in the control panel. Attach the green Ground wire to the chassis ground lug on the control panel. See below for wiring diagram.

**3-Phase**
**< 5 HP**

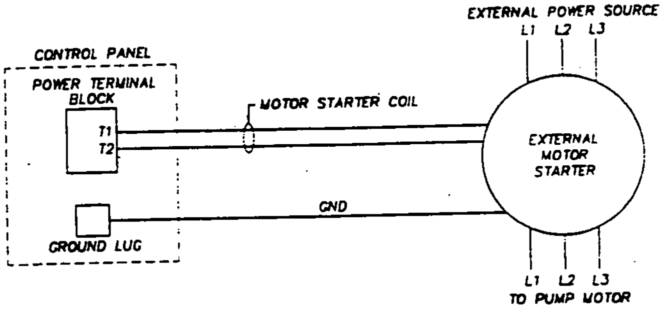


## Wiring Pump Motors Larger Than 5 HP

Pump motors larger than 5 HP require external motor starters. Wire from the motor starter contactor to terminals T1 and T2 on the single phase terminal block in the control panel. Attach the green Ground wire to the chassis ground lug on the control panel. Then wire from a separate power source. through the motor starter and to the pump motor as shown below.

Before working on the pump, disconnect power at **BOTH** the control panel and the external motor starter circuit breaker.

### 3-Phase >5 HP



### Wire Probe To Panel

1. Deploy the probe at the well head but do not lower into the well until precheck procedures have been completed.

2. Wire the probe cable to a signal junction box mounted at the well head. Attach the probe cable leads to the terminal strip inside the junction box.

If you are using an old style probe with integral connector, plug the connector into a probe adapter pigtail (PN 2390063) and then wire the adapter into the junction box.

3. Hardwire from the junction box to the SITEPRO control panel and run the cable through the access port in the side of the SITEPRO enclosure.

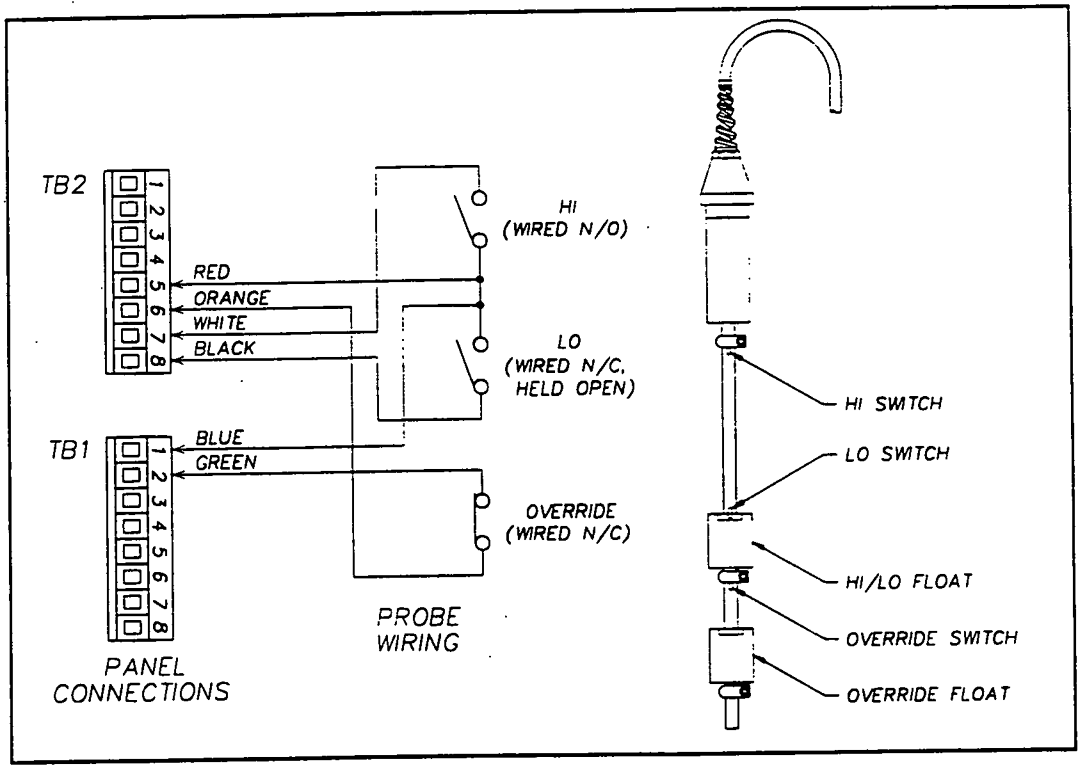


**FIGURE 2-3.** Wiring a standard ORS Water Table Depression Pump probe to the SITEPRO™ 2000 Control Panel.

4. Attach the probe cable leads to terminal strips TB1 and TB2 inside the SITEPRO control panel. Refer to Figure 2-2 (p. 2-5) for terminal strip locations. Refer to Figure 2-3 (above) for wiring connections.

When wiring into the SITEPRO control panel, do not run intrinsically safe (probe) wires within 2 inches of non-intrinsically safe (power) wires or components.

## SYSTEM PRECHECK

Before deploying the pump and probe in the well. carry out the precheck procedures described on pages 4-8 through 4-10 of your SITEPRO manual.

For surface mounted pumps, check the direction of pump rotation by briefly applying power to the motor. Running the pump in reverse could cause the impeller to spin off.

## SYSTEM DEPLOYMENT

1. Lower the pump (submersible systems) or intake (surface mounted systems) into the well. Submersible pumps are typically equipped with a winch assembly. Do not suspend the pump by its start cord or discharge hose.

2. Suspend the intake at least 5' (1.5m) below the level of drawdown without resting it directly on the well bottom. Prevent debris from reaching the pump intake.

3. Confirm that the output hose of the pump is connected to suitable piping or to a proper runoff. Check local regulations.

4. Lower the probe into the well. To prevent false OVERRIDE signals, suspend the probe at least 3' (1m) above the pump intake.

The Water Table Depression Pump is now ready for startup and operation.

# CHAPTER 3: SYSTEM OPERATION

*Chapter Summary*

*This chapter contains the following information:*

- ***Startup*** *- How to start your Water Table Depression Pump.*
- ***Operation*** *- How to adjust flow rate and cycling rate.*

## SYSTEM STARTUP

Before starting the pump, read your SITEPRO 2000 Water Table Depression Pump Control Panel manual and become thoroughly familiar with all panel controls and indicators. Proceed as follows to start the pump:

1. Open the globe valve completely by turning it counter-clockwise.

Surface mounted pumps require an initial prime. Refer to Appendix C for procedure.

2. With the PUMP STATUS switch in the OFF position, turn the PUMP POWER and CONTROL POWER switches to ON.

3. After the panel has gone through its self-test routine, turn the PUMP STATUS switch to AUTO. The pump should start and begin cycling on and off as the water level rises and falls in the well.

The system should be purged if free hydrocarbon is present in the well at deployment. To do this, place the output hose in a suitable container and run the pump on HAND until the water runs clear. Dispose of purged hydrocarbon according to local codes.

4. With the pump running on AUTO, reduce the rate of cycling to a minimum by adjusting the pump globe valve.

If you are installing a deep well submersible pump, refer to the specifications provided in Appendix A and confirm that the volume of water passing through the pump is sufficient for adequate cooling.

## OPERATION

1. With the pump running on AUTO, establish a pumping level and throttle down the outflow with the globe valve. Reduce the rate of pump cycling as far as possible without going below the minimum flow rate recommended by the pump's manufacturer. Ideally, the pump should be valved to approach continuous operation while maintaining the desired level of drawdown.

2. Adjust the position of the probe to the desired level of drawdown. Use the marks on the probe cable to determine depth.

Refer to the SITEPRO manual for details of control panel operation.

# CHAPTER 4: SYSTEM MAINTENANCE

*Chapter Summary*

*This chapter contains the following information:*

- ***Maintenance schedule*** *- What to check and when to check it.*

A schedule of maintenance procedures is presented in Table 4-1 on page 4-2.

It is essential that the probe shaft and floats be cleaned on a regular basis. Use Alconox detergent, warm water and a soft brush. The required frequency of cleanings is highly site specific and must be determined by the user. Failure to clean the probe will result in fouling that could cause system malfunction.

Additional pump maintenance procedures are provided in the pump appendices at the back of the manual.

WTDP-48

WATER TABLE DEPRESSION PUMP SYSTEM
FREQUENCY OF MAINTENANCE TASKS / QUARTERLY CALENDAR

| TASK | WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 | WEEK 5 | WEEK 6 | WEEK 7 | WEEK 8 | WEEK 9 | WEEK 10 | WEEK 11 | WEEK 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHECK FLOW RATE TO ENSURE MINIMUM CYCLING FREQUENCY | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| REMOVE COVER FROM PROBE AND CLEAN FLOATS | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| CHECK START BOX FOR MOISTURE ACCUMULATION (WHEN APPLICABLE) |  | ● |  | ● |  | ● |  | ● |  | ● |  | ● |
| TAKE CURRENT DRAW READINGS AND COMPARE WITH APPROPRIATE MOTOR SPEC. IN APPENDIX |  |  |  | ● |  |  |  | ● |  |  |  | ● |
| INSPECT HOSES AND WIRES FOR CRACKS, CUTS, OR ABRASIONS |  |  |  |  |  |  |  |  |  |  |  | ● |

**TABLE 4-1.** Schedule of maintenance procedures.

# CHAPTER 5: SYSTEM TROUBLESHOOTING

*Chapter Summary*

*This chapter contains the following information:*

- ***Getting Help*** *- What to do before calling ORS for assistance.*
- ***Service Locations*** *- A list of ORS service center locations.*
- ***Troubleshooting Procedures*** *- How to determine if your pump requires service.*

Before working on the pump, disconnect power at the panel or service and carry out standard lockout/tagout procedures.

## GETTING HELP

If the troubleshooting procedures in this chapter indicate a component failure, call ORS Environmental Equipment after documenting the problem as outlined below.

- Read the entire manual and become thoroughly familiar with all system components and troubleshooting procedures.

- Prepare a written list of all problems encountered while operating the equipment.

## SERVICE LOCATIONS

ORS Field Service personnel are trained on all aspects of ORS equipment and are dedicated to helping you maximize the efficiency and cost effectiveness of your Water Table Depression Pump. For technical support of ORS products, call one of the ORS Field Service offices listed below:

**Southern California**
ORS Environmental Equipment
20000/200 Mariner Ave.
Torrance, CA 90510
(310) 542-1782  FAX: 310 371-4782

**New England Area**
ORS Environmental Equipment
32 Mill St.
Greenville, NH 03048
(800) 228-2310  FAX: (603) 878-3866

## TROUBLESHOOTING PROCEDURES

These procedures are meant to be carried out by personnel qualified to work on electrical circuitry. If in doubt, obtain the services of a qualified electrician.

Before proceeding with this chapter, carefully read the troubleshooting section of your SITEPRO 2000 Water Table Depression Pump Control Panel manual.

### • Problem: Pump Running But No Water Delivered

*Cause:*

1. Discharge valve closed.
2. Discharge hose kinked or blocked.
3. Pump has lost prime (surface mounted pumps only).
4. Pump motor running backwards (3-phase motors only).

*Remedy:*

1. Open valve.
2. Locate blockage and clear.

3. Check for air leaks in the suction pipes and reprime pump according to the procedures in Appendix C.
4. Reverse any two legs at the connection between the pump power cord and the control panel.

If problem persists, refer to the pump troubleshooting procedures in Appendices A and C at the back of this manual.

- **Problem: Pump Will Not Run On HAND Or AUTO**

*Cause:*

1. Power turned off at panel.
2. Power failure at site.
3. Thermal/current overload or short circuit has tripped panel circuit breaker.
4. Fuse blown in start box (3-wire pumps only).
5. Control panel malfunction.

*Remedy:*

1. Refer to SITEPRO manual and restore power at panel.
2. Trace power failure and restore power at service.
3. Refer to page 6-6 of SITEPRO manual and troubleshoot tripped breaker. If problem persists, refer to the pump troubleshooting procedures in Appendices A and C at the back of this manual.
4. If 3-wire pump, check for blown fuse in start box.

5. Check control panel. If no indicators are illuminated. refer to page 6-7 of SITEPRO manual and check for blown fuse in panel.

- **Problem: Pump Runs On HAND But Not On AUTO**

*Cause:* If the pump runs on HAND but not on AUTO. the problem is either a faulty probe or a control circuit failure.

*Remedy:* Refer to SITEPRO manual and troubleshoot panel.

# APPENDIX A

# DEEP WELL SUBMERSIBLE PUMPS

# 1. Shipment Inspection

*Examine the components carefully to make sure no damage has occurred to the pump-end, motor, cable or control box during shipment.*

This Grundfos Submersible Pump should remain in its shipping carton until it is ready to be installed. The carton is specially designed to protect it from damage. During unpacking and prior to installation, **care should be taken that the pump is not dropped or mishandled:** if a submersible pump is damaged or bent, misalignment can occur.

The motor is equipped with an electrical cable. **Under no circumstances should the cable be used to support the weight of the pump.**

You will find a loose data plate wired to the pump. It should be securely mounted at the well or attached to the control box.

# 2. Pre-Installation Checklist

*Before beginning installation procedures, the following checks should be made. They are all critical for the proper installation of this submersible pump.*

## 1. Condition of the Well

If the pump is to be installed in a new well, the well should be fully developed and bailed or blown free of cuttings and sand. The stainless steel construction of the Grundfos submersible makes it resistant to abrasion; however, no pump, made of any material, can forever withstand the destructive wear that occurs when constantly pumping sandy water.

If this pump is used to replace an oil-filled submersible or oil-lubricated line-shaft turbine in an existing well, the **well must be blown or bailed clear of oil.**

Determine the maximum depth of the well, and the drawdown level at the pump's maximum capacity. Pump selection and setting depth should be made based on this data.

The inside diameter of the well casing should be checked to ensure that it is not smaller than the size of the pump and motor.

## 2. Condition of the Water

Submersible well pumps are designed for pumping clear, cold water, free of air or gases. Decreased pump performance and life expectancy can occur if the water is not clear, cold or contains air or gases.

**Maximum water temperature should not exceed 102°F.** Special consideration must be given to the pump and motor if it is to be used to pump water above 102°F.

The Grundfos stainless steel submersible is highly resistant to the normal corrosive environment found in some water wells.

If water well tests determine an excessive or unusual corrosive quality, or exceeds 102°F, contact your Grundfos representative for information concerning specially designed pumps for these applications.

## 3. Installation Depth

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawndown level of the well. For flow rates exceeding 100 gpm, the NPSH may have to be considered. Refer to NPSH curves in technical catalog.

The bottom of the motor should never be installed lower than the top of the well screen or within five feet of the well bottom.

If the pump is to be installed in a lake, pond, stream, tank or larger diameter well, the water velocity passing over the motor must be sufficient to ensure proper motor cooling. The minimum water flow rates which insure proper cooling for the various motor sizes are listed in Table A.

## 4. Electrical Supply

The motor voltage, phase and frequency indicated on the motor nameplate should be checked against the actual available electrical supply.

# 3. Wire Cable Type and Size

The type of wire used between the pump and control boxes should be approved for submersible pump application. The conductor can be solid or stranded. The cable may be individual insulated conductors twisted, insulated conductors molded side by side in one flat cable or insulated conductors with a round overall jacket. The insulation conductor should be type RW, RUW, TW or equivalent and must be suitable for use with submersible pumps. See Table D for recommended sizes of cable for various cable lengths.

## Splicing the Motor Cable 4.

***The cable splice is a very important part of the installation of the submersible pump and must be done with extreme care.***

If the splice is carefully made, it will be as efficient as any other portion of the cable, and will be completely watertight.

There are a number of cable splicing kits available today — epoxy-filled, rubber sealed and so on. Many perform well if the manufacturer's directions are followed carefully. If one of these kits is not used, we recommend the following method for splicing the motor cable to the drop cable:

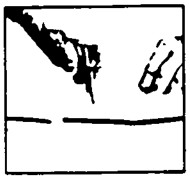


FIG. 4-A


FIG. 4-B


FIG. 4-C


FIG. 4-D

1. Examine the motor cable and the drop cable carefully for damage.

2. Cut the motor leads off in a staggered manner. Cut the ends of the drop cable so that the ends match up with the motor leads. (See Figure 4-A) On single-phase motors, **be sure to match the colors.**

3. Strip back and trim off ½ inch of insulation from each lead, making sure to scrape the wire bare to obtain a good connection. Be careful not to damage the copper conductor when stripping off the insulation.

4. Insert a properly sized "Sta-Kon" type connector on each pair of leads, again making sure that colors are matched. Using a "Sta-Kon" crimping pliers, indent the lugs. (See Figure 4-B) Be sure to squeeze down hard on the pliers, particularly when using large cable.

5. Form a piece of electrical insulation putty tightly around each "Sta-Kon." The putty should overlap on the insulation of the wire. (See Figure 4-C)

6. Use a good quality tape, such as "#33 Scotch Waterproof" or "Plymouth Rubber Company Slipknot Grey." Wrap each wire and joint tightly for a distance of about 2½ inches on each side of the joint. Make a minimum of four passes over each joint and overlap each pass approximately one inch to assure a completely watertight seal. (See Figure 4-D)

## Installation 5.

***The riser pipe should be properly sized and selected based on estimated flow-rates and friction-loss factors. Attaching pump to riser pipe:***

A back-up wrench should be used when the riser pipe is attached to the pump. The pump should only be gripped by the four flats on the top of the discharge chamber. **Under no circumstances, grip the body of the pump, cable guard or motor.**

**The threaded end of the first section of the riser pipe or the nipple must not come in contact with the check valve retainer in the discharge chamber of the pump when tightened down.**

After the first section of the riser pipe has been attached to the pump, the lifting cable or elevator should be clamped to the pipe. **Do not clamp the pump.** When raising the pump and riser section, be careful not to place bending stress on the pump by picking it up by the pump-end only.

**Make sure that the electrical cables are not cut or damaged in any way when the pump is being lowered in the well.**

## If steel riser pipe is used:

We recommend that steel riser pipes always be used with the larger submersibles. A pipe thread compound should be used on all joints. Make sure the joints are adequately tightened in order to resist the tendency of the motor to loosen the joints when stopping and starting.

The drop cable should be secured to the riser pipe at frequent intervals to prevent sagging, looping and possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above and below the splice.

## If plastic riser pipe is used:

It is recommended that plastic type riser pipe be used only with the smaller domestic submersibles. The manufacturer or representative should be contacted to insure the pipe type and physical characteristics are suitable for this use. Use the correct joint compound recommended by the specific pipe manufacturer. Besides making sure that joints are securely fastened, we recommend the use of a torque arrester when using plastic pipe.

**Do not connect the first plastic riser section directly to the pump.** Always attach a metallic nipple or adapter into the discharge chamber of the pump. **The threaded end of the nipple or adapter must not come in contact with the check valve retainer in the discharge chamber of the pump when tightened down.**

The drop cable should be secured to the riser pipe at frequent intervals to prevent sagging, looping and possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above each joint.

Important — plastic pipe tends to stretch under load. This stretching must be taken into account when securing the cable to the riser pipe. Leave 3 to 4 inches of slack between clips or taped points. This tendency for plastic pipe to stretch will also affect the calculation of the pump setting depth. As a general rule, you can estimate that plastic pipe will stretch to approximately 2% of its length. For example, if you installed 200 feet of plastic riser pipe, the pump may actually be down 204 feet. If the depth setting is critical, check with the manufacturer of the pipe to determine exactly how much you have to compensate for pipe stretch.

When plastic riser pipe is used, it is recommended that a safety cable be attached to the pump to lower and raise it. The discharge number of Grundfos 4 inch submersibles is designed to accommodate this cable (Figure 5-A).

FIG. 5-A

## Protect the well from contamination

To protect against surface water from entering the well and contaminating the water source, the well should be finished off above grade, and a locally approved well seal or pitless adapter unit utilized.

# 6 ■ Electrical

***All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.***

**WARNING: A faulty motor or wiring can be a serious electrical shock hazard if it or surrounding water are accessible to human contact. To avoid this danger, connect the motor frame to the power supply grounding terminal with copper conductor no smaller than the circuit conductors unless the motor and surrounding water are inaccessible, as in a drilled well. In all installations connect above ground metal plumbing to the power supply ground per National Code Article 250-80 to prevent electrical shock hazard.**

Verification of the electrical supply should be made to insure the voltage, phase and frequency match that of the motor. Motor voltage, phase, frequency and full-load current information can be found on the nameplate attached to the motor. Motor electrical data can be found on Table E.

**If voltage variations are larger than ± 10%, do not operate the pump.**

Generally, direct on-line starting is approved due to the extremely fast run-up time of the motor (0.1 second maximum), and the low moment of inertia of the pump and motor. Direct on-line starting current (locked rotor amp) is between 4 and 6.5 times the full-load current.

If direct on-line starting is not acceptable, and reduced starting current is required, an auto-transformer or resistant starter should be used. It is recommended that resistant starters be used for 5 to 30 HP motors (depending on cable length). For motors over 30 HP, use auto-transformer starters.

## Engine Driven Generators and Transformers

If the submersible pump is going to be operated using an engine driven generator, we suggest the manufacturer of the generator be contacted to insure the proper generator is selected and used. See Table B for generator sizing information.

If power is going to be supplied through transformers, Table C outlines the minimum KVA rating and capacity required for satisfactory pump operation.

## Control Box

1. **Single-Phase Motors:**

Single-phase motors must be connected as indicated in the motor control box.

2. **Three-Phase Motors**

Three-phase motors must be used with the proper size and type motor starter to ensure the motor is protected against damage from low voltage, phase failure, current unbalance and overload current. A properly sized starter with ambient compensated extra quick-trip overloads must be used to give the best possible motor winding protection. **Each motor line must be protected on all three legs with overloads.** The thermal overloads supplied must trip in less than 10 seconds at locked rotor (starting) current. For starter and overload protection guide, see Table H

**Pumps should NEVER be started to check rotation unless the pump is totally submerged. Severe damage may be caused to the pump and motor if they are run dry.**

## High Voltage Surge Arresters

In addition to the motor starter with overloads, a high voltage surge arrester should be used to protect the motor against lightning and switching surges. Lightning voltage surges in power lines are caused when lightning strikes somewhere in the area. Switching surges are caused by the opening and closing of switches on the main high-voltage distribution power lines.

The correct voltage-rated arrester should be installed on the supply (line) side of the control box or starter (see Figures 6-A and 6-B). **The arrester must be grounded in accordance with the National Electric Code and Local governing regulations.**

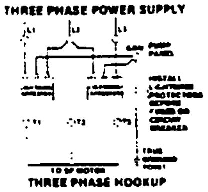


FIG. 6-A

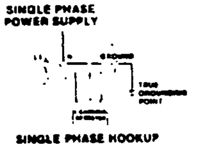


FIG. 6-B

**The warranty on all three-phase submersible motors is VOID if:**
1. The motor is operated with single-phase power through a phase converter.
2. Three-leg ambient compensated extra quick-trip overload protectors are not used.
3. Three-phase current balance is not checked and recorded. (See **START-UP Section 7** for instructions.)
4. High voltage surge arresters are not installed.

## Control Box and Surge Arrester Grounding

The control box shall be permanently grounded in accordance with the National Electric Code and local governing codes or regulations. The ground wire should be a bare copper conductor at least the same size as the drop cable wire size. Ground wire should be run as short a distance as possible and securely fastened to a true grounding point.

True grounding points are considered to be: a grounding rod driven into the water strata; steel well casing submerged into the water lower than the pump setting level; and steel discharge pipes without insulating couplings. If plastic discharge pipe and well casing are used, a properly sized bare copper wire should be connected to a stud on the motor and run to the control panel. Do not ground to a gas supply line. Connect the grounding wire to the ground point first and then to the terminal in the control box.

## Wiring Checks

Before making the final wiring connections on the drop cable to the control box terminal, it is good practice to check the insulation resistance to ensure that the cable and splice are good. Measurements for a new installation must be 1,000,000 ohm or more. Do not start the pump if the measurement is less than this. If it is above, finish wiring and verify that all electrical connections are made in accordance with the wiring diagram. Check to ensure the control box and high voltage surge arrester have been grounded.

## Start-Up 7

***After the pump has been set into the well and the wiring connections have been made, the following procedures should be performed.***

*a. Attach a temporary horizontal length of pipe to the riser pipe.*
*b. Install a gate valve and another short length of pipe to the temporary pipe.*
*c. Adjust the gate valve one-third of the way open.*
*d. Verify that the electrical connections are in accordance with the wiring diagram.*

## Three-Phase Motors

1. **Check the direction of rotation.**

Three-phase motors can run in either direction depending on how they are connected to the power supply. So, when the three cable leads are first connected to the power supply, there is a 50% chance that the motor will run in the proper direction. To **make sure the motor is running in the proper direction, carefully follow the procedures below:**

- a. Start the pump and check the water quantity, and pressure developed.
- b. Stop the pump and interchange any two leads.
- c. Start the pump and again check the water quantity and pressure.
- d. Compare the results observed. The wire connection which gave the highest pressure and largest water quantity is the correct connection.

2. **Check for current unbalance.**

Current unbalance causes the motor to have reduced starting torque, overload tripping, excessive vibration and poor performance which can result in early motor failure. It is very important current unbalance be checked in all three-phase systems. **Current unbalance between the legs should not exceed 5% under normal operating conditions.**

The supply power service should be verified to see if it is a two or three transformer system. The information can be obtained by counting the transformers or by contacting your power company. If two transformers are present, the system is an "open delta" or "wye". If three transformers are present, the system is true three-phase.

**Make sure the transformer ratings in kilovolt amps (KVA) is sufficient for the motor load.** See Table C.

The percentage of current unbalance can be calculated by using the following formulas and procedures:

$$\text{Average current} = \frac{\text{Total of current values measured on each leg}}{3}$$

$$\text{\% Current unbalance} = \frac{\text{Greatest amp difference from the average}}{\text{average current}} \times 100$$

Determine the percentage of current unbalance by:

Step 1. Measure and record current readings in amps for each leg (hookup). Disconnect power.

Step 2. Shift or roll the motor leads from left to right so the drop cable lead that was on terminal 1 is now on 2, lead on 2 is now on 3, and lead on 3 is now on 1 (hookup 2). Rolling the motor leads in this manner will not reverse the motor rotation. Start the pump, measure and record current reading on each leg. Disconnect power.

Step 3. Again shift drop cable leads from left to right so the lead on terminal 1 now goes to 2, 2 to 3, and 3 to 1 (hookup 3). Start pump, measure and record current reading on each leg. Disconnect power.

Step 4. Add together the values for each hookup.

Step 5. Divide the total by 3 to obtain the average.

Step 6. Compare each single leg reading from the average to obtain the greatest amp difference from the average.

Step 7. Divide this difference by the average to obtain the percentage of unbalance.

Use the wiring hookup which provides the lowest percentage of unbalance. (See Table "F" for a specific example of correcting for three-phase power unbalance).

## Developing the Well

After proper rotation and current unbalance have been checked, start the pump and let it operate until the water runs clear of sand, silt and other impurities.

Slowly open the valve in small increments as the water clears until the valve is all the way open. **The pump should not be stopped until the water runs clear.**

If the water is clean and clear when the pump is first started, the valve should still be **slowly opened** until it is all the way open. As the valve is being opened, the draw down should be checked to ensure the pump is always submerged. **The dynamic water level should always be more than 3 feet above the inlet strainer of the pump.**

Disconnect the temporary piping arrangements and complete the final piping connections. Start the pump and test the system. Check and record the voltage and current draw on each motor lead.

# Operating and Maintenance

The pump and system should be periodically checked for water quantity, pressure, draw down, periods of cycling, and operation of controls.

**Under no circumstances should the pump be operated for any prolonged periods of time with the discharge valve closed.** This can result in motor and pump damage due to overheating. A properly sized relief should be installed at the well head to prevent the pump from running against a closed valve.

If the pump fails to operate, or there is a loss of performance, refer to the Trouble Shooting Section 8.

# Trouble-Shooting 8.

The majority of problems that develop with submersible pumps are electrical, and most of these problems can be serviced without pulling the pump from the well. The following charts cover most of the submersible service work. As with any trouble-shooting procedure, start with the simplest solution first: always make all the above ground checks before considering pulling the pump from the well.

Basically, only two instruments are needed — a combination voltmeter/ampmeter, and an ohmmeter. These are relatively inexpensive and can be obtained from most water systems suppliers.

**WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. It's recommended that rubber gloves and boots be worn and that care be taken to have metal control boxes and motors grounded to power supply ground or steel drop pipe or casing extending into the well. WARNING: Submersible motors are intended for operation in a well. When not operated in a well, failure to connect motor frame to power supply in neutral ground may result in serious electrical shock.**

## Preliminary Tests

### Supply Voltage

**How to Measure**

By means of a volt meter, which has been set to the proper scale, measure the voltage at the control box or starter.

On single-phase units measure between line and neutral.

On three-phase units measure between the legs (phases).

**What It Means**

When the motor is under load, the voltage should be withing ± 10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low the motor should be changed to the correct supply voltage.

### Current Measurement

**How to Measure**

By use of an ampmeter, set on the proper scale, measure the current on each power lead at the control box or starter. See the Electrical Data, Table E for motor amp draw information.

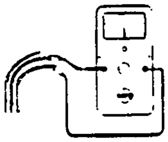
Current should be measured when the pump is operating at constant discharge pressure when the motor is fully loaded.

**What It Means**

If the amp draw exceeds the listed service factor amps (SFA) or if the current unbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burnt contacts on motor starter.
2. Loose terminals in starter or control box or possible cable defect. Check winding and insulation resistances.
3. Too high or low supply voltage.
4. Motor windings are shorted.
5. Pump is damaged causing a motor overload.

### Winding Resistance



**How to Measure**

Turn off power and disconnect the drop cable leads in the control box or starter. Using an ohm meter, set the scale selectors to Rx1 for values under 10 ohms and Rx10 for values over 10 ohms.

Zero adjust the meter and measure the resistance between leads. Record the values.

Motor resistance values can be found in the Electrical Data, Table E. Cable resistance values in Table G

**What It Means**

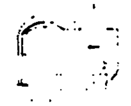
If all the ohm values are normal, and the cable colors correct, the windings are not damaged.

If any one ohm value is less than normal the motor may be shorted.

If any one ohm value is greater than normal, there is a poor cable connection or joint. The windings or cable may also be open.

If some of the ohm values are greater than normal and some less, the drop cable leads are mixed. To verify lead colors, see resistance values in Electrical Data, Table E.

### Insulation Resistance



**How to Measure**

Turn off power and disconnect the drop cable leads in the control box or starter. Using an ohm or mega ohm meter set the scale selector to Rx100K and zero adjust the meter.

Measure the resistance between the lead and ground. (Discharge pipe or well casing if steel.)

**What It Means**

For ohm values, refer to table on following page. Motors of all Hp, voltage, phase and cycles duties have the same value of insulation resistance.

| * CONDITION OF MOTOR AND LEADS | OHM VALUE | MEGOHM VALUE |
|---|---|---|
| New Motor. | 2,000,000 (or more) | 2.0 |
| Used motor which can be reinstalled in the well. | 1,000,000 (or more) | 1.0 |
| MOTOR IN WELL. Ohm readings are for drop cable plus motor. | | |
| A motor in the well in reasonable good condition. | 500,000 - 1,000,000 | 0.5 - 1.0 |
| A motor which may have been damaged by lightning or with damaged leads. Do not pull the pump for this reason. | 20,000 - 500,000 | 0.02 - 0.5 |
| A motor which definitely has been damaged or with damaged cable. The pump should be pulled and repairs made to the cable or the motor replaced. The motor will not fail for this reason alone, but it will probably not operate for long. | 10,000 - 20,000 | 0.01 - 0.02 |
| A motor which has failed or with completely destroyed cable insulation. The pump must be pulled and the cable repaired or the motor replaced. The motor will not run in this condition. | less than 10,000 | 0 - 0.01 |

# Trouble Shooting Chart

| Fault | Possible Causes | How to Check | How to Correct |
|---|---|---|---|
| **A. Pump Does Not Run.** | 1. No electricity at pump panel. | Check for voltage at pump panel. | If no voltage at pump panel, check house or feeder panel for tripped circuits. |
| | 2. Fuses are blown or circuit breakers are tripped. | Remove fuses and check for continuity with ohmmeter. | Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and cable must be checked. |
| | 3. Motor starter overloads are burnt or have tripped out. | Check for voltage on line and load side of starter. | Replace burnt heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil. |
| | 4. Starter does not energize. | Energize control circuit and check for voltage at the holding coil. | If no voltage, check control circuit. If voltage, check holding coil for shorts. Replace bad coil. |
| | 5. Defective controls. | Check all safety and pressure switches for operation. Inspect contact in control devices. | Replace worn or defective parts. |
| | 6. Motor and/or cable are defective. | Turn off voltage, disconnect drop leads from control box to the motor. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. | If open winding or ground is found, remove pump and recheck values at the surface. Repair or replace motor or cable. |
| | 7. Defective capacitor. | Turn off voltage, discharge capacitor. Check with ohmmeter (RX-100K). | Replace if defective. |
| **B. Pump Runs But Does Not Deliver Water.** | 1. Water level in well is too low or well is collapsed. | Check well draw down. | Water level should be at least 3 feet above pump inlet during operation. |
| | 2. Integral pump check valve is blocked. | Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shut-off. | Remove pump and inspect discharge section. Remove blockage, repair valve and valve seat if necessary. Check for other damage. Rinse out pump and reinstall. |
| | 3. Inlet strainer is clogged. | Same as number two above. | Remove pump and inspect. Clean strainer, check integral, check valve for blockage, rinse out pump and reinstall. |

| Fault | Possible Causes | How to Check | How to Correct |
|---|---|---|---|
| | 4. Pump is defective. | Same as number two above. | Convert PSI to feet (PSI x 2.31 ft/ PSI = __ ft). add elevation from top of well to water level to the pressure reading. Refer to the specific pump curve for shut-off head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect. |
| **C. Pump Runs But at Reduced Capacity.** | 1. Wrong rotation. | Check for proper electrical connection in control box. | Correct wiring and change leads as required. |
| | 2. Draw down is larger than anticipated. | Check draw down during pump operation. | Lower pump if possible. If not, throttle discharge valve and install water level control. |
| | 3. Discharge piping or valve leaking. | Examine system for leaks. | Repair leaks. |
| | 4. Pump strainer or check valve are clogged. | Remove pump and inspect. | Clean, repair, rinse out pump and reinstall. |
| | 5. Pump worn. | Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shut-off. | Convert PSI to feet (PSI x 2.31 ft/ PSI = ___ ft). add elevation from top of well to water level to the pressure reading. Refer to the specific pump curve for shut-off head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect. |
| **D. Pump Cycles Too Much.** | 1. Pressure switch is not properly adjusted or is defective. | Check pressure setting on switch and operation. Check voltage across closed contacts. | Readjust switch or replace if defective. |
| | 2. Level control is not properly set or is defective. | Check setting and operation. | Readjust setting (refer to manufacturer data). Replace if defective. |
| | 3. Insufficient air charging or leaking tank or piping. | Pump air into tank or diaphram chamber. | Check diaphram for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume. |
| | 4. Plugged snifter valve or bleed orifice. | Examine valve and orifice for dirt or corrosion. | Clean and/or replace if defective. |
| | 5. Tank is too small. | Check tank size. | Tank volume should be approximately 10 gallons for each gpm of pump capacity. |
| **E. Fuses Blow Or Circuit Breakers Trip.** | 1. High or low voltage. | Check voltage at pump panel. | If not within ± 10%, check wire size and length of run to pump panel. |
| | 2. Three phase current unbalance. | Check current draw on each lead. | Must be within ± 5%, if not contact power company. |
| | 3. Control box wiring and components. | Check control box parts, match parts list. Check wiring matches wiring diagram. Check for loose or broken wires or terminals. | Correct as required. |
| | 4. Capacitor. | Discharge capacitor. Check using an ohmmeter (RX-100K). | When meter is made, the ohmmeter needle should jump forward and slowly drift back. If no meter movement, replace the capacitor. |
| | 5. Starting relay (Franklin single phase motors only). | Check resistance of relay coil with an ohmmeter (RX-1000). Check contacts for wear. | Replace defective relay. |

# TABLE A

## Minimum Water Flow Requirements for Submersible Pump Motors

| Motor Diameter | Casing or Sleeve I.D. in Inches | Min. GPM Flow Pass the Motor |
|---|---|---|
| 4" | 4 | 1.2 |
| | 5 | 7 |
| | 6 | 13 |
| | 7 | 21 |
| | 8 | 30 |
| 6" | 6 | 10 |
| | 7 | 28 |
| | 8 | 45 |
| | 10 | 85 |
| | 12 | 140 |
| | 14 | 198 |
| | 16 | 275 |
| 8" | 8 | 10 |
| | 10 | 55 |
| | 12 | 110 |
| | 14 | 180 |
| | 16 | 255 |

a A flow inducer or sleeve must be used if the water enters the well above the motor or if there is insufficient water flow past the motor

b The minimum water velocity over 4" motors is 0.25 feet per second.

c The minimum water velocity over 6" and 8" motors is 0.5 feet per second.

# TABLE B

## Engine Driven Generators for Submersible Pumps

| Motor HP for Single or Three Phase Units | Minimum Kilowatt Rating of Generator for Three-Wire Submersible Pump Motors | |
|---|---|---|
| | Externally Regulated | Internally Regulated |
| 0.33 | 1.5 | 1.2 |
| 0.50 | 2.0 | 1.5 |
| 0.75 | 3.0 | 2.0 |
| 1.0 | 4.0 | 2.5 |
| 1.5 | 5.0 | 3.0 |
| 2.0 | 7.5 | 4.0 |
| 3.0 | 10.0 | 5.0 |
| 5.0 | 15.0 | 7.5 |
| 7.5 | 20.0 | 10.0 |
| 10.0 | 30.0 | 15.0 |
| 15.0 | 40.0 | 20.0 |
| 20.0 | 60.0 | 25.0 |
| 25.0 | 75.0 | 30.0 |
| 30.0 | 100.0 | 40.0 |
| 40.0 | 100.0 | 50.0 |
| 50.0 | 150.0 | 50.0 |
| 60.0 | 175.0 | 75.0 |
| 75.0 | 250.0 | 100.0 |
| 100.0 | 300.0 | 150.0 |

**Notes:**

1. Table is based on typical 80°C. rise continuous duty generators with 35% maximum voltage dip during starting single and three phase motors.
2. Contact the manufacturer of the generator whenever possible to assure his unit has adequate capacity to run the submersible motor
3. If the generator rating is in KVA instead of kilowatts, multiply the above ratings by 1.25 to obtain KVA

# TABLE C

## Transformer Capacity Required for Three-Phase Submersible Pump Motors

| Three-Phase Motor HP | Minimum Total KVA Required* | Minimum KVA Rating for Each Transformer | |
|---|---|---|---|
| | | 2 Transformers Open Delta or Wye | 3 Transformers Delta or Wye |
| 1½ | 3 | 2 | 1 |
| 2 | 4 | 2 | 1½ |
| 3 | 5 | 3 | 2 |
| 5 | 7½ | 5 | 3 |
| 7½ | 10 | 7½ | 5 |
| 10 | 15 | 10 | 5 |
| 15 | 20 | 15 | 7½ |
| 20 | 25 | 15 | 10 |
| 25 | 30 | 20 | 10 |
| 30 | 40 | 25 | 15 |
| 40 | 50 | 30 | 20 |
| 50 | 60 | 35 | 20 |
| 60 | 75 | 40 | 25 |
| 75 | 90 | 50 | 30 |
| 100 | 120 | 65 | 40 |

*Pump motor KVA requirements only, and does not include allowances for other loads.

# TABLE D

## Submersible Pump Cable Selection Chart 60 Hz

The following tables list the recommended copper cable sizes and various cable lengths for submersible pump motors. These tables comply with the 1978 edition of the National Electric Code Table 310-16, Column 2 for 75°C wire. The ampacity (current carrying properties of a conductor) have been divided by 1.25 per the N.E.C., Article 430-22, for motor branch circuits based on motor amps at rated horsepower.

To assure adequate starting torque, the maximum cable lengths are calculated to maintain 95% of the service entrance voltage at the motor when the motor is running at maximum nameplate amps. Cable sizes larger than specified may always be used and will reduce power usage.

**The use of cables smaller than the recommended sizes will void the warranty. Smaller cable sizes will cause reduced starting torque and poor motor operation.**

## TABLE D Submersible Pump Cable Selection Chart 60 Hz

*continued*

### SINGLE-PHASE MOTOR MAXIMUM CABLE LENGTH (Motor to Service Entrance) (2)

| Motor Rating | | Copper Wire Size (1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Volts | HP | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 0 | 00 |
| 115 | ⅓ | 134 | 212 | 333 | 522 | 810 | 1240 | 1890 | 2550 | |
| | ½ | 100 | 159 | 249 | 390 | 608 | 930 | 1410 | 1310 | |
| 230 | ⅓ | 533 | 850 | 1350 | 2110 | 3290 | 5025 | 7650 | | |
| | ½ | 404 | 641 | 1003 | 1575 | 2450 | 3750 | 5710 | | |
| | ¾ | 293 | 473 | 740 | 1161 | 1810 | 2760 | 4210 | 5680 | |
| | 1 | 248 | 392 | 617 | 968 | 1507 | 2300 | 3510 | 4730 | 5920 |
| | 1½ | 205 | 326 | 510 | 801 | 1248 | 1920 | 2930 | 3950 | 4940 |
| | 2 | 180 | 286 | 449 | 703 | 1096 | 1675 | 2550 | 3440 | 4300 |
| | 3 | | 229 | 359 | 563 | 877 | 1339 | 2041 | 2750 | 3440 |
| | 5 | | | 216 | 315 | 490 | 750 | 1442 | 1540 | 1925 |
| | 7½ | | | | 270 | 362 | 553 | 842 | 1136 | 1420 |
| | 10 | | | | | 250 | 425 | 650 | 675 | 1100 |

**CAUTION** Use of wire size smaller than listed will void warranty

**FOOTNOTES:**

(1) If aluminum conductor is used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of same size

(2) The portion of the total cable which is between the service entrance and a 3 ø motor starter should not exceed 25% of the total maximum length to assure reliable starter operation. Single phase control boxes may be connected at any point of the total cable length

### THREE-PHASE MOTOR MAXIMUM CABLE LENGTH (Motor to Service Entrance) (2)

| Motor Rating | | Copper Wire Size (1) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Volts | HP | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 0 | 00 | 000 | 0000 |
| 208 | 1.5 | 320 | 510 | 800 | 1260 | | | | | | | |
| | 2 | 250 | 390 | 610 | 960 | 1500 | | | | | | |
| | 3 | 180 | 290 | 450 | 710 | 1110 | 1690 | | | | | |
| | 5 | | | 300 | 470 | 730 | 1110 | 1690 | | | | |
| | 7½ | | | | 340 | 530 | 810 | 1230 | 1550 | | | |
| | 10 | | | | 250 | 390 | 600 | 920 | 1240 | 1540 | | |
| | 15 | | | | | 270 | 410 | 630 | 650 | 1060 | 1270 | |
| | 20 | | | | | | 320 | 480 | 550 | 810 | 970 | 1150 |
| | 25 | | | | | | | 390 | 530 | 660 | 790 | 930 |
| | 30 | | | | | | | | 430 | 540 | 650 | 750 |
| 230V | 1.5 | 430 | 680 | 1070 | 1680 | | | | | | | |
| | 2 | 320 | 510 | 790 | 1250 | 1940 | | | | | | |
| | 3 | 240 | 380 | 600 | 940 | 1470 | 2240 | | | | | |
| | 5 | | 250 | 390 | 620 | 960 | 1470 | 2230 | | | | |
| | 7½ | | | 290 | 450 | 700 | 1070 | 1630 | 2230 | | | |
| | 10 | | | | 340 | 520 | 800 | 1220 | 1640 | 2050 | | |
| | 15 | | | | | 360 | 550 | 830 | 1130 | 1410 | 1680 | |
| | 20 | | | | | | 420 | 640 | 860 | 1070 | 1280 | 1510 |
| | 25 | | | | | | 340 | 520 | 700 | 870 | 1040 | 1230 |
| | 30 | | | | | | | 420 | 570 | 710 | 850 | 1000 |
| 460V | 1.5 | 1720 | | | | | | | | | | |
| | 2 | 1280 | 2030 | | | | | | | | | |
| | 3 | 960 | 1530 | 2400 | | | | | | | | |
| | 5 | 630 | 1000 | 1570 | 2470 | | | | | | | |
| | 7½ | 460 | 730 | 1150 | 1800 | 2810 | | | | | | |
| | 10 | | 550 | 850 | 1340 | 2090 | 3190 | | | | | |
| | 15 | | | 590 | 920 | 1430 | 2190 | 3340 | | | | |
| | 20 | | | | 700 | 1100 | 1670 | 2550 | 3440 | | | |
| | 25 | | | | 570 | 890 | 1360 | 2070 | 2600 | 3500 | | |
| | 30 | | | | | 730 | 1110 | 1690 | 2280 | 2850 | 3400 | |
| | 40 | | | | | | 850 | 1300 | 1750 | 2190 | 2610 | 3070 |
| | 50 | | | | | | 680 | 1040 | 1400 | 1750 | 2090 | 2450 |
| | 60 | | | | | | | 870 | 1180 | 1470 | 1760 | 2070 |
| | 75 | | | | | | | | 950 | 1190 | 1420 | 1670 |
| | 100 | | | | | | | | | 890 | 1060 | 1240 |
| 575V | 1.5 | 2640 | | | | | | | | | | |
| | 2 | 1860 | | | | | | | | | | |
| | 3 | 1490 | 2370 | | | | | | | | | |
| | 5 | 980 | 1560 | 2440 | | | | | | | | |
| | 7½ | 720 | 1150 | 1800 | 2820 | | | | | | | |
| | 10 | 540 | 850 | 1340 | 2090 | | | | | | | |
| | 15 | | 590 | 920 | 1440 | 2245 | | | | | | |
| | 20 | | | 700 | 1090 | 1700 | 2600 | | | | | |
| | 25 | | | | 890 | 1390 | 2130 | 3240 | | | | |
| | 30 | | | | 730 | 1130 | 1730 | 2640 | 3560 | | | |
| | 40 | | | | | 870 | 1330 | 2030 | 2730 | 3280 | | |
| | 50 | | | | | | 1060 | 1620 | 2190 | 2620 | 3128 | |
| | 60 | | | | | | 900 | 1360 | 1840 | 2210 | 2640 | 3100 |
| | 75 | | | | | | | 1100 | 1490 | 1790 | 2130 | 2510 |
| | 100 | | | | | | | | 1110 | 1330 | 1590 | 1860 |

# TABLE E

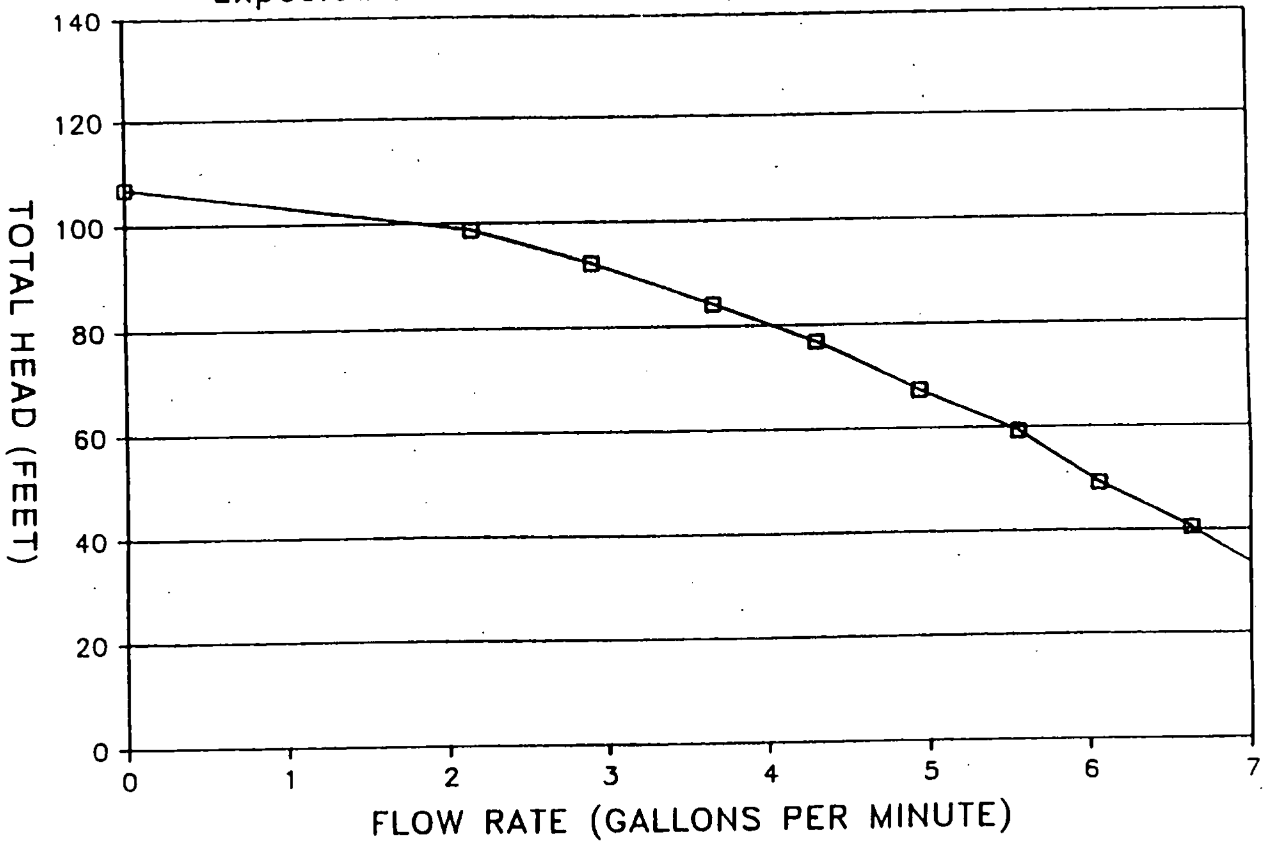
## Electrical Data — 60 Hz Submersible Pump Motors

### FRANKLIN

| RATED HP | VOLTS | PH | SERVICE FACTOR | RATED HP AMPS | SERVICE FACTOR AMPS | CIR BREAK OR STANDARD FUSE | DUAL ELEMENT FUSE | KVA CODE | LOCKED ROTOR AMPS | WINDING RESISTANCE (OHMS) |
|---|---|---|---|---|---|---|---|---|---|---|
| **4 Inch, Two Wire** | | | | | | | | | | |
| ⅓ | 115 | 1 | 1.75 | 7.0 | 8.9 | 25 | 10 | S | 48.4 | 1.5-1.9 |
| | 230 | 1 | 1.75 | 3.5 | 4.4 | 15 | 5 | S | 24.2 | 6.0-7.4 |
| ½ | 115 | 1 | 1.60 | 9.6 | 11.9 | 30 | 15 | R | 62.4 | 1.0-1.3 |
| | 230 | 1 | 1.60 | 4.8 | 5.9 | 15 | 7 | R | 31.2 | 4.2-5.2 |
| ¾ | 230 | 1 | 1.50 | 5.4 | 8.0 | 20 | 9 | N | 40.2 | 2.7-3.4 |
| 1 | 230 | 1 | 1.40 | 9.2 | 9.8 | 25 | 12 | M | 46.0 | 2.2-2.8 |
| 1½ | 230 | 1 | 1.30 | 10.6 | 13.1 | 35 | 15 | [illegible] | 56.8 | 1.5-1.9 |
| **4 Inch, Three Wire** | | | | | | | | | | |
| ⅓ | 115 | 1 | 1.75 | 7.0 | 8.9 | 25 | 10 | N | 32.8 | BY 1.5-1.9<br>RY [illegible] |
| | 230 | 1 | 1.75 | 3.5 | 4.4 | 15 | 5 | N | 16.4 | BY [illegible]<br>RY 23.4-28.6 |
| ½ | 115 | 1 | 1.60 | 9.6 | 11.9 | 30 | 15 | M | 46.0 | BY 1.0-1.3<br>RY [illegible] |
| | 230 | 1 | 1.60 | 4.8 | 5.9 | 15 | 7 | M | 23.1 | BY 4.2-5.2<br>RY [illegible] |
| ¾ | 230 | 1 | 1.50 | 5.4 | 8.0 | 20 | 9 | M | 33.1 | BY 2.7-3.4<br>RY [illegible] |
| 1 | 230 | 1 | 1.40 | 8.0 | 9.6 | 25 | 12 | L | 42.0 | BY [illegible]<br>RY [illegible] |
| 1½ | 230 | 1 | 1.30 | 9.1 | 11.5 | 30 | 15 | J | 52.0 | BY [illegible]<br>RY [illegible] |
| 2 | 230 | 1 | 1.25 | 10.0 | 13.2 | 35 | 15 | G | 51.0 | BY [illegible]<br>RY [illegible] |
| 3 | 230 | 1 | 1.15 | 14.0 | 17.0 | 45 | 20 | F | 71.0 | BY [illegible]<br>RY [illegible] |
| 5 | 230 | 1 | 1.15 | 23.0 | 27.5 | 80 | 30 | F | 118.0 | BY [illegible]<br>RY [illegible] |
| 1½ | 200 | 3 | 1.30 | 5.0 | 7.3 | 20 | 9 | K | 39.0 | 2.4-3.4 |
| | 230 | 3 | 1.30 | 5.2 | 6.3 | 20 | 8 | K | 34.0 | 3.2-4.1 |
| | 460 | 3 | 1.30 | 2.6 | 3.1 | 15 | 4 | K | 17.0 | 11.3-15.0 |
| | 575 | 3 | 1.30 | 2.1 | 2.5 | 15 | 3 | K | 14.0 | 15.1-26.0 |
| 2 | 200 | 3 | 1.25 | 8.0 | 9.4 | 25 | 10 | L | 53.0 | 1.9-2.4 |
| | 230 | 3 | 1.25 | 7.0 | 8.2 | 20 | 10 | L | 46.0 | 2.4-3.0 |
| | 460 | 3 | 1.25 | 3.5 | 4.1 | 15 | 5 | L | 23.0 | 9.7-12.0 |
| | 575 | 3 | 1.25 | 2.8 | 3.3 | 15 | 4 | L | 18.0 | 13.6-18.9 |
| 3 | 200 | 3 | 1.15 | 11.5 | 13.1 | 35 | 15 | K | 70 | 1.3-1.7 |
| | 230 | 3 | 1.15 | 10.0 | 11.4 | 30 | 15 | K | 61 | 1.8-2.2 |
| | 460 | 3 | 1.15 | 5.0 | 5.7 | 15 | 7 | K | 31 | 7.0-8.7 |
| | 575 | 3 | 1.15 | 4.0 | 4.8 | 15 | 6 | K | 24 | 11.0-13.6 |
| 5 | 200 | 3 | 1.15 | 17.5 | 20.0 | 50 | 25 | K | 120 | 0.70-0.94 |
| | 230 | 3 | 1.15 | 15.2 | 17.4 | 45 | 20 | K | 104 | 0.93-1.2 |
| | 460 | 3 | 1.15 | 7.6 | 8.7 | 25 | 10 | K | 52 | [illegible]-4.4 |
| | 575 | 3 | 1.15 | 6.1 | 7.0 | 20 | 8 | K | 42 | 5.6-6.9 |
| 7½ | 200 | 3 | 1.15 | 27.0 | 30.8 | 80 | 35 | J | 158 | 0.55-0.68 |
| | 230 | 3 | 1.15 | 23.5 | 26.8 | 70 | 30 | J | 143 | 0.76-0.93 |
| | 460 | 3 | 1.15 | 11.7 | 13.4 | 35 | 15 | J | 72 | 2.4-3.4 |
| | 575 | 3 | 1.15 | 9.3 | 10.7 | 30 | 12 | J | 57 | 3.5-5.1 |
| 10 | 460 | 3 | 1.15 | 15.6 | 17.6 | 45 | 20 | K | 108 | 1.8-2.3 |
| | 575 | 3 | 1.15 | 12.5 | 14.1 | 40 | 20 | K | 86 | [illegible]-3.5 |
| **6 Inch** | | | | | | | | | | |
| 5 | 230 | 1 | 1.15 | 26.0 | 29.5 | 80 | 35 | E | 99 | BY 0.55-0.68<br>RY [illegible] |
| 7½ | 230 | 1 | 1.15 | 34.5 | 40.0 | 100 | 45 | E | 157 | BY 0.40-0.50<br>RY 0.98-1.2 |
| 10 | 230 | 1 | 1.15 | 45.0 | 52.0 | 150 | 60 | E | 223 | BY 0.27-0.33<br>RY 0.80-0.98 |
| 5 | 200 | 3 | 1.15 | 17.0 | 19.1 | 50 | 25 | J | 103 | 0.70-0.88 |
| | 230 | 3 | 1.15 | 14.8 | 16.6 | 45 | 20 | J | 90 | 0.87-1.1 |
| | 460 | 3 | 1.15 | 7.2 | 8.3 | 25 | 10 | J | 45 | 3.1-4.1 |
| | 575 | 3 | 1.15 | 5.9 | 6.6 | 20 | 8 | J | 36 | 5.7-7.0 |
| 7½ | 200 | 3 | 1.15 | 24.2 | 27.5 | 70 | 30 | J | 156 | 0.48-0.59 |
| | 230 | 3 | 1.15 | 21.0 | 23.9 | 70 | 30 | J | 136 | 0.56-0.71 |
| | 460 | 3 | 1.15 | 10.5 | 11.9 | 30 | 15 | J | 68 | 2.1-2.9 |
| | 575 | 3 | 1.15 | 8.4 | 9.5 | 25 | 12 | J | 54 | 4.0-4.8 |
| 10 | 200 | 3 | 1.15 | 32.1 | 36.8 | 100 | 40 | K | 235 | 0.28-0.46 |
| | 230 | 3 | 1.15 | 27.9 | 32.0 | 80 | 35 | K | 204 | 0.35-0.55 |
| | 460 | 3 | 1.15 | 13.9 | 16.0 | 40 | 20 | K | 102 | 1.5-2.1 |
| | 575 | 3 | 1.15 | 11.1 | 12.8 | 35 | 15 | K | 82 | 2.5-3.2 |

## GRUNDFOS PUMPS CORP.

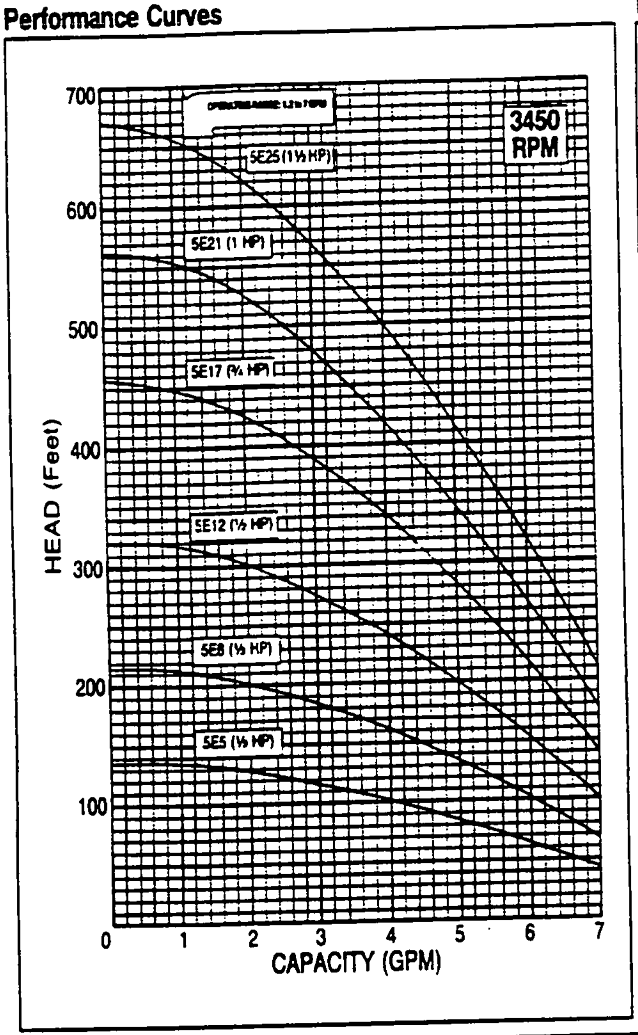
Expected Performance: 5E4, 1PH x 230V, 60 Hz.

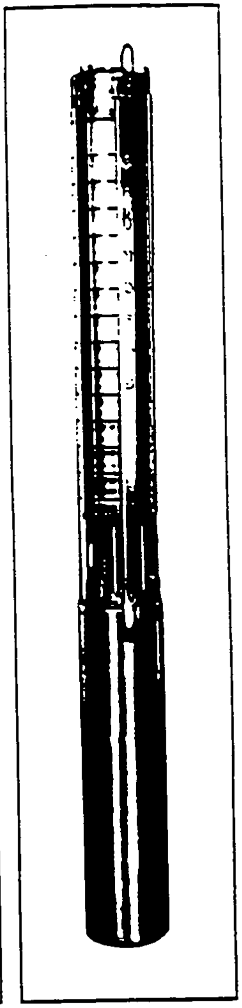


# 5E

**Redi-Flo Enviromental Pump**

## Performance Curves





## Electrical Data, Dimensions. and Weights ①

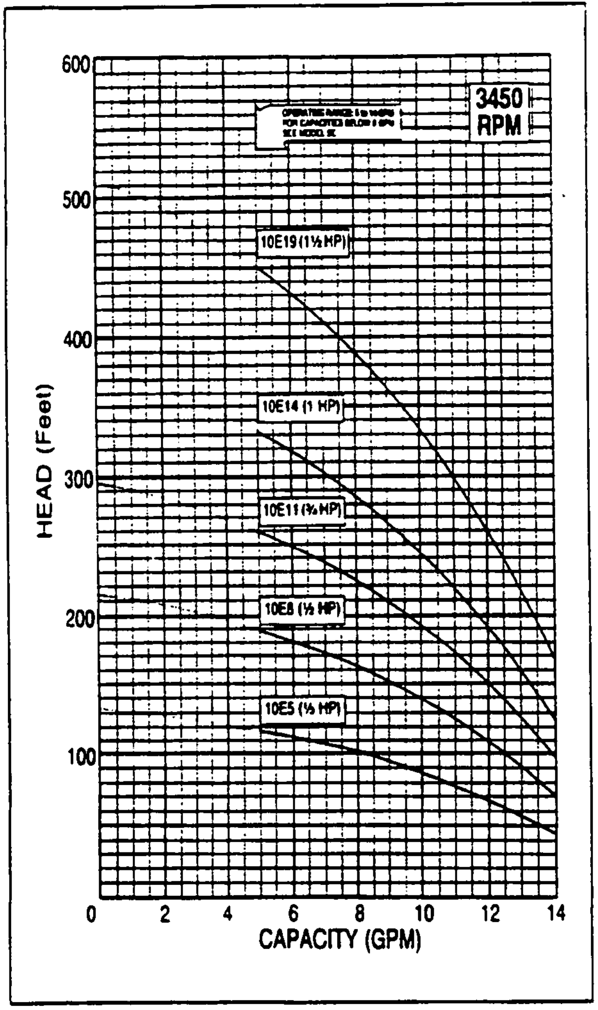
| PUMP TYPE | MOTOR | | | | DIMENSIONS (In Inches) | | | | | | NET WEIGHT (LBS.)② | SHIP. WEIGHT (LBS.)② |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HP | SF | PH | VOLTS | OVERALL LENGTH A | MOTOR LENGTH B① | PUMP END LENGTH C | MAX. DIA. D | INLET E | DISCH. PIPE SIZE (NPT) F | | |
| 5E5 | ⅓ | 1.75 | 1 | 230 | 20 9/16 | 10 | 10 9/16 | 3 31/32 | 3 ¼ | 1 | 24 | 26 |
| 5E8 | ⅓ | 1.75 | 1 | 230 | 22 ¾ | 10 | 12 ¾ | 3 31/32 | 3 ¼ | 1 | 26 | 28 |
| 5E12 | ½ | 1.60 | 1 | 230 | 26 13/16 | 10 13/16 | 16 | 3 31/32 | 3 ¼ | 1 | 28 | 29 |
| 5E17 | ¾ | 1.50 | 1 | 230 | 31 7/16 | 11 ⅜ | 20 3/16 | 3 31/32 | 3 ¼ | 1 | 31 | 32 |
| 5E21 | 1 | 1.40 | 1 | 230 | 35 7/16 | 12 | 23 7/16 | 3 31/32 | 3 ¼ | 1 | 33 | 35 |
| 5E25 | 1 ½ | 1.30 | 1 | 230 | 40 5/16 | 13 9/16 | 26 ¾ | 3 31/32 | 3 ¼ | 1 | 35 | 37 |

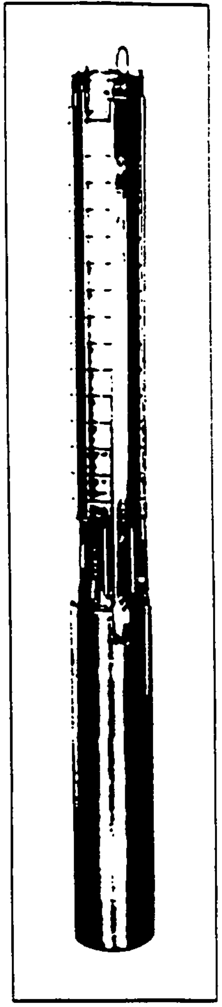
① Data for Grundfos MS402E motors. ② Does not include motor leads.

# 10E

Redi-Flo Enviromental Pump

## Performance Curves





## Electrical Data, Dimensions, and Weights ①

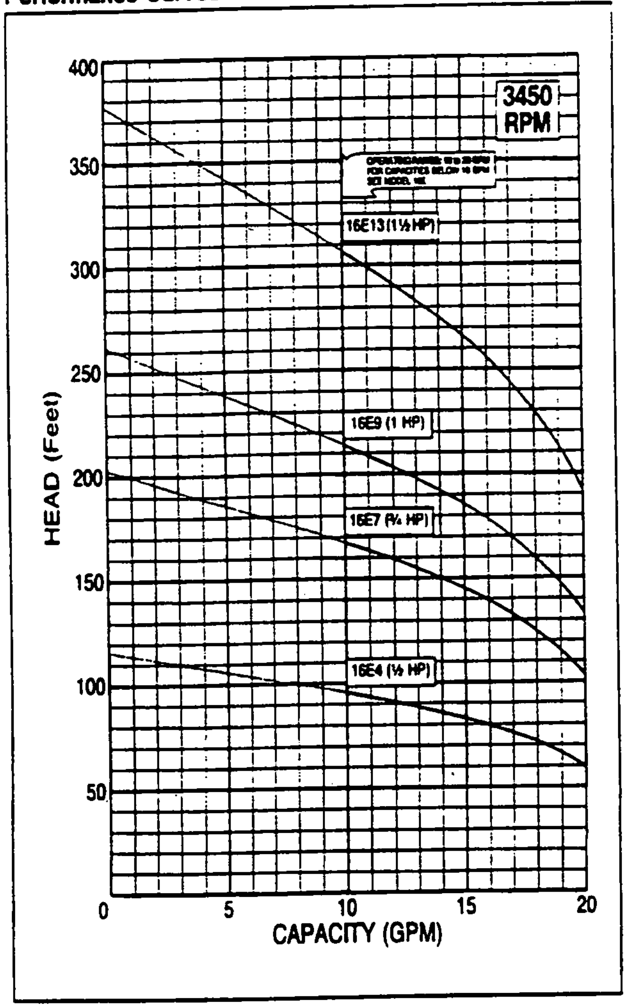
| PUMP TYPE | MOTOR |  |  |  | DIMENSIONS (In Inches) |  |  |  |  |  | NET WEIGHT (LBS.)② | SHIP WEIGHT (LBS.)② |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | HP | SF | PH | VOLTS | OVERALL LENGTH A | MOTOR LENGTH B① | PUMP END LENGTH C | MAX. DIA. D | INLET E | DISCH. PIPE SIZE (NPT) F |  |  |
| 10E5 | ⅓ | 1.75 | 1 | 230 | 20 5/16 | 10 | 10 5/16 | 3 31/32 | 3 ¼ | 1 ¼ | 24 | 25 |
| 10E8 | ½ | 1.60 | 1 | 230 | 23 9/16 | 10 13/16 | 12 ¾ | 3 31/32 | 3 ¼ | 1 ¼ | 26 | 28 |
| 10E11 | ¾ | 1.50 | 1 | 230 | 26 9/16 | 11 ⅜ | 15 3/16 | 3 31/32 | 3 ¼ | 1 ¼ | 28 | 30 |
| 10E14 | 1 | 1.40 | 1 | 230 | 29 11/16 | 12 | 17 11/16 | 3 31/32 | 3 ¼ | 1 ¼ | 31 | 32 |
| 10E19 | 1 ½ | 1.30 | 1 | 230 | 35 ⅜ | 13 9/16 | 21 13/16 | 3 31/32 | 3 ¼ | 1 ¼ | 35 | 37 |

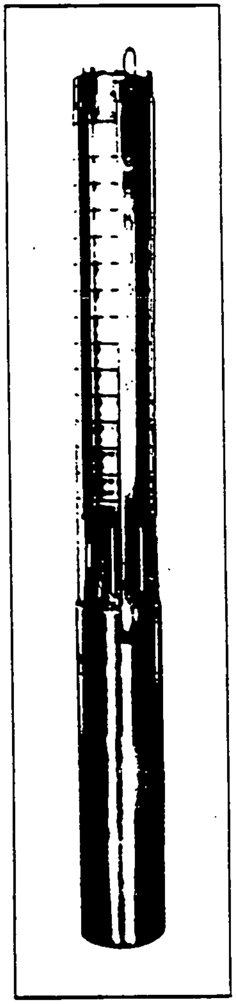
① Data for Grundfos MS402E motors. ② Does not include motor leads.

# 16E

Red-Flo Environmental Pump

## Performance Curves





## Electrical Data, Dimensions, and Weights ①

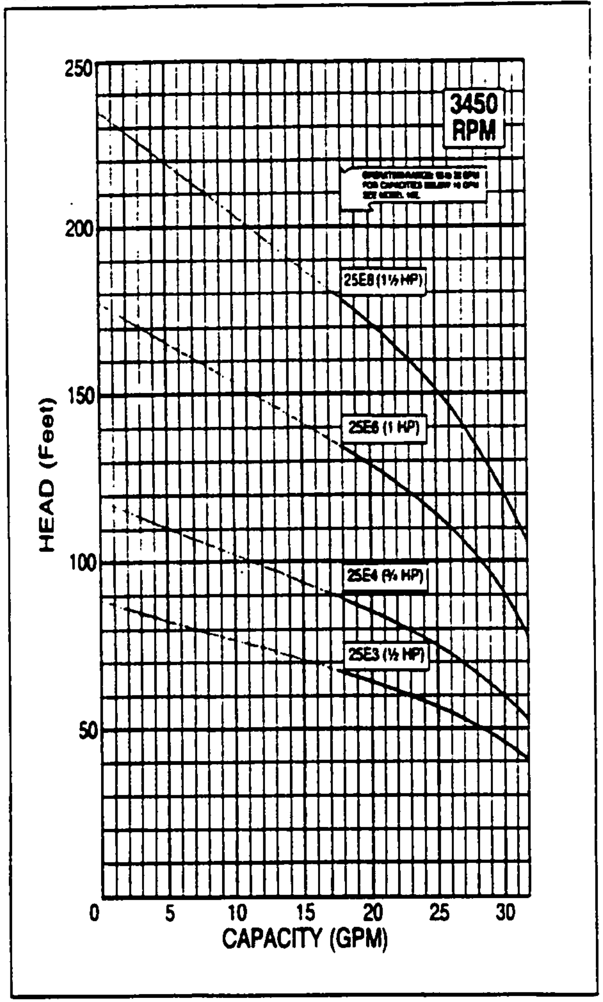
| | MOTOR | | | | DIMENSIONS (In Inches) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PUMP TYPE | HP | SF | PH | VOLTS | OVERALL LENGTH A | MOTOR LENGTH B① | PUMP END LENGTH C | MAX. DIA. D | INLET E | DISCH. PIPE SIZE (NPT) F | NET WEIGHT (LBS.)② | SHIP. WEIGHT (LBS.)② |
| 16E4 | ½ | 1.60 | 1 | 230 | 20 ¼ | 10 13/16 | 9 7/16 | 3 31/32 | 3 ¼ | 1 ¼ | 25 | 27 |
| 16E7 | ¾ | 1.50 | 1 | 230 | 23 ¼ | 11 ⅜ | 11 ⅞ | 3 31/32 | 3 ¼ | 1 ¼ | 27 | 28 |
| 16E9 | 1 | 1.40 | 1 | 230 | 25 9/16 | 12 | 13 9/16 | 3 31/32 | 3 ¼ | 1 ¼ | 28 | 30 |
| 16E13 | 1 ½ | 1.30 | 1 | 230 | 30 7/16 | 13 9/16 | 16 ⅞ | 3 31/32 | 3 ¼ | 1 ¼ | 33 | 34 |

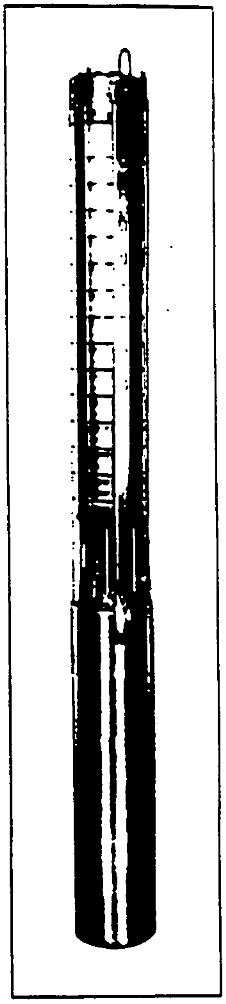
① Data for Grundfos MS402E motors. ② Does not include motor leads.

# 25E

**Redi-Flo Environmental Pump**

## Performance Curves





## Electrical Data, Dimensions, and Weights ①

| PUMP TYPE | MOTOR |  |  |  | DIMENSIONS (In Inches) |  |  |  |  |  | NET WEIGHT (LBS.)② | SHIP WEIGHT (LBS.)② |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | HP | SF | PH | VOLTS | OVERALL LENGTH A | MOTOR LENGTH B① | PUMP END LENGTH C | MAX. DIA. D | INLET E | DISCH. PIPE SIZE (NPT) F |  |  |
| 25E3 | ½ | 1.60 | 1 | 230 | 19⅜ | 10 13/16 | 8 9/16 | 3 31/32 | 3 ¼ | 1 ½ | 24 | 25 |
| 25E4 | ¾ | 1.50 | 1 | 230 | 20 13/16 | 11 ⅜ | 9 7/16 | 3 31/32 | 3 ¼ | 1 ½ | 25 | 27 |
| 25E6 | 1 | 1.40 | 1 | 230 | 23 1/16 | 12 | 11 1/16 | 3 31/32 | 3 ¼ | 1 ½ | 27 | 29 |
| 25E8 | 1 ½ | 1.30 | 1 | 230 | 26 5/16 | 13 9/16 | 12 ¾ | 3 31/32 | 3 ¼ | 1 ½ | 28 | 30 |

① Data for Grundfos MS402E motors. ② Does not include motor leads.

## MODEL 40S

## 40 GPM

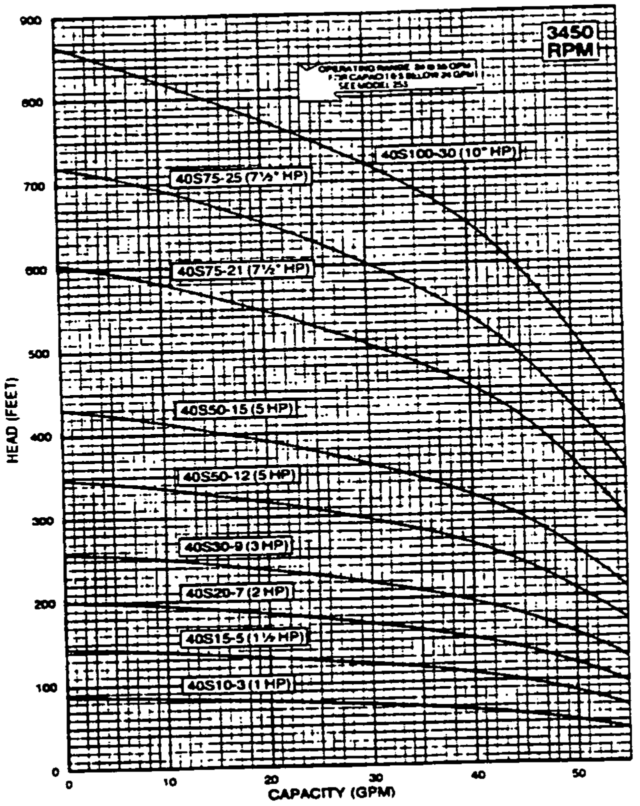
**GRUNDFOS**

FLOW RANGE
24 to 55 GPM
PUMP OUTLET
2" NPT

* A 4-inch motor is provided as standard for these models.

Specifications are subject to change without notice.

### PERFORMANCE CURVES



### DIMENSIONS AND WEIGHTS

| MODEL NO. | HP | LENGTH (INCHES) | WIDTH (INCHES) | APPROX. UNIT SHIPPING WT. (LBS.) |
|---|---|---|---|---|
| 40S10-3 | 1 | 25 ⅝ | 3 15/16 | 32 |
| 40S15-5 | 1 ½ | 30 ½ | 3 15/16 | 37 |
| 40S20-7 | 2 | 33 | 3 15/16 | 41 |
| 40S30-9 | 3 | 43 ⅝ | 3 15/16 | 65 |
| 40S50-12 | 5 | 51 ⅛ | 3 15/16 | 78 |
| 40S50-15 | 5 | 56 ⅛ | 3 15/16 | 84 |
| 40S75-21 | 7 ½* | 74 ½ | 3 15/16 | 120 |
| 40S75-25 | 7 ½* | 81 ⅛ | 3 15/16 | 124 |
| 40S100-30 | 10* | 103 ½ | 3 15/16 | 181 |

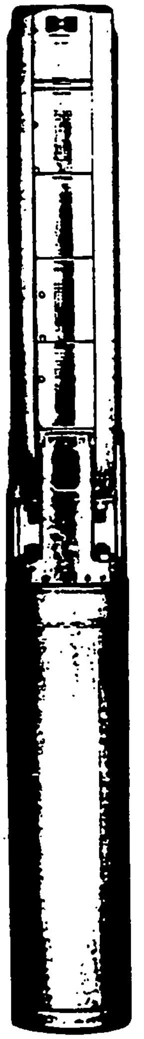
APPENDIX A: DEEP WELL SUBMERSIBLE PUMPS

# MODEL 60S

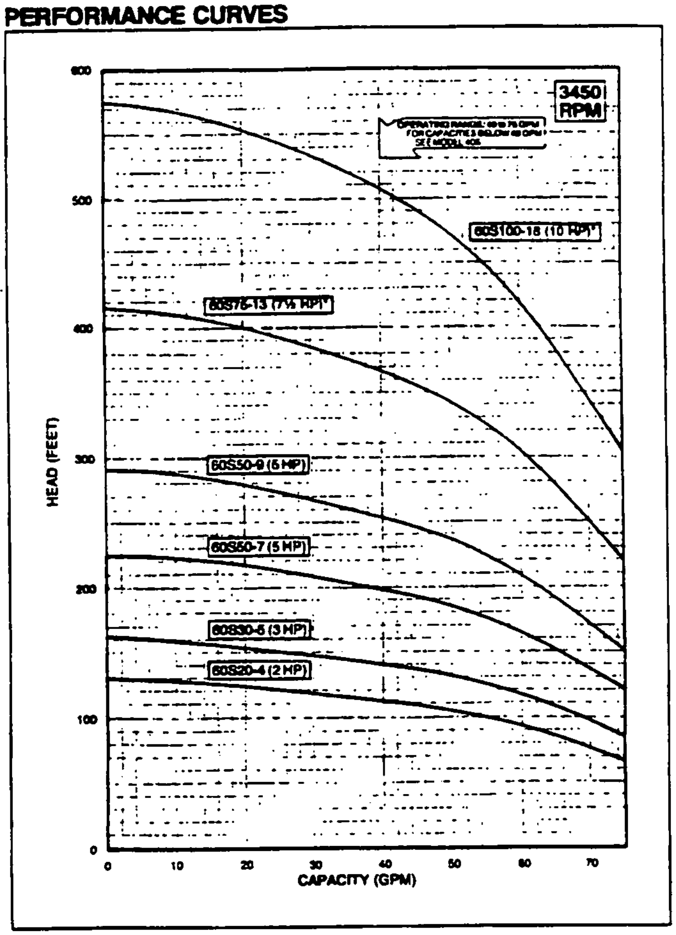
# 60 GPM

**GRUNDFOS**

FLOW RANGE
40 to 75 GPM
PUMP OUTLET
2" NPT



## PERFORMANCE CURVES



## DIMENSIONS AND WEIGHTS

| MODEL NO. | HP | LENGTH (INCHES) | WIDTH (INCHES) | APPROX. UNIT SHIPPING WT. (LBS.) |
|---|---|---|---|---|
| 60S20-4 | 2 | 31 1/4 | 3 15/16 | 39 |
| 60S30-5 | 3 | 40 3/4 | 3 15/16 | 64 |
| 60S50-7 | 5 | 48 5/8 | 3 15/16 | 75 |
| 60S50-9 | 5 | 53 3/4 | 3 15/16 | 80 |
| 60S75-13 | 7 1/2* | 70 | 3 15/16 | 106 |
| 60S100-18 | 10* | 87 1/4 | 3 15/16 | 160 |

Specifications are subject to change without notice.

* A 4-inch motor is provided as standard on these models.

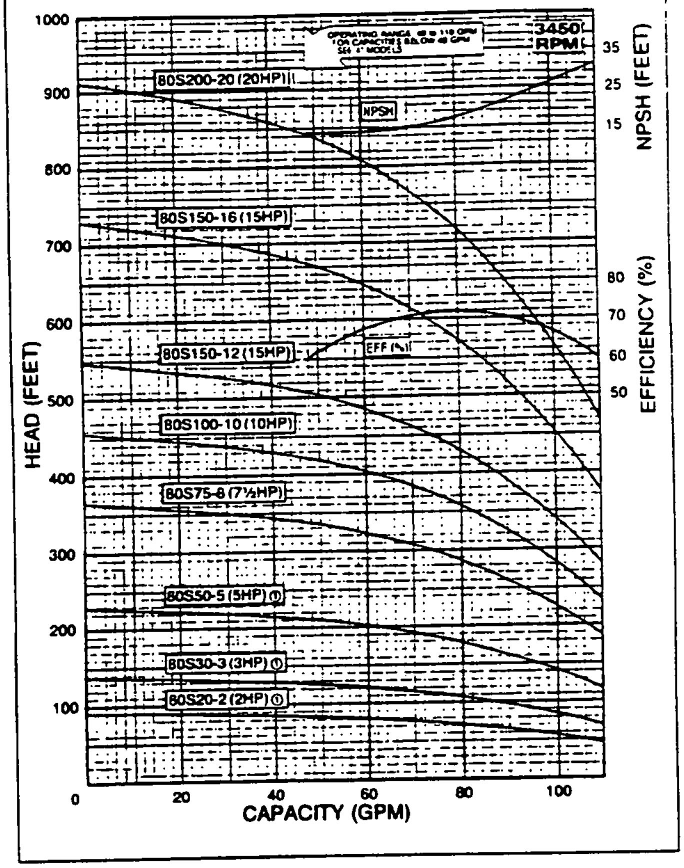
**MODEL**
# 80S

# 80 GPM

**GRUNDFOS**

FLOW RANGE
48 to 110 GPM
PUMP OUTLET
3" NPT

## PERFORMANCE CURVES



## DIMENSIONS AND WEIGHTS

| MODEL NO. | HP | MIN. WELL SIZE (INCHES) | LENGTH (INCHES) | MAX. WIDTH (INCHES) | APPROX. UNIT SHIPPING WT. (LBS.) |
|---|---|---|---|---|---|
| 80S20-2 | 2① | 6 | 33⅝ | 5 3/16 | 51 |
| 80S30-3 | 3① | 6 | 37⅞ | 5 3/16 | 65 |
| 80S50-5 | 5① | 6 | 44⅜ | 5 3/16 | 87 |
| 80S75-8 | 7½ | 6 | 51½ | 5½ | 144 |
| 80S100-10 | 10 | 6 | 56¼ | 5½ | 154 |
| 80S150-12 | 15 | 6 | 62¼ | 5½ | 173 |
| 80S150-16 | 15 | 6 | 69½ | 5½ | 184 |
| 80S200-20 | 20 | 6 | 99 | 5½ | 207 |

NOTES: ① 4-inch motor. Specifications are subject to change without notice.

APPENDIX A: DEEP WELL SUBMERSIBLE PUMPS

REF. DWGS CE-31 CE-24

| 1/3HP ASSEMBLIES | 115VAC | 230VAC |
|---|---|---|
| RESISTANCES AT MOTOR | | |
| BLACK to YELLOW | 1.5-1.9 ohm | 6.0-7.4 ohm |
| RED to YELLOW | 5.7-7.1 ohm | 23.4-28.6ohm |
| CURRENT AT MOTOR | | |
| RUNNING CURRENT | 7.0 AMP | 3.5 AMP |
| LOCK ROTOR CURRENT | 32.8 AMP | 16.4 AMP |

REF. DWGS CE-6 CE-36

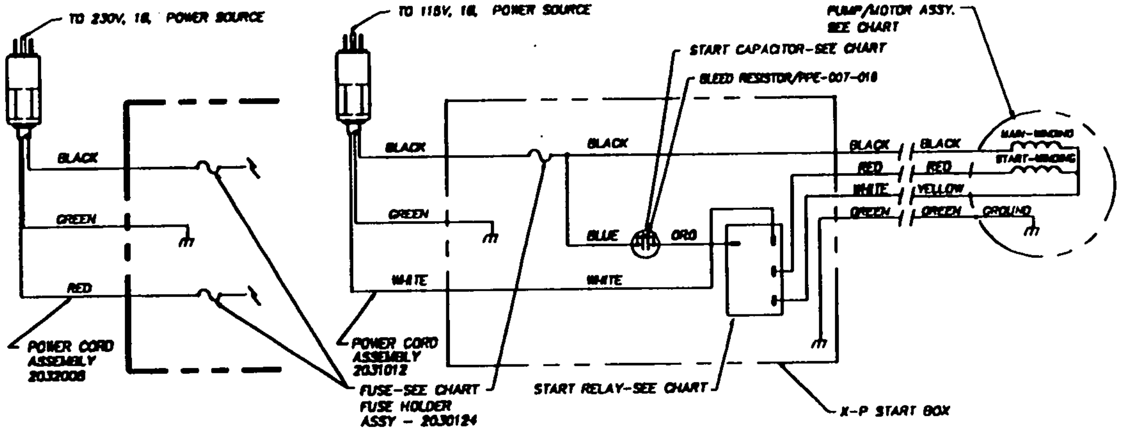
| 1/2HP ASSEMBLIES | 115VAC | 230VAC |
|---|---|---|
| RESISTANCES AT MOTOR | | |
| BLACK to YELLOW | 1.0-1.3 ohm | 4.2-5.2 ohm |
| RED to YELLOW | 3.8-4.7 ohm | 15.5-19.0 ohm |
| CURRENT AT MOTOR | | |
| RUNNING CURRENT | 9.6 AMP | 4.8 AMP |
| LOCK ROTOR CURRENT | 46.0 AMP | 23.1 AMP |

REF. DWG CE-11

| 3/4HP, 230VAC ASSEMBLY | |
|---|---|
| RESISTANCES AT MOTOR | |
| BLACK to YELLOW | 2.7-3.4 ohm |
| RED to YELLOW | 11.0-13.6 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 6.4 AMP |
| LOCK ROTOR CURRENT | 33.1 AMP |

REF. DWG CE-13

| 1HP, 230VAC ASSEMBLY | |
|---|---|
| RESISTANCES AT MOTOR | |
| BLACK to YELLOW | 2.2-2.8 ohm |
| RED to YELLOW | 9.6-11.7 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 8.0 AMP |
| LOCK ROTOR CURRENT | 42.0 AMP |



| ASSEMBLY # | PUMP/MOTOR | START CAPACITOR | START RELAY | FUSE SIZE |
|---|---|---|---|---|
| 2031037 | 1/3HP, 115V, 60HZ, 1PH.<br>PPE-018-062 | 159-191uF, 115VAC<br>PPE-008-084 | SOLID STATE, 1/3HP, 115V<br>PPE-014-097 | ABC 25 AMP<br>PPE-011-012 |
| 2032059 | 1/3HP, 230V, 60HZ, 1PH.<br>PPE-018-039 | 43-53uF, 230VAC<br>PPE-008-051 | SOLID STATE, 1/3HP, 230V<br>PPE-014-098 | ABC 15 AMP<br>PPE-011-008 |
| 2031035 | 1/2HP, 115V, 60HZ, 1PH.<br>PPE-018-016 | 250-300uF, 115VAC<br>PPE-008-038 | SOLID STATE, 1/2HP, 115V<br>PPE-014-099 | ABC 30 AMP<br>PPE-011-001 |
| 2032106 | 1/2HP, 230V, 60HZ, 1PH.<br>PPE-018-061 | 59-71uF, 230VAC<br>PPE-008-047 | SOLID STATE, 1/2HP, 230V<br>PPE-014-100 | ABC 15 AMP<br>PPE-011-008 |
| 2032010 | 3/4HP, 230V, 60HZ, 1PH.<br>PPE-018-014 | 86-103uF, 230VAC<br>PPE-008-025 | SOLID STATE, 3/4HP, 230V<br>PPE-014-101 | ABC 20 AMP<br>PPE-011-014 |
| 2032053 | 1HP, 230V, 60HZ, 1PH.<br>PPE-018-015 | 105-126uF, 230VAC<br>PPE-008-009 | SOLID STATE, 1HP, 230V<br>PPE-014-102 | ABC 25 AMP<br>PPE-011-012 |

START BOX SCHEMATICS FOR 60HZ
DEEP WELL SUBMERSIBLE WATER PUMPS

ORS ENVIRONMENTAL EQUIPMENT

WTDP-36B

# APPENDIX A: DEEP WELL SUBMERSIBLE PUMPS

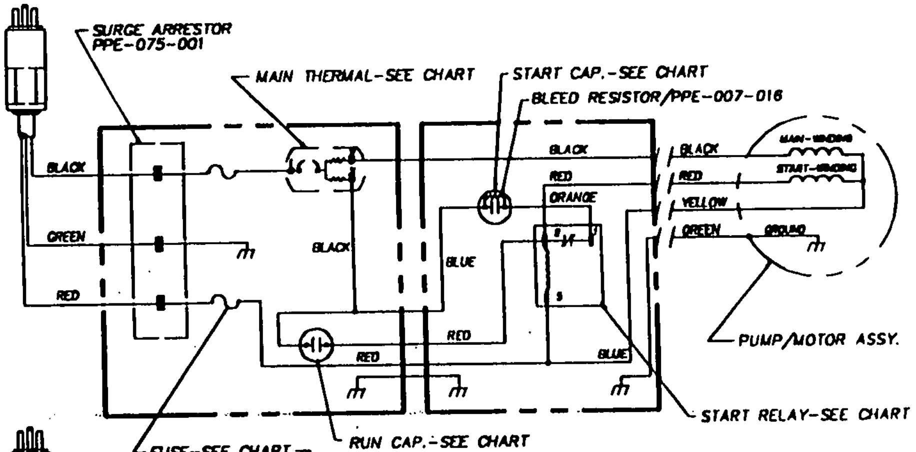
START BOX SCHEMATICS FOR 60Hz
DEEP WELL SUBMERSIBLE WATER PUMPS

ORS ENVIRONMENTAL EQUIPMENT
A DIV. OF GROUNDWATER TECHNOLOGY, INC.

## 1.5 HP SCHEMATIC

REF. DRAWING: CE-12

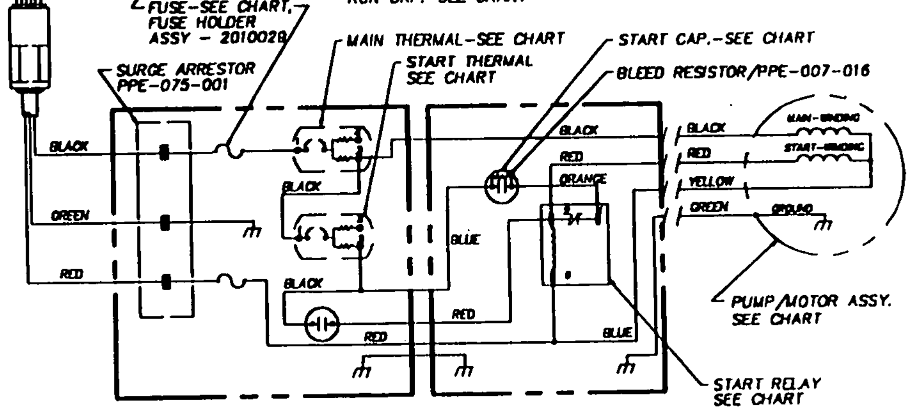
| | |
|---|---|
| 1.5HP, 230VAC ASSEMBLY | |
| RESISTANCES AT MOTOR | |
| BLACK to YELLOW | 1.5-1.9 ohm |
| RED to YELLOW | 6.2-6.5 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 9.1 AMP |
| LOCK ROTOR CURRENT | 52.0 AMP |



## 2 HP SCHEMATIC

REF. DRAWING: CE-5

| | |
|---|---|
| 2HP, 230VAC ASSEMBLY | |
| RESISTANCES AT MOTOR | |
| BLACK to YELLOW | 1.8-2.3 ohm |
| RED to YELLOW | 5.2-7.1 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 10.0 AMP |
| LOCK ROTOR CURRENT | 51.0 AMP |



| ASSEMBLY # | PUMP/MOTOR | START CAP. | RUN CAP. | START RELAY | FUSE SIZE | THERMALS |
|---|---|---|---|---|---|---|
| 2032057 | 1.5 HP, 230V, 60Hz, 1PH.<br>PPE-018-043 | 105-126uF, 220VAC<br>PPE-008-009 | 10uF, 370VAC<br>PPE-008-023 | MECH., 230V, 60Hz<br>PPE-014-104 | ABC 30 AMP<br>PPE-011-011 | MAIN: PPE-066-001<br>START: NONE |
| 2032022 | 2HP, 230V, 60Hz, 1PH.<br>PPE-018-023 | 104-126uF, 220VAC<br>PPE-008-113 | 20uF, 370 VAC<br>PPE-008-044 | MECH., 230V, 60Hz<br>PPE-014-104 | ABC 30 AMP<br>PPE-011-001 | MAIN: PPE-066-011<br>START: PPE-066-010 |

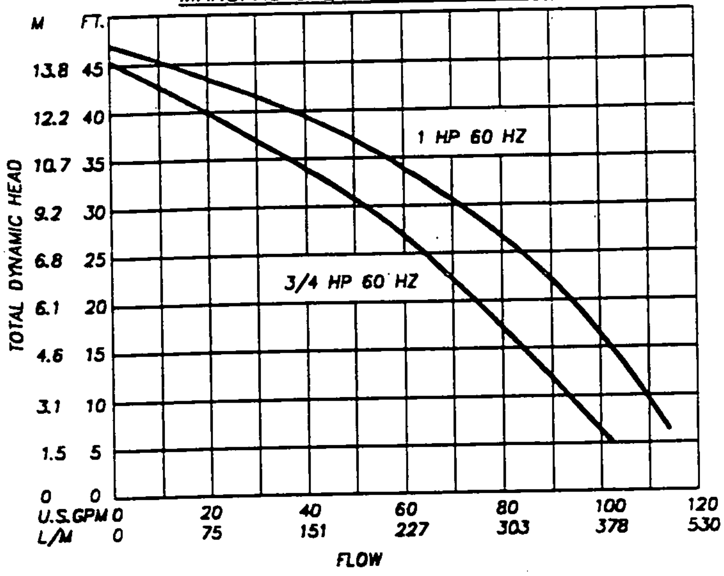
WTDP-39B

# APPENDIX B

# SHALLOW WELL SUBMERSIBLE PUMPS

EC-16SP

MANUFACTURER'S PERFORMANCE CURVE



## ORS ENVIRONMENTAL EQUIPMENT AVERAGE PERFORMANCE TEST DATA

| SHALLOW WELL SUBMERSIBLE | MAX FLOW | MAX HEAD |
|---|---|---|
| 3/4 HP | 58 GPM | 45 FT |
| 1 HP | 65 GPM | 49 FT |

### STANDARD SPECIFICATIONS

RATING: 3/4 HP OR 1 HP AT 3450 RPM
POWER: 115V OR 230V, 1 PHASE, 60 Hz

### MAINTENANCE REQUIREMENTS

This pump is supplied with prelubricated bearings.

THE TWO ROTARY BEARINGS ARE OIL LUBRICATED.

The seals should be inspected every 400 to 500 operating hours (more frequently if abrasives are present). To make a quick check of the seals' condition, drain and inspect the oil in the seal chamber. If oil removed from the pump contains water or abrasive, replace the seals.

Flush inside seal chamber of diffuser, thoroughly insuring it is free of abrasives. Refill oil chamber with three ounces (90ml) of 20W non-detergent oil with rust and oxidation inhibitors. After replacing oil, replace oil plug securely.

KEEP CABLE GLAND NUTS TIGHT. CHECK FREQUENTLY.

When a job is completed and before pumps are stored, drain the oil from the seal chamber (mandatory before freezing weather). If dirt or water are found in the oil, replace the seals, bearings, lower "O" rings and oil.

# APPENDIX B: SHALLOW WELL SUBMERSIBLE PUMPS

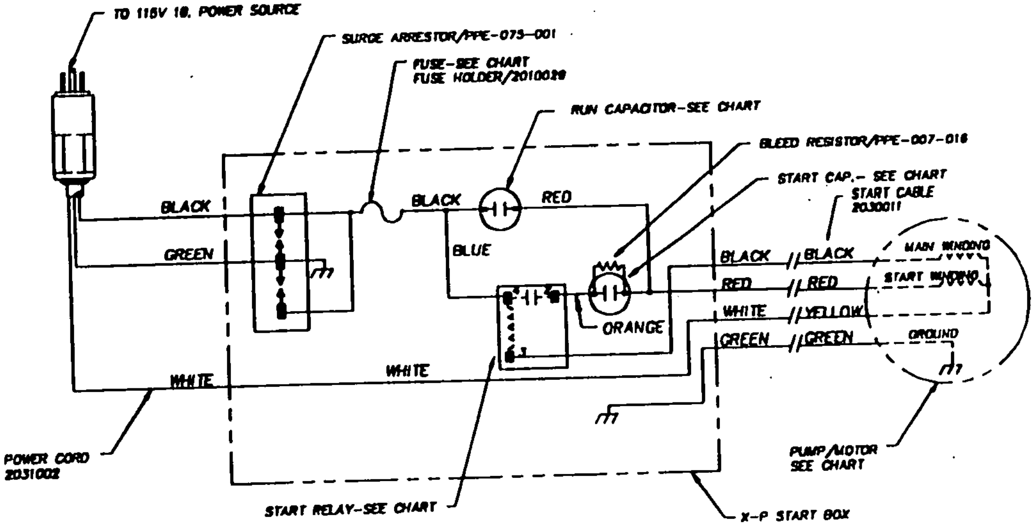
## START BOX SCHEMATIC FOR 115VAC, 60Hz, SHALLOW WELL SUBMERSIBLE WATER PUMPS

REF. DWG CE-18

| 2031043 | |
|---|---|
| RESISTANCES AT MOTOR | |
| RED to YELLOW | 8.3 ohm |
| RED to BLACK | 10.4 ohm |
| BLACK to YELLOW | 1.2 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 9.5 AMP |
| LOCK ROTOR CURRENT | 28.3 AMP |

REF. DWG CE-20

| 2031057 | |
|---|---|
| RESISTANCES AT MOTOR | |
| RED to YELLOW | 6.8 ohm |
| RED to BLACK | 7.8 ohm |
| BLACK to YELLOW | .97 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 11.0 AMP |
| LOCK ROTOR CURRENT | 38.3 AMP |



| ASSEMBLY # | PUMP/MOTOR | RUN CAPACITOR | START CAPACITOR | START RELAY | FUSE SIZE |
|---|---|---|---|---|---|
| 2031043 | 3/4HP, 115V, 60HZ, 1PH.<br>PPP-005-028 | 35uF, 370VAC<br>PPE-008-052 | 53-64 uF, 250VAC<br>PPE-008-115 | KLIXON: 4CR-1-758<br>PPE-014-105 | ABC 20 AMP<br>PPE-011-014 |
| 2031057 | 1HP, 115V, 60HZ, 1PH.<br>PPP-005-007 | 35uF, 370VAC<br>PPE-008-052 | 53-64 uF, 250VAC<br>PPE-008-115 | KLIXON: 4CR-1-758<br>PPE-014-105 | ABC 20 AMP<br>PPE-011-014 |

ORS ENVIRONMENTAL EQUIPMENT
A DIV. OF GROUNDWATER TECHNOLOGY INC.

WTDP-37; 11/29/89; REV.0
APPROVED BY: R.G.

WTDP-40A

REF. DRAWING: CE-40

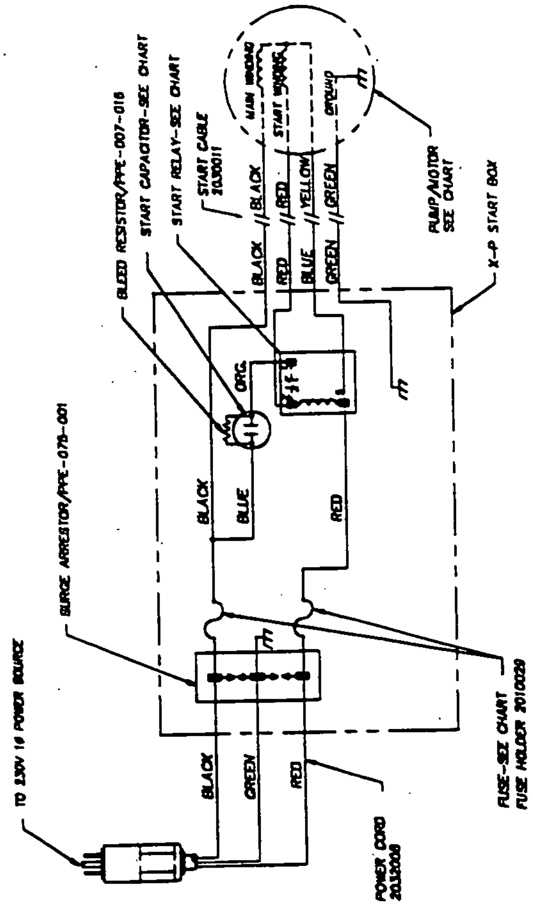
| 2032031 | |
|---|---|
| RESISTANCES AT MOTOR | |
| RED to YELLOW | 9.0 ohm |
| RED to BLACK | 8.8 ohm |
| BLACK to YELLOW | 4.8 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 5.8 AMP |
| LOCK ROTOR CURRENT | 18.1 AMP |

REF. DRAWING: CE-19

| 2032095 | |
|---|---|
| RESISTANCES AT MOTOR | |
| RED to YELLOW | 9.0 ohm |
| RED to BLACK | 9.0 ohm |
| BLACK to YELLOW | 3.9 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 6.7 AMP |
| LOCK ROTOR CURRENT | 23.1 AMP |

REF. DRAWING: CE-16

| 2032029 | |
|---|---|
| RESISTANCES AT MOTOR | |
| RED to YELLOW | 4.3 ohm |
| RED to BLACK | 5.8 ohm |
| BLACK to YELLOW | 1.6 ohm |
| CURRENT AT MOTOR | |
| RUNNING CURRENT | 12.8 AMP |
| LOCK ROTOR CURRENT | 51.0 AMP |



| ASSEMBLY # | PUMP/MOTOR | START CAPACITOR | START RELAY | FUSE SIZE |
|---|---|---|---|---|
| 2032031 | 3/4HP, 230V, 60HZ, 1PH.<br>PPP-005-023 | 108-130uF, 220-250 VAC<br>PPE-008-114 | 3ARR3 MARS 551<br>PPE-014-106 | ABC 8 AMP<br>PPE-011-015 |
| 2032095 | 1HP, 230V, 60HZ, 1PH.<br>PPP-005-045 | 108-130uF, 220-250 VAC<br>PPE-008-114 | 3ARR3 MARS 551<br>PPE-014-106 | ABC 8 AMP<br>PPE-011-015 |
| 2032029 | 2HP, 230V, 60HZ, 1PH.<br>PPP-005-041 | 189-227uF, 250VAC<br>PPE-008-116 | 3ARR3 MARS 551<br>PPE-014-106 | ABC 20 AMP<br>PPE-011-014 |

START BOX SCHEMATIC FOR 230VAC, 60Hz,
SHALLOW WELL SUBMERSIBLE WATER PUMPS

ORS ENVIRONMENTAL EQUIPMENT
A DIV. OF GROUNDWATER TECHNOLOGY, INC.

APPENDIX B: SHALLOW WELL SUBMERSIBLE PUMPS

## ELECTRICAL DATA

### 60 HZ

| HORSEPOWER | PHASE | VOLTS | MAX. RATED CURRENT AMPS. | | | MAX KW INPUT | WINDING RESISTANCE IN OHMS ± 5% NOMINAL | | | BREAKER RATED AMPS or FUSE+ | CABLE | | MIN. GEN. SIZE (KW) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NO LOAD | FULL LOAD | LOCK'D ROTOR | | WHITE BLACK | WHITE RED | RED BLACK | | SIZE AWG | MAX LENG. FT** | |
| ¾ | 1 | 115 | 8.3 | 10.4 | 33.5 | 1.0 | 1.2 | 9.3 | 10.4 | +20.0 | 14/4 | 107. | 2.0 |
| | 1 | 230 | 4.0 | 5.2 | 21.9 | | 5.0 | 12.0 | 12.0 | 6.5 | | 275. | |
| | 3 | 230 | 2.2 | 3.2 | 17.3 | | 6.3 | 6.3 | 6.3 | 3.6 | | 596. | |
| | 3 | 460 | .9 | 1.3 | 8.5 | | 25.5 | 25.5 | 25.5 | 2.0 | | 2210. | |
| | 3 | 575 | .6 | 1.0 | 7.7 | | 31.0 | 31.0 | 31.0 | 1.5 | ↓ | 3460. | ↓ |
| 1 | 1 | 115 | 12.1 | 13.1 | 39.5 | 1.2 | .90 | 7.4 | 8.3 | +20.0 | 14/4 | 83. | 2.5 |
| | 1 | 230 | 6.0 | 7.1 | 22.5 | | 2.90 | 8.4 | 8.4 | 8.0 | | 197. | |
| | 3 | 230 | 1.65 | 2.7 | 19.5 | | 5.0 | 5.0 | 5.0 | 4.5 | | 455. | |
| | 3 | 460 | .8 | 1.6 | 9.8 | | 20.0 | 20.0 | 20.0 | 2.0 | ↓ | 1824. | ↓ |
| 2 | 1 | 115 | 13.6 | 25.3 | 88.7 | 2.6 | .4 | 1.1 | 1.5 | 2.6 | 12/4 | 127. | 4.0 |
| | 1 | 230 | 6.9 | 12.8 | 51.0 | | 1.6 | 4.2 | 5.8 | 13.0 | | 197. | |
| 2½ | 1 | 230 | 6.6 | 10.6 | 41. | 2.3 | 2.0 | 2.0 | 2.0 | 13.0 | | 212. | 5.0 |
| | 3 | 230 | 4.5 | 6.8 | 49.2 | | 2.0 | 2.0 | 2.0 | 9.0 | | 329. | |
| | 3 | 460 | 2.4 | 4.1 | 31.3 | | 8.0 | 8.0 | 8.0 | 4.5 | | 1315. | |
| | 3 | 575 | 1.6 | .3.2 | 26.1 | | 10.4 | 10.4 | 10.4 | 3.6 | | 2080. | ↓ |
| 2¾ | 1 | 230 | 4.0 | 12.5 | 52.6 | 2.5 | 1.6 | 4.2 | 5.8 | 13.0 | | 307 | 7.0 |
| 3½ | 1 | 230 | 10.5 | 18.4 | 90.1 | 3.8 | .85 | 2.2 | 2.2 | 22.0 | | 195. | 7.5 |
| 5 | 1 | 230 | 10.1 | 17.9 | 82. | 5.2 | .85 | .85 | .85 | 22.0 | | 198. | 15.0 |
| | 3 | 230 | 8. | 15.5 | 87.8 | | .85 | .85 | .85 | 18.0 | | 220. | |
| | 3 | 460 | 4.2 | 7.8 | 43.9 | | 3.60 | 3.60 | 3.60 | 9.0 | | 925. | |
| | 3 | 575 | 3.1 | 6.2 | 35.1 | | 5.20 | 3.60 | 5.20 | 7.2 | | 898. | |
| 5 2 STAGE | 3 | 230 | 8.5 | 15.2 | 87.8 | 5.2 | .85 | .85 | .85 | 18.0 | | 220. | |
| | 3 | 460 | 4.2 | 7.6 | 43.9 | | 3.60 | 3.60 | 3.60 | 9.0 | | 925. | |
| | 3 | 575 | 3.1 | 6.1 | 35.1 | | 5.20 | 3.60 | 5.20 | 7.2 | ↓ | 898. | ↓ |
| 10 HV | 3 | 230 | 13.0 | 30.0 | 208.0 | 10.0 | .30 | .30 | .30 | 34.0 | 8/3/3* | 324. | 30.0 |
| | 3 | 460 | 6.5 | 15.0 | 104.0 | | 1.14 | 1.14 | 1.14 | 18.0 | 12/4 | 344. | |
| | 3 | 575 | 5.2 | 12.0 | 83.0 | | 2.0 | 2.0 | 2.0 | 13.6 | ↓ | 467. | |
| 10 HH | 3 | 230 | 13.0 | 28.6 | 208.0 | 10.0 | .30 | .30 | .30 | 34.0 | 8/3/3* | 363. | |
| | 3 | 460 | 6.5 | 14.3 | 104.0 | | 1.14 | 1.14 | 1.14 | 18.0 | 12/4 | 362. | |
| | 3 | 575 | 5.2 | 11.5 | 83.0 | | 2.0 | 2.0 | 2.0 | 13.6 | ↓ | 560. | ↓ |
| 15 HV | 3 | 230 | 14.4 | 39.0 | 288.0 | 14.0 | .21 | .21 | .21 | 45.0 | 8/3/3* | 266. | 40.0 |
| | 3 | 460 | 7.2 | 19.5 | 144.0 | | .75 | .75 | .75 | 22.0 | 12/4 | 420. | |
| | 3 | 575 | 5.8 | 15.6 | 110.0 | | 1.21 | 1.21 | 1.21 | 18.0 | ↓ | 658. | |
| 15 HH | 3 | 230 | 14.4 | 36.8 | 288.0 | 14.0 | .21 | .21 | .21 | 45.0 | 8/3/3* | 268. | |
| | 3 | 460 | 7.2 | 18.4 | 144.0 | | .75 | .75 | .75 | 22.0 | 12/4 | 445. | |
| | 3 | 575 | 5.8 | 14.7 | 110.0 | | 1.21 | 1.21 | 1.21 | 18.0 | ↓ | 698. | ↓ |
| 25 HV & HH | 3 | 230 | 22.8 | 65.8 | 464.0 | 25.0 | .37 | .37 | .37 | 80.0 | 6/3/3* | 322. | 60.0 |
| | 3 | 460 | 11.4 | 32.9 | 232.0 | | .10 | .10 | .10 | 40.0 | | 522. | |
| | 3 | 575 | 9.1 | 26.3 | 185.0 | | .55 | .55 | .55 | 30.0 | ↓ | 812. | ↓ |
| 50 HV & HH | 3 | 460 | 19.7 | 56.0 | 360. | 45.0 | .19 | .19 | .19 | 60.0 | 6/3/3* | 336. | 100.0 |
| | 3 | 575 | 15.8 | 44.6 | 288. | | .29 | .29 | .29 | 50.0 | ↓ | 533. | ↓ |

*TYPE G CABLE = 3 POWER CONDUCTORS + 3 COPPER FILLERS USED AS GROUND.

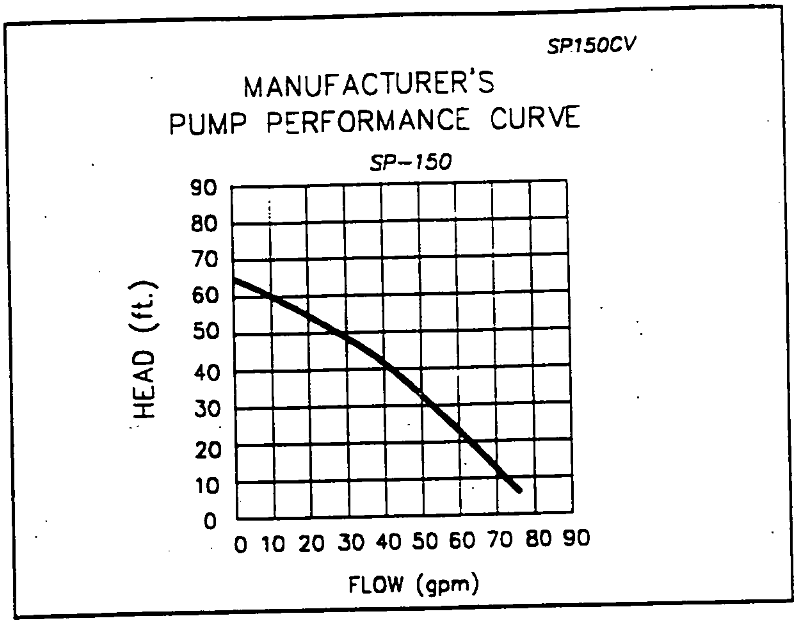
**5% Voltage Drop

IMPELLER GAP: .020-.030. ALL MODELS

1 HP = .746 KW 1 KW = 1000 WATTS

# APPENDIX C

# SURFACE MOUNTED PUMPS



## SPECIFICATIONS

Motor Size: 1 HP

Voltage: 115/230VAC

Hz: 60

Phase: Single

RPM: 3600 (Nominal)

Weight: 110 lbs.(Pump and Motor)

Rating: Explosion Proof

## PRIMING

The surface mounted Water Table Depression Pump is a self priming centrifugal pump. The pump must receive an initial prime before it is put into operation.

✋ Do not run the pump before priming except to check for proper rotation (see Chapter 3).

Prime the pump as follows:

1. Completely fill the pump volute and suction line.
2. Bleed air from the pump by removing the top plug from the volute while filling with water.
3. After filling volute, turn the pump shaft and add more water if required.

During initial startup, close the discharge valve and then slowly open it as the motor develops full RPM. This allows a gradual buildup of power requirement. If the pump does not build up pressure as the motor develops speed, shut down and reprime. Do not attempt to prime or add liquid while the pump is in operation.

## PUMP TROUBLESHOOTING PROCEDURES

- **Problem: No Liquid Delivered**

1. Pump not primed.
2. Speed too low. Check voltage.
3. Incorrect rotation. Pump must rotate in the direction of the arrow cast into the volute.

4. Air leak on suction side of pump.

5. Discharge head too high for pump. Use larger lines and reduce number of els, etc.

6. Suction lift too high. Relocate pump.

- **Problem: Not Enough Liquid Delivered**

1. Incorrect rotation. Pump must rotate in the direction of the arrow cast into the volute.

2. Air leak on suction side of pump.

3. Speed too low. Check voltage.

4. Discharge head too high.

5. Impeller or volute worn.

6. Excessive clearance between volute and impeller. Reset by loosening pump shaft set screws and moving impeller toward the volute. Recommended clearance is .010" - .015".

7. Suction not submerged deeply enough. This can cause air to enter suction line.

- **Problem: Pump Does Not Generate Enough Pressure.**

1. Speed too low.

2. Incorrect rotation. Pump must rotate in the direction of the arrow cast into the volute.

3. Leaking suction line.

4. Air in liquid being pumped.

5. Damaged impeller.

- **Problem: Pump Gradually Loses Suction**

1. Leaky suction line.

2. Leaky foot valve.

3. Suction lift excessive.

4. Air or gas in liquid.

- **Problem: Motor Runs Hot**

Most motors will feel hot even when not overloaded.

1. Low voltage.

2. Discharge head lower than calculated. This can cause pump to deliver higher volume. Throttle discharge.

3. Liquid heavy or viscous.

4. Binding seal.

- **Problem: Seal Leaks**

1. Worn or cracked seal faces.

2. Abrasives being pumped causing seals to separate.

3. Pump running dry.

4. Liquid not compatible with seals.

# APPENDIX D

# WINCH ASSEMBLY

APPENDIX D: WINCH ASSEMBLY

# OPERATION OF WINCH ASSEMBLY

Winch assemblies are available for all Deep Well and Shallow Well Submersible pumping systems. Mount the winch on the well casing as shown on the next page. Attach the winch cable to the lifting lug on the pump. Carefully lower the pump into the well and suspend at the desired level.

The standard winch cable supplied with ORS pumping systems has a rated break strength of 2000 lb. Using the recommended design ratio of 1/5, the rated break strength gives a maximum hanging weight of 400 lb.

Because each application is different, it is impossible for us to anticipate the exact hanging weight of your system. Hanging weight is the sum of pump weight, the weight of all discharge piping and the weight of any water trapped inside the piping. Although it is unlikely that you will exceed the 400 lb. maximum, we highly recommend that you take the time to calculate the hanging weight of your system before deployment.

Use the following procedure to calculate hanging weight.

1. Weigh your pump assembly including the intake and any attached probes.
2. The weight of discharge piping can be calculated by weighing a sample length and multiplying by the number of feet suspended in the well. For example, 1-1/2" rubber transfer hose (ORS Part #PPP-001-013) weighs approximately 1 lb. per foot. Therefore, 100' of this hose will weigh 100 lb.

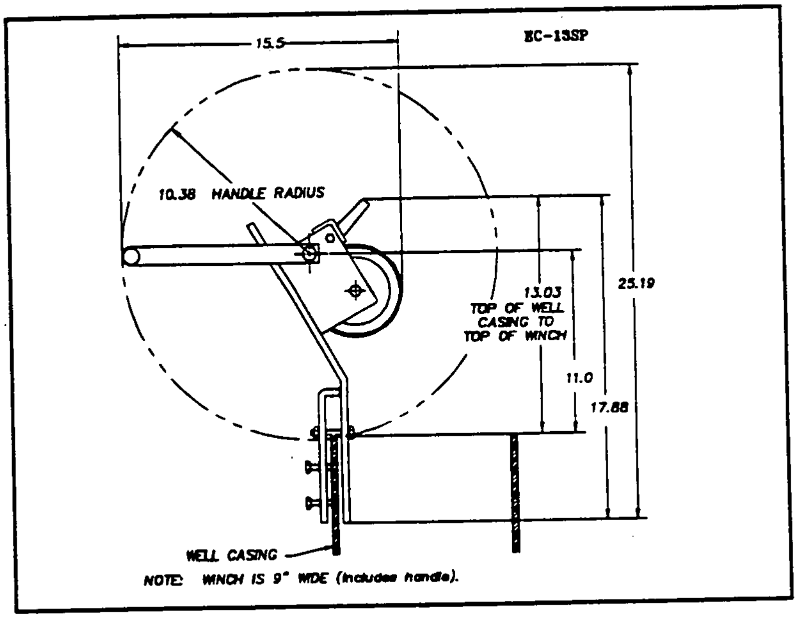
3. The weight of water in the discharge piping can be estimated by calculating the volume of water in the piping and then converting volume to weight as follows:

Volume ($in^3$) = 3.14 x (inside radius of pipe)$^2$ x length of pipe

Gallons = 0.00433 x Volume ($in^3$)

Pounds of water = 8.325 x Gallons

4. Find the sum of pump weight, piping weight and water weight. This sum will provide a close approximation of total hanging weight. If total hanging weight approaches or exceeds 400 lb., ORS can provide an optional winch cable with an increased break strength rating.



NOTE: WINCH IS 9" WIDE (includes handle).

**FIGURE D-1.** Dimensions of the winch assembly.

# ORS ENVIRONMENTAL EQUIPMENT
# RETURN POLICY

Permission is required to return equipment to the ORS Environmental Equipment factory in Greenville, NH. A Return Authorization Number will be issued upon receipt of your request to return, which should include reasons for the return. Your return shipment to us must have this R.A.# clearly marked on the outside of each package.

Proof of date of purchase is required for processing of all warranty requests.

This policy applies to both equipment sales and repair orders.

**FOR A RETURN AUTHORIZATION, PLEASE CALL OUR SERVICE DEPARTMENT AT 800-228-2310 or 603-878-2500.**

## Equipment Decontamination

Prior to return, all equipment must be thoroughly cleaned and decontaminated. During decontamination, personnel should wear protective clothing and observe the cautions outlined below.

**ORS reserves the right to refuse any equipment not properly decontaminated. ORS may also choose to decontaminate equipment at a fee which will be applied to the repair invoice.**

### Decontamination Solutions

The determination of what decontamination solution to use should be based on the types of contaminants present and the materials to be decontaminated. The fabrics of protective clothing are made of organic polymers which may be dissolved or destroyed by organic solvents. The metals and gaskets of tools may be damaged by overly acidic or basic compounds. Some decontamination solvents should be entirely avoided. The toxicity or physical hazards associated with using some once commonly used decontamination solutions can be as potentially dangerous as the site contaminants.

It is important to be certain that the decon solution, the contaminant, and the material to be cleaned are all compatible with each other. If they are not, it is possible to produce toxic or flammable gases, heat, splattering, bubbling, fire, or explosion. If an uncommonly used method and/or chemical solution is being considered for decontamination, it is important to consult with an experienced chemist to ensure chemical compatibility.

Some common decontamination solutions are listed below along with the contaminants they are effective against:

| Solution | Effective Against |
|---|---|
| Water | Short-chain hydrocarbons, inorganic compounds, salts, some organic acids, other polar compounds. |
| Dilute Acids | Basic (caustic or alkaline) compounds, amines, hydrazines. |
| Dilute Bases | Acidic compounds, phenols, thiols, some nitro- and sulfonic compounds. |
| Organic Solvents | Nonpolar compounds ( such as some organic compounds) |

The use of organic solvents is not recommended because 1) organic solvents can permeate and/or degrade the protective clothing, and 2) they are generally toxic and may result in unnecessary employee exposure to hazardous chemicals.

When in doubt, use a dish washing liquid detergent. As a decontamination solution, it is readily available. is the safest of all the above, and is usually strong enough if used generously.

The use of steam can also be effective for decontamination. A water-lazer (pressurized water) is exceptionally valuable.

The following substances are noted for their particular efficiency in removing certain contaminants or for decontaminating certain types of equipment.

| Solution | Effective Against |
|---|---|
| Penetone | PCB Contamination (since penetone may also remove paint, it is a good idea to spot-test before use) |
| Liquinox | Contaminated pumps |
| Ivory liquid | Oils |
| Diluted HTH | Cyanides |
| Radiac | Low level radioactivity |
| Isopropanol | Biological agents (should not be used on rubber products since it will break down rubber) |

| | |
|---|---|
| Hexane | Certain types of lab or sampling equipment (use of hexane is discouraged due to its flammability and toxicity) |
| Zep | General purpose cleaning |
| Alconox | General purpose cleaning |

### Decontamination Solutions to Avoid

Some decontamination solutions should be avoided because of their toxicity, flammability, or harmful effects to the environment.

Halogenated hydrocarbons, such as carbon tetrachloride, should not be used because of their toxicity, possible incompatibility, and some because of their flammability.

Organic decontamination solutions should not be used on personal protective equipment (PPE) because they may degrade the rubber or other materials comprising the PPE.

Mercurials are sometimes used for sterilization. They should be avoided because of their toxicity.

Chemical leaching, polymerization, and halogen stripping should all be avoided because of possible complications during decontamination.

Sand-blasting, a method of physical removal, should be avoided because the sand used on the contaminated object usually needs to be disposed of as hazardous waste, a very costly proposition. Also, sand-blasting exposes personnel to silica, a carcinogen.

Freon is known to be particularly effective for the cleansing of PCB's, but its effect on the ozone layer is extremely harmful. Its use should be discouraged.

Strong acids or bases should not be used when cleaning metals and gaskets of tools or other equipment because of the possibility of corrosion.

### Disposal of Decontamination Solutions and Waste Water

All solutions and water used for decontamination must be collected. If lab analyses indicate that the water and/or solutions exceed allowable contamination levels, they must be treated as hazardous waste. Alternatively, the solutions and water may be treated on-site to lower the contamination levels and render them nonhazardous.

Containers such as 55-gallon drums should be available for storage of wastes.

Spent decontamination solutions can be collected by using heavy-duty plastic sheets, visqueen sheets, kiddie pools, or if needed, a larger containment basin. The decontamination of equipment must be performed on the sheets or in the basins. They could be placed on a slight angle so that the spent decontamination solutions drain into a collection basin or drum.

## Recommended Supplies for Decontamination of Personnel, Clothing, and Equipment

The list below contains recommendations for supplies which should be on hand for the decontamination of personnel, clothing and equipment. Depending on the site activities, not all of these items may be needed. Alternatively, some additional items not listed here may be required.

- Drop cloths of plastic or other suitable material, such as visqueen, for heavily contaminated equipment.
- Disposal collection containers, such as drums or suitably lined trash cans for disposable clothing and heavily contaminated personal protective clothing or equipment to be discarded.
- Lined box with adsorbents for wiping or rinsing off gross contaminants and liquid contaminants.
- Wash tubs of sufficient size to enable workers to place booted foot in and wash off contaminants (without a drain or with a drain connected to a collection tank or appropriate treatment system).
- Rinse tubs of sufficient size to enable workers to place booted foot in and hold the solution used to rinse the wash solutions and contaminants after washing (without a drain or with a drain connected to a collection tank or appropriate treatment system)
- Wash solutions selected to wash off and reduce the hazards associated with the contaminated wash and rinse solutions.
- Rinse solution (usually water) to remove contaminants and contaminated wash solutions.
- Long-handled, soft-bristled brushes to help wash and rinse off contaminants.
- Lockers and cabinets for storage of decontaminated clothing and equipment.
- Storage containers for contaminated wash and rinse solutions.
- Plastic sheeting, sealed pads with drains, or other appropriate method for containing and collecting contaminated wash and rinse water spilled during decontamination.
- Shower facilities for full body wash or, at a minimum, personal wash sinks (with drains connected to collection tank or appropriate treatment system).
- Soap or wash solution, wash cloths and towels.
- Clean clothing and personal item storage lockers and/or closets.

## Standard Equipment Limited Warranty

All references to the Customer herein shall mean the Customer or the Lessee as applicable.

(a) ORS Environmental Equipment, a Division of Groundwater Technology, Inc. (ORS), warrants that any Equipment which it manufactures will be free from substantial defects in material and workmanship for a period of one (1) year from the date such goods are delivered to a carrier by ORS for shipment to the Customer.

(b) The Customer agrees that the liability of ORS hereunder shall be limited to replacing, repairing or issuing credit for, at ORS's discretion, any Equipment which is returned F.O.B. ORS's plant within the applicable term of the warranty, provided that (i) upon examination of the Equipment ORS determines that the alleged defect constitutes a substantial defect, and (ii) the warranty made herein is not invalid pursuant to Section (d) hereof. The Customer agrees that such replacement, repair or credit shall be its sole and exclusive remedies hereunder. For purposes hereof, a substantial defect shall mean any defect which prevents the Equipment from operating in accordance with ORS's published specifications. In the event that ORS determines that Equipment which is no longer manufactured by it contains a substantial defect and the warranty covering the defective equipment is not invalid pursuant to Section (d) hereof, the Purchaser's sole and exclusive remedy hereunder shall be the repair of such Equipment or the replacement of such Equipment with new equipment at ORS's discretion. In no case is Equipment to be returned by the Customer without first submitting a warranty claim in writing to ORS and obtaining a return authorization number from ORS. Equipment which is repaired or replaced pursuant to this warranty shall continue to be warranted for the unexpired portion of the warranty term applicable to the Equipment so repaired or replaced. ORS shall make the final determination as to the existence or cause of any alleged defect.

(c) The foregoing warranty shall not be valid (i) if the alleged defect is the result of abuse, misuse, accident, alteration, neglect or unauthorized repair; (ii) if ORS requires installation of Equipment by specifically approved ORS employee and such installation is not effected, or the Equipment is otherwise installed improperly; or (iii) if the Equipment is resold by the Customer. Any repair shall be deemed unauthorized unless it is made (i) by ORS or a duly authorized agent of ORS or (ii) with the written consent of ORS.

(d) The operating efficiency of treatment, abatement, and recovery Equipment and systems is affected by factors extrinsic to their manufacture, including operating environment and such conditions of use as contaminant and related substance build-up, the frequency and type of operator maintenance and other external variables. For these reasons, specific levels of performance cannot be guaranteed for such Equipment and systems.

(e) **THIS WARRANTY IS THE SOLE WARRANTY MADE BY ORS TO THE CUSTOMER AND IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS, EXPRESS OR IMPLIED. ORS EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

(f) **THE CUSTOMER AGREES THAT IN NO EVENT SHALL ORS BE LIABLE FOR SPECIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS OF LOSS OF USE OR ANY OTHER ECONOMIC LOSS, WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY.**

(g) **THE REMEDIES PROVIDED HEREIN ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES.**

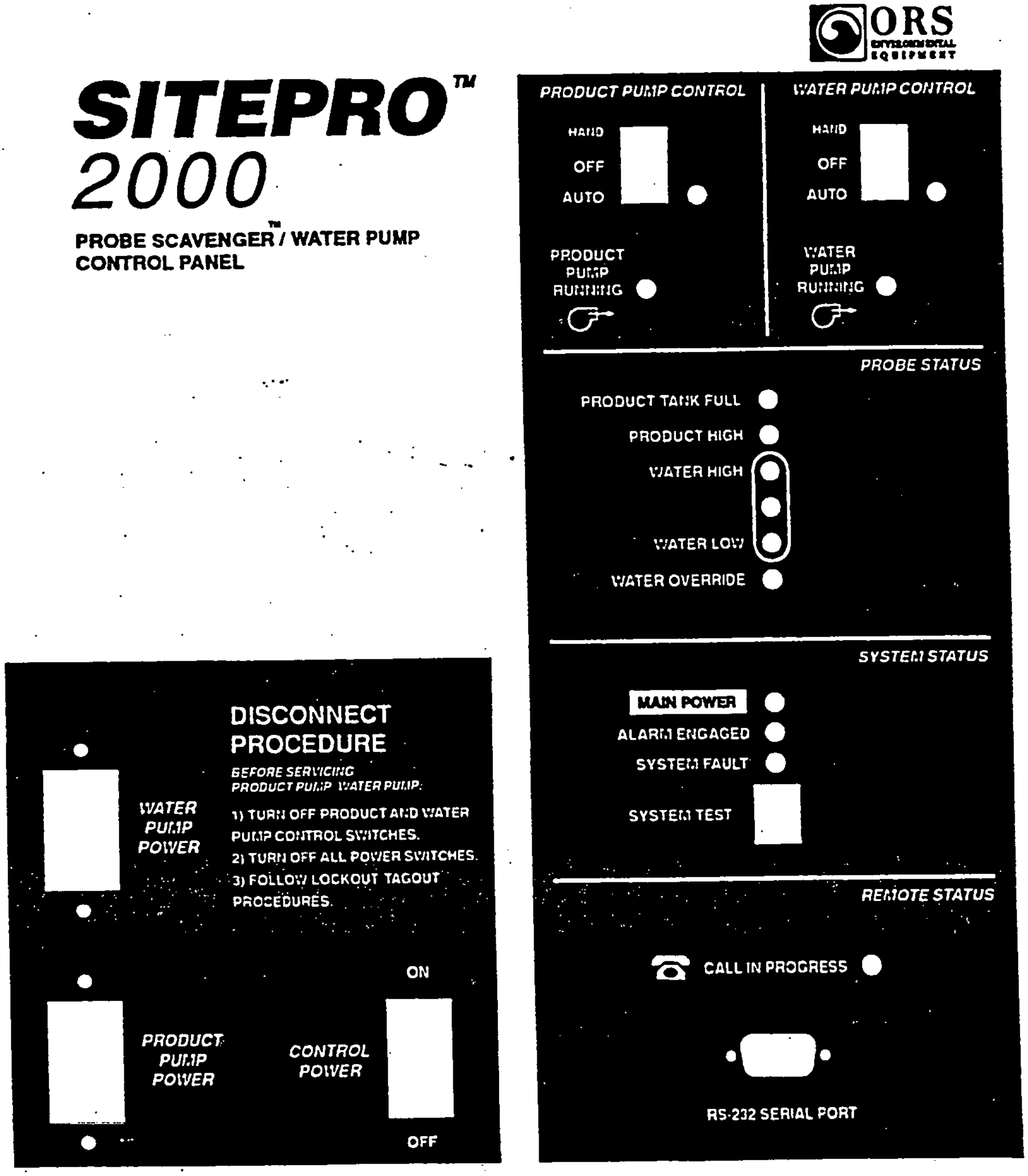


FIGURE 4-1. The SITEPRO™ 2000 Probe Scavenger™/Water Pump Control Panel faceplate showing controls and indicators.

Because the SITEPRO 2000 Probe Scavenger/Water Pump Control Panel combines the functions of two panels in one, the descriptions of controls and indicators presented below are organized into separate Product Pump and Water Pump sections. Controls and indicators associated with general panel functions (System Test, etc.) are described in a separate section under the heading General Panel Functions.

## *GENERAL PANEL FUNCTIONS*

### CONTROL POWER Switch

The CONTROL POWER switch controls distribution of power to the panel's ***microprocessor***. When this switch is in the OFF position, no power can reach the system control circuitry, switches or indicators.

### SYSTEM TEST Button

Single Panel Applications

In single panel applications, the SYSTEM TEST button activates the SITEPRO 2000 self-test routine. Self-test is automatically activated each time the panel is powered up or is manually activated whenever the SYSTEM TEST button is pushed. Self-test consists of the following checks.

- Check all indicators. (SYSTEM FAULT indicator blinks if problem found).
- Perform ***RAM*** test. (Checks all memory locations for proper function; SYSTEM FAULT indicator blinks if problem found).
- Perform ***ROM*** test. (Checks program memory; SYSTEM FAULT indicator blinks if problem found).

- Perform *A/D* test. (Checks *A/D* converter; SYSTEM FAULT indicator blinks if problem found).

- Performs Clock test. (Checks accuracy of system clock; SYSTEM FAULT indicator blinks if problem found).

- Perform Purge test. (Checks panel purge pressure in purged panels; SYSTEM FAULT indicator blinks five times if pressure low).

### Network Applications

When your SITEPRO panel is part of a ***network***, the SYSTEM TEST button provides an additional ***alarm*** diagnostic feature. The first time the button is pressed, the ALARM ENGAGED indicator blinks the ***alarm channels*** of all the ***alarms*** present on the ***Interlock Communication Bus*** in the order in which they occurred. When the button is pressed again, the self-test routine is run as described on p. 4-3.

## SYSTEM STATUS Indicators

The SYSTEM STATUS indicators provide information on the ***Interlock Communication Bus*** (ICB), aid in the diagnosis of system errors and display the power status of the panel. Indicator functions are described below:

### MAIN POWER

When illuminated, power is reaching the system ***microprocessor.*** When blinking, the panel is waiting to get on the ICB.

### ALARM ENGAGED

This indicator provides information on the status of the panel's ***alarm channels***. During routine panel operation

(SYSTEM TEST button not pressed), the indicator can be in any one of three states;

- **Off** - No alarms are being received by the panel either from local ***interlock*** devices or from the ***Interlock Communication Bus***.
- **Steadily Illuminated** - The panel has been shut down by an alarm broadcast on the ***Interlock Communication Bus***.
- **Blinking** - The panel has received an ***alarm*** from an ***interlock*** connected directly to the panel. The panel may or may not be shut down depending upon the setting of its RECEIVE switch. The indicator will fast blink after a manual RESET until all alarms are cleared.

In ***network*** applications, the ALARM ENGAGED indicator can be used to detect and trace ***alarms*** on the ***Interlock Communication Bus***. If the SYSTEM TEST button is pressed once, the ALARM ENGAGED indicator will blink to indicate which ***alarm channels*** have been activated. The ***alarm channel*** codes (one blink = channel 1, etc.) will be displayed in the order in which they originally occurred. For example, if a tank high level ***alarm*** on Channel 1 shut down a pump that caused a subsequent high level ***alarm*** on Channel 2, the ALARM ENGAGED indicator would blink once, pause, and then blink twice. This sequence will be repeated three times.

If no alarms are present on the ***Interlock Communication Bus***, the panel will go into its self-test routine when the SYSTEM TEST button is pushed.

### SYSTEM FAULT

When flashing, the panel self-test procedure has detected an error. Refer to "PROBLEM SOLVING" (Chapter 6) for error code interpretation.

### REMOTE STATUS Indicators

This section of the panel faceplate is dedicated to functions related to the telemonitoring option.

### CALL IN PROGRESS

This indicator is steadily illuminated whenever the modem is in use for either an incoming or outgoing call. Do not use the *RS-232* Serial Port while the CALL IN PROGRESS indicator is illuminated. Doing so will terminate any ongoing call. When blinking, the CALL IN PROGRESS indicator alerts the user to a fault in the telemonitoring electronics. Call ORS for assistance.

## *PUMP CONTROL FUNCTIONS*

### PUMP POWER Switches

The WATER PUMP POWER and PRODUCT PUMP POWER switches operate the circuit breakers for the pumps. When either of these switches is turned to the ON position, power is applied to its pump whenever the control relay is closed. When these switches are turned to the OFF position, power cannot be applied to the pumps regardless of the settings of any other panel controls.

⚠

Before working on the pumps, the operator must (1) turn the PUMP POWER switches to OFF (2) turn the CONTROL POWER switch to OFF and (3) secure the panel door according to standard lockout/tagout procedures.

**PUMP CONTROL Switches**

These are three position switches with HAND, OFF and AUTO positions. Both WATER PUMP CONTROL and PRODUCT PUMP CONTROL switches function identically as described below.

HAND

In the HAND position, the PUMP CONTROL switch overrides sensor input and applies power directly to the pump.

AUTO

In the AUTO position, ON/OFF switching of the pump is controlled by sensor input from the downwell probe.

OFF

In the OFF position, the pump will not run.

**PUMP CONTROL Indicators**

These indicators monitor the setting of the PUMP CONTROL switches and provide information on the status of each pump.

AUTO

The yellow AUTO indicator is illuminated whenever the PUMP CONTROL switch is in the AUTO position. If the PUMP CONTROL switch fails, its AUTO indicator will blink.

PUMP RUNNING

When steadily illuminated, the pump is running. When blinking, the pump motor has been shut down by a thermal overload or a tripped circuit breaker.

## PROBE STATUS Indicators

These three indicators allow the user to monitor the status of the downwell and tankfull probes. These indicators are not functional if either the CONTROL POWER switch or both PUMP CONTROL switches are in the OFF position. Indicator functions are described below:

### PRODUCT TANK FULL

When illuminated, the product recovery tank has become full. The product pump will be shut down by an interlock alarm on Channel 1. The water pump will continue running. After draining the product recovery tank, clear the alarm by turning the PRODUCT PUMP CONTROL switch to OFF and then back to AUTO.

### PRODUCT HIGH

The Product (top) float on the downwell probe is suspended in hydrocarbon. The product pump will run as long as the HI/LO Water float is below the WATER HIGH switch.

### WATER HIGH

The HI/LO Water float is at the top of its travel or (if the unlabeled MEDIUM indicator is also illuminated) is on its way down. When the float reaches the WATER HIGH switch at the top of its travel, the water pump is started and a Water Alarm disables the product pump control circuit.

### MEDIUM

This unlabeled indicator provides information on the direction the HI/LO Water float is moving. If both the MEDIUM and WATER HIGH indicators are illuminated, the float is moving down. If both the MEDIUM and WATER LOW indicators are illuminated, the float is rising.

### WATER LOW

The HI/LO Water float is either at the bottom of its travel or (if the unlabeled MEDIUM indicator is also illuminated) is on its way up. The water pump will shut off when the HI/LO Water float reaches the WATER LOW switch at the bottom of its travel. The pump will not restart until the float reaches the WATER HIGH switch at the top of its travel.

### WATER OVERRIDE

When steadily illuminated, the OVERRIDE float has shut off the water pump. Reset the panel by turning the WATER PUMP CONTROL switch to OFF and then to AUTO.

## SYSTEM PRECHECK PROCEDURES

Before starting the system, carry out the following precheck procedures.

**Check Wiring**

1. Refer to the wiring diagrams in Chapter 2 and check all wiring connections to the panel.
2. With the PUMP CONTROL switches in the OFF position, turn the PUMP POWER and CONTROL POWER switches to ON.

**Run Self-Test**

3. Press the SYSTEM TEST button. All the panel indicators should be illuminated briefly as the microprocessor goes through its self-test routine.

If the SYSTEM FAULT indicator comes on after the SYSTEM TEST button has been pushed, the self-test routine has detected a fault in the panel electronics. Document the problem as instructed in Chapter 6, and call ORS for assistance.

**Check Pumps**

4. Briefly turn each PUMP CONTROL switch to HAND. The pumps should start and the PUMP RUNNING indicators should be illuminated.

5. With the probe held in an upright position, turn both PUMP CONTROL switches to AUTO. Neither pump should run and the WATER LOW and WATER OVERRIDE indicators should be illuminated.

**Check Product Switch**

6. Lift the Product float. The product pump should start and the PRODUCT HIGH, WATER LOW and WATER OVERRIDE indicators should be illuminated.

**Check Water Alarm**

7. With the Product float still held up, lift the OVERRIDE and HI/LO WATER floats to their upper stops. The product pump will stop and the water pump will start. The PRODUCT HIGH and WATER HIGH indicators will be illuminated.

**Check OVERRIDE**

8. With the water pump running, test the OVERRIDE function by dropping the OVERRIDE float. The water pump should stop and the WATER OVERRIDE indicator should be illuminated.

**Check HI/LO Water Float**

9. Lift the OVERRIDE float to restart the water pump. Lower the Product float and allow the HI/LO Water float to slowly drop to its bottom stop. The product pump will remain off and the water pump will continue running until the HI/LO Water float reaches its bottom stop.

Once precheck procedures have been completed, the SITEPRO 2000 control panel is ready for operation.

## ERROR MESSAGES

In the sections below, all possible local error messages are listed and described. If your SITEPRO 2000 is equipped with the telemonitoring option, refer to the SITEPRO Manager software manual for remote monitoring protocol and procedures.

Before beginning troubleshooting procedures, press the SELF TEST button to confirm that all panel indicators are functional.

- **Error Message: Water Pump Control AUTO Indicator Blinking**

*Cause:* The WATER PUMP CONTROL switch is faulty.

*Remedy:* Call ORS for assistance.

- **Error Message: Product Pump Control AUTO Indicator Blinking**

*Cause:* The PRODUCT PUMP CONTROL switch is faulty.

*Remedy:* Call ORS for assistance.

- **Error Message: WATER PUMP RUNNING Indicator Blinking**

*Cause:* The motor current has deviated from specifications and has shut down the water pump.

*Remedy:*

1. Refer to your water pump O & M manual and remedy the cause of the problem.

2. When the pump has cooled, restart the system by turning the WATER PUMP CONTROL switch OFF and then back to AUTO.

⚠ Before working on the water pump, carry out the DISCONNECT PROCEDURE printed on the front of the SITEPRO 2000 faceplate.

- **Error Message: PRODUCT PUMP RUNNING Indicator Blinking**

*Cause:* The motor current has deviated from specifications and has shut down the product pump.

*Remedy:*

1. Refer to your product pump O & M manual and remedy the cause of the problem.
2. When the pump has cooled, restart the system by turning the PRODUCT PUMP CONTROL switch to RESET and then back to AUTO.

⚠ Before working on the product pump, carry out the DISCONNECT PROCEDURE printed on the front of the SITEPRO 2000 faceplate.

- **Error Message: MAIN POWER Indicator Blinking (Network Applications Only)**

*Cause:* The panel is waiting to get on the bus or is no longer connected to the network.

*Remedy:* Check the ***network*** connections on TB4. If no loose connections are found, confirm than none of the other panels has fallen off the network.

- **Error Message: SYSTEM FAULT Indicator Blinks Once**

| | |
|---|---|
| *Cause:* | The panel has failed the Self Test routine. |
| *Remedy:* | Call ORS for assistance. |

- **Error Message: SYSTEM FAULT Indicator Blinks Twice**

| | |
|---|---|
| *Cause:* | An Interlink Communication Bus failure has occurred. The panel will shut down.. |
| *Remedy:* | Call ORS for assistance. |

- **Error Message: SYSTEM FAULT Indicator Blinks Three Times**

| | |
|---|---|
| *Cause:* | Line voltage has deviated more than 20% from specified value. |
| *Remedy:* | Check power at service and restore to specifications. |

- **Error Message: SYSTEM FAULT Indicator Blinks Four Times**

| | |
|---|---|
| *Cause:* | The temperature inside the panel has risen over the specified maximum. |
| *Remedy:* | Determine cause of problem and correct. |

- **Error Message: SYSTEM FAULT Indicator Blinks Five Times**

| | |
|---|---|
| *Cause:* | The panel purge pressure has dropped below the specified minimum. The panel will shut down. |
| *Remedy:* | 1. Check for loose or disconnected purge air hose.<br>2. Check function of purge air compressor. |

- **Error Message: SYSTEM FAULT Indicator Blinks Six Times**

| | |
|---|---|
| *Cause:* | This error message indicates a probe fault caused by one of the following conditions.<br>1. The probe has become disconnected from the panel.<br>2. The probe has a stuck float or faulty reed switch. |
| *Remedy:* | 1. Check all connections between the probe and the panel.<br>2. Clean the probe and free all floats on the shaft.<br>If the error message persists, call ORS for assistance. |

- **Error Message: CALL IN PROGRESS Indicator Blinking (Telemonitoring Applications Only)**

| | |
|---|---|
| *Cause:* | A communications fault has been detected. |
| *Remedy:* | Clear the error message by turning the CONTROL POWER switch OFF, waiting 5 seconds, and then turning the switch to ON. If the error message persists, call ORS for assistance. |

## ADDITIONAL TROUBLESHOOTING PROCEDURES

In addition to the error conditions described above, the following problems could cause an interruption in system operation.

### • Problem: PUMP POWER Switch Tripped OFF

*Cause:*

A tripped circuit breaker could be caused by:

1. Breaker too small for motor.
2. Short in wiring between panel and motor
3. Faulty motor drawing excessive current.

*Remedy:*

1. Refer to the trip amps specification printed on the side of the breaker. Confirm that the breaker is properly sized for the motor being used.
2. Use an Ohm meter to check for shorts in the motor wiring.
3. Check the motor for damage.

⚠ Before working on either pump, carry out the DISCONNECT PROCEDURE printed on the front of the SITEPRO 2000 faceplate.

## • Problem: No Panel Indicators Illuminated

*Cause:* Either a fuse is blown or no power is reaching the panel.

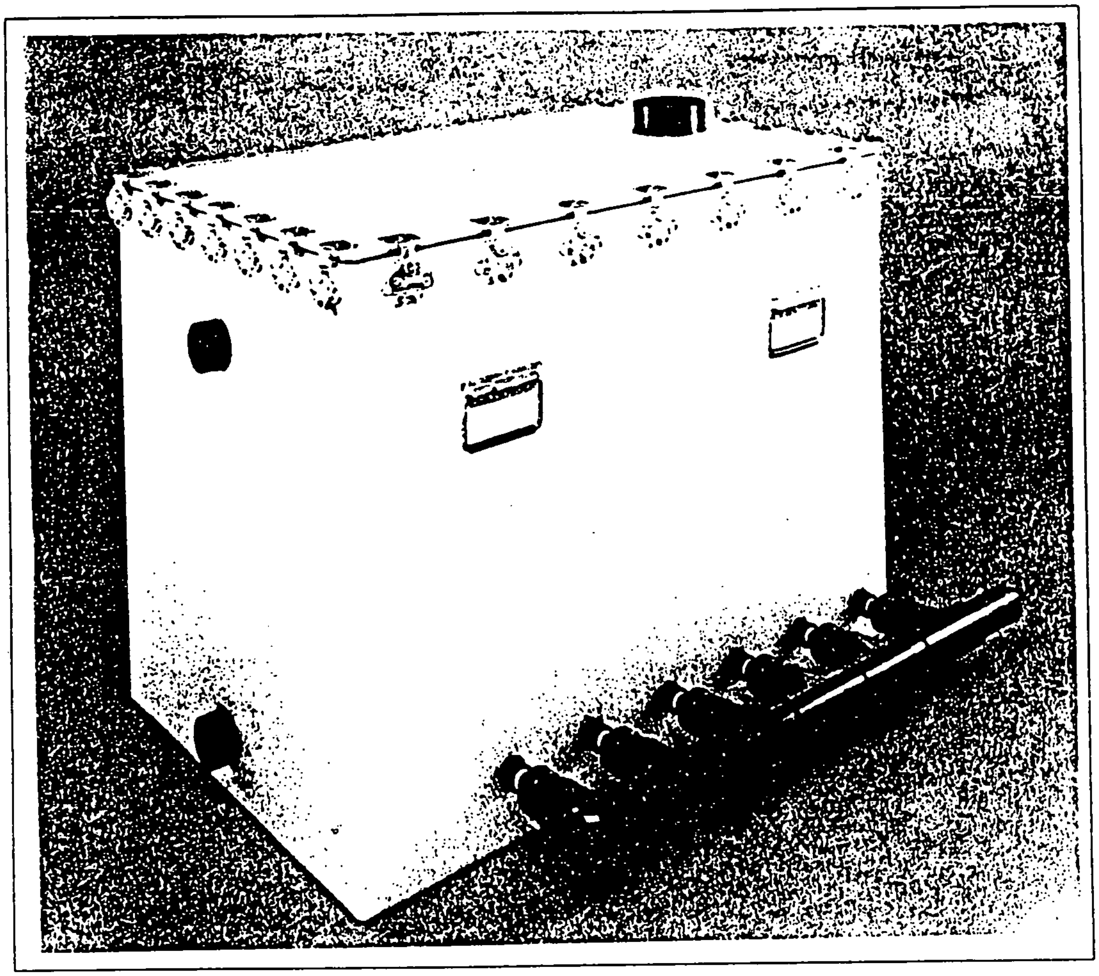
*Remedy:*

1. Use a voltmeter to check for power at the terminal block on the panel chassis.
2. If power is present, the problem is a blown fuse behind the circuit board shield. Call ORS for assistance.
3. If no power is present at the terminal block, problem is a power failure at the service. Restore power and restart the system by repeating the panel startup procedure described in Chapter 4.

"Specialists in Aeration and Mixing Equipment"

# BREEZE

## AIR STRIPPING SYSTEM



## INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

800 / 879-3677 ■ 612 / 521-8519 ■ fax 612 / 521-1455

## Table of Contents

## 1.0 SAFETY PRECAUTIONS

1 - READ ALL INSTRUCTIONS BEFORE OPERATING THE EQUIPMENT.

2 - For maximum safety and extended product life, follow all installation and maintenance procedures in this manual.

3 - Do not place anything heavier than 75 pounds on the tank.

4 - Use the handles when lifting the tank and only lift the tank when it is empty.

5 - Do not stand on or step into the tank.

6 - Never smoke or use an open flame near the tank.

## 2.0 BREEZE AIR STRIPPING TANK DESCRIPTION

### 2.1 UNIT DESCRIPTION

The BREEZE Air Stripping Tank varies from model to model. Each model has a number of compartments ranging from four to seven. One compartment at the discharge end is empty and called a quiescent chamber. Its purpose is to let water settle before it is drained from the tank and to allow for addition of controls. The rest of the compartments are identical, each containing two 24 inch stainless steel coarse bubble diffusers (see figure 1 below for process flow diagram and figure 2 for cutaway side view).

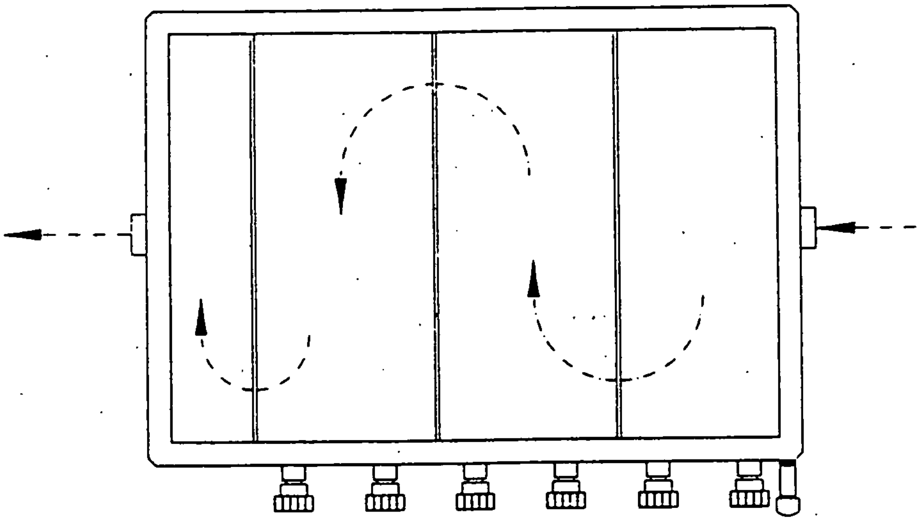


Figure 1 Process Flow Diagram

## 3.0 PRINCIPLES OF AIR STRIPPING

Stripping volatile organic compound (VOC) from water with the use of air depends on the driving force of the compound to exit from water to air. The driving force is controlled by the volatility (how fast a compound changes from a liquid to a gas) and the partial pressure of the compound in contact with the water. This is commonly known as Henry's Law Constant.

When stripping VOC's from water, in addition to volatility the affinity (how well a compound is attracted to water) also plays a major role. Henry's Law takes all of these into account and assigns a constant number to each VOC. Easily strippable VOC's have a high Henry's constant and difficult to strip VOC's have a low Henry's constant. For example, Ethylene has approximately twice the solubility of Ethane. The difference is due to their chemical structure and their ability to break the hydrogen bonding between the water molecules.

| | Henry's Constant |
|---|---|
| Ethylene | 11,530 atmosphere/mole fraction |
| Ethane | 26,790 atmosphere/mole fraction |

Henry's Constant is used in determining the air to water ratio to strip a particular VOC. The stripping ratio tells us what volume of air needs to be pumped into the system to strip different compounds to achieve the required efficiency.

## 4.0 METHOD OF OPERATION

Contaminated water is pumped in through the water inlet pipe at a predetermined rate. At the same time, air is pumped in through the diffusers. The diffusers shear the air into tiny bubbles that uniformly distribute them throughout the water. The water level is maintained below the top of the internal compartments. The compartments are interconnected through holes on the alternating sides of the compartment. This arrangement forces the contaminated water to go over the diffusers in each compartment and effectively treats the water. This serpentine flow arrangement also prevents short circuiting and back flow. Since the air is released in small, confined compartments, vigorous mixing and shearing action takes place. The vigorous mixing action causes intimate contact between the contaminated water and the air.

The partial pressure of the VOC's in the air being zero, the driving force for the VOC's to exit the water is very great. The VOC's freely pass from the water to the air, which is vented out.

## 5.0 UNPACKING PROCEDURES

### 5.1 UNPACKING

AEROMIX ships each BREEZE Air Stripping Tank enclosed in a particle board box. Included with the BREEZE Air Stripping Tank is an air manifold, o-rings for the manifold, CYCLONE stainless steel diffusers, and removable lock-down top. Since the stack (vent pipe) heights vary from state to state, the customer is asked to provide the stack pipe.

### 5.2 INSPECTION

Your BREEZE Air Stripping Tank was inspected and tested at our factory. You should, however, inspect the tank for shipping damage before taking it out of the box. Report any damage immediately to the freight carrier and AEROMIX.

When inspecting the tank, look for holes, cracks, broken pipes, etc. Remove the tank lid and make sure that the diffusers are properly seated and screwed in all the way. If not, tighten the diffusers by fully screwing them in and making sure that the smaller holes are facing upwards and that the diffusers are level with the tank bottom.

## 6.0 INSTALLATION

The BREEZE Air Stripping system should be installed according to the approved specifications. The tank is assembled as follows:

1.) Make sure all CYCLONE stainless steel diffusers are screwed in tightly and the smaller holes are facing upwards. Also, diffusers should be level with the tank bottom.

2.) The lid should be locked down by turning the butterfly clips clockwise and locking the clips down.

3.) Air manifold is screwed on hand tight at first, making sure rubber o-rings fit between manifold and header. If leakage occurs, tighten manifold with wrench.

4.) Blower should be placed higher than water level to prevent damage to unit. Installation of a U-Tube (see figure 3) or use of a one way valve are alternatives to placing the blower higher than the BREEZE Air Stripping Tank. Aeromix recommends a U-Tube rather than a one way valve to minimize head losses through the air piping system.

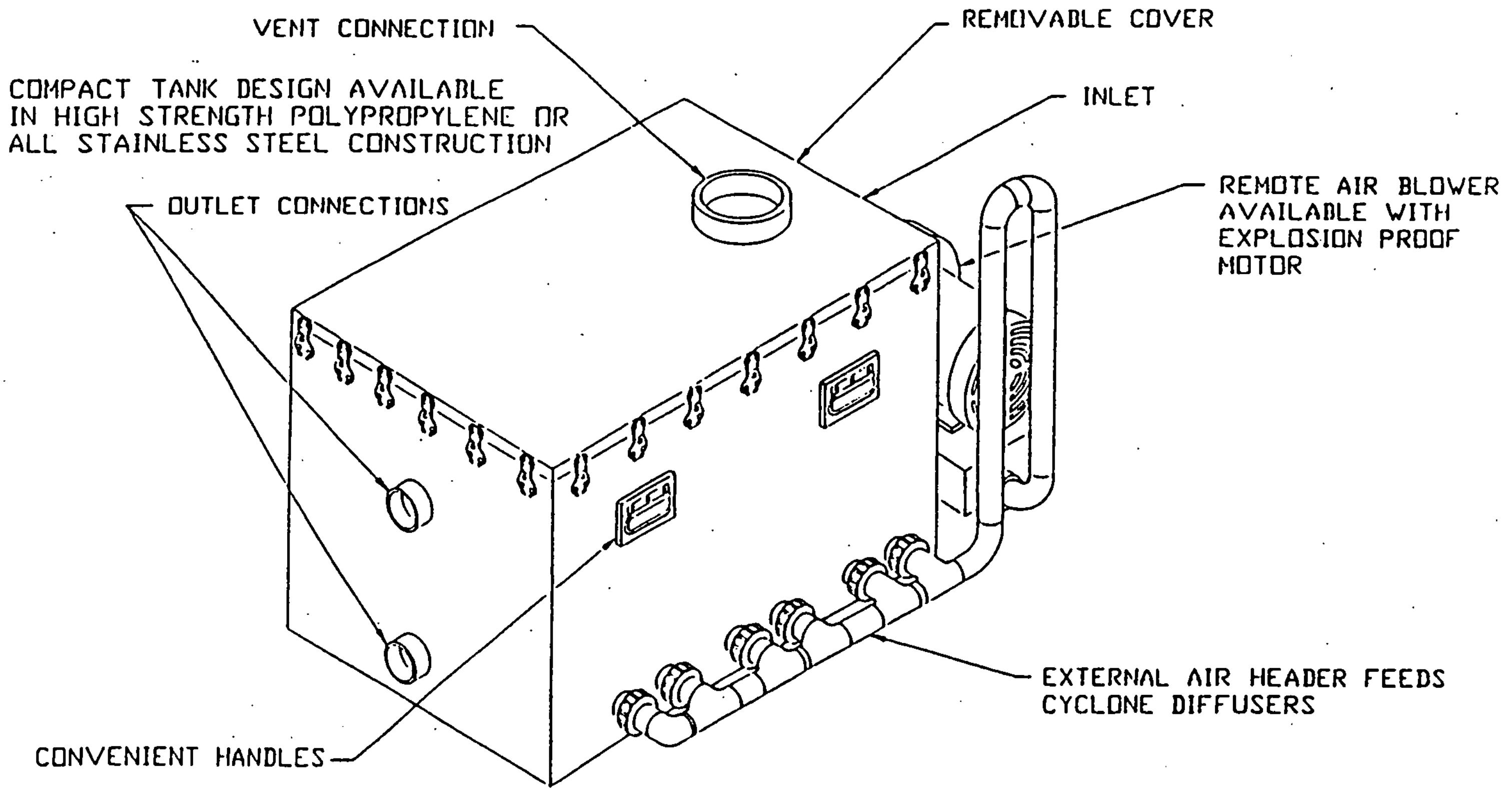


**Figure 3 Breeze with U-Tube in place**

## 7.0 MAINTENANCE

Once installed the BREEZE is virtually maintenance free. Two things need to be checked periodically.

1) The water level in the tank should be monitored to keep it below the maximum water level mark.

2) Every six months the stainless steel diffusers should be checked for deposits and cleaned as needed.

For blower maintenance guidelines follow the manufacturers instructions included with this manual.

## 8.0 SERVICE POLICY

When returning goods for warranty or repair work, contact AEROMIX to obtain a return material order (RMO) number. Any equipment returned but not containing an RMO number will not be accepted.

## 9.0 STANDARD WARRANTY

AEROMIX SYSTEMS, INCORPORATED warrants its products to be free of defects in material or workmanship for a period of 12 months from shipment, when these products are operated in accordance with our written instructions and when installed properly. Equipment or accessories not manufactured by AEROMIX SYSTEMS, INCORPORATED but supplied by us carry a full warranty supplied by the manufacturer. We will repair or replace any item which fails within the warranty period when it is returned freight prepaid to our nearest authorized service facility. All equipment will be returned freight prepaid. Damage, vibration, or excess wear caused by contact with foreign objects, highly corrosive, highly abrasive or high temperature solutions, or solutions with high levels of large suspended solids is not covered. This warranty is exclusive and in lieu of all other warranties, whether expressed or implied including any warranty of merchantability or fitness for a particular application. In no event will AEROMIX SYSTEMS, INCORPORATED be liable for any consequential, incidental, or other types of damages.

# 10.0 BLOWER MANUFACTURER INFORMATION

EG&G ROTRON

# ROTRON REGENERATIVE BLOWERS

## INSTALLATION INSTRUCTIONS

### INSTALLATION INSTRUCTIONS FOR SL SERIES AND DR SERIES BLOWERS

1] EXCESS AIR — Bleed excess air off. DO NOT throttle to reduce flow. When bleeding off excess air, the blower draws less power and runs cooler.

2] BOLT IT DOWN — Any blower must be secured against movement prior to starting or testing, to prevent injury or damage.

3] WIRING — Blowers must be wired and protected/fused in accordance with local and national electrical codes. All integral-motor blowers must be grounded to prevent electrical shock.

4] PIPING — All blowers (except SL series) should be piped, muffled, and/or filtered prior to starting. Care must be taken so that no foreign material enters the blower. If foreign material does enter the blower, it could cause internal damage or may exit at extremely high velocity.

5] SUPPORT THE PIPING — The blower flanges and nozzles are designed as connection points only, and are not designed to be support members.

6] PRESSURE/SUCTION MAXIMUMS — The maximum pressure and/or suction listed on the model label should not be exceeded. This can be monitored by means of a pressure or suction gage (available from Rotron), installed in the piping at the blower outlet or inlet. Also, if problems do arise, the Rotron Application Engineering staff will need to know the operating pressure/suction, to properly diagnose the problem.

7] REMOTE DRIVE (MOTORLESS) BLOWERS — Properly designed and installed guards should be used on all belts, pulleys, couplings, etc. Due to the range of uses, drive guards are the responsibility of the customer or user.

CAUTION: Plastic piping should not be used on blowers larger than 1 HP that are operating near their maximum pressure or suction point. Blower housing and nearby piping temperatures can exceed 200 degrees Fahrenheit. Access by personnel to the housing or nearby piping should be limited, guarded, or marked, to prevent danger of burns.

## MAINTENANCE AND LUBRICATION PROCEDURE

All models in the DR series through (and including) the DR7 are equipped with sealed bearings and require no maintenance. DR8 and larger models are fitted with Alemite grease fittings and should be lubricated periodically, according to the schedule below.

| LUBRICANT | DUTY | RELUBRICATION SCHEDULE IN MONTHS | NUMBER OF FULL* STROKES PER FITTING |
|---|---|---|---|
| Shell Dolium R | Light | 12 | 2 |
| | Medium | 12 | 2 |
| | Heavy | 6 | 3 |

* Two-inch long string per full stroke

Shell Dolium R grease is used at the factory. Any grease used MUST be compatible. Wipe fittings clean before applying grease gun.

CAUTION: Lubricate motors at standstill only.

Should excessive amounts of material pass through the blower, it is suggested that the cover(s) and impeller(s) be removed periodically and cleaned to avoid impeller imbalance. Impeller imbalance greatly speeds bearing wear, thus reducing blower life.

For further information regarding Rotron Regenerative Blowers, please contact Applications Engineering, EG&G Rotron Industrial Division, (914) 246-3401.

## TROUBLE SHOOTING

| | | POSSIBLE CAUSE *3 Phase Units **1 Phase Units | REMEDY |
|---|---|---|---|
| IMPELLER DOES NOT TURN | HUMMING SOUND | 1. *One phase of power line not connected<br>2. *One phase of stator winding open<br>3. Bearings defective<br>4. Impeller jammed by foreign material<br>5. Impeller jammed against housing or cover<br>6. **Capacitor open | 1. Connect<br>2. Contact Factory<br>3. Change bearings<br>4. Clean<br>5. Adjust<br>6. Change capacitor |
| | NO SOUND | 1. *Two phases of power line not connected<br>2. *Two phases of stator winding open | 1. Connect<br>2. Contact factory |
| IMPELLER TURNS | BLOWN FUSE | 1. Insufficient fuse capacity<br>2. Short circuit | 1. Use fuse of proper rating<br>2. Repair |
| | MOTOR OVERHEATED OR PROTECTOR TRIPS | 1. High or low voltage<br>2. *Operating in single phase condition<br>3. Bearings defective<br>4. Impeller rubbing against housing or cover<br>5. Impeller or air passage clogged by foreign material<br>6. Unit operating beyond performance range<br>7. Capacitor shorted<br>8. *One phase of stator winding short circuited | 1. Check input voltage<br>2. Check connections<br>3. Check bearings<br>4. Adjust<br>5. Clean<br>6. Contact factory<br>7. Change capacitor<br>8. Contact factory |
| | ABNORMAL SOUND | 1. Impeller rubbing against housing or cover<br>2. Impeller or air passages clogged by foreign material<br>3. Bearings defective | 1. Adjust<br>2. Clean<br>3. Change bearings |
| | PERFORMANCE BELOW STAND | 1. Leak in piping<br>2. Piping and air passages clogged<br>3. Impeller rotation reversed<br>4. Leak in Compressor<br>5. Low voltage | 1. Tighten<br>2. Clean<br>3. Check wiring<br>4. Tighten cover, flange<br>5. Check input voltage |

Industrial Division
ROTRON INC., Sawyer Industrial Park, Saugerties, N.Y. 12477 TEL. (914) 246-3401 TWX: 510-247-9033

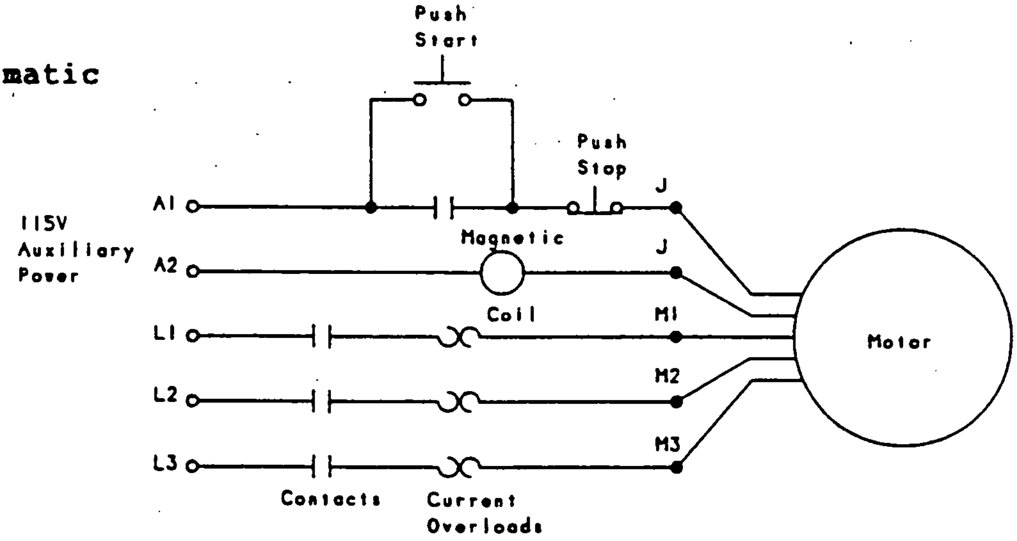
EG&G ROTRON
Industrial Division
North Street, Saugerties, NY 12477
TEL. (914) 246-3401 FAX: (914) 246-3802

**IMPORTANT:** Read Before Wiring this Explosion-proof Blower

This EG&G Rotron Explosion-proof Regenerative blower is equipped with **Pilot Duty Thermal Overload protection.** When properly wired to a motor starter, this protection limits the motor winding temperature rise per the National Electric Code (NEC) article 500. Failure to properly wire this blower is a NEC violation and could cause an **explosion.** EG&G takes no responsibility for damages incurred by negligent use of this product, and may not warranty a blower on which the P.D.T.O. is not properly connected.

In all cases, follow the motor controller manufacturer's instructions. The following schematic is for conceptual understanding only, and may not apply to all motor controllers.

## Schematic



J - Pilot Duty Thermal Overload Protection wires
L - Power leads from circut breaker box.
M - Motor leads (refer to wiring diagram inside T'box or on motor nameplate).

The above schematic is shown for a three phase motor. For a single phase motor disregard L3 and M3. Pushing the START button completes the auxiliary control circuit, allowing current to flow through the magnetic coil. The contacts are magnetically closed, starting the motor and latching the auxiliary circuit. The motor will continue to run until the STOP push button is depressed, the motor reaches the overload temperature, or the current sensing overloads trip out.

If you have any questions, EG&G Rotron Application Engineers are available at (914) 246-3401 for your assistance.

06/29/92
REV A

## POLICY REGARDING INSTALLATION OF EG&G ROTRON REGENERATIVE BLOWERS IN HAZARDOUS LOCATIONS

EG&G Rotron will not knowingly specify, design or build any regenerative blower for installation in a hazardous, explosive location without the proper NEMA motor enclosure. EG&G Rotron does not recognize sealed blowers as a substitute for explosion proof motors. Sealed units with standard TEFC motors should never be utilized where local, state, and/or federal codes specify the use of explosion proof equipment. EG&G Rotron has a complete line of regenerative blowers with explosion-proof motors. Division I & II, Class 1, Group D; Class 2, Groups F & G requirements are met with these standard explosion-proof blowers.

EG&G Rotron offers general application guidance; however, suitability of the particular blower selection is ultimately the responsibility of the user, not the manufacturer of the blower.

# Engineering Document Package

GOULDS PUMPS, INC.
INDUSTRIAL PRODUCTS GROUP

GOULDS PUMPS, INC.
SLURRY PUMP DIVISION

East Centre Street
Ashland, Pennsylvania 17921
Phone: 717-875-2660
Telex: 7401749
Fax: 717-875-2657

**TO:** Mobile Oil Corporation
One Babcock Street
Buffalo, NY 14210

**ATTN:** Glen Heffner

**FROM:** Diane Kirkauskas
Contract Administrator

**DATE:** June 25, 1993

**SUBJECT:** F.O. #416072
P.O. #BG3-989X6700A

Thank you for your valued order. We hope that we have met all of your requirements.

Enclosed please find 2 copies of the Engineering Document Package for the subject order. This package includes certified dimensional drawings, sectional drawings with parts list, performance curve, coupling data, motor data, and instruction manuals.

Please review carefully prior to installing and operating the pumps which you have ordered.

DK/cf

Enclosure

cc: GPI-Fairfield, Mike Sabatine

| | |
|---|---|
| CUSTOMER: | MOBIL OIL CORPORATION |
| PURCHASE ORDER # | BG3-989X6700A |
| PUMP MODEL | 3171S |
| PUMP SIZE | 4x4-8 |
| PUMP SERIAL # | 416A072 |
| ITEM NO. | 001 |
| SERVICE: | STORM SEWER SUMP PUMP |

## TABLE OF CONTENTS

**GOULDS PUMPS, INC.**

SLURRY PUMP DIVISION, Ashland, Pennsylvania

# 3171 DIMENSIONAL OUTLINE ST,S,M,MT GROUP

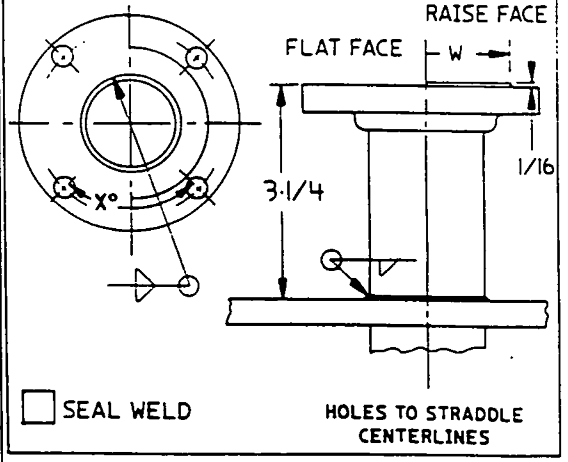
| | SIZE | A | B | D | E | F | G | H° | J | | | R | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ST | 1X1-5 | 3 5/8 | 1 1/2 | 1 3/16 | 8 1/16 | 20 1/2 | 22 | 60 | 6 | | | 6 | 14 1/4 |
| | 1X1-1/2-6 | 3 5/8 | 2 | 1/2 | 8 3/8 | 20 1/2 | 22 | 60 | 6 | | | 5 13/16 | 15 1/4 |
| | 1-1/2X3-6 | 3 5/8 | 3 | 15/16 | 9 1/8 | 20 1/2 | 22 | 60 | 6 | | | 5 3/16 | 16 3/4 |
| S | 1X1-1/2-8 | 3 5/8 | 2 | 5/8 | 10 1/16 | 20 1/2 | 22 | 60 | 6 | | | 4 1/4 | 17 |
| | 1-1/2X2-8 | 3 5/8 | 2 | 1/8 | 9 5/8 | 20 1/2 | 22 | 60 | 6 | | | 4 3/8 | 17 |
| | 2-1/2X3-8 | 3 5/8 | 3 | 1/2 | 10 5/16 | 20 1/2 | 22 | 60 | 6 | | | 3 13/16 | 19 1/2 |
| | ■ 4X4-8 | 4 | 4 | 5/8 | 12 1/16 | 25 | 26 1/2 | 60 | 6 | | | 3 5/16 | 22 1/2 |
| | 1-1/2X2-11 | 4 | 2 | ★3/8 | 11 3/8 | 25 | 26 1/2 | 60 | 6 | | | 4 9/16 | 20 1/2 |
| | 2-1/2X3-11 | 4 | 3 | 1/16 | 12 1/16 | 25 | 26 1/2 | 60 | 6 | | | 4 3/16 | 22 1/2 |
| M | 3X4-11 | 4 1/2 | 4 | 1/16 | 12 13/16 | 29 1/2 | 31 | 45 | 8 | | | 4 | 24 |
| | 4X6-11 | 4 1/2 | 4 | ★5/32 | 14 1/4 | 29 1/2 | 31 | 45 | 8 | | | 3 11/16 | 26 1/2 |
| | 1-1/2X3-13 | 4 1/2 | 3 | 7/32 | 13 5/8 | 29 1/2 | 31 | 45 | 8 | | | 4 3/4 | 25 |
| | 2-1/2X3-13 | 4 1/2 | 3 | ★ 1/2 | 13 3/16 | 29 1/2 | 31 | 45 | 8 | | | 4 11/16 | 25 |
| | 3X4-13 | 4 1/2 | 4 | ★11/16 | 13 13/16 | 29 1/2 | 31 | 45 | 8 | | | 4 5/16 | 25 1/2 |
| | 4X6-13 | 4 1/2 | 4 | ★ 1/8 | 14 3/4 | 29 1/2 | 31 | 45 | 8 | | | 3 11/16 | 27 1/2 |
| MT | 1-1/2X2-8 | 4 | 3 | 1 1/16 | 11 3/8 | 25 | 26 1/2 | 60 | 6 | | | 4 3/8 | 20 |
| | 2-1/2X3-8 | 4 1/2 | 4 | 2 3/8 | 13 13/16 | 29 1/2 | 31 | 45 | 8 | | | 3 13/16 | 22 3/4 |
| | | | | | | | | | | | | | |

## O APPROX.

| MOTOR | GROUP ST,S,M,MT | | | |
|---|---|---|---|---|
| | STANDARD | | UPR.STF.BOX | |
| | ST,S | M,MT | ST,S | M,MT |
| 143 | 21-1/2 | | 25-7/8 | |
| 145 | 22-1/2 | | 26-7/8 | |
| 182 | 27-1/2 | | 31-7/8 | |
| ■ 184TC | 27-1/2 | | 31-7/8 | |
| 213 | 34-3/4 | 36-1/2 | 39-1/8 | 41-5/8 |
| 215 | 34-3/4 | 36-1/2 | 39-1/8 | 41-5/8 |
| 254 | 34-3/4 | 36-1/2 | 39-1/8 | 41-5/8 |
| 256 | 36-1/4 | 38 | 40-5/8 | 43-1/8 |
| 284 | | 37-1/8 | | 42-1/4 |
| 286 | | 37-1/8 | | 42-1/4 |
| 324 | | 42-1/8 | | 47-1/4 |
| 326 | | 42-1/8 | | 47-1/4 |
| 364 | | 54-5/8 | | 59-1/4 |
| 365 | | 54-5/8 | | 59-1/4 |
| | | | | |

## 150 #FLANGE ☐ FLAT ■ RAISED FACE

| "B" PIPE SIZE | O.D. | B.C. | NO.& SIZE OF HOLES | W | X° |
|---|---|---|---|---|---|
| 1-1/2 | 5 | 3-7/8 | 4-5/8 | 2-7/8 | 90° |
| 2 | 6 | 4-3/4 | 4-3/4 | 3-5/8 | 90° |
| 3 | 7-1/2 | 6 | 4-3/4 | 5 | 90° |
| ■ 4 | 9 | 7-1/2 | 8-3/4 | 6-3/16 | 45° |



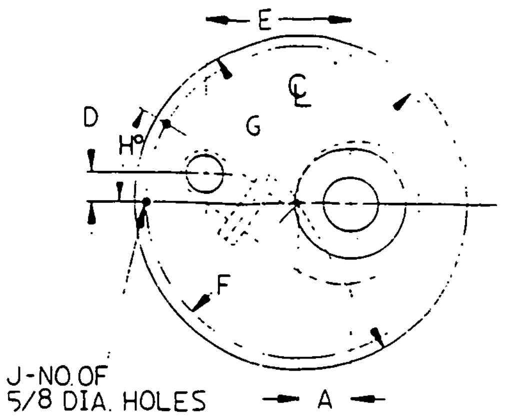
☐ SEAL WELD

HOLES TO STRADDLE CENTERLINES

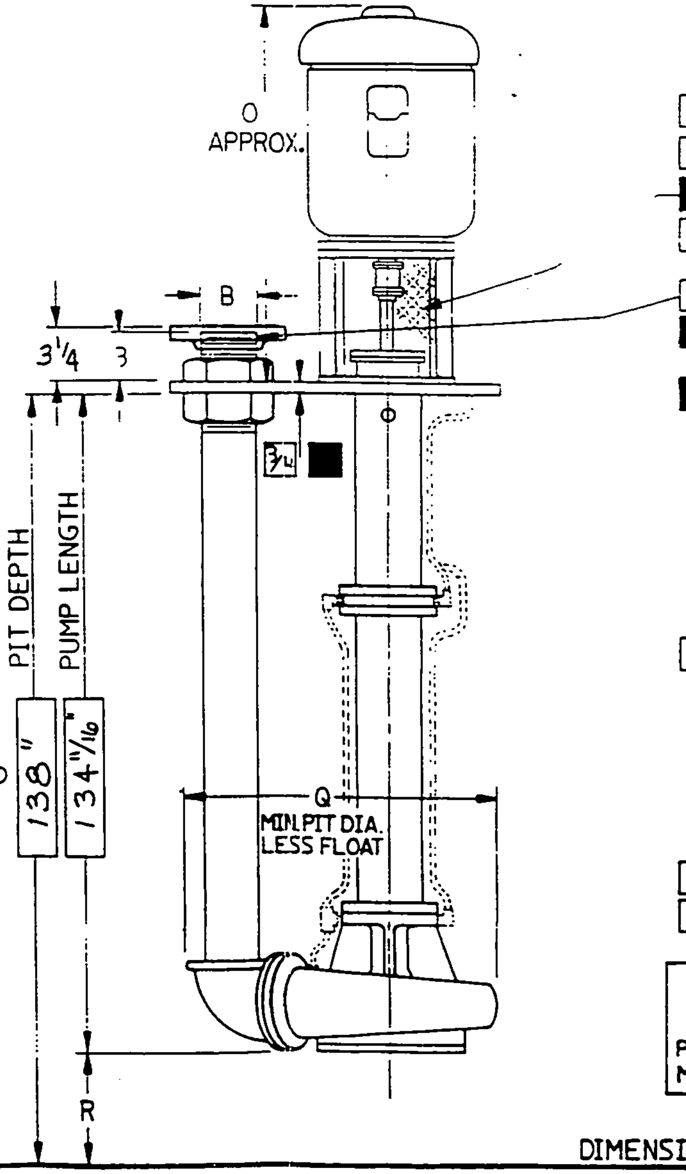
NOTE: ★ INDICATES DISCHARGE PIPE LOCATED BELOW HORIZONTAL ℄ OF SUPPORT PLATE, OTHERS ARE ABOVE ℄.

| REV. | BY |
|---|---|
| | |

TYPICAL
NOT TO SCALE



J-NO. OF 5/8 DIA. HOLES



OPTIONAL FEATURES PROVIDED ONLY WHEN BOX IS CHECKED

☐ FLOAT SWITCH
☐ HIGH WATER ALARM
■ COUPLING GUARD
☐ UPPER STUFFING BOX

☐ THREADED DISCH.
■ FLANGED DISCH.

■ LUBRICATION LINES
QTY. ______
TYPE: ■ FLUSH
☐ GREASE
FROM:
☐ SUPPORT PL.
■ CASING

☐ GUIDE BEARINGS
- ☐ CARBON
- ■ RUBBER/316SS
- ☐ BRONZE
- ☐ VITON
- ☐ TEFLON
- ☐ IRON
- ☐ OTHER ______

☐ FLOAT
☐ TAILPIPE

APPROX. WEIGHTS
PUMP 723
MOTOR 110

DIMENSIONS IN INCHES

**GOULDS PUMPS. INC.**
VERTICAL PRODUCTS DIVISION
(TEXAS OPERATIONS)
PO BOX 5487,
LUBBOCK, TEXAS 79417

GOULDS SERIAL NO. 416A072
CUSTOMER MOBIL OIL CORP.
CUSTOMER P.O. BG3-989X6700A
BRANCH ORDER NO. ______
EQUIP. OR ITEM 001
SERVICE STORM SEWER
SUMP PUMP

| PUMP SIZE | ASSM.# | CONST. | QTY. | IMP. DIA. |
|---|---|---|---|---|
| 4x4-8 | 20 | 316SS | 1 | 6.12 |
| LIQUID | G.P.M. | T.D.H. | SP. GR. | TEMP. |
| STORM SEWER | 300 | 25' | 1.0 | — |

| MTR. SHFT. | FRAME | H.P. | R.P.M. | PH./HZ./V. |
|---|---|---|---|---|
| 1.12 | 184TC | 5 | 1800 | 3/60/460 |

FURN. BY FACTORY
MFG. BY
ENCL. XP

SPECIAL CONSTRUCTION
COUPLING GUARD
316 SS LUBE LINES FROM CASING
316 SS (4") 150# R. F. DISCH. FLANGE

CERTIFIED CORRECT
☐ FOR APPROVAL
■ FOR RECORD

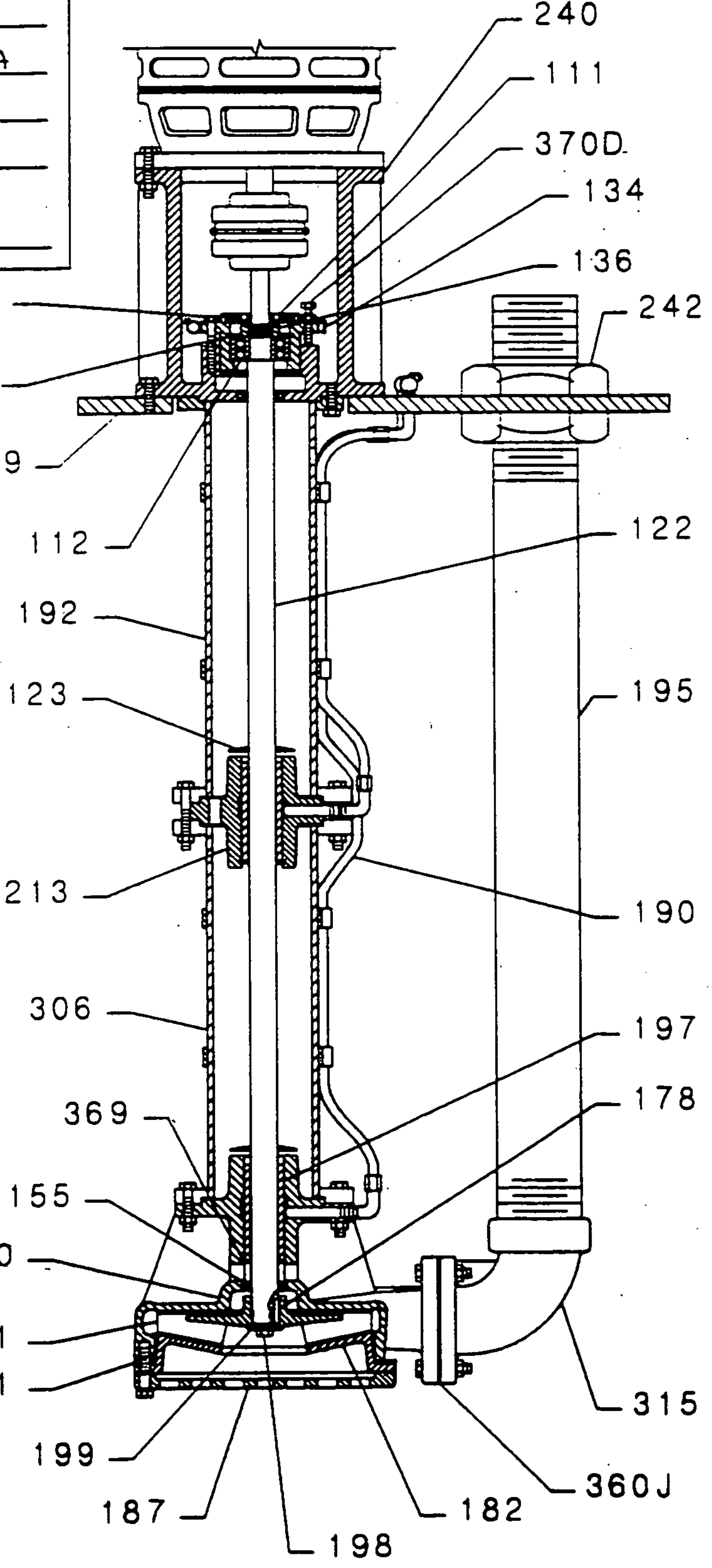
BY J.R. Vann DATE 6/23/93

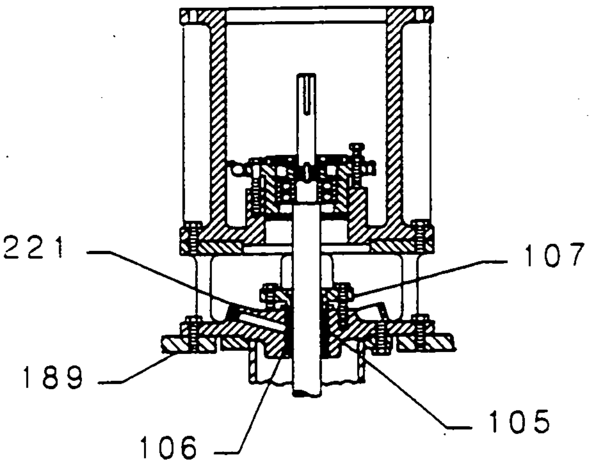
| DRAWING NO. | REV. | DATE |
|---|---|---|
| D01359B | | |

GOULDS PUMPS, INC.
SLURRY PUMP DIVISION
ASHLAND PA

GOULDS SERIAL NO. 416A072
CUSTOMER Mobil Oil Corp.
CUSTOMER P.O. BG3-989X6700A
BRANCH ORDER NO.
EQUIP. OR ITEM 001
SERVICE
Storm Sewer Sump Pump

# SECTIONAL VIEW
# MODEL 3171





UPPER STUFFING BOX

☐ REQUIRED
■ NOT REQUIRED

## Parts List and Materials of Construction

| Item No. | No. Req'd. Per Pump | Part Name | Standard Materials of Construction: All Iron | Bronze Fitted | All Bronze | All 316SS | All Alloy 20 | All Hastelloy B or C |
|---|---|---|---|---|---|---|---|---|
| 100 | 1 | Casing | ~~1000~~ | | ~~1102~~ | 316 | ~~GA-20~~ | ~~Hastelloy~~ |
| 101 | 1 | Impeller | ~~1000~~ | ~~1102~~ | | 316 | ~~GA-20~~ | ~~Hastelloy~~ |
| 105 | 1 | Upper Stuffing Box Lantern Ring | ~~Teflon~~ | | | | | |
| 106 | 1 Set | Upper Stuffing Box Packing | ~~ACRYLIC YARN~~ | | | | | |
| 107 | 1 | Upper Stuffing Box Gland | ~~1000 or as Specified~~ | | | | | |
| 111 | 1 | Bearing End Cover | Buna-N | | | | | |
| 112 | 1 | Ball Bearing | Steel | | | | | |
| 122 | 1 | Pump Shaft | ~~Steel~~ | | 316 | | ~~G-20~~ | ~~Hastelloy~~ |
| 123 | ▲ | Deflector | Buna-N | | | | | |
| 134 | 1 | Bearing Shell | 1000 | | | | | |
| 136 | 1 | Bearing Lock Nut | Steel | | | | | |
| 155 | 1 | Casing Bushing | Carbon Teflon | | | | | |
| 178 | 1 | Impeller Key | 316 | | | | ~~G-20~~ | ~~Hastelloy~~ |
| 182 | 1 | Suction Cover | ~~1000~~ | | ~~1102~~ | 316 | ~~GA-20~~ | ~~Hastelloy~~ |
| 187 | 1 | Strainer | ~~1000~~ | | ~~1102~~ | 316 | ~~GA-20~~ | ~~Hastelloy~~ |
| 189 | 1 | Pump Support Plate | Steel ~~or as Specified~~ | | | | | |
| 190 | ▲ | Lubrication or Flush Pipe (When Used) | ~~Steel~~ | | 316 | | ~~G-20~~ | ~~Hastelloy~~ |
| 192 | 1 | Head Column | ~~Steel~~ | | ~~Brass~~ | 316 | ~~G-20~~ | ~~Hastelloy~~ |
| 195 | 1 | Discharge Pipe | ~~Steel~~ | | ~~Brass~~ | 316 | ~~C-20~~ | ~~Hastelloy~~ |
| 197 | ▲ | Steady Bearings | Carbon ■ | | | | | |
| 198 | 1 | Impeller Screw | ~~316~~ | | | 316 | ~~C-20~~ | ~~Hastelloy~~ |
| 199 | 1 | Impeller Washer | ~~316~~ | | | 316 | ~~C-20~~ | ~~Hastelloy~~ |
| 213 | ▲ | Steady Bearing Housing | ~~1000~~ | | ~~1102~~ | 316 | ~~GA-20~~ | ~~Hastelloy~~ |
| 221 | 1 | Upper Stuffing Box (When Used) | ~~1000 or as Specified~~ | | | | | |
| 240 | 1 | Motor Support | 1000 | | | | | |
| 242 | 1 | Pipe Collar (Discharge Pipe) | 1000 | | | | | |
| 306 | ▲ | Column Extension | ~~Steel~~ | | ~~Brass~~ | 316 | ~~G-20~~ | ~~Hastelloy~~ |
| 315 | 1 | Discharge Elbow | ~~1000~~ | | ~~1102~~ | 316 | ~~GA-20~~ | ~~Hastelloy~~ |
| 351 | 1 | Gasket — Suction Cover to Casing | Nitrile Acrylic | | | | | |
| 361-A | 1 | Retaining Ring — Ball Bearing | Steel | | | | | |
| 369 | ▲ | Retaining Ring — Steady Bearing | 316 | | | | ~~C-20~~ | ~~Hastelloy~~ |
| 370-C | 3 | Hex Head Tap Bolts — Bearing Shell to Bearing Housing | Steel | | | | | |
| 370-D | 3 | Hex Head Tap Bolts — Adjustable | Steel | | | | | |
| 437 | 1 | Pit Cover (Optional) (not illus.) | Steel | | | | | |

▲ Dependent on pit depth.

■ Also available in rubber, carbon, viton, teflon, bronze and iron. Use 316 or alloy shaft with rubber or viton bearings.

## Construction Details

| | | | ST | | | S | | | | | | M | | | | | | MT | | L | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 x 1-5 | 1 x 1½-6 | 1½ x 3-6 | 1 x 1½-8 | 1½ x 2-8 | 2½ x 3-8 | 4 x 4-8 | 1½ x 2-11 | 2½ x 3-11 | 3 x 4-11 | 4 x 6-11H | 1½ x 3-13 | 2½ x 3-13 | 3 x 4-13 | 4 x 6-13 | 1½ x 2-8 | 2½ x 3-8 | 6 x 8-13 | 8 x 10-11 |
| Pump | Weight—2 Foot Depth—Less Motor | †Lb. (kg) | 275 (125) | 280 (127) | 295 (134) | 305 (138) | 315 (143) | 325 (147) | 390 (179) | 385 (175) | 425 (197) | 540 (245) | 590 (268) | 535 (243) | 550 (449) | 570 (259) | 600 (272) | 325 (147) | 335 (152) | 830 (376) | 910 (413) |
| | Weight—Add for Each 6" of Length | †Lb. (kg) | 13 (6) | 14 (6) | 15 (7) | 14 (6) | 14 (6) | 15 (7) | 17 (8) | 14 (6) | 15 (7) | 20 (9) | 20 (9) | 19 (9) | 19 (9) | 20 (9) | 20 (9) | 14 (6) | 15 (7) | 35 (16) | 40 (18) |
| | Weight—Add for Upper Stuffing Box | †Lb. (kg) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 100 (45) | 100 (45) |
| | Casing Thickness—Volute | in. (mm) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 3/8 (10) | 3/8 (10) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 1/2 (13) | 1/2 (13) | 5/16 (8) | 3/8 (10) | 9/16 (14) | 9/16 (14) |
| | Casing Thickness—Side Walls | in. (mm) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 7/16 (11) | 7/16 (11) | 5/16 (8) | 5/16 (8) | 1/2 (13) | 1/2 (13) |
| | Maximum Diameter of Solids | in. (mm) | 3/16 (5) | 1/4 (6) | 1/2 (13) | 9/32 (7) | 9/32 (7) | 15/16 (24) | 15/16 (24) | 11/32 (9) | 19/32 (15) | 19/32 (15) | 1 1/8 (29) | 1/4 (6) | 19/32 (15) | 19/32 (15) | 19/32 (15) | 9/32 (7) | 15/16 (24) | 19/32 (15) | 1 3/16 (30) |
| Shaft | Diameter at Impeller | in. (mm) | 11/16 (17) | | | Tapered 1.1118 (28) Large End | | | | | | Tapered 1.585 (40) Large End | | | | | | | | Tapered 2.222 (56) Large End | |
| | Diameter at Coupling End | in. (mm) | 7/8 (22) | | | | | | | | | 1 3/8 (35) | | | | | | | | 1 7/8 (48) | |
| | Diameter at Steady Bearing | in. (mm) | 1 1/8 (29) | | | | | | | | | 1 5/8 (41) | | | | | | | | 2 1/4 (57) | |
| Bearings | Ball Bearing | | MRC 5305 or Equal | | | | | | | | | MRC 5308 or Equal | | | | | | | | MRC 5311 or Equal | |
| | Steady Bearing—Sleeve Type | in. (mm) | 1 1/8 I.D. x 1 5/8 O.D. x 3 1/2 LG.<br>(29 x 41 x 89) | | | | | | | | | 1 5/8 I.D. x 2 1/8 O.D. x 4 LG.<br>(41 x 54 x 102) | | | | | | | | 2 1/4 I.D. x 2 15/16 O.D. x 6 9/16 LG. (57x75x167) | |
| General | Maximum Total Working Pressure—Casing | | 150 PSI (1034 kPa) | | | | | | | | | | | | | | | | | | |
| | Maximum Test Pressure—Casing | | 225 PSI (1551 kPa) | | | | | | | | | | | | | | | | | | |
| | Max. Liquid Temp.—Without Up. Stuff. Box | | 180°F (82°C) | | | | | | | | | | | | | | | | | | |
| | Max. Liquid Temp.—Up. Stuff. Box—Cooling | | 450°F (232°C)* | | | | | | | | | | | | | | | | | | |

* Higher temperatures can be handled. Refer application to factory with complete data.

† Group L is for 3 foot pit depth.

GOULDS SERIAL NO. 416A072

CUSTOMER Mobil Oil Corp.

CUSTOMER P.O. NO. BG3-989X6700A

BRANCH ORDER NO.

EQUIP. OR ITEM NO. 001

SERVICE Storm Sewer Sump Pump

G.P.M. 300

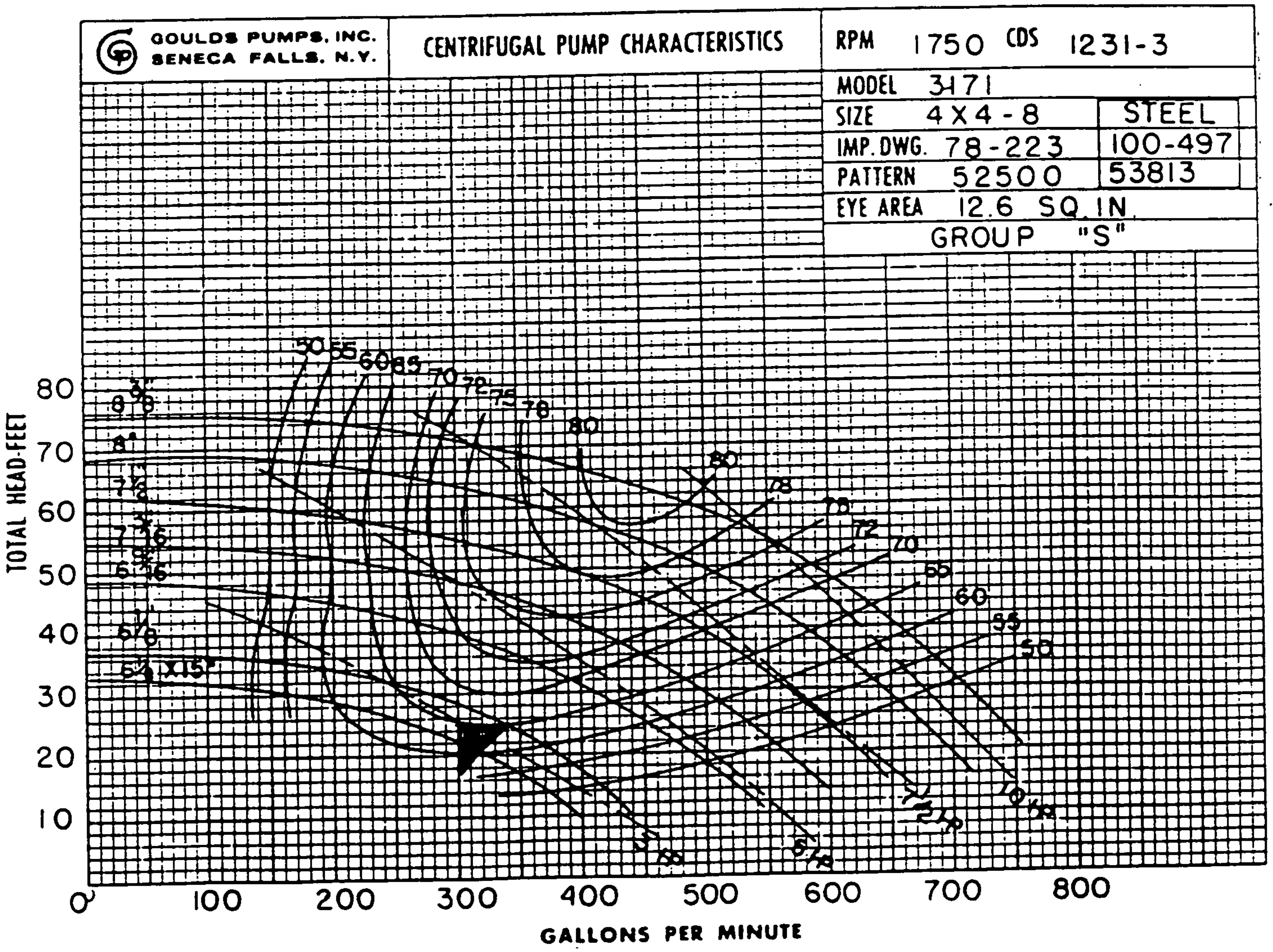
TOTAL HEAD 25'

EFF. %

CURVE NO. 1231-3

IMPELLER DIA. 6 1/8

GOULDS PUMPS INC. TEXAS OP.



**GOULDS PUMPS, INC.**
**SENECA FALLS, N.Y.**

CENTRIFUGAL PUMP CHARACTERISTICS

RPM 1750 CDS 1231-3

MODEL 3171

SIZE 4 X 4 - 8 STEEL

IMP. DWG. 78-223 100-497

PATTERN 52500 53813

EYE AREA 12.6 SQ. IN.

GROUP "S"

ENR005 GOULDS PUMPS. INC. 6/23/93 PAGE
SLURRY PUMP DIVISION REPLACEMENT PARTS DATA SHEET 13:53:18
MODEL 3171

PUMP SERIAL NUMBER 416A072 QUANTITY ORDERED 1
DESCRIPTION MOBILE OIL CORP 3171S 4X4-8 C/A DLK
FACTORY ORDER NUMBER 416072 DATE ORDERED 6/15/93
PURCHASE ORDER NUMBER BG3989X670
CUSTOMER MOBIL OIL CORPORATION
ACCTS. PAYABLE
P.O. BOX 1561
MERRIFIELD VA 22116

PUMP B/M NUMBER 416072 S-NUMBER *********************
SIZE: 3171S 4X4-8
OPERATING CONDITIONS: GPM 300. TDH 25'. RPM 1750
MOTOR DESCRIPTION: 5HP.1800RPM.184TC.XP.3/60/460

| | ITEM | DESCRIPTION | QTY | PART NUMBER |
|---|---|---|---|---|
| * | | SLEEVE CPLG WOODS 7S | 1 | 84777 3 0000 |
| * | | HUB WOODS 7S 1.128 .25X.12 KWY | 1 | 91755 12 0000 |
| | 100 | CSG 4X4-8 RDSN | 1 | D002898 1203 |
| * | 101 | IMPLR 4X4-8 6.12"DIA | 1 | 100-497 261203 |
| * | 111 | CVR BRG DR ST /S GP RBR | 1 | B001778 0000 |
| * | 112 | BRG BALL | 1 | 3049 305000000 |
| * | 122 | PUMPSHAFT S GP RDSN W/O USB | 1 | D00247B19 2216 → 339 |
| * | 123 | DEFLECTOR RDSN | 2 | A00187B01 5121 |
| * | 136 | ASSY NUT LK BRG DR | 1 | 8601 0005 0000 |
| * | 155 | COLLAR CSG TEF ST S WP ENCL | 1 | B00590B01 0000 |
| * | 178 | KEY SQ IMPLR .25X.25 | 1 | 49589 116 2229 |
| * | 178 | KEY SQ .18X.18 1.75LG | 1 | 49589 57 2210 |
| * | 182 | CVR SUCT 4X4-8 | 1 | 100-489 1203 |
| | 187 | STRAINER 2X3-8 4X4-8 (54241) | 1 | 101-31 1203 |
| | 189 | SPRT PL .75 26.5IN DIA | 1 | 82-172 1 3201 |
| | 190 | TBG 316SS .37"OD 20GA | 91 | 4207 061204207 |
| | 192 | COLUMN HD ST GP RDSN | 1 | C00744B08 6504 |
| | 192 | EXT COL RDSN | 1 | B00319B03 6504 |
| | 195 | ELBOW DISCH 4X4-8 4X6-13 | 1 | 82-81 1203 |
| | 195 | PIPE 316SS SCHED 40 4IN DIA | 125 | 6504 0064 6504 |
| | 195 | PIPE DISCH 4X4-8 4IN | 1 | B00308B20 6504 |
| * | 197 | BRG STDY RBR ST S GP RDSN | 2 | B00277B03 0000 |
| * | 198 | SCREW IMPLR S GP 1.0IN | 1 | B00055B06 2229 |
| * | 199 | WASHER PLAIN BOLT SIZE .50" | 10 | A00189B02 2229 |
| * | 199 | WASHER .50" SAE | 4 | 49519 57 2229 |
| * | 199 | WASHER IMPLR .531ID 1.250D S | 1 | A00027B02 2229 |
| * | 199 | WASHER LOCK HEL SPRING .50" | 12 | 49522 7 2210 |
| * | 199 | ASSY WSHR LOCK BRG DR | 1 | 8910 0005 0000 |
| | 213 | HSG STDY BRG 316SS RDSN | 1 | C00802B01 1203 |
| | 213 | SHELL BRG ST/S GP MTR SUP | 1 | C01934B 1000 |
| | 240 | MOTOR SPRT C-FACE LTR 8 2000 | 1 | D01547B 1000 |
| | 242 | PLUG PIPE HEX HD .25IN 18NPT | 1 | 63122 2 2229 |
| | 242 | PLUG PIPE HEX HD .25IN 18NPT | 5 | 63122 2 2210 |
| | 242 | PLUG PIPE HEX HD .25IN 18NPT | 1 | 63122 2 2229 |
| | 242 | NUT PIPE 4IN DIA NPSF | 2 | 72552 1203 |
| | 242 | CONN CPRSN ML .37X.25 | 3 | 8875 0604 0000 |

ENR005 GOULDS PUMPS, INC. 6/23/93 PAGE
SLURRY PUMP DIVISION REPLACEMENT PARTS DATA SHEET 13:53:18
MODEL 3171

PUMP SERIAL NUMBER 416A072 QUANTITY ORDERED 1
DESCRIPTION MOBILE OIL CORP 3171S 4X4-3 C/A DLK
FACTORY ORDER NUMBER 416072 DATE ORDERED 6/15/93
PURCHASE ORDER NUMBER BG3989X670
CUSTOMER MOBIL OIL CORPORATION
ACCTS. PAYABLE
P.O. BOX 1561
MERRIFIELD VA 22116

PUMP B/M NUMBER 416072 S-NUMBER ********************

| ITEM | DESCRIPTION | QTY | PART NUMBER |
|---|---|---|---|
| 242 | ELBOW COMP ML .37X.25 | 1 | 8875 106040000 |
| 242 | TEE ML BR .37TX.25P 6-SBU-SS | 1 | 8877 106040000 |
| 245 | NAMEPLATE ROTATION | 1 | A020219 3211 |
| * 333 | SEAL OIL | 1 | 8690 470710000 |
| 351 | GASKET CVR SUCT S GP .0001THK | 1 | 27218 2 5136 |
| 351 | GASKET DISCH FLG 4X4-3 0006 | 1 | 70038 8 5136 |
| * 361 | RING RTNG SS N5008 AISI632 | 2 | A0025081620000 |
| * 361 | RING RTNG DR ASSY ST/S | 1 | 53101 244 0000 |
| 370 | NUT HEX STDTHD UNC CL2B .62IN | 4 | 49507 109 2229 |
| 370 | SCR CAP HEX .50-13 UNC 1.25"LG | 4 | 49511 203 2229 |
| 370 | SCR CAP HEX .50-13 UNC 2.00"LG | 6 | 49511 206 2229 |
| 370 | SCR CAP HEX .62-11UNCX1.50" LG | 2 | 49511 252 2229 |
| 370 | SCR CAP HEX .62-11 UNC 2.75"LG | 4 | 49511 257 2229 |
| 370 | SCR CAP HEX .50-13 UNC 2.50"LG | 6 | 49511 209 2229 |
| 370 | SCREW,DRIVE TYPE U 1/4" | 2 | 91778-003-2226 |
| 370 | NUT HEX STD THD HVY JAM .37IN | 3 | 49507 54 2210 |
| 370 | SCR CAP HEX .50-13 UNC 1.20"LG | 4 | 49511 203 2210 |
| 370 | SCR CAP HEX .50-13 UNC 1.50"LG | 14 | 49511 204 2229 |
| 370 | BOLT TAP HEX .38X2"LG | 4 | 49521 107 2210 |
| 370 | BOLT TAP HEX .38X2.25"LG | 3 | 49521 108 2210 |
| 370 | ASSY FTG RELIEF DR | 1 | 72416 03000000 |
| 370 | ASSY FTG LUB DR | 1 | 9008 017280000 |
| 370 | SCREW,DRIVE TYPE U 1/4" | 2 | 91778-003-2226 |
| 501 | CPLG GUARD WO/USB | 1 | 802861802 3122 |

* – RECOMMENDED SPARE PARTS

# GOULDS PUMPS

## Installation, Operation and Maintenance Instructions

**MODELS 3171, 3172, 3173, 3174**

# Foreword

The design, material, and workmanship incorporated in the construction of Goulds Pumps makes them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by correct application, proper installation, periodic inspection and careful maintenance. This instruction manual was prepared to assist operators in understanding the construction and the correct methods of installing, operating and maintaining these pumps.

Study thoroughly Sections I, II, III, IV and V and carefully follow the instructions for installation and operation. Sections VI and VII are answers to trouble and maintenance questions. Keep this instruction manual handy for reference. Further information can be obtained by contacting the Engineering Application Division, Goulds Pumps, Inc., Lubbock, Texas, or your local branch office.

**WARNING:** Goulds Pumps, Inc. will not be liable for any damages or delay caused by failure to comply with the provisions of this instruction manual.

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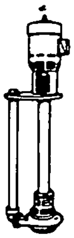
# TABLE OF CONTENTS

# SECTION I — DESCRIPTION OF UNITS

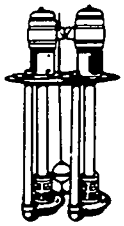
## I-A. Model 3171



**Submerged or Wet Pit Type — Single Unit**

With this type of unit the pump is placed directly into a sump or vessel using either the standard support plate or a combination of support plate and optional pit cover. Optional liquid level controls can be furnished to start and stop pump motor automatically.

## I-B. Model 3172



**Submerged or Wet Pit Type — Duplex Unit**

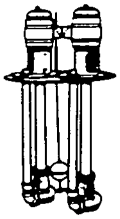
Identical to Model 3171 except that two pumps are mounted on a pit cover. Pit cover is necessary for unit to be identified as a Model 3172. The optional float control normally furnished is an alternator which controls both pumps automatically.

## I-C. Model 3173

**Dry Pit Type — Single Unit**

This unit is usually mounted in a dry pit or other enclosure depending upon user's requirements. Suction flange is provided in place of strainer for connection to liquid supply source. Casing contains a conventional packed stuffing box. Level controls are optional.

## I-D. Model 3174



**Dry Pit Type — Duplex Unit**

Same as Model 3173 except two pumps are mounted on a common pit cover.

**IMPORTANT:**

1. Standard pump rotation is clockwise looking downwards. See arrow on motor support.
   Operating pump in the wrong rotation may cause severe damage. Provide check valve to stop back flow and backward rotation.
2. Avoid undue impacts or shocks while handling pump assembly.
3. Never force pump parts during assembly.
4. Steady Bearings — Steady bearings are supplied in various optional constructions depending on the service. Refer to Section III for bearing lubrication.
5. Impeller is an open design for a wide range of industrial applications — corrosives, non-corrosives, clean, dirty, slurries or solids. Refer to Section VII-B for impeller adjustment.
6. Do not put pipe strain or bending moments on discharge piping. Piping should be independently supported and should line up naturally with the pump discharge connection.

# SECTION II — INSTALLATION

## II-A. Storage, Uncrating & Handling

### Storage

Goulds normal domestic storage preparation is suitable for protecting the pump during shipment in covered trucks. It also provides protection during covered storage at the jobsite. If the pump is to be idle and exposed to the elements for an extended period, either before or after installation, special precautions are required. Special preservatives and wrapping may be required but must be removed after installation.

It is considered good practice to rotate the shaft approximately 30° every few weeks while the pump is in storage.

### Uncrating

Care should be taken when uncrating pumps. If shipment is not delivered in good order, and in accordance with the bill of lading, note the damage or shortage on both receipt and freight bill.

**Make any claims to the transportation company promptly.** Instruction sheets as well as the instruction book for the pump are included in the shipment — DO NOT DISCARD.

### Handling

Care should be used in moving pumps. Do not lift assembled unit by eyebolts, units should be slung under support plate and column.

## II-B. Preparation for Installation

Vertical units are shipped completely assembled, except for motor, level controls and external bearing flush (if required). Check all bolts and nuts on entire unit to make sure they are securely tightened. Install level controls per manufacturer's recommendations.

## II-C. Installation of Unit in Pit

1. Installation must be done with care to avoid damage and to insure proper operation.
2. Check clearance between the unit and pit. There must be at least ½ inch clearance between the sides of pumping unit and any portion of the pit. There should be 4 to 6 inches from the bottom of the pump to the bottom of the pit.
3. Lower assembled pump (less motor) carefully into pit. Guide unit carefully so that it does not strike sides of pit.
4. When coverplate is supported on the pit, level the coverplate. Shim under coverplate when necessary to level unit. Pump must hang straight down to avoid placing a bending stress on the unit. Bolt coverplate to the supports on the pit.

## II-D. Assembly of Motor to Motor Support

If motor is shipped from Goulds' factory, both coupling halves will be assembled on shafts in their correct positions. If motor is shipped direct or furnished by customer, the motor half coupling must be fitted on motor shaft..

Place motor on motor support (240) and tighten bolts snugly.

## II-E. Rotation Check

Before coupling is connected, motor should be wired and the direction of rotation checked. A rotation arrow is located on the coverplate. *Serious damage could occur if pump is run in wrong direction.* Standard rotation for Model 3171 is CW as viewed from the driver.

## II-F. Connection of Piping

Connect discharge pipe to discharge connection above coverplate. This pipe should be as direct as possible, and should have a minimum number of fittings. A gate valve should be used for flow control.

## II-G. Alignment of Flexible Coupling

Alignment of the pump and motor through the flexible coupling is of extreme importance for trouble-free mechanical operation.

Check for coupling alignment by laying a straight edge across both coupling rims at four points 90° apart. When the straight edge rests evenly at all four points, the coupling will be in correct alignment.

Tighten motor mounting bolts.

## II-H. Impeller Adjustment

Impeller clearance is adjusted at the factory but should always be re-adjusted prior to pump operation.

Clearance between impeller and casing should be checked using procedure in VII-B.

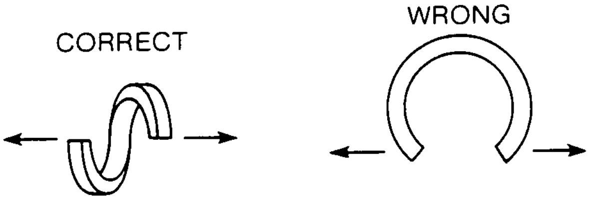
## II-J. Connection of Flexible Coupling

Connect coupling, following instructions furnished in the box of fittings, for the particular make of coupling used. This data is supplied separately, giving complete instructions for connection, lubrication, alignment, and maintenance.

## II-K. Stuffing Boxes

### 1. Packing — Upper Stuffing Box.

An upper stuffing box is available as an option when it is desirable to seal vapors, fumes, etc. in the sump or tank. Die-formed packing rings are supplied and special care must be used during installation. To install, twist the ring sideways just enough to get it around the shaft. **Do not attempt to pull rings straight out.** See Figure 1.



STUFFING BOX PACKING

**Figure 1**

Two piece Teflon lantern rings are supplied as standard. Install as shown in Figure 2. **Note: 2 pieces make one ring. Notches must face one another but need not be aligned.**

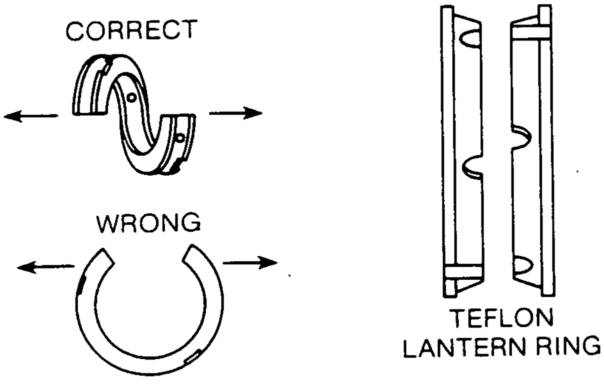


**Figure 2**

Packing and lantern rings are shipped loose and must be installed at startup. To pack the stuffing box, install the packing and lantern ring in the proper sequence, 3 rings, lantern ring, 2 rings, gland. Firmly seat each ring. Stagger joints in each ring 90°. Make sure center of lantern ring lines up with flush tap in the stuffing box.

Since the upper stuffing box seals vapors only, there is no leakage at the gland. Standard lubrication is by a grease cup lubricator. The handle or top should be given a turn or two every 100 hours of operation. Sealing liquid may be supplied through a line from the discharge pipe if the pump fluid is clean. If it is abrasive, an outside source of clean liquid should be used. After the packing has been completely run in, at least 40 to 60 drops per minute should be allowed to trickle from the stuffing box at all times with a clean liquid flush.

### 2. Packing — Dry Pit — Model 3173

For dry pit (see Figure 3) applications, the 3171 casing is furnished with a stuffing box, gland and an open column adapter to facilitate installation and removal of packing rings. The stuffing box in this application is used to seal leakage from the casing in the same manner as a horizontal pump.

Installation and lubrication of the packing rings and lantern ring is identical to section II-K 1.

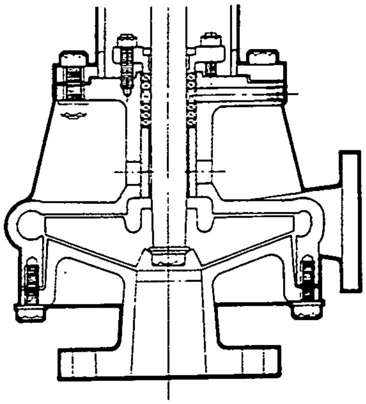


Figure 3

### 3. Mechanical Seals.

When mechanical seals are furnished, they are installed and adjusted at the factory. To properly prepare the seal for operation, lubrication or flush lines must be connected. Standard lubrication is an oil reservoir — gravity fed directly to the seal face. Separate seal manufacturer's installation drawings are attached to the pump and should be filed for future use in maintaining the seal and in adjusting the seal when the pump is disassembled.

## II-L. Float Controls

PARTS LIST

| Item No. | No. Req'd. Per Pump | Part Name | Construction | | |
|---|---|---|---|---|---|
| | | | Class A | Class B | Class C |
| 334 | 1 | Float Rod | Steel or Brass | 316SS | 316SS |
| 335 | 4 | Float Rod Collar | Steel or Brass | 316SS | 316SS |
| 336 | 1 | Lower Float Rod Guide | Steel or Brass | | 316SS |
| 337 | 1 | Upper Fl. Rod Guide Pipe | Steel | | |
| 339 | 1 | Float Switch or Alternator | — | — | — |
| 342 | 1 | Float | Steel or Copper | 316SS | 316SS |
| 366 | 1 | Lower Fl. Rod Guide Arm | Steel or Brass | | 316SS |
| 398 | 1 | Float Switch Bracket | 1000 | | |
| 435 | 1 | Float Switch Support Pipe | Steel | | |
| 437 | 1 | Pit Cover (optional) | Steel | | |

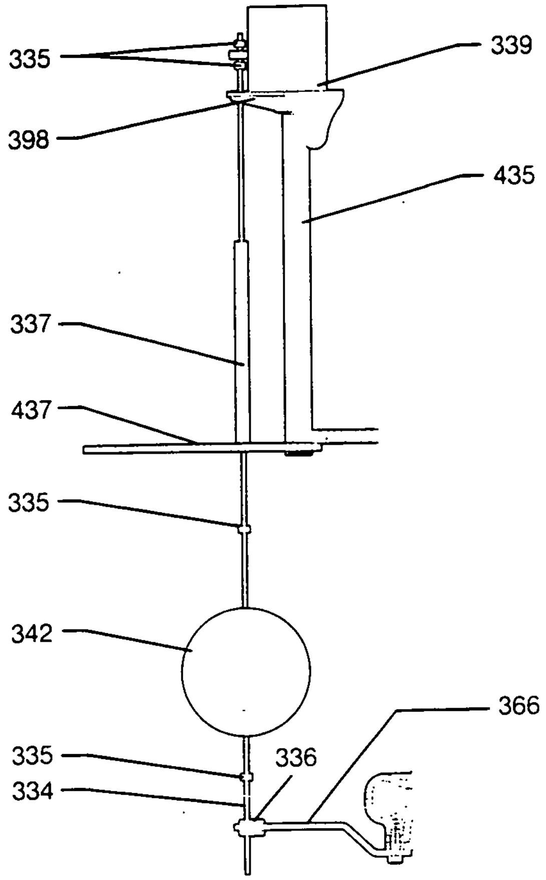


Figure 4

### A. Float Switch Level Control

A single float and rod assembly is used with the float switch on a simplex unit or with the alternator on a duplex unit. See Figure 4 for installation. The center hole float, Item 342, rides free on the float rod, Item 334, as the water level changes. On and off water levels can be adjusted by moving collars, Item 335. As the liquid level rises, the float contacts the upper collar and upward movement of the float rod causes the mechanical contacts inside the control to close, completing the circuit to the magnetic starter and starts the pump. Operation continues until liquid level drops below ball level.

### B. Mechanical Alternator

Mechanical alternators for duplex operation use standard ball and rod assemblies as described. Mechanical contacts inside alternator complete circuit to magnetic starter and start first pump. Operation continues until liquid level drops below ball level. Repeat cycle completes circuit through second set of contacts and starts second pump. In the event of single pump failure or peak pumping demands, inactive pump is automatically started.

### C. High Water Alarms

The standard high water alarm is used as a switch to activate an external alarm when the liquid level rises to a preset position. Switch is mounted on a pipe above the support plate. A steel pipe connected to the same connection extends vertically into the sump. As liquid level rises beyond the pipe end, air inside pipe compresses alarm diaphragm and closes the switch. One alarm assembly is recommended for each wet pit installation.

# SECTION III — PREPARATION FOR OPERATION

## III-A. Pump Bearings

1. **Thrust Bearing** — Ball bearings are standard on all 3171 units and are lubricated at the factory. Do not grease at too frequent intervals. To grease bearings insert grease thru the lube fitting while rotating the shaft until grease appears thru the relief fitting.
2. **Steady Bearings**
   (a) **Carbon or Carbon Filled Teflon**

   These bearings are chemically inert in most liquids and can be used in liquids up to the temperature limits of the pump. They should not be used in liquids containing abrasive solids.

   These bearings require no lubrication, however clear flush from the support plate may be furnished if desired.

   (b) **Fluted Rubber or Viton**

   These bearings consist of fluted rubber or Viton contained within a metal shell. Clear water from an outside source, 1 to 2 GPM, is required to each bearing housing. They are ideally suited for liquids containing abrasive solids but are limited to 160° F temperature liquid. Corrosion resistant shafting is required.

   Viton is usually more applicable to slightly more corrosive services.

   (c) **Metallic Bearings**

   Both cast iron and bronze steady bearings are available and must be grease lubricated. Lack of lubrication can lead to galling and eventual seizing. It becomes extremely difficult to keep enough grease in the housing when handling hot liquids, caustic solutions or solvents.

   Unless an adequate maintenance program exists, it is recommended that a self-lubricating bearing such as carbon be used in place of the metallic bearing.

   (d) **Sealed Bearings**

   Recommended for abrasive liquids where no outside flush is available. The carbon bearing is sealed within the housing by two lip seals and filled by grease by a pressure lubricator located above the support plate. The pressure cup must be kept full of grease.

## III-B. Motor Bearing and Coupling

Check to be sure the motor bearings and coupling are properly lubricated. Refer to manufacturer's recommendations.

# SECTION IV — STARTING PUMP

## IV-A. Priming

Before starting the pump, check impeller centerline submergence. The pump must be full of liquid with specified submergence head above centerline of the impeller.

Do not run the pump dry, as this might damage pump parts or steady bearings. Do not run the pump without a clear outside flush to each steady bearing housing if it is required.

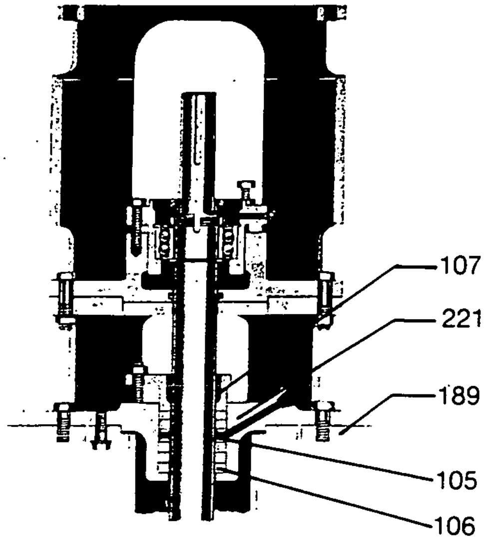
## IV-B. Flush Flows

Before pump is started, the flushing flow specified in Section III should be started (when furnished).

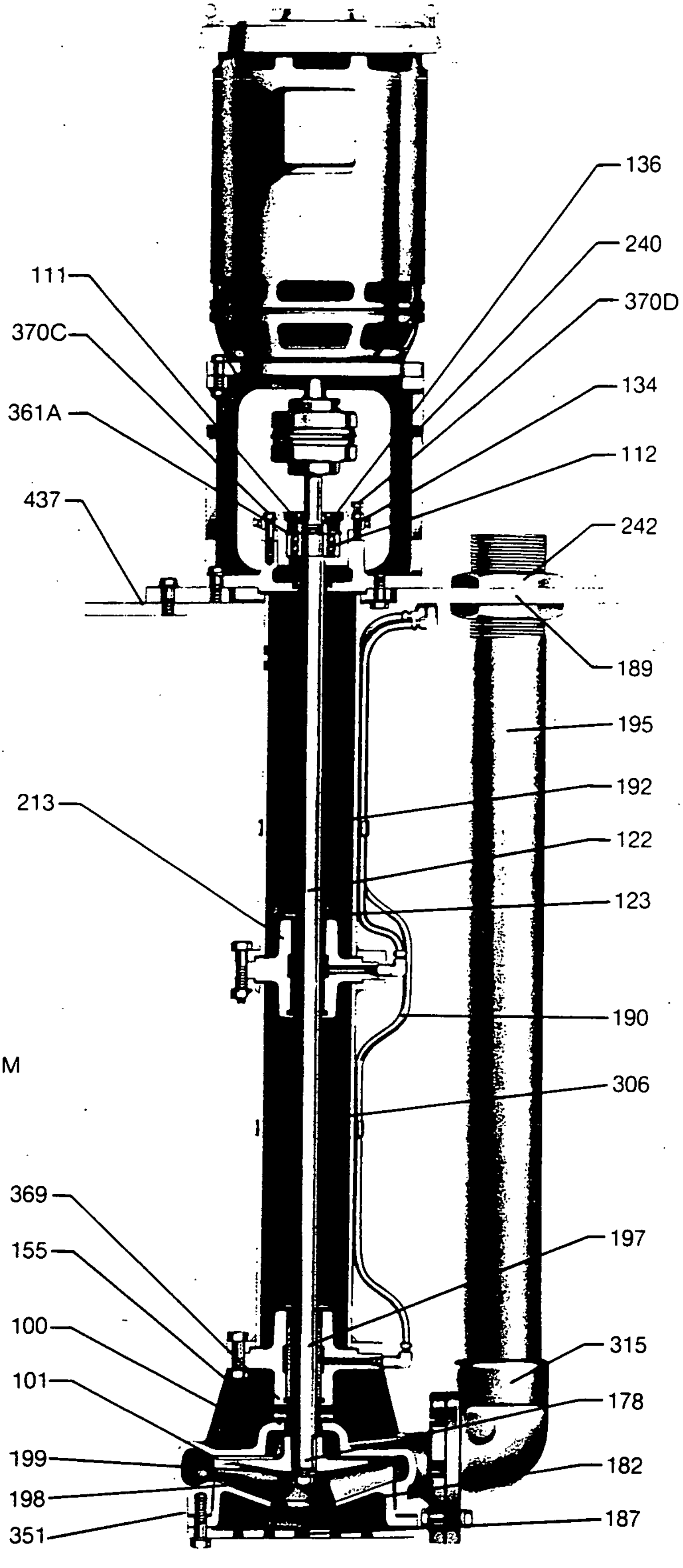
## IV-C. Check for Free Turning

Before pump is started, rotate the pump by hand to be sure it turns freely, and does not rub or bind.

## V-E. Sectional View, Parts List and Materials of Construction



Upper Stuffing Box



### Materials of Construction

| | |
|---|---|
| **1000** | Cast Iron ASTM A48 |
| **1102** | Bronze ASTM B584 C83600 |
| **316** | Stainless Steel ASTM A276 Type 316 (Wrought), ASTM A296 Gr. CF-8M (Cast) |
| **GA-20** | Cast Gould-A-Loy 20 ASTM A296 Gr. CN-7M |
| **C-20** | Wrought Carpenter 20 CB3 ASTM B473 |

## Parts List and Materials of Construction

| Item No. | No. Req'd. Per Pump | Part Name | Standard Materials of Construction | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | All Iron | Bronze Fitted | All Bronze | All 316SS | All Alloy 20 | All Hastelloy B or C |
| 100 | 1 | Casing | 1000 | | 1102 | 316 | GA-20 | Hastelloy |
| 101 | 1 | Impeller | 1000 | 1102 | | 316 | GA-20 | Hastelloy |
| 105 | 1 | Upper Stuffing Box Lantern Ring | Teflon | | | | | |
| 106 | 1 Set | Upper Stuffing Box Packing | — Non-Asbestos — | | | | | |
| 107 | 1 | Upper Stuffing Box Gland | 1000 or as Specified | | | | | |
| 111 | 1 | Bearing End Cover | Buna-N | | | | | |
| 112 | 1 | Ball Bearing | Steel | | | | | |
| 122 | 1 | Pump Shaft | Steel | | 316 | | C-20 | Hastelloy |
| 123 | ▲ | Deflector | Buna-N | | | | | |
| 134 | 1 | Bearing Shell | 1000 | | | | | |
| 136 | 1 | Bearing Lock Nut | Steel | | | | | |
| 155 | 1 | Casing Bushing | Carbon Teflon | | | | | |
| 178 | 1 | Impeller Key | 316 | | | | C-20 | Hastelloy |
| 182 | 1 | Suction Cover | 1000 | | 1102 | 316 | GA-20 | Hastelloy |
| 187 | 1 | Strainer | 1000 | | 1102 | 316 | GA-20 | Hastelloy |
| 189 | 1 | Pump Support Plate | Steel or as Specified | | | | | |
| 190 | ▲ | Lubrication or Flush Pipe (When Used) | Steel | | 316 | | C-20 | Hastelloy |
| 192 | 1 | Head Column | Steel | | Brass | 316 | C-20 | Hastelloy |
| 195 | 1 | Discharge Pipe | Steel | | Brass | 316 | C-20 | Hastelloy |
| 197 | ▲ | Steady Bearings | Carbon ■ | | | | | |
| 198 | 1 | Impeller Screw | 316 | | | 316 | C-20 | Hastelloy |
| 199 | 1 | Impeller Washer | 316 | | | 316 | C-20 | Hastelloy |
| 213 | ▲ | Steady Bearing Housing | 1000 | | 1102 | 316 | GA-20 | Hastelloy |
| 221 | 1 | Upper Stuffing Box (When Used) | 1000 or as Specified | | | | | |
| 240 | 1 | Motor Support | 1000 | | | | | |
| 242 | 1 | Pipe Collar (Discharge Pipe) | 1000 | | | | | |
| 306 | ▲ | Column Extension | Steel | | Brass | 316 | C-20 | Hastelloy |
| 315 | 1 | Discharge Elbow | 1000 | | 1102 | 316 | GA-20 | Hastelloy |
| 351 | 1 | Gasket — Suction Cover to Casing | Nitrile Acrylic | | | | | |
| 361-A | 1 | Retaining Ring — Ball Bearing | Steel | | | | | |
| 369 | ▲ | Retaining Ring — Steady Bearing | 316 | | | | C-20 | Hastelloy |
| 370-C | 3 | Hex Head Tap Bolts — Bearing Shell to Bearing Housing | Steel | | | | | |
| 370-D | 3 | Hex Head Tap Bolts — Adjustable | Steel | | | | | |
| 437 | 1 | Pit Cover (Optional) (not illus.) | Steel | | | | | |

▲ Dependent on pit depth.
■ Also available in rubber, carbon, viton, teflon, bronze and iron
Use 316 or alloy shaft with rubber or viton bearings.

## Construction Details

| | | | ST | | | S | | | | | | M | | | | | | MT | | L | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 x 1-5 | 1 x 1½-6 | 1½ x 3-6 | 1 x 1½-8 | 1½ x 2-8 | 2½ x 3-8 | 4 x 4-8 | 1½ x 2-11 | 2½ x 3-11 | 3 x 4-11 | 4 x 6-11H | 1½ x 3-13 | 2½ x 3-13 | 3 x 4-13 | 4 x 6-13 | 1½ x 2-8 | 2½ x 3-8 | 6 x 8-13 | 8 x 10-11 |
| Pump | Weight—2 Foot Depth—Less Motor | †Lb. (kg) | 275 (125) | 280 (127) | 295 (134) | 305 (138) | 315 (143) | 325 (147) | 390 (179) | 385 (175) | 425 (197) | 540 (245) | 590 (268) | 535 (243) | 550 (449) | 570 (259) | 600 (272) | 325 (147) | 335 (152) | 830 (376) | 910 (413) |
| | Weight—Add for Each 6" of Length | †Lb. (kg) | 13 (6) | 14 (6) | 15 (7) | 14 (6) | 14 (6) | 15 (7) | 17 (8) | 14 (6) | 15 (7) | 20 (9) | 20 (9) | 19 (9) | 19 (9) | 20 (9) | 20 (9) | 14 (6) | 15 (7) | 35 (16) | 40 (18) |
| | Weight—Add for Upper Stuffing Box | †Lb. (kg) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 35 (16) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 40 (18) | 100 (45) | 100 (45) |
| | Casing Thickness—Volute | in. (mm) | 5/15 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 3/8 (10) | 3/8 (10) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 7/16 (11) | 1/2 (13) | 1/2 (13) | 5/16 (8) | 3/8 (10) | 9/16 (14) | 9/16 (14) |
| | Casing Thickness—Side Walls | in. (mm) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 5/16 (8) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 3/8 (10) | 7/16 (11) | 7/16 (11) | 5/16 (8) | 5/16 (8) | 1/2 (13) | 1/2 (J3) |
| | Maximum Diameter of Solids | in. (mm) | 3/16 (5) | 1/4 (6) | 1/2 (13) | 9/32 (7) | 9/32 (7) | 15/16 (24) | 15/16 (24) | 11/32 (9) | 19/32 (15) | 19/32 (15) | 1 1/8 (29) | 1/4 (6) | 19/32 (15) | 19/32 (15) | 19/32 (15) | 9/32 (7) | 15/16 (24) | 19/32 (15) | 1 3/16 (30) |
| Shaft | Diameter at Impeller | in. (mm) | 11/16 (17) | | | Tapered .1.1118 (28) Large End | | | | | | Tapered 1.585 (40) Large End | | | | | | | | Tapered 2.222 (56) Large End | |
| | Diameter at Coupling End | in. (mm) | 7/8 (22) | | | | | | | | | 1 3/8 (35) | | | | | | | | 1 7/8 (48) | |
| | Diameter at Steady Bearing | in. (mm) | 1 1/8 (29) | | | | | | | | | 1 5/8 (41) | | | | | | | | 2 1/4 (57) | |
| Bearings | Ball Bearing | | MRC-5305 or Equal | | | | | | | | | MRC 5308 or Equal | | | | | | | | MRC 5311 or Equal | |
| | Steady Bearing—Sleeve Type | in. (mm) | 1 1/8 I.D. x 1 5/8 O.D. x 3 1/2 LG.<br>(29 x 41 x 89) | | | | | | | | | 1 5/8 I.D. x 2 1/8 O.D. x 4 LG.<br>(41 x 54 x 102) | | | | | | | | 2 1/4 I.D x 2 15/16 O D.x6 9/16 LG.<br>(57x75x167) | |
| General | Maximum Total Working Pressure—Casing | | 150 PSI (1034 kPa) | | | | | | | | | | | | | | | | | | |
| | Maximum Test Pressure—Casing | | 225 PSI (1551 kPa) | | | | | | | | | | | | | | | | | | |
| | Max Liquid Temp.—Without Up. Stuff. Box | | 180° F (82° C) | | | | | | | | | | | | | | | | | | |
| | Max. Liquid Temp.—Up. Stuff. Box—Cooling | | 450° F (232° C)* | | | | | | | | | | | | | | | | | | |

* Higher temperatures can be handled. Refer application to factory with complete data.
† Group L is for 3 foot pit depth.

# SECTION V — OPERATION

## V-A. Operating at Reduced Capacities

A centrifugal pump should never be operated continuously near shut-off or zero capacity, or with the discharge valve closed. To do so may shorten the life of the pump and greatly increase down time and maintenance.

Operation with the discharge valve closed will cause a temperature increase in the liquid within the casing on dry pit applications. If this condition exists over a long period, the temperature of the liquid may increase until the boiling point is reached. If this occurs, the rotating parts are exposed to vapor and may score or seize to stationary parts.

Hydraulic radial thrust is unbalanced when the pump is operating near shut-off and this subjects the shaft to abnormal deflection and accelerated lower steady bearing wear. The pump will be noisy, will vibrate excessively and may result in shaft breakage.

A simple method of relieving the pump of undue strain is to extend a by-pass line from the pump discharge line back to the sump or tank. A throttle valve or an orifice plate should be placed in the by-pass line and sufficient flow returned to allow the pump to operate at a capacity reasonably near its rating. The by-passed liquid should always be returned to the source of supply and discharged below the liquid level to avoid air entrainment.

## V-B. Operating at Reduced Head

On motor driven pumps, when discharge head or pressure is dropped considerably below the rated point for any length of time, the motor should be watched for overloading. If this condition is likely to persist, arrangements should be made either to manually or automatically throttle the discharge valve to build up head to a safe point.

## V-C. Operating with Surge Conditions In Line

If pump is installed with a quick closing valve in discharge line that closes when pump is running, dangerous pressure surges may be built up that can cause damage to the pump or line. In services of this kind, some cushioning arrangement must be provided to protect the pumping equipment.

## V-D. Freezing Conditions

When exposed to freezing conditions and pump is standing idle, liquid inside dry pit units should be drained to prevent freezing and pump damage. Water flush lines should also be protected from freezing.

# SECTION VI — TROUBLE CHECK LIST

## VI-A. No Liquid Delivered

1. Priming — casing and suction pipe not completely filled with liquid on dry pit units. No liquid in pit on wet pit units.
2. Speed too low.
3. Discharge head too high. Check total head (particularly friction loss).
4. Suction lift too high (suction pipe may be too small or long, causing excessive friction loss). Check with vacuum or compound gauge.
5. Impeller, suction pipe or strainer completely plugged.
6. Wrong direction of rotation.
7. Air pocket in suction line.
8. Not enough suction head for hot or volatile liquids. Check carefully as this is a frequent cause of trouble on such service.

## VI-B. Not Enough Liquid Delivered

1. Priming — no liquid in pit on wet pit units.
2. Speed too low.
3. Discharge head higher than anticipated. Check total head (particularly friction loss).
4. Suction lift too high (suction pipe may be too small or long, causing excessive friction loss). Check with vacuum or compound gauge.
5. Impeller, suction pipe or strainer partially plugged.
6. Wrong direction of rotation.
7. Not enough suction head for hot or volatile liquids. Check carefully as this is a frequent cause of trouble on such service.
8. Mechanical Defects:
   a. Impeller clearance too great.
   b. Impeller damage.

## VI-C. Not Enough Pressure

1. Speed too low.
2. Air or gases in liquid.
3. Impeller diameter may be too small.
4. Mechanical defects:
   a. Impeller clearance too great.
   b. Impeller damaged.
5. Wrong direction of rotation.
6. Be sure pressure gauge is in correct place on discharge nozzle or discharge pipe.
7. Impeller not properly adjusted.

## VI-D. Pump Works Awhile Then Quits

1. Check float controls.
2. Not enough suction head for hot or volatile liquids. Check carefully as this is a frequent cause of trouble on such service.
3. Air or gases in liquid.
4. Impeller suction pipe or strainer plugged.

### VI-E. Pump Takes Too Much Power

1. Speed too high.
2. Head lower than rating, pumps too much liquid.
3. Liquid heavier than anticipated. Check viscosity and specific gravity.
4. Mechanical defects:
   a. Shaft bent.
   b. Rotating element binds.
   c. Pump and driving unit misaligned.
5. Wrong direction of rotation.

### VI-F. Pump is Noisy

1. Hydraulic noise — cavitation, suction lift too high. Check with vacuum or compound gauge.
2. Mechanical Defects:
   a. Shaft bent.
   b. Rotating parts bind, are loose or broken.
   c. Bearings worn out.
   d. Pump and driving unit misaligned.
   e. Impeller rubbing on suction cover or casing.

When connected to electric motors, check whether motor wiring is correct and receives full voltage.

## SECTION VII — CARE & MAINTENANCE

### VII-A. Lubrication

1. Thrust Bearing. See Section III-A.
2. Steady Bearing. See Section III-A.
3. Motor Bearings and Coupling. Follow manufacturer's recommendation.

### VII-B. Adjusting Impeller Clearance

If a gradual loss in head and/or capacity occurs, performance can be restored by adjusting the impeller. It is also recommended that the impeller clearance be set at installation prior to start up.

To adjust the impeller clearance:

1. Disconnect Coupling.
2. Loosen adjustment bolts and jam nuts (D).
3. Tighten shell bolts (C) while rotating the shaft until impeller lightly contacts suction cover.

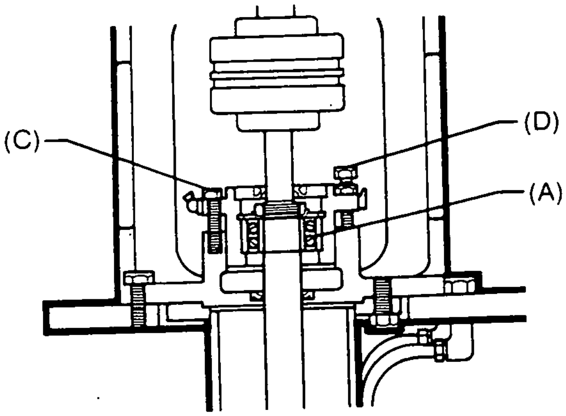


Figure 5

4. Loosen bolts (C) until a .015" feeler gauge can be inserted between the underside of the bolt head and the bearing shell (A).
5. Make sure jam nuts on bolts (D) are loose. Tighten bolts (D) evenly until bearing shell is tight against bolts (C). Make sure all bolts are tight. Tighten jam nuts.

With the above method, the rotating element and impeller have been moved .015" away from the suction cover, thus giving the required clearance between these two parts. Rotate shaft several times to check for free turning.

### VII-C. Disassembling Unit

To prepare pump for disassembly proceed as follows:

1. Lock out power supply to motor.
2. Shut off valves controlling flow from pump.
3. Drain liquid from dry pit units. If corrosive and/or toxic, use extreme caution.
4. Disconnect coupling.
5. Disconnect motor and remove motor from support.
6. Disconnect discharge pipe at the discharge flange.
7. Dismantle flow controls (when furnished).
8. Remove bolts holding mounting plate to support, and lift pump from the sump and lay horizontally on proper supports.
9. Remove stuffing box gland if any.

The numbers located on the following figures refer to the procedure steps. For example, Number 1 on Figure 6, refers to Step 1.

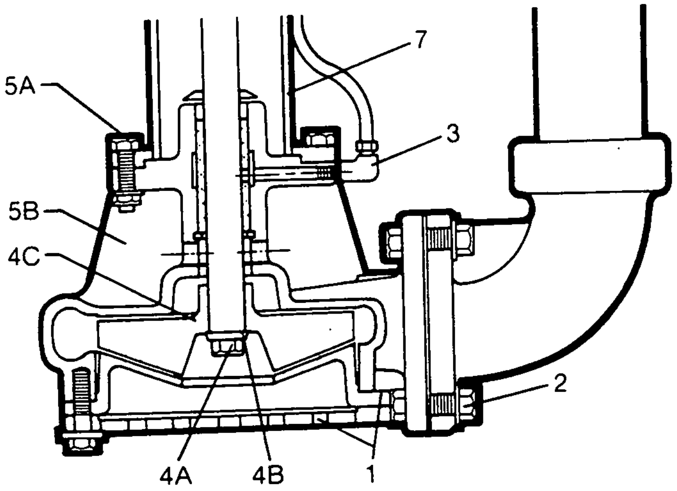


Figure 6

1. Remove strainer and suction cover.
2. Disconnect discharge pipe from casing.
3. Disconnect any steady bearing flush tubing.
4. Remove impeller screw (4A) and washer (4B) and pull impeller (4C) and key off shaft. Either of two methods can be used to remove the impeller:
   (a) Refer to Section VII-B and loosen bearing shell bolts (C) and jam nuts on bolts (D). Tighten bolts (D) until the impeller is pushed off the shaft.

(b) A puller, which pushes against the shaft can be used to pull the impeller off the shaft.

5. Remove column to casing bolts (5A) and pull casing (5B) from column.
6. Remove column to steady bearing housing bolts and slide column pipe off shaft. On longer units, there are one or more column pipes and steady bearing housings.

   Starting at the casing end of the pump, remove column pipes and steady bearing housings one at a time. While removing columns, support shaft to prevent bending and possible damage to the bearings. **Note: Match mark each column pipe-bearing housing joint to enable correct position of these parts during reassembly.**
7. Remove pump half coupling hub and key.
8. Remove bearing shell bolts and slide bearing shell assembly from bearing housing.
9. Remove adjustment bolts and jam nuts.
10. Remove end cover/lip seal from bearing shell. A screwdriver can be used to pry the seal from the housing.
11. Remove retaining ring and slide bearing shell off the bearing and shaft.
12. Remove bearing locknut and washer. Pull bearing off shaft with a puller.

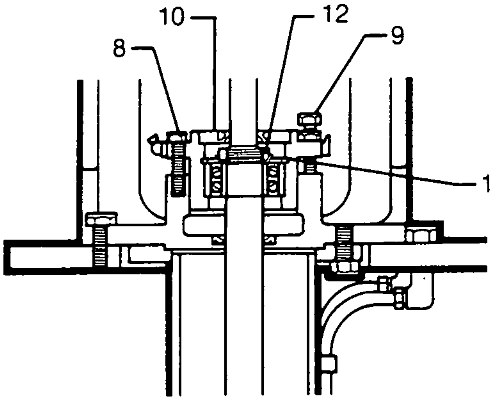


**Figure 7**

13. The motor support, bearing housing and upper stuffing box (if provided) need not be removed unless they are to be replaced. If pump has an upper stuffing box the packing and lantern ring should be replaced.
14. Steady bearings and casing bushing should not be removed unless they are to be replaced.

## VII-D. Inspection and Overhaul

1. **Impellers** — Replace if impeller shows excessive erosion, corrosion, extreme wear or vane breakage. Check impeller balance.
2. **Shafts** — Check shaft to see that it is straight. Bearing areas (ball and steady bearings) must be smooth and in good condition. Replace if necessary.
3. **Ball Bearings** — Replace if worn, loose or rough and noisy when rotated. New bearings should not be unwrapped until ready for use. Replacement bearings must be the proper size and type as specified. Refer to Construction Details, Section V-E.

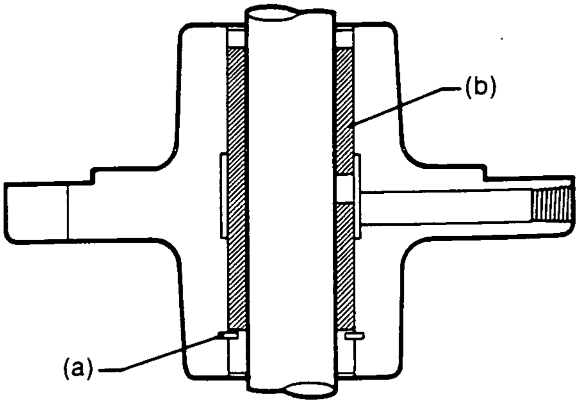


**Figure 8**

4. **Steady Bearings** — Check bearing bore for excessive wear and roughness. Replace worn or damaged bearings.

   To replace steady bearings (refer to Figure 8):
   - (a) Remove Truarc ring at bottom of housing or casing and casing bushing from casing.
   - (b) Press bearings from housing using a suitable tool.
   - (c) Apply a light coating of oil to the bore of bearing housing and the O.D. of bearings.
   - (d) Replace the Truarc ring in the steady bearing housing or casing and the casing bushing in the casing.
   - (e) Carefully press the new bearing into the housing down to the Truarc ring. It is not necessary to align the bearing lube holes with the housing lube hole.

For sealed bearing housings (refer to Figure 9):

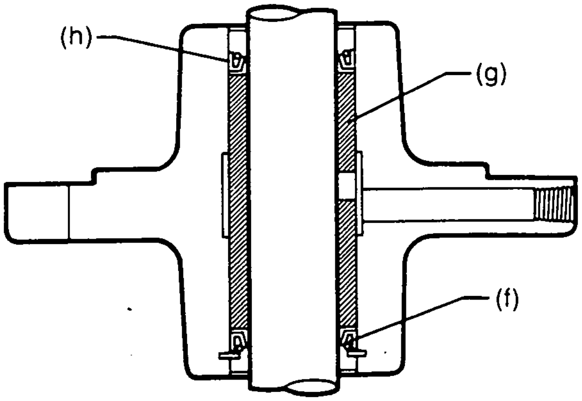


**Figure 9**

Repeat steps (a) thru (d) above.

(f) Press a new lip seal into the bearing housing down to the Truarc ring. Care should be taken to keep the seal "Square" as it is pressed.

(g) Press the new bearing down to the lip seal.

(h) Press the second lip seal down to the bearing.

All steady bearings within the same group have the same outside dimension. Any bearing material, metallic, graphite, fluted, etc. can be inter-changed within that housing without any modification (includes sealed bearings).

5. **Oil Seals** — Replace if torn or otherwise damaged. Seals are held by a press fit. Lips on seals should face outward (away from bearings).

## VII-E. Reassembly

This section covers reassembly of pump after complete disassembly. Make sure all directions in Section VII-D, Inspection and Overhaul, have been followed.

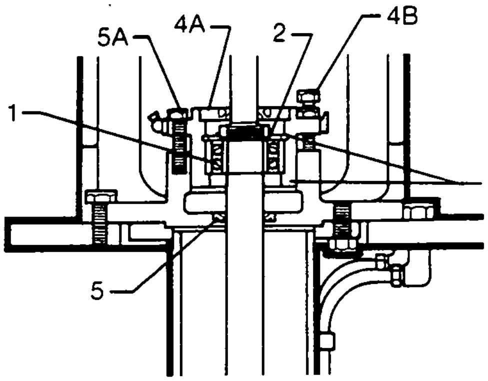


Figure 10

1. Lubricate bearing seat on shaft and slide the ball bearing on the shaft as far as possible by hand. Start the bearing square on the shaft and use a driving sleeve to firmly seat the bearing.
2. Place bearing lockwasher and locknut on shaft and tighten firmly. Bend tang on lockwasher into groove in locknut. A spanner wrench should be used to tighten the locknut.
3. Slide bearing shell on pump end of shaft and over bearing. Insert retaining ring in bearing shell groove keeping flat side of ring against bearing.
4. Slide bearing end cover (4A) over shaft and seat in shell, replace adjustment bolts (4B). Tighten jam nuts finger tight.
5. With the support plate in a vertical position, insert the shaft-bearing shell assembly into the bearing housing from the motor stand side. Do not damage bearing grease seal (5). Replace bearing shell to housing bolts (5A). Supports should be provided to support both the column pipe and the shaft.
6. Slide the head column over the pump shaft and against the bearing housing. Refer to Figure 11. The vent hole end of the column should be positioned near the support plate.

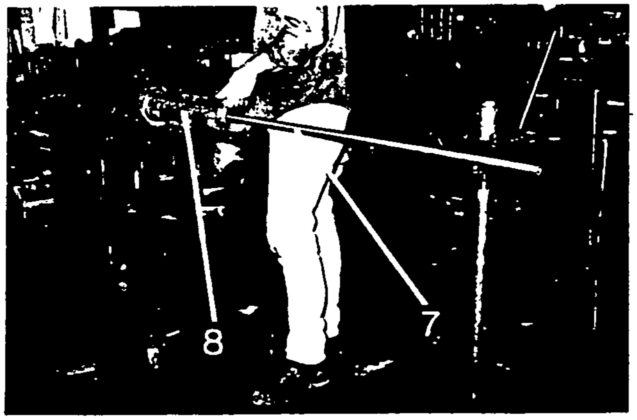


Figure 11

7. Slide a steady bearing housing (when furnished) against the column pipe flange. If flush tubing is used, make sure drilled flush opening in bearing housing flange matches location of holes in support plate.
8. Install additional column pipes and bearing housings, if any.
9. Install and bolt casing to column. Make sure discharge nozzle aligns with discharge pipe hole in support plate.
10. Add a film of oil to shaft and place impeller and key on shaft.
11. After loosening all bolts on the ball bearing shell, add the impeller screw (with fiber insert in place) and washer to end of shaft. Tightening the impeller screw will push the impeller the remaining distance on the shaft. Do not exceed the following torque values when tightening the impeller screw.
    Groups ST & S — 500 inch-pounds
    Groups M, MT, L — 900 inch-pounds
12. Place the suction cover (with gasket in place) and the strainer against the casing and bolt in place. If the unit is furnished with float controls, the lower float rod guide arm is fastened to the casing with an extra long bolt.
13. Check the axial travel of the impeller within the casing by using the procedure in Section VII-B. If the travel is less than .030", add gaskets between the suction cover and casing.
14. Connect discharge elbow and piping to casing.
15. Make sure that the discharge pipe collars (near support plate) are tight and that no strain has been placed on the pump. Rotate shaft by hand to assure that no binding is present.
16. Replace the pump half coupling hub.
17. Connect all auxiliary piping.
18. Lubricate pump bearings as described in Section III-A.
19. If unit has packed upper stuffing box or casing, repack box with new packing and lantern ring. Refer to Section II-K.
20. Follow directions in Sections I, II, III, IV and V for installation and operation. **Pay particular attention to instructions concerning alignment, rotation and impeller adjustment.**

## VII-F. Spare Parts

To insure against possible long and costly "downtime" periods, especially on critical services, it is advisable to have spare parts on hand.

1. One set of group parts should be maintained for every one to three pumps of that particular group size in operation. Pumps of the same group size and pit depth have all parts interchangeable except casing and impeller.

The following is a list of recommended group parts:

(a) Ball bearing - coupling end (112) — one required.

(b) Steady bearing (197) — quantity depends on pump length.

2. For each size pump it is suggested that one impeller (101) and one shaft (122) be maintained.

## VII-G. Instructions for Ordering Spare Parts

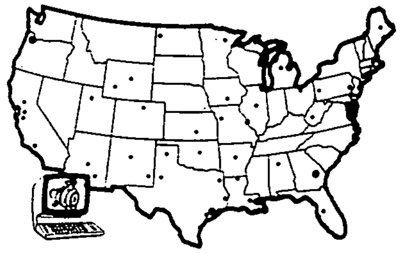
Only genuine "Goulds' Repair Parts" should be used in your Model 3171. To assure proper efficient pump operation, your orders should include:

1. Model number, size of the pump and serial number. This data can all be obtained from the nameplate.
2. Indicate the names, part numbers and materials of the parts required.
3. Give quantity of parts required.
4. Give complete billing and shipping instructions.

# A pump is only as good as its parts.

The Goulds pump featured in this instruction manual is made up of many different parts. All are engineered and precision manufactured to make the pump perform as intended. Therefore it's *most important* to make sure that you use only genuine Goulds replacement parts.

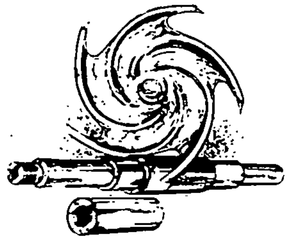
To assure that you can make no better choice than Goulds, we offer the best pump parts program in the industry. We call it "pump parts like never before" and very simply means unsurpassed *availability, service, quality* and *value*.



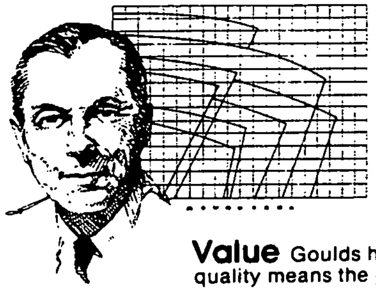
**Availability** A nationwide, computer-controlled distribution network backed by factory programs designed to get you the part you need — when you need it.

**Service** Our Certified Original Parts specialists are dedicated to serving your parts needs by:

- Helping minimize parts inventories
- Delivering parts
- Providing maintenance consultation service



**Quality** Goulds is committed to providing the highest *original* quality and sometimes *better* if design or material improvements have been made.



**Value** Goulds high standards of quality means the part will fit right and meet original standards of performance.

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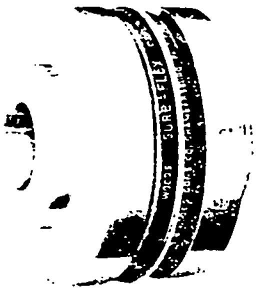
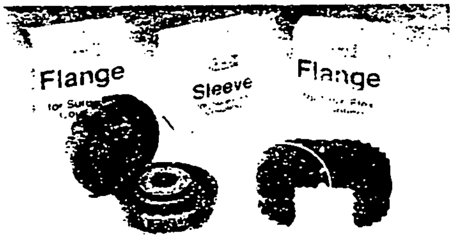
Form 741D

# Wood's Sure-Flex® Couplings

# Installation Instructions



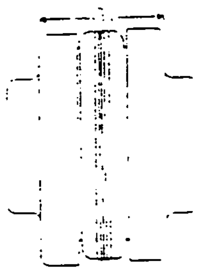
Sure-Flex flanges (outer metallic parts) and sleeves (inner elastomeric members) come in many sizes and types. First, determine the size and type of components being used. Remove all components from their boxes, and loosely assemble the coupling on any convenient surface. (Do not attempt to install the wire ring on the two-piece E or N sleeve at this time.) Also check maximum RPM values in Table 2 against operating speed. All rubber sleeves (EPDM and Neoprene) have the same ratings for a given size and may be used interchangeably. However, because rubber and Hytrel sleeves have completely different ratings, they never should be used interchangeably.



**1** Inspect all coupling components and remove any protective coatings or lubricants from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shafts.

**2** Slide one coupling flange onto each shaft, using snug-fitting keys where required. With the Type B flange, it may be necessary to expand the bore by wedging a screwdriver into the saw cut of the bushing.

**3** Position the flanges on the shafts to approximately achieve the $G_1$ dimension shown in Table 2. It is usually best to have an equal length of shaft extending into each flange. Tighten one flange in its final position. Refer to Table 1 for fastener torque values. Slide the other far enough away to install the sleeve. With a two-piece sleeve, do not move the wire ring to its final position, allow it to hang loosely in the groove adjacent to the teeth, as shown.



**4** Slide the losse flange on the shaft until the sleeve is completely seated in the teeth of each flange, (The "$G_1$" dimension is for reference and not critical.) Secure the flange to the shaft using the torque values from Table 1.

### TABLE 1 — FASTENER TORQUE VALUES (ft.-lbs.)

| Coupling Size | TYPE J | TYPE S | TYPE B | TYPE SC* | | TYPE C | |
|---|---|---|---|---|---|---|---|
| | 2 Setscrews at 90° | 2 Setscrews at 90° | 3 Hex Head Cap Screws | 4 Hex Head Cap Screws Flange to Hub | 1 Setscrew over Keyway in Hub | Clamping Screws | 1 Setscrew over Keyway |
| 3 | 3 | . . . | . . . | . . . | . . . | . . . | . . . |
| 4 | 3 | . . . | . . . | 5½** | 13 | . . . | . . . |
| 5 | 7 | 13 | . . . | 4 | 13 | . . . | . . . |
| 6 | 13 | 13 | 5 | 9 | 13 | 15 | 13 |
| 7 | 13 | 13 | 5 | 9 | 13 | 30 | 13 |
| 8 | 23 | 23 | 9 | 18 | 23 | 55 | 13 |
| 9 | . . . | 23 | 9 | 31 | 23 | 55 | 13 |
| 10 | . . . | 23 | 15 | 50 | 50 | 130 | 13 |
| 11 | . . . | 23 | 30 | 75 | 50 | 130 | 13 |
| 12 | . . . | 50 | 60 | 150 | 100 | 250 | 13 |
| 13 | . . . | 100 | 75 | 150 | 165 | . . . | . . . |
| 14 | . . . | 100 | 75 | 150 | 165 | . . . | . . . |
| 16 | . . . | 100 | 135 | 150 | 165 | . . . | . . . |

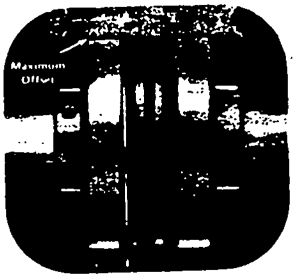
*Torque values apply to hub size when different than flange size.
**Value for socket head clamping screw.

# Sure-Flex *Installation Instructions (continued)*

Different coupling sleeves require different degrees of alignment precision. Locate the alignment values for your sleeve size and type in Table 2 below.

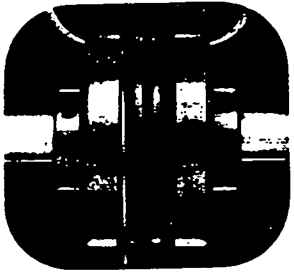
**5** Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling **without rotating** the coupling. If the maximum offset exceeds the figure shown under "Parallel" in Table 2, realign the shafts.

**Parallel**



**6** Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions **without rotating** the coupling. The difference between the maximum and minimum must not exceed the figure given under "Angular" in Table 2. If a correction is necessary, be sure to recheck the parallel alignment.

**Angular**



## TABLE 2 – MAXIMUM RPM AND ALLOWABLE MISALIGNMENT

(Dimensions in inches)

| Sleeve Size | Maximum RPM | Types JE, JN, JES, JNS, E & N | | | *Type H & HS | | |
|---|---|---|---|---|---|---|---|
| | | Parallel | Angular | $G_1$ | Parallel | Angular | $G_1$ |
| 3 | 9200 | .010 | .035 | 1.188 | .... | .... | .... |
| 4 | 7600 | .010 | .043 | 1.500 | .... | .... | .... |
| 5 | 7600 | .015 | .056 | 1.938 | .... | .... | .... |
| 6 | 6000 | .015 | .070 | 2.438 (1) | .010 | .016 | 2.500 |
| 7 | 5250 | .020 | .081 | 2.563 | .012 | .020 | 2.625 |
| 8 | 4500 | .020 | .094 | 2.938 | .015 | .025 | 3.000 |
| 9 | 3750 | .025 | .109 | 3.500 | .017 | .028 | 3.563 |
| 10 | 3600 | .025 | .128 | 4.063 | .020 | .032 | 4.125 |
| 11 | 3600 | .032 | .151 | 4.875 | .022 | .037 | 4.938 |
| 12 | 2800 | .032 | .175 | 5.688 | .025 | .042 | 5.750 |
| 13 | 2400 | .040 | .195 | 6.688 | .030 | .050 | 6.688 |
| 14 | 2200 | .045 | .242 | 7.750 | .035 | .060 | 7.813 |
| 16 | 1500 | .062 | .330 | 10.250 | .... | .... | .... |

Note: Values shown above apply if the actual torque transmitted is more than 1/4 the coupling rating. For lesser torque, reduce the above values by 1/2.

* Type H and HS sleeves **should not** be used as direct replacements for EPDM or Neoprene sleeves.

(1) Value when using 6J flanges is 2.125.

**7** If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

**8** Install coupling guards per OSHA requirements.

CAUTION: **Coupling sleeves may be thrown from the coupling assembly with substantial force when the coupling is subjected to a severe shock load or abuse.**

**T. B. WOOD'S SONS COMPANY** • Chambersburg, PA 17201
**T. B. WOOD'S CANADA LTD.** • Stratford, Ontario N5A 6V6

Printed in U.S.A.

Datacon

EMERSON

**Title:** HORIZONTAL EXPLOSIONPROOF FOOTLESS MOTOR, VERTICAL MOUNT, CL I, GROUP D, T2B
**Frame:** 184TC
**T·pe:** LCF

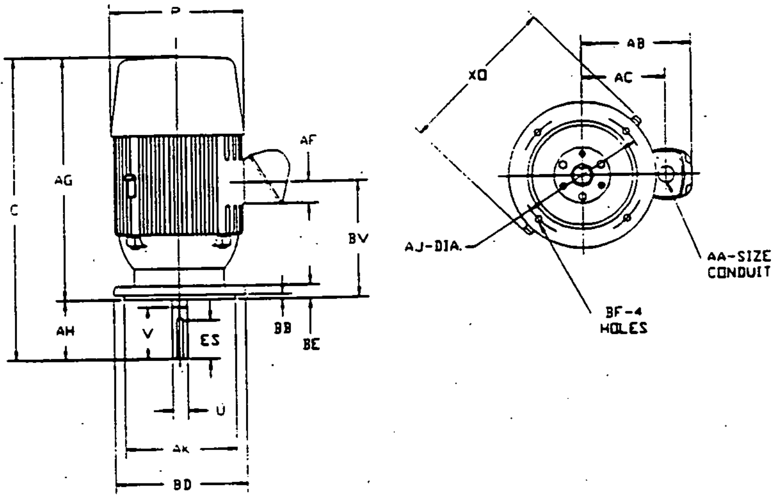
US MOTORS

**USEM Model No.:**
G45126
**Customer Name:**
GOULDS PUMPS INC.

**Customer P.O.:**

**USEM Order No:**

**Certified By:**
MMM
**Date:** 11/10/1992
**H.P.:** 5
**RPM:** 1800
**Phase:** 3
**Hz:** 60
**Volts:** 230/460
**Remarks:**



| NEMA FRAME | C | P* | T | U | V MIN. | AA | AB | AC | AF | AG | AH- | AJ | AK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 184TC | 17-1/2 | 9-1/2 | ------ | 1-1/8 | 2-9/16 | 3/4 | 7-5/8 | 5-3/4 | 2-1/4 | 14-5/8 | 2-5/8 | 7-1/4 | 8-1/2 |

| BB MIN. | BD MAX. | BE | BF# | BV | ES MIN. | XO | SQUARE KEY |
|---|---|---|---|---|---|---|---|
| 1/4 | 9 | 19/32 | 1/2-13x3/4 | 5-1/8 | 1-3/4 | 11-3/8 | 1/4 |

-Dimension measured with motor in vertical position, shaft down
# Tap size and bolt penetration allowance
* Largest motor width

NOTES :
Shaft extension diameter tolerance: +.0000"/-.0005" up to 1-1/2" inclusive.
Larger diameters: +.000"/-.001"

All rough casting dimensions may vary by 1/4" due to casting variations.

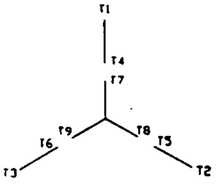
Conduit box opening may be located in steps of 90 degrees. Standard as shown with conduit opening down.

## Spare Parts

BEARINGS ·

| LOWER END | UPPER END |
|---|---|
| 6307-J/C3 | 6205-J/C3 |

MOTOR WIRING DIAGRAM
9 LEAD DUAL VOLTAGE (WYE CONN.)



| VOLTAGE | L1 | L2 | L3 | TOGETHER |
|---|---|---|---|---|
| LOW | (T1,T7) | (T2,T8) | (T3,T9) | (T4, T5, T6) |
| HIGH | T1 | T2 | T3 | (T4,T7) (T5,T8) (T6,T9) |

TO REVERSE DIRECTION OF ROTATION INTERCHANGE CONNECTIONS L1 AND L2.

EACH LEAD MAY HAVE ONE OR MORE CABLES COMPRISING THAT LEAD. IN SUCH CASE EACH CABLE WILL BE MARKED WITH THE APPROPRIATE LEAD NUMBER.

## U.S. ELECTRICAL MOTORS - MOTOR PERFORMANCE 3 PHASE

HERTZ: 60
VOLTS: 230/460
Full Load RPM: 1727
POLES: 4
NEMA CODE: G
SERVICE FACTOR: 1.15
FULL LOAD AMPERES: 13.6 at 230 volts

TORQUE:

| | | | | |
|---|---|---|---|---|
| BREAKDOWN: | 255 | % | 38.8 | lb-ft |
| LOCKED ROTOR: | 214 | % | 32.5 | lb-ft |
| RATED LOAD: | 15.2 | lb-ft | | |

| HP LOAD | PCT. EFF. | PCT. P.F. |
|---|---|---|
| Full | 83.0 | 83.0 |
| 3/4 | 85.4 | 77.8 |
| 1/2 | 85.2 | 67.0 |

NOTES: ______________________________

THE ABOVE DATA IS TYPICAL, UNLESS NOTED OTHERWISE

# GENERAL INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

## SAFETY FIRST

High voltage and rotating parts can cause serious or fatal injury. Safe installation, operation, and maintenance must be performed by qualified personnel. Familiarization with and adherence to NEMA MG2, the National Electrical Code, and local codes is recommended. It is important to observe safety precautions to protect personnel from possible injury. Personnel should be instructed to:

1. Avoid contact with energized circuits or rotating parts.
2. Disconnect and lock out all power sources before initiating any maintenance or repair.
3. Act with care in accordance with prescribed procedures in handling and lifting this equipment.
4. Be sure unit is electrically grounded in accordance with code requirements.
5. Be sure equipment is properly enclosed to prevent access by children or other unauthorized personnel in order to prevent possible accidents.
6. Be sure shaft key is fully captive before unit is energized.
7. Avoid contact with capacitors until safe discharge procedures have been completed.
8. Most units are shipped without oil. Always be sure oil lubricated units are filled with correct oil to proper level before operating.
9. Provide proper safeguards for personnel against rotating parts and applications involving high inertia loads which can cause overspeed.
10. Avoid extended exposure to equipment with high noise levels.
11. Be familiar with the equipment and read all instructions thoroughly before installing on equipment.

## INSPECTION AND HANDLING

Inspect unit to make sure no damage has occurred during shipment. Check Nameplate for correct speed, horsepower, voltage, Hertz, and phase for conformance with power supply and equipment. **WARNING:** Units should be lifted using all eyebolts or lugs if provided. These eyebolts or lugs are provided for lifting this unit only and must not be used to lift any additional weight. Lifting angle must not exceed 15° with shank of eyebolt. If not provided, eyebolts to be used must be per ASTM A489 or equivalent. All eyebolts must be securely tightened. Be careful not to touch overhead power lines with lifting equipment. Failure to observe this warning may result in serious personal injury or property damage.

## STORAGE

Units should be stored indoors, in a clean, dry location. Winding should be protected from excessive moisture absorption. **NOTE:** If motors are to be stored for over one year, refer to U.S. Electrical Motors. If gear and belt transmission units are to be stored for over six months, refer to U.S. Electrical Motors.

## LOCATION

Units should be located in a clean, well-ventilated area for maximum life. **WARNING:** Units should be located in a suitable enclosure to prevent access by children or other unauthorized personnel to prevent possible accidents.

## MOUNTING

Mount units on a firm, flat surface sufficiently rigid to prevent vibration.

Drive belts and chains should be within recommended limits of tightness. Couplings should be properly aligned and balanced. For drive recommendations, refer to drive or equipment manufacturers or U.S. Electrical Motors. For application of drive equipment, refer to NEMA MG1.

Motors have been dynamically balanced using a half key the same length as the full key shipped with the motor. If pulley length is less than this key length, rework long key by removing one-half of excess length between pulley and end of key to maintain balance.

Do not restrict motor ventilation. Unless otherwise specified on Nameplate, motor is designed for operation in 40°C (104°F) maximum ambient temperature. **NOTE:** Motors operating under rated load and ambient conditions may feel hot when touched; this is normal and should not be cause for concern. When in doubt, measure frame temperature and confer with nearest office. Standard grease lubricated units can be operated in minimum ambient of -20°F. Special lubricants are required for temperatures outside this range.

If unit has been stored in a damp location, dry out thoroughly before operating.

**WARNING:** Guards should be provided for all exposed rotating parts to prevent possible personal injury. Keep fingers and foreign objects away from ventilation and other openings. Applications involving HIGH INERTIAL LOADS may damage equipment due to motor overspeed during coast down. Such applications should be referred to U.S. Electrical Motors.

**CAUTION:** Do not force drive coupling or other equipment onto shaft, as bearing damage may result.

## POWER SUPPLY AND CONNECTIONS

The power supply must agree with values on Nameplate. Terminal voltage should not vary more than ±10% of Nameplate voltage at rated frequency. Unbalanced line voltage, even a small amount, will cause overheating. Do not exceed the continuous rated operating current on the Nameplate. Starting controls and overload protection should be properly sized in accordance with the National Electrical Code and the control manufacturer's recommendations.

Motor connections should be made by following instructions on connection diagram. Determine direction of rotation before connecting driven equipment. Note direction of rotation label if supplied. Rotation may be reversed on three phase motors by interchanging any two line connections. On two phase motors, interchange A-1 and A-2; and on single phase motors interchange leads per connection diagram on motor. Wiring of units, controls, and grounding shall be in accordance with local and National Electrical Code requirements. **WARNING:** Failure to properly ground unit may cause serious injury to personnel. Where unexpected starting could be hazardous to personnel, do not use automatic reset starting devices.

## OIL LUBRICATION

Most oil lubricated units are shipped without oil. Add oil of the correct viscosity for the ambient temperature, per Nameplate on unit, to proper level.

Make certain an oil with mild EP additives is used on wormgear units.

Refer to Nameplate or Lubrication Instruction Plate for oil viscosity and oil change interval. **WARNING:** For applications in the food and drug industry (including animal food), consult the petroleum supplier for lubricants that are acceptable to the Food and Drug Adminstration and other governing bodies.

## MAINTENANCE

Inspect units at regular intervals. Keep units clean and ventilation openings clear of dust, dirt or other debris. Lubricate units per this operating instruction folder and instruction plate on unit. Excessive lubrication may damage the unit. Do not over grease! **WARNING:** Disconnect all power sources to the unit and discharge all parts which may retain an electrical charge before attempting any maintenance or repair. Screens and covers must be maintained in place when unit is in operation. Motors for use in hazardous locations - Class I & II Installation: Repairs of these motors must be made by the manufacturer or authorized service station approved by the manufacturer and U.L. to maintain the U.L. Listing. The U.L. Listing applies to the electrical motor only and not to the belt or gear transmissions or other devices that may be connected to the motor.

## VARIDRIVE® UNITS

Do not turn control wheel while unit is not operating as this may cause damage to the unit. Handwheel position is a relative speed indication only. Use direct speed sensing accessory for precise speed indication. Units equipped with electric remote speed indicator accessory are not calibrated at the factory and must be calibrated at site. Refer to calibration instructions with meter.

VARIDRIVES equipped with splined shafts require monthly lubrication for 8 hour/day service, and semi-monthly for 24 hour/day service. (For complete instructions for entire drive, refer to the lubrication instruction plate on unit.) Operate VARIDRIVE through its entire speed range weekly. **WARNING:** Do not force control wheel beyond speed limits shown on Nameplate. The mechanism and belt are designed for the rated speed and horsepower shown on the Nameplate. Operation beyond these limits may result in damage to the belt and mechanism and possible injury to personnel. The covers on the frame case must not be removed or left off while unit is in operation. Do not attempt to disassemble or repair the driven pulley discs as high spring force may be released, causing injury to personnel. Refer to authorized Service Center. Refer to VARIDRIVE Installation and Maintenance Manual for complete belt changing instructions.

For additional detailed information, request specific product installation and maintenance manual from U.S. Electrical Motors, St. Louis, MO 63136

## RENEWAL PARTS AND WARRANTY SERVICE

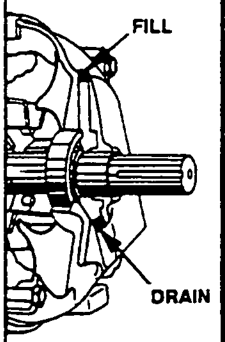
When inquiring for renewal parts, call the U.S. Electrical Motor Service Department (Memphis, Tennessee) or Parts Stocking Distributors. For warranty service call the nearest U.S. Electrical Motors Service Station. Give them complete nameplate data including ID number, etc.

## LUBRICATION INSTRUCTIONS

Some small motors have sealed-for-life bearings which require no relubrication. Regreaseable bearings are shipped with a high quality, wide temperature range grease in the bearings.

Motors can be regreased by stopping the motor, removing drain plug and pumping new grease into fill hole. Run motor with drain plug removed until excess grease has been discharged (min. 10 mins.). Stop motor and replace drain plug.

Units that operate at speeds greater than 1800 RPM should be lubricated on a more frequent maintenance schedule depending on duty cycle. Use a low pressure grease gun and avoid overgreasing.



**SUGGESTED REGREASING INTERVALS**

| SERVICE | MOTOR HORSEPOWER | | |
|---|---|---|---|
| | UNDER 50 | 50-100 | 100 UP |
| A | 3-5 Yrs. | 2-4 Yrs. | 2 Yrs. |
| B | 2-4 Yrs. | 1-1/2 Yrs. | 1-1/2 Yrs. |
| C | 1-2 Yrs. | 1 Yr. | 6 Mos. |
| D | 4 Mos. | 4 Mos. | 3 Mos. |

| SERVICE SYMBOL | TYPE OF SERVICE |
|---|---|
| A | Infrequent operation or light duty in clean atmosphere. |
| B | 8-16 Hrs/Day in clean, relatively dry atmosphere. |
| C | 12-24 Hrs/Day, heavy duty, or if moisture is present. |
| D | Heavy duty in dirty, dusty locations; high ambients; moisture laden atmosphere; vibration. |

**Recommended Greases**

Use the following greases or equivalent grease unless a special grease is specified on the nameplate.

| MANUFACTURER | TRADE NAME |
|---|---|
| CHEVRON | SR I #2 |
| SHELL | DOLIUM R |

| | OFFICES | PHONE | FAX |
|---|---|---|---|
| CALIFORNIA | 19877 Quiroz CT., Walnut, CA 91789 | (909) 594-5470 | (909) 594-2389 |
| CONNECTICUT | 326 West Main St., Milford, CT 06460 | (203) 877-1762 | (203) 877-2398 |
| ILLINOIS | 2050 South Carboy Road, Mt. Prospect, IL 60056 | (708) 952-3500 | (708) 952-0158 |
| TENNESSEE | 3363 Miac Cove, Memphis, TN 38118 | (901) 794-5500 | (901) 794-0741 |
| TENNESSEE (PARTS) | 3363 Miac Cove, Memphis, TN 38118 | (901) 367-5918 | (901) 366-4225 |
| TEXAS | 12068 Forest Gate Drive, Dallas, TX 75243 | (214) 644-0470 | (214) 644-0254 |
| WORLD HEADQUARTERS MISSOURI | 8100 West Florissant Avenue, P.O. Box 3946, St. Louis, MO 63136 | (314) 553-2000 | (314) 553-1156 |

**U.S. ELECTRICAL MOTORS**
DIVISION EMERSON ELECTRIC CO.
8100 WEST FLORISSANT AVENUE
P.O. BOX 3946
ST. LOUIS, MO 63136

EMERSON

Printed in the U.S.A.

# Appendix B

## CRITICAL DEVICES LIST

**Mobil Buffalo Terminal #31-010**
625 Elk Street
Buffalo, NY

| Item # | Device | Description | Inspection Criteria/ Procedure | Frequency | Corrective Action | Rationale |
|---|---|---|---|---|---|---|
| 1 | High Level Sensors (LSHH-106, LSH-107) in Storm Water Sump | Alarms for high water levels in the Storm Water Sump, will cause the Alarm Indicators to Illuminate Yellow then Red. | Manual check the level set point and perform a failure test. Verify that both Alarm Indicators Illuminate properly. | weekly | Check bulbs & level sensors, repair or replace as necessary. | Alerts Operators of need to address sump high level condition before overflow. Indicates need for manual pumpout. |
| 2 | High Level Sensors (LSHH-109, LSH-110) in Oily Water Separator | Indicates High Product Level in tank, need to arrange for product disposal, need to stop further filling to prevent overfill. | Manual check the sight glass level and high level indicator. | weekly | Check sight glass, indicators & level sensors. Repair or replace as necessary. | Stop filling to avoid overflow of Tank. Alert Operator of need for manual pumpout of collected product. |
| 3 | High Level Indicator on 8000-gal Product Storage Tank | LSH-109 Signals alarm for high water levels in OWS, LSH-110 signals alarm for High Product Level in tank. | Manual check the level set point and perform a failure test. Verify that either high level condition will shutdown sump pump. Verify that LSH-109 activates "Product Full" indicator. | weekly | Check bulbs & level sensors, & interlocks. Repair or replace as necessary. | Shutdown of sump pump to avoid overflow of OWS. Alerts Operator of need for disposal of collected product. |
| 4 | Heaters & Heat Trace Tape Systems | Units activated seasonally for winterization of the process equipment. | Check general integrity and physical condition. Check interlocks and test heater/heat trace thermostats by exposure to cold to verify operation, verify heaters turn ON and OFF properly. | Weekly During Winter | Shut Down, repair or replace. | Prevents process lines and equipment from freezing. |
| 5 | Well and Vault Covers | Covers over all remediation equipment located outside of the treatment enclosure. | Visually confirm general integrity and fit. | Quarterly | Repair or replace | Protects equipment, prevents environmental exposure and trip / fall hazards. |
| 6 | Notification and Warning Signs | Communicate hazards within equipment compound (Fire Safety, Electrical Hazard, Environmental Hazards, Emergency Response Information). | Visually confirm general integrity. | Monthly | Repair or replace. | Warns of potential hazards and prevents worker exposure and accidents. |

# Appendix C

**Mobil Buffalo Terminal #31010**

625 Elk Street
Buffalo, NY

INSPECTOR: ____________________

MONTH: ____________

# WELL POINT SYSTEM AND LIFT STATION DAILY INSPECTION FORM

| | | WELL POINT METER | | STORM WATER LIFT STATION | | OIL - WATER SEPARATOR | | VACUUM GAUGE READINGS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | WELL POINT PUMPS | | 105TK YARD | N.E. OF WP BUILDING | WEST END AT TRAPS |
| | | | | | | | | EAST | WEST | | | |
| DATE | TIME | TOTALIZER READING | DAILY GALLONS | TOTALIZER READING | DAILY GALLONS | TOTALIZER READING | DAILY GALLONS | VACUUM "H20 | VACUUM "H2O | VACUUM "H2O | VACUUM "H2O | VACUUM "H2O |
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Notes:

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**Mobil Buffalo Terminal #31-010**
625 Elk Street
Buffalo, NY

INSPECTOR: ____________________

DATE: ___/___/___

# DUAL-PHASE PUMPING SYSTEM DAILY INSPECTION FORM

| | | | | | 1000-gal PRODUCT RECOVERY TANK | | |
|---|---|---|---|---|---|---|---|
| **Well ID** | **SYSTEM OPERATION STATUS** | **CONTROL FAULT DETAIL** | **PUMP FAULT DETAIL** | **LEAKAGE OBSERVED** | **TOTALIZER (gallons)** | **TANK LEVEL**<br>**Empty** **Full** | **PUMP OUT REQUIRED** |
| RW-1 | ☐ NORMAL<br>☐ FAULT | ☐ REC. TANK FULL<br>☐ PROBE FAILURE<br>☐ VOLT RANGE<br>☐ HIGH TEMP | ☐ WATER PUMP OFF/DOWN<br>☐ PRODUCT PUMP OFF/DOWN | ☐ WATER SYSTEM<br>☐ PRODUCT SYSTEM | | E 1 2 3 4 5 6 7 8 9 F | Y N |
| RW-2 | ☐ NORMAL<br>☐ FAULT | ☐ REC. TANK FULL<br>☐ PROBE FAILURE<br>☐ VOLT RANGE<br>☐ HIGH TEMP | ☐ WATER PUMP OFF/DOWN<br>☐ PRODUCT PUMP OFF/DOWN | ☐ WATER SYSTEM<br>☐ PRODUCT SYSTEM | | E 1 2 3 4 5 6 7 8 9 F | Y N |
| RW-3 | ☐ NORMAL<br>☐ FAULT | ☐ REC. TANK FULL<br>☐ PROBE FAILURE<br>☐ VOLT RANGE<br>☐ HIGH TEMP | ☐ WATER PUMP OFF/DOWN<br>☐ PRODUCT PUMP OFF/DOWN | ☐ WATER SYSTEM<br>☐ PRODUCT SYSTEM | | E 1 2 3 4 5 6 7 8 9 F | Y N |
| RW-4 | ☐ NORMAL<br>☐ FAULT | ☐ REC. TANK FULL<br>☐ PROBE FAILURE<br>☐ VOLT RANGE<br>☐ HIGH TEMP | ☐ WATER PUMP OFF/DOWN<br>☐ PRODUCT PUMP OFF/DOWN | ☐ WATER SYSTEM<br>☐ PRODUCT SYSTEM | | E 1 2 3 4 5 6 7 8 9 F | Y N |
| RW-5 | ☐ NORMAL<br>☐ FAULT | ☐ REC. TANK FULL<br>☐ PROBE FAILURE<br>☐ VOLT RANGE<br>☐ HIGH TEMP | ☐ WATER PUMP OFF/DOWN<br>☐ PRODUCT PUMP OFF/DOWN | ☐ WATER SYSTEM<br>☐ PRODUCT SYSTEM | | E 1 2 3 4 5 6 7 8 9 F | Y N |
| RW-6 | ☐ NORMAL<br>☐ FAULT | ☐ REC. TANK FULL<br>☐ PROBE FAILURE<br>☐ VOLT RANGE<br>☐ HIGH TEMP | ☐ WATER PUMP OFF/DOWN<br>☐ PRODUCT PUMP OFF/DOWN | ☐ WATER SYSTEM<br>☐ PRODUCT SYSTEM | | E 1 2 3 4 5 6 7 8 9 F | Y N |

Notes:

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# Mobil Buffalo Terminal #31010

625 Elk Street
Buffalo, NY

INSPECTOR: ____________ DATE: ___/___/___

## WATER TREATMENT SYSTEM DAILY INSPECTION FORM

| | | | 8000-gal PRODUCT STORAGE TANK | |
|---|---|---|---|---|
| SYSTEM COMPONENT | SYSTEM OPERATION STATUS | ANY FAULTS OR LEAKS OBSERVED | TANK LEVEL Empty Full | PUMP OUT REQUIRED |
| PRODUCT STORAGE TANK | ☐ NORMAL | Y N | E 1 2 3 4 5 6 7 8 9 F | Y N |
| INLET STRAINER | ☐ < 5psi INLET PRESSURE<br>☐ > 5psi INLET PRESSURE | ☐ WATER SYSTEM<br>☐ PRODUCT SYSTEM | | |
| OWS | ☐ NORMAL<br>☐ FAULT | ☐ WATER LEVEL<br>☐ PRODUCT LEVEL | BLOWER PRESSURE READINGS | |
| AIR SPARGE TANK 1 | ☐ NORMAL<br>☐ FAULT | ☐ BLOWER<br>☐ TANK / PIPING | | |
| AIR SPARGE TANK 2 | ☐ NORMAL<br>☐ FAULT | ☐ BLOWER<br>☐ TANK / PIPING | | |
| AIR SPARGE TANK 3 | ☐ NORMAL<br>☐ FAULT | ☐ BLOWER<br>☐ TANK / PIPING | | |

Notes:

MOBIL BUFFALO TERMINAL #31-010
625 Elk Street
Buffalo, NY

# GENERAL EQUIPMENT SERVICING SHEET

| DATE | TECHNICIAN | EQUIPMENT SERVICED | REASON FOR SERVICING | SERVICE PERFORMED |
|---|---|---|---|---|
| | | | | |
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Notes:

# Appendix D

**Mobil Business Resources Corporation**

464 Doughty Boulevard
Inwood, New York 10096

February 14, 1998

New York State Department of
Environmental Conservation
Region 9
270 Michigan Avenue
Buffalo New York 14203-2999
ATTN: Timothy Dieffenbach

**4th Quarter Report**
**Mobil Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**
**NYSDEC Spill #s: 88-08982**
**93-05522**

Dear Mr. Dieffenbach:

Attached is the 4th Quarter Report covering the period October through December 1997. Separate phase hydrocarbons ("SPH") were present in several site monitoring wells as well as several site recovery wells. The largest amount of apparent separate phase hydrocarbon thickness was recorded at MW-8 (8.05 feet). Total dissolved phase BTEX concentration of the remediation system influent remained consistent with past data (2,040 ug/l, 10/31/97; 2,254 ug/l, 11/30/97; 860 ug/l, 12/31/97).

The remediation system operated throughout the reporting period. The Well Point System, the Sump Pump, and the Treatment System operated continuously throughout the period. Operational difficulties were encountered with the RW-1 level control system and the RW-5 water pump and probe scavenger systems. The RW-6 system was shut down during the period and requires a complete rebuild of the well head connections. This work is scheduled for February 1998. The oil/water separator oil reservoir was collecting water, which did not affect the system performance, however did require additional work to pump out the water. The RW-2 level control probe offered maintenance problems and will be replaced in February 1998.

Groundwater & Environmental Services, Inc. continues to work on the issue of creating hydrographs for several of the site wells. Significant data transfer difficulties have been encountered. It is proposed that new hydrographs be created which will encompass only the data starting with 1997 to the present. It is believed that historical data can be reviewed through the existing reports, and GES will begin new graphs starting with 1997, which will provide 9 months of overlap. If this is not acceptable, please notify Brian Carey (GES) and another solution will be reached.

If you have any questions and/or comments, please contact me at (516) 371-1484.

Sincerely,

Brian Carey FOR

Michael A. Lamarre
Environmental Engineer

cc: B. Carey – GES

# SITE MONITORING REPORT

MOBIL TERMINAL 31-010
625 ELK STREET
BUFFALO, NEW YORK

MOBIL BUSINESS RESOURCES CORPORATION
464 DOUGHTY BOULEVARD
2ND FLOOR/ENVIRONMENTAL
INWOOD, NEW YORK 11096-1342

**Report Date**
**February 14, 1998**

Prepared by:

**Brian Carey**
**Project Engineer**

FOR

**Vincent S. Maresco**
**Sr. Project Manager**

GROUNDWATER & ENVIRONMENTAL SERVICES, INC.
100 River Rock Drive
Suite 201
Buffalo, New York 14207
(716) 873-4021

# PROJECT STATUS REPORT

February 14, 1998

4th Quarter Report 1997

Mobil Terminal #31-010
625 Elk Street
Buffalo, New York
(716) 827-5127

**Mobil Contact:** Michael Lamarre

**Regulatory Interaction:**

Spill #: 88-08982 and 93-05522
Agency: NYSDEC, Region 9
Agency Contact: Tim Dieffenbach
270 Michigan Avenue
Buffalo, New York 14203
(716) 851-7220

**Site Phase:** Remediation through liquid phase petroleum recovery.

**Work Completed This Quarter:** System operation and maintenance, quarterly liquid level measurements, monthly system sampling.

**Site Conditions:**

Number of wells: 33 Monitoring Wells, 14 Piezometers, 6 Recovery Wells

Water Table Elevation Data: Water table elevations in the monitoring wells ranged from 568.20 feet at MW-20 to 584.56 feet at MW-16 (18.40 to 4.73 feet below top of casing)

Dissolved Contamination: 860 ug/l Total BTEX, System Influent, 12/29/97

Separate Phase Contamination: The maximum apparent product thickness measured 8.05 feet at MW-8 on 12/30/97

**Risk Assessment:**

Buffalo River immediately adjacent to the South.

# Mobil Facility # 31-010
# Buffalo, New York
# 4th Quarter Report

**Remediation Information:**

Six Recovery Wells containing groundwater and product pumps. Recovered product is pumped into a 1,000 gallon tank at each Recovery Well. A Well Point System collects groundwater along the edge of the property adjacent to the Buffalo River. Facility Storm Water is collected in the Lift Station. Recovered groundwater and Storm Water is pumped through an oil/water separator and a set of three air sparge tanks.

**Groundwater Discharge Permit Information:**

System water effluent is discharged to the Buffalo Sewer Authority. Permit limit for EPA Method 602 is 5.3 mg/l. All discharge parameters are sampled for and reported by Mobil.

**Air Effluent Discharge Permit Information:**

Sparge Tank air effluent is discharged to the atmosphere through a 50 foot stack. Discharge emissions are calculated from the influent/effluent water sampling. Discharge limits and rates are detailed in the Permit Compliance Tables.

# Mobil Facility # 31-010
# Buffalo, New York
# 4th Quarter Report

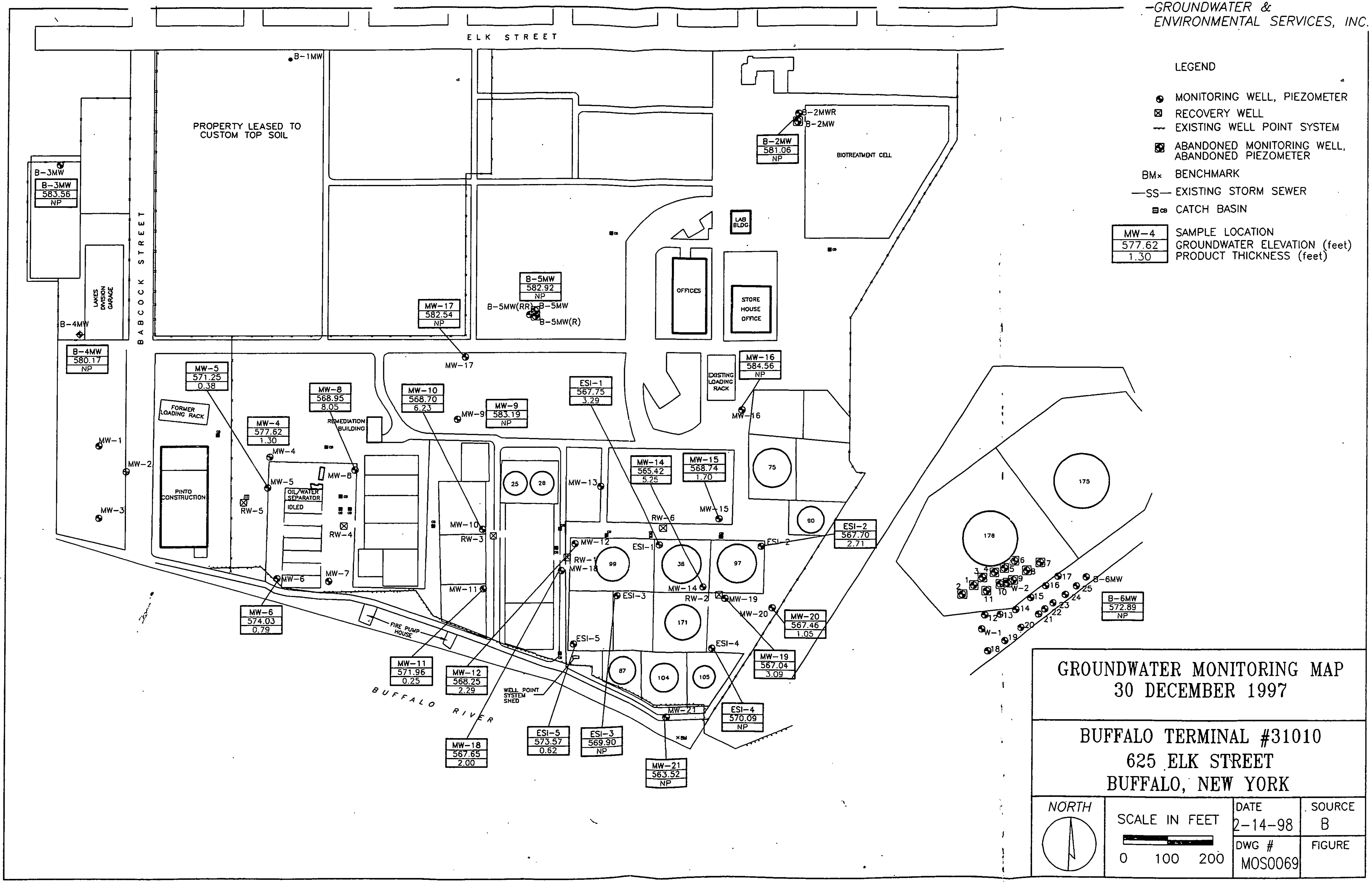
| Date of Visit | Activity |
|---|---|
| 10/2/97 | Recovery System operation and maintenance performed. Replaced sorbent pads in storm sewer catch basins. |
| 10/9/97 | Respond to call from Terminal. Oil reservoir was filling with water. Closed inlet valve slightly to reduce overflow into reservoir. |
| 10/10/97 | Recovery System operation and maintenance performed. RW-2 product pump was down, floats were malfunctioning, cleaned floats, fuse was blown in controls, must be replaced. Replaced sorbents in storm sewer catch basins. |
| 10/24/97 | Recovery System operation and maintenance performed. Replaced fuses in RW-2 product pump controls. Removed and cleaned RW-2 level control probe. Restarted RW-2 system. RW-5 water pump inoperational, must be replaced, RW-5 left down. Replaced sorbents in storm sewer catch basins. |
| 10/31/97 | Recovery System operation and maintenance performed. Removed and cleaned RW-1 level control probe, restarted system. Sampled system influent and effluent for 8020 BTEX. Replaced sorbents in storm sewer catch basins. |
| 11/7/97 | Recovery System operation and maintenance performed. Removed and cleaned RW-1 level control probe, restarted system. Replaced sorbents in storm sewer catch basins. |
| 11/23/97 | Recovery System operation and maintenance performed. Shut down RW-1 system, level control probe failed, must be replaced. RW-2 was found in water override, restarted system. Replaced sorbents in storm sewer catch basins. |
| 11/30/97 | Sampled system influent and effluent for 8020 BTEX. |
| 12/3/97 | Recovery System operation and maintenance performed. RW-2 was found in water override, restarted system. Replaced RW-5 water pump and level control probe shield. Restarted RW-5 system. Removed and cleaned WPS flow meter, reinstalled. Vacuumed out WPS discharge line to remove sediment. Replaced sorbents in storm sewer catch basins. |
| 12/7/97 | Respond to call from terminal. Opened sparge tank valves to reduce oil reservoir water over flow. |
| 12/16/97 | Recovery System operation and maintenance performed. Install new level control probe in RW-1, restart system. Found RW-3 level control probe float stuck, cleaned and restarted. RW-2 found in override, restarted. Replaced sorbents in storm sewer catch basins. |
| 12/22/97 | RW-1 level control probe found to be fouled, cleaned and restarted. |
| 12/23/97 | Recovery System operation and maintenance performed. RW-5 product pump not operational, left down. RW-5 water flow meter not operating properly, however water pump is operational. Replaced sorbents in storm sewer catch basins. |

| | |
|---|---|
| 12/29/97 | Sampled system influent and effluent for 8020 BTEX. |
| 12/30/97 | Quarterly liquid level measurements were taken. Replaced sorbents in storm sewer catch basins. |
| 12/31/97 | Recovery System operation and maintenance performed. RW-5 water pump continues to operate, however flow meter is not functioning. |

## Mobil Facility # 31-010
## Buffalo, New York
## 4th Quarter Report

**List of Attachments:**

*GROUNDWATER & ENVIRONMENTAL SERVICES, INC.*



LEGEND

| | |
|---|---|
| ● | MONITORING WELL, PIEZOMETER |
| ☒ | RECOVERY WELL |
| — | EXISTING WELL POINT SYSTEM |
| ▣ | ABANDONED MONITORING WELL,<br>ABANDONED PIEZOMETER |
| BM× | BENCHMARK |
| —SS— | EXISTING STORM SEWER |
| ▭CB | CATCH BASIN |
| MW-4<br>577.62<br>1.30 | SAMPLE LOCATION<br>GROUNDWATER ELEVATION (feet)<br>PRODUCT THICKNESS (feet) |

# GROUNDWATER MONITORING MAP
30 DECEMBER 1997

## BUFFALO TERMINAL #31010
625 ELK STREET
BUFFALO, NEW YORK

| | | |
|---|---|---|
| DATE | 2-14-98 | SOURCE B |
| DWG # | MOS0069 | FIGURE |

## TABLE 1

## LIQUID LEVEL DATA SHEET

**CLIENT:** Mobil
**LOCATION:** Buffalo Terminal
**FACILITY #:** 31-010

**DATE:** 12/30/97

| MW# | CASING ELEV. | DTP | DTW | APT | ELEV-W | ELEV-W (ADJ) |
|---|---|---|---|---|---|---|
| ESI-1 | 586.98 | 15.94 | 19.23 | 3.29 | 567.75 | 570.05 |
| ESI-2 | 586.66 | 16.25 | 18.96 | 2.71 | 567.70 | 569.60 |
| ESI-3 | 588.68 | NP | 18.78 | NA | 569.90 | NA |
| ESI-4 | 587.08 | NP | 16.99 | NA | 570.09 | NA |
| ESI-5 | 587.06 | 12.87 | 13.49 | 0.62 | 573.57 | 574.00 |
| MW-3 | 582.19 | NC | NC | NA | NA | NA |
| MW-4 | 585.96 | 7.04 | 8.34 | 1.30 | 577.62 | 578.53 |
| MW-5 | 585.81 | 14.18 | 14.56 | 0.38 | 571.25 | 571.52 |
| MW-6 | 586.18 | 11.36 | 12.15 | 0.79 | 574.03 | 574.58 |
| MW-8 | 587.28 | 10.28 | 18.33 | 8.05 | 568.95 | 574.59 |
| MW-9 | 588.13 | NP | 4.94 | NA | 583.19 | NA |
| MW-10 | 584.88 | 9.95 | 16.18 | 6.23 | 568.70 | 573.06 |
| MW-11 | 585.81 | 13.60 | 13.85 | 0.25 | 571.96 | 572.14 |
| MW-12 | 586.99 | 16.45 | 18.74 | 2.29 | 568.25 | 569.85 |
| MW-13 | 584.46 | NC | NC | NA | NA | NA |
| MW-14 | 586.96 | 16.29 | 21.54 | 5.25 | 565.42 | 569.10 |
| MW-15 | 586.81 | 16.37 | 18.07 | 1.70 | 568.74 | 569.93 |
| MW-16 | 589.29 | NP | 4.73 | NA | 584.56 | NA |
| MW-17 | 587.69 | NP | 5.15 | NA | 582.54 | NA |
| MW-18 | 582.33 | 12.68 | 14.68 | 2.00 | 567.65 | 569.05 |
| MW-19 | 585.28 | 15.15 | 18.24 | 3.09 | 567.04 | 569.20 |
| MW-20 | 585.86 | 17.35 | 18.40 | 1.05 | 567.46 | 568.20 |
| MW-21 | 582.68 | NP | 19.16 | NA | 563.52 | NA |
| B-2MW | 587.70 | NP | 6.64 | NA | 581.06 | NA |
| B-3MW | 586.81 | NP | 3.25 | NA | 583.56 | NA |
| B-4MW | 586.96 | NP | 6.79 | NA | 580.17 | NA |
| B-5MW | 587.56 | NP | 4.64 | NA | 582.92 | NA |
| B-6MW | 596.45 | NP | 23.56 | NA | 572.89 | NA |

Notes:
*All elevations in feet.
NP=No Separate-Phase Hydrocarbons d
NC=Not Collected, well inaccessible.
NA=Not Applicable
Elev. (PVC) = Elevation of top of well casing.

DTP = Depth to separate-phase hydrocarbon.
DTW = Depth to water.
APT = Apparent thickness of separate-phase hydrocarbon.
Elev. W = Water table elevation.
(ADJ) = Water table elevation adjusted for the presence of separate-phase hydrocarbons.

**Mobil Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

## Table 2

## OPERATIONS REPORT

### Groundwater and Liquid Phase Petroleum Recovery System

Reporting Period: October 1997

### RECOVERY WELL DATA

| **Water Recovery** | RW-1 | RW-2 | RW-3 | RW-4 | RW-5 | RW-6 | W. POINT SYSTEM | STORM SEWER | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Total Water Pumped (gal) | 49,405 | 132,725 | 14,404 | 122,323 | 124,401 | 0 | 4,167,000 | 5,658,792 | 10,269,050 |
| Incremental Flow Rate (gpm) | 1.1 | 2.9 | 0.3 | 2.7 | 2.7 | 0.0 | 90.4 | 122.8 | 222.9 |
| Total Flow Since 9-23-93: | 9,825,290 | 4,389,174 | 428,211 | 2,045,142 | 5,760,306 | 366,994 | 144,594,898 | 227,814,288 | 393,216,135 |
| No. of Days in Period for Recovery.Wells: | | 32 | No. of Days in Period for WP System: | | | | 32 | | |
| Reported for period 9/29/97 through 10/31/97. | | | | | | | | | |
| **Liquid Phase Recovery** | | | | | | | | | |
| Through Period | 18 | 0 | 1 | 0 | 84 | 0 | 0 | NA | 103 |
| Total since 9-23-93: | 12,862 | 2,910 | 296 | 2,572 | 779 | 3 | 4,364 | NA | 23,786 |
| Reported for period 9/29/97 through 10/31/97. | | | | | | | | | |
| **Low Probe Depth Settings** | | | | | | | | | |
| At Period Start: | 20.8 | 21.7 | 19.2 | 19.7 | 18 | 16 | | | |
| At Period End: | 20.8 | 21.7 | 19.2 | 19.7 | 18 | 16 | | | |
| **Estimated Run Time** | | | | | | | | | |
| Through Reporting Water Pump Period (days): | 29 | 28 | 32 | 32 | 25 | 0 | 32 | 32 | |
| Percent Run Time: | 91% | 88% | 100% | 100% | 78% | 0% | 100% | 100% | |
| Through Reporting Product Pump Period (days): | 29 | 14 | 32 | 32 | 25 | 0 | NA | NA | |
| Percent Run Time: | 91% | 44% | 100% | 100% | 78% | 0% | NA | NA | |

**Mobil Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

## Table 3

## OPERATIONS REPORT

### Groundwater and Liquid Phase Petroleum Recovery System

Reporting Period: November 1997

### RECOVERY WELL DATA

| **Water Recovery** | RW-1 | RW-2 | RW-3 | RW-4 | RW-5 | RW-6 | W. POINT SYSTEM | STORM SEWER | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Total Water Pumped (gal) | 52,500 | 38,037 | 16,931 | 92,628 | 0 | 0 | 1,904,000 | 7,226,514 | 9,330,610 |
| Incremental Flow Rate (gpm) | 1.6 | 1.1 | 0.5 | 2.8 | 0.0 | 0.0 | 57.5 | 218.2 | 281.7 |
| Total Flow Since 9-23-93: | 9,877,790 | 4,427,211 | 445,142 | 2,137,770 | 5,760,306 | 366,994 | 146,498,898 | 235,040,802 | 402,546,745 |
| No. of Days in Period for Recovery Wells: | | 23 | No. of Days in Period for WP System: | | | | 23 | | |
| Reported for period 10/31/97 through 11/23/97 | | | | | | | | | |
| **Liquid Phase Recovery** | | | | | | | | | |
| Through Period | 75 | 0 | 3 | 0 | 0 | 0 | 0 | NA | 96 |
| Total since 9-23-93: | 12,937 | 2,910 | 299 | 2,572 | 779 | 3 | 4,364 | NA | 23,882 |
| Reported for period 10/31/97 through 11/23/97 | | | | | | | | | |
| **Low Probe Depth Settings** | | | | | | | | | |
| At Period Start: | 20.8 | 21.7 | 19.2 | 19.7 | 18.0 | 16.0 | | | |
| At Period End: | 20.8 | 21.7 | 19.2 | 19.7 | 18.0 | 16.0 | | | |
| **Estimated Run Time** | | | | | | | | | |
| Through Reporting Water Pump Period (days): | 12 | 15 | 23 | 23 | 0 | 0 | 23 | 23 | |
| Percent Run Time: | 52% | 65% | 100% | 100% | 0% | 0% | 100% | 100% | |
| Through Reporting Product Pump Period (days): | 12 | 15 | 23 | 23 | 0 | 0 | NA | NA | |
| Percent Run Time: | 52% | 65% | 100% | 100% | 0% | 0% | NA | NA | |

**Mobil Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

## Table 4

## OPERATIONS REPORT

### Groundwater and Liquid Phase Petroleum Recovery System

Reporting Period: December 1997

**RECOVERY WELL DATA**

| **Water Recovery** | RW-1 | RW-2 | RW-3 | RW-4 | RW-5 | RW-6 | W. POINT SYSTEM | STORM SEWER | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Total Water Pumped (gal) | 36,170 | 73,321 | 10,071 | 111,630 | 587 | 0 | 3,508,000 | 9,254,151 | 12,993,930 |
| Incremental Flow Rate (gpm) | 0.6 | 1.3 | 0.2 | 2.0 | 0.0 | 0.0 | 62.5 | 164.8 | 231.4 |
| Total Flow Since 9-23-93: | 9,913,960 | 4,500,532 | 455,213 | 2,249,400 | 5,760,893 | 0 | 150,006,898 | 244,294,953 | 415,540,675 |
| No. of Days in Period for Recovery Wells: | | 39 | No. of Days in Period for WP System: | | | | 39 | | |
| Reported for period 11/23/97 through 12/31/97. | | | | | | | | | |
| **Liquid Phase Recovery** | | | | | | | | | |
| Through Period | 0 | 0 | 0 | 0 | 51 | 0 | 0 | NA | 51 |
| Total since 9-23-93: | 12,937 | 2,910 | 299 | 2,572 | 830 | 3 | 4,364 | NA | 23,915 |
| Reported for period 11/23/97 through 12/31/97. | | | | | | | | | |
| **Low Probe Depth Settings** | | | | | | | | | |
| At Period Start: | 20.8 | 21.7 | 19.2 | 19.7 | 18.0 | 16.0 | | | |
| At Period End: | 20.8 | 21.7 | 19.2 | 19.7 | 18.0 | 16.0 | | | |
| **Estimated Run Time** | | | | | | | | | |
| Through Reporting Water Pump Period (days): | 13 | 28 | 33 | 39 | 29 | 0 | 39 | 39 | |
| Percent Run Time: | 33% | 72% | 85% | 100% | 74% | 0% | 100% | 100% | |
| Through Reporting Product Pump Period (days): | 13 | 28 | 33 | 39 | 10 | 0 | NA | NA | |
| Percent Run Time: | 33% | 72% | 85% | 100% | 26% | 0% | NA | NA | |

**Mobil Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

## Table 5

## PERMIT COMPLIANCE

### Groundwater Recovery System

**Sample Date: 10/31/97**

System Type: Air Sparge Tank (3 in parallel)
Permit Type: NYSDEC Division of Air, Certificate to Operate
Permit Number: 9-1402-00600/00024-0
Permit Approval Date: 4/18/96
Permit Expiration Date: 6/30/00

### SPARGE TANK EMISSIONS

| | Benzene | Toluene | Ethylbenzene | Xylenes |
|---|---|---|---|---|
| **WATER** | | | | |
| Influent Concentration (ug/l): | 980 | 150 | 240 | 670 |
| Effluent Concentration (ug/l): | 310 | 18 | 79 | 210 |
| Flow Rate (Gal/min): | 85 | 85 | 85 | 85 |
| **AIR** | | | | |
| Air Stripper Efficiency: | 68.37% | 88.00% | 67.08% | 68.66% |
| Emission Rate (lb/hr): | 0.0285 | 0.0056 | 0.0068 | 0.0196 |
| Discharge Limits (lb/hr): | 0.055 | 0.200 | 0.300 | 1.600 |

Notes:
Flow rate based on flowmeter reading at time of sampling.
Air Stripper Emission Rate = (Avg. influent conc. - Avg. effluent conc.) x (flow rate)(conversion factor)
If analytes are ND, then the detection limits are used to calculate emission rates.
Conversion Factor = (1 L/.2642 gal)(1 g/1000000 ug)(1 LB/454 g)(60 min/hr) = 5.002E-07

**Mobil Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

## Table 6

## PERMIT COMPLIANCE

### Groundwater Recovery System

**Sample Date: 11/30/97**

| | |
|---|---|
| System Type: | Air Sparge Tank (3 in parallel) |
| Permit Type: | NYSDEC Division of Air, Certificate to Operate |
| Permit Number: | 9-1402-00600/00024-0 |
| Permit Approval Date: | 4/18/96 |
| Permit Expiration Date: | 6/30/00 |

### SPARGE TANK EMISSIONS

| | Benzene | Toluene | Ethylbenzene | Xylenes |
|---|---|---|---|---|
| **WATER** | | | | |
| Influent Concentration (ug/l): | 1100 | 24 | 340 | 790 |
| Effluent Concentration (ug/l): | 170 | 5 | 51 | 140 |
| Flow Rate (Gal/min): | 109.8 | 109.8 | 109.8 | 109.8 |
| **AIR** | | | | |
| Air Stripper Efficiency: | 84.55% | 79.17% | 85.00% | 82.28% |
| Emission Rate (lb/hr): | 0.0511 | 0.0010 | 0.0159 | 0.0357 |
| Discharge Limits (lb/hr): | 0.055 | 0.200 | 0.300 | 1.600 |

Notes:
Flow rate based on flowmeter reading at time of sampling.
Air Stripper Emission Rate = (Avg. influent conc. - Avg. effluent conc.) x (flow rate)(conversion factor)
If analytes are ND, then the detection limits are used to calculate emission rates.
Conversion Factor = (1 L/.2642 gal)(1 g/1000000 ug)(1 LB/454 g)(60 min/hr) = 5.002E-07

**Mobil Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

## Table 7

## PERMIT COMPLIANCE

### Groundwater Recovery System

**Sample Date: 12/29/97**

| | |
|---|---|
| System Type: | Air Sparge Tank (3 in parallel) |
| Permit Type: | NYSDEC Division of Air, Certificate to Operate |
| Permit Number: | 9-1402-00600/00024-0 |
| Permit Approval Date: | 4/18/96 |
| Permit Expiration Date: | 6/30/00 |

### SPARGE TANK EMISSIONS

| | Benzene | Toluene | Ethylbenzene | Xylenes |
|---|---|---|---|---|
| **WATER** | | | | |
| Influent Concentration (ug/l): | 250 | 110 | 70 | 430 |
| Effluent Concentration (ug/l): | 24 | 15 | 10 | 100 |
| Flow Rate (Gal/min): | 100.9 | 100.9 | 100.9 | 100.9 |
| **AIR** | ▨ | ▨ | ▨ | ▨ |
| Air Stripper Efficiency: | 90.40% | 86.36% | 85.71% | 76.74% |
| Emission Rate (lb/hr): | 0.0114 | 0.0048 | 0.0030 | 0.0167 |
| Discharge Limits (lb/hr): | 0.055 | 0.200 | 0.300 | 1.600 |

Notes:
Flow rate based on flowmeter reading at time of sampling.
Air Stripper Emission Rate = (Avg. influent conc. - Avg. effluent conc.) x (flow rate)(conversion factor)
If analytes are ND, then the detection limits are used to calculate emission rates.
Conversion Factor = (1 L/.2642 gal)(1 g/1000000 ug)(1 LB/454 g)(60 min/hr) = 5.002E-07

# APPENDIX A

Laboratory Analytical Data

Lancaster Laboratories
*A division of Thermo Analytical Inc.*

**LLI Sample No. WW 2813648**
Collected: 10/31/97 at 16:00 by BC

Submitted: 11/ 5/97 Reported: 11/11/97
Discard: 12/12/97

SYS-INF Grab Water Sample
LOC# 31-010 PRCA# 951061 PHC# 5L
MOBIL: 625 Elk Street, NY

Account No: 09593
Mobil Oil Corporation
464 Doughty Blvd., 2nd Floor
Inwood NY 11096-1342

P.O. 31-010
Rel.

AS RECEIVED

| CAT NO. | ANALYSIS NAME | RESULTS | LIMIT OF QUANTITATION | UNITS |
|---|---|---|---|---|
| 8208 | BTEX (8020) | | | |
| 0776 | Benzene | 980. | 5. | ug/l |
| 0777 | Toluene | 150. | 5. | ug/l |
| 0778 | Ethylbenzene | 240. | 5. | ug/l |
| 0779 | Total Xylenes | 670. | 20. | ug/l |

QUALITY CONTROL REPORT

8208 BTEX (8020) Batch: 97310A63

| | SAMPLE LOQ | SAMPLE UNITS | BLANK | | DUP RPD | MS | MSD | MS RPD | LCS | LCS DUP | LCS RPD | LCS LIMITS LOW | LCS LIMITS HIGH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0776 Benzene | 5. | ug/l | < 1. | ug/l | | 105 | 106 | 1 | 101 | | | 78 | 138 |
| 0777 Toluene | 5. | ug/l | < 1. | ug/l | | 104 | 105 | 0 | 99 | | | 78 | 118 |
| 0778 Ethylbenzene | 5. | ug/l | < 1. | ug/l | | 103 | 104 | 1 | 97 | | | 77 | 119 |
| 0779 Total Xylenes | 20. | ug/l | < 3. | ug/l | | 102 | 102 | 0 | 95 | | | 76 | 116 |

SURROGATE SUMMARY

| | TRIAL ID | SURROGATE | RECOVERY % | SURROGATE LIMITS LOW | SURROGATE LIMITS HIGH |
|---|---|---|---|---|---|
| 8208 BTEX (8020) | | TFT | 101 | 70 | 130 |

LABORATORY CHRONICLE

| CAT NO | ANALYSIS NAME | METHOD | TRIAL | ID | ANALYSIS DATE AND TIME | ANALYST |
|---|---|---|---|---|---|---|
| 8208 | BTEX (8020) | SW-846 8020A | 1 | | 11/07/97 0016 | Andrea L. Smith |

1 COPY TO GES-NY ATTN: Mr. Brian Carey

Questions? Contact your Client Services Representative
De Brooks at (717) 656-2300
22:45:14 D 0001 2 130271 589296
547 0.00 00003100 ASR000

Respectfully Submitted
Michele McClarin, B.A.
Manager, Volatiles

Lancaster Laboratories
*A division of Thermo Analytical Inc.*

LLI Sample No. WW 2813649
Collected: 10/31/97 at 16:15 by BC

Submitted: 11/ 5/97 Reported: 11/11/97
Discard: 12/12/97

SYS-EFF Grab Water Sample
LOC# 31-010 PRCA# 951061 PHC# 5L
MOBIL: 625 Elk Street, NY

Account No: 09593
Mobil Oil Corporation
464 Doughty Blvd., 2nd Floor
Inwood NY 11096-1342

P.O. 31-010
Rel.

| CAT NO. | ANALYSIS NAME | AS RECEIVED RESULTS | LIMIT OF QUANTITATION | UNITS |
|---|---|---|---|---|
| 8208 | BTEX (8020) | | | |
| 0776 | Benzene | 310. | 1. | ug/l |
| 0777 | Toluene | 18. | 1. | ug/l |
| 0778 | Ethylbenzene | 79. | 1. | ug/l |
| 0779 | Total Xylenes | 210. | 3. | ug/l |

QUALITY CONTROL REPORT

| | SAMPLE LOQ | SAMPLE UNITS | BLANK | | DUP RPD | MS | MSD | MS RPD | LCS | LCS DUP | LCS RPD | LCS LIMITS LOW | LCS LIMITS HIGH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8208 BTEX (8020) | | | Batch: 97310A68 | | | | | | | | | | |
| 0776 Benzene | 1. | ug/l | < 1. | ug/l | | 105 | 106 | 1 | 101 | | | 78 | 138 |
| 0777 Toluene | 1. | ug/l | < 1. | ug/l | | 104 | 105 | 0 | 99 | | | 78 | 118 |
| 0778 Ethylbenzene | 1. | ug/l | < 1. | ug/l | | 103 | 104 | 1 | 97 | | | 77 | 119 |
| 0779 Total Xylenes | 3. | ug/l | < 3. | ug/l | | 102 | 102 | 0 | 95 | | | 76 | 116 |

SURROGATE SUMMARY

| | TRIAL ID | SURROGATE | RECOVERY % | SURROGATE LIMITS LOW | SURROGATE LIMITS HIGH |
|---|---|---|---|---|---|
| 8208 BTEX (8020) | | TFT | 101 | 70 | 130 |

LABORATORY CHRONICLE

| CAT NO | ANALYSIS NAME | METHOD | TRIAL | ID | ANALYSIS DATE AND TIME | ANALYST |
|---|---|---|---|---|---|---|
| 8208 | BTEX (8020) | SW-846 8020A | 1 | | 11/07/97 0051 | Andrea L. Smith |

1 COPY TO GES-NY

ATTN: Mr. Brian Carey

Questions? Contact your Client Services Representative
De Brooks at (717) 656-2300
22:45:38 D 0001 2 130271 589296
547 0.00 00003100 ASR000

Respectfully Submitted
Michele McClarin, B.A.
Manager, Volatiles

# Mobil Easter egion Analysis Request/Chain Custody

**Lancaster Laboratories**
*A division of Thermo Analytical Inc.*

**For Lancaster Laboratories use only**
Acct. #: 9543 Sample #: 2813648-49

Please print.

SCR#:

Mobil Consultant: GES
Consultant Project Manager: BRIAN CAREY
Consultant Phone #: 716-873-4021 Fax #: 716-873-4175
Location Code #: 31010 PRCA/AFE#: 951061
Commitment Code #:  Phase Code: 5L
Site Address: 625 ELK STREET State: NY
Sampler: BRIAN CAREY
Mobil Engineer: MIKE LAMARRE

| Sample Identification | Date Collected | Time Collected | Grab | Composite | Soil | Water ☐ Potable ☐ NPDES | Oil ☐ Air ☐ | BTEX 602 ☐ +MTBE ☐ +NAPH ☐ +TBA ☐ | BTEX 8020 ☒ +MTBE ☐ +NAPH ☐ +TBA ☐ | TPH API GRO ☐ DRO ☐ | TPH Mobil DRO ☐ MRO ☐ | TPH 418.1 ☐ | BTEX 8021 ☐ MTBE ☐ NAPH ☐ STARS GAS ☐ STARS FUEL ☐ | 8270 BNA ☐ STARS PAH ☐ | TPH MA VPH ☐ MA EPH ☐ | | | | | | Remarks | Temperature (if requested) amples upon receipt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYS - INF | 10/31/97 | 16:00 | X | | | X | | | 3 | | | | | | | | | | | | PRESERVED - HCl | 5.0 |
| SYS - EFF | 10/31/97 | 16:15 | X | | | X | | | 3 | | | | | | | | | | | | PRESERVED - HCl | ↓ |

Analyses Requested: List total number of containers in the box under each analysis.

**Turnaround Time Requested** (TAT) (please circle):
[✓ MOBIL STD. TAT] 72 hour 48 hour
24 hour other _____ day

**Data Package Options** (please circle if requested)

| | |
|---|---|
| QC Summary | GLP |
| Type I (Tier I) | Other |
| Type II (Tier II) | Disk |
| Type III (NJ Red. Del.) | |
| Type IV (CLP) | |
| Type VI (Raw Data) | |

SDG Complete? Yes No

Site-specific QC required? Yes No (If yes, indicate QC sample and submit triplicate volume.)

Internal Chain of Custody required? Yes No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Brian Carey | 11/4/97 | 10:00 | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | Vesa Zook | 11/5/97 | 0915 |

# Analysis Repo

**Lancaster Laboratories**
*A division of Thermo Analytical Inc.*

LLI Sample No. WW 2833894
Collected: 11/30/97 at 16:00 by BC

Submitted: 12/ 4/97 Reported: 12/10/97
Discard: 1/10/98

SYS-INF Grab Water Sample
LOC# 31-010 PRCA#951061 PHC#5L
MOBIL: 625 Elk St., Buffalo, NY

Account No: 09593
Mobil Oil Corporation
464 Doughty Blvd., 2nd Floor
Inwood NY 11096-1342

P.O. 31-010
Rel.

| CAT NO. | ANALYSIS NAME | AS RECEIVED RESULTS | LIMIT OF QUANTITATION | UNITS |
|---|---|---|---|---|
| 8208 | BTEX (8020) | | | |
| 0776 | Benzene | 1,100. | 5. | ug/l |
| 0777 | Toluene | 24. | 5. | ug/l |
| 0778 | Ethylbenzene | 340. | 5. | ug/l |
| 0779 | Total Xylenes | 790. | 20. | ug/l |

## QUALITY CONTROL REPORT

8208 BTEX (8020) Batch: 97341A68

| | SAMPLE LOQ | SAMPLE UNITS | BLANK | | DUP RPD | MS | MSD | MS RPD | LCS | LCS DUP | LCS RPD | LCS LIMITS LOW | HIGH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0776 Benzene | 5. | ug/l | < 1. | ug/l | | 103 | 103 | 0 | 103 | | | 78 | 138 |
| 0777 Toluene | 5. | ug/l | < 1. | ug/l | | 99 | 99 | 0 | 101 | | | 78 | 118 |
| 0778 Ethylbenzene | 5. | ug/l | < 1. | ug/l | | 99 | 99 | 0 | 97 | | | 77 | 119 |
| 0779 Total Xylenes | 20. | ug/l | < 3. | ug/l | | 97 | 97 | 0 | 96 | | | 76 | 116 |

## SURROGATE SUMMARY

| | TRIAL ID | SURROGATE | RECOVERY % | SURROGATE LIMITS LOW | HIGH |
|---|---|---|---|---|---|
| 8208 BTEX (8020) | | TFT | 102 | 70 | 130 |

## LABORATORY CHRONICLE

| CAT NO | ANALYSIS NAME | METHOD | TRIAL | ANALYSIS ID | DATE AND TIME | ANALYST |
|---|---|---|---|---|---|---|
| 8208 | BTEX (8020) | SW-846 8020A | 1 | | 12/08/97 0044 | Abul I. Siddiqui |

1 COPY TO GES-NY ATTN: Mr. Brian Carey

Questions? Contact your Client Services Representative
De Brooks at (717) 656-2300
12:56:33 D 0001 2 130271 593472
547 0.00 00003100 ASR000

Respectfully Submitted
Michele McClarin, B.A.
Manager, Volatiles

MEMBER ACIL

Lancaster Laboratories
2425 New Holland Pike
PO Box 12425
Lancaster PA 17605-2425
717-656-2300 Fax 717-656-2681

See reverse side for explanation of symbols and abbreviations

**Lancaster Laboratories**
*A division of Thermo Analytical Inc.*

LLI Sample No. WW 2833895
Collected: 11/30/97 at 16:15 by BC

Submitted: 12/ 4/97 Reported: 12/10/97
Discard: 1/10/98

SYS-EFF Grab Water Sample
LOC# 31-010 PRCA#951061 PHC#5L
MOBIL: 625 Elk St., Buffalo, NY

Account No: 09593
Mobil Oil Corporation
464 Doughty Blvd., 2nd Floor
Inwood NY 11096-1342

P.O. 31-010
Rel.

| CAT NO. | ANALYSIS NAME | AS RECEIVED RESULTS | LIMIT OF QUANTITATION | UNITS |
|---|---|---|---|---|
| 8208 | BTEX (8020) | | | |
| 0776 | Benzene | 170. | 1. | ug/l |
| 0777 | Toluene | < 5. | 5. | ug/l |
| 0778 | Ethylbenzene | 51. | 1. | ug/l |
| 0779 | Total Xylenes | 140. | 3. | ug/l |

Due to the presence of an interferent near its retention time, the normal reporting limit was not attained for toluene.

QUALITY CONTROL REPORT

| | SAMPLE LOQ | SAMPLE UNITS | BLANK | | DUP RPD | MS | MSD | MS RPD | LCS | LCS DUP | LCS RPD | LCS LIMITS LOW | HIGH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8208 BTEX (8020) | | | Batch: 97341A68 | | | | | | | | | | |
| 0776 Benzene | 1. | ug/l | < 1. | ug/l | | 103 | 103 | 0 | 103 | | | 78 | 138 |
| 0777 Toluene | 5. | ug/l | < 1. | ug/l | | 99 | 99 | 0 | 101 | | | 78 | 118 |
| 0778 Ethylbenzene | 1. | ug/l | < 1. | ug/l | | 99 | 99 | 0 | 97 | | | 77 | 119 |
| 0779 Total Xylenes | 3. | ug/l | < 3. | ug/l | | 97 | 97 | 0 | 96 | | | 76 | 116 |

SURROGATE SUMMARY

| | TRIAL ID | SURROGATE | RECOVERY % | SURROGATE LIMITS LOW | HIGH |
|---|---|---|---|---|---|
| 8208 BTEX (8020) | | TFT | 104 | 70 | 130 |

LABORATORY CHRONICLE

| CAT NO | ANALYSIS NAME | METHOD | TRIAL | ANALYSIS ID | DATE AND TIME | ANALYST |
|---|---|---|---|---|---|---|
| 8208 | BTEX (8020) | SW-846 8020A | 1 | | 12/08/97 0302 | Abul I. Siddiqui |

1 COPY TO GES-NY ATTN: Mr. Brian Carey

Questions? Contact your Client Services Representative
De Brooks at (717) 656-2300
12:56:55 D 0001 2 130271 593472
547 0.00 00003100 ASR000

Respectfully Submitted
Michele McClarin, B.A.
Manager, Volatiles

MEMBER ACIL

# Mobil Eastern Region Analysis Request/Chain of Custody

**Lancaster Laboratories**
A division of Thermo Analytical Inc.

For Lancaster Laboratories use only
Acct. #: 9593 Sample #: 2833894-895

Please print.

SCR#:

Mobil Consultant: GES
Consultant Project Manager: BRIAN CAREY
Consultant Phone #: 716-~~634~~873-402 Fax #: 716-873-4175
Location Code #: 31010 PRCA/AFE#:
Commitment Code #: Phase Code:
Site Address: 625 ELK ST BUFFALO State: NY
Sampler: BRIAN CAREY
Mobil Engineer: MIKE LAMARRE

**Matrix** | **Analyses Requested** List total number of containers in the box under each analysis.

| Sample Identification | Date Collected | Time Collected | Grab. | Composite | Soil | Water ☐ Potable ☐ NPDES | Oil ☐ Air ☐ | BTEX 602 ☐ +MTBE ☐ +NAPH ☐ +TBA ☐ | BTEX 8020 ☒ +MTBE ☐ +NAPH ☐ +TBA ☐ | TPH API GRO ☐ DRO ☐ | TPH Mobil DRO ☐ MRO ☐ | TPH 418.1 ☐ | BTEX 8021 ☐ MTBE ☐ NAPH ☐<br>STARS GAS ☐ STARS FUEL ☐ | 8270 BNA ☐ STARS PAH ☐ | TPH MA VPH ☐ MA EPH ☐ | | | | | Remarks | Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYS - INF | 11-30-97 | 16:00 | X | | | X | | | 3 | | | | | | | | | | | PRESERVED HCl | 6.0° |
| SYS - EFF | 11-30-97 | 16:15 | X | | | X | | | 3 | | | | | | | | | | | PRESERVED HCl | ↓ |

Turnaround Time Requested (TAT) (please circle):
[✓ MOBIL STD. TAT] 72 hour 48 hour
24 hour other ____ day

Data Package Options (please circle if requested)
QC Summary GLP
Type I (Tier I) Other
Type II (Tier II) Disk
Type III (NJ Red. Del.)
Type IV (CLP)
Type VI (Raw Data)

SDG Complete? Yes No

Site-specific QC required? Yes No (If yes, indicate QC sample and submit triplicate volume.)

Internal Chain of Custody required? Yes No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| | 12/5/97 | 15:00 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: Harlan Collins | 12-4-97 | 0845 |

# Lancaster Laboratories
*A division of Thermo Analytical Inc.*

**LLI Sample No. WW 2849233**
Collected: 12/29/97 at 11:30 by BC

Submitted: 12/30/97 Reported: 1/ 8/98
Discard: 2/ 8/98

SYS-INF Grab Water Sample
LOC# 31-010 PRCA# 951061 PHC# 5L
MOBIL: 625 Elk St. Buffalo, NY

Account No: 09593
Mobil Oil Corporation
464 Doughty Blvd., 2nd Floor
Inwood NY 11096-1342

P.O. 31-010
Rel.

| CAT NO. | ANALYSIS NAME | AS RECEIVED RESULTS | LIMIT OF QUANTITATION | UNITS |
|---|---|---|---|---|
| 8208 | BTEX (8020) | | | |
| 0776 | Benzene | 250. | 1. | ug/l |
| 0777 | Toluene | 110. | 1. | ug/l |
| 0778 | Ethylbenzene | 70. | 1. | ug/l |
| 0779 | Total Xylenes | 430. | 3. | ug/l |

## QUALITY CONTROL REPORT

8208 BTEX (8020) Batch: 98002A64

| | SAMPLE LOQ | SAMPLE UNITS | BLANK | | DUP RPD | MS | MSD | MS RPD | LCS | LCS DUP | LCS RPD | LCS LIMITS LOW | HIGH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0776 Benzene | 1. | ug/l | < 1. | ug/l | | 119 | 108 | 10 | 105 | | | 78 | 138 |
| 0777 Toluene | 1. | ug/l | < 1. | ug/l | | 110 | 106 | 4 | 100 | | | 78 | 118 |
| 0778 Ethylbenzene | 1. | ug/l | < 1. | ug/l | | 108 | 106 | 1 | 98 | | | 77 | 119 |
| 0779 Total Xylenes | 3. | ug/l | < 3. | ug/l | | 111 | 102 | 8 | 98 | | | 76 | 116 |

## SURROGATE SUMMARY

| | TRIAL ID | SURROGATE | RECOVERY % | SURROGATE LIMITS LOW | HIGH |
|---|---|---|---|---|---|
| 8208 BTEX (8020) | | TFT | 99 | 70 | 130 |

## LABORATORY CHRONICLE

| CAT NO | ANALYSIS NAME | METHOD | TRIAL | ID | ANALYSIS DATE AND TIME | ANALYST |
|---|---|---|---|---|---|---|
| 8208 | BTEX (8020) | SW-846 8020A | 1 | | 01/03/98 0322 | Barry R. Shoemaker |

1 COPY TO GES-NY ATTN: Mr. Brian Carey

Questions? Contact your Client Services Representative
De Brooks at (717) 656-2300
07:26:00 D 0001 2 130271 596755
547 0.00 00003100 ASR000

Respectfully Submitted
Michele McClarin, B.A.
Manager, Volatiles

Lancaster Laboratories
*A division of Thermo Analytical Inc.*

**LLI Sample No. WW 2849234**
Collected: 12/29/97 at 11:45 by BC

Submitted: 12/30/97 Reported: 1/ 8/98
Discard: 2/ 8/98

SYS-EFF Grab Water Sample
LOC# 31-010 PRCA# 951061 PHC# 5L
MOBIL: 625 Elk St. Buffalo, NY

Account No: 09593
Mobil Oil Corporation
464 Doughty Blvd., 2nd Floor
Inwood NY 11096-1342

P.O. 31-010
Rel.

| CAT NO. | ANALYSIS NAME | AS RECEIVED RESULTS | LIMIT OF QUANTITATION | UNITS |
|---|---|---|---|---|
| 8208 | BTEX (8020) | | | |
| 0776 | Benzene | 24. | 1. | ug/l |
| 0777 | Toluene | 15. | 1. | ug/l |
| 0778 | Ethylbenzene | 10. | 1. | ug/l |
| 0779 | Total Xylenes | 100. | 3. | ug/l |

QUALITY CONTROL REPORT

8208 BTEX (8020) Batch: 98002A64

| | SAMPLE LOQ | SAMPLE UNITS | BLANK | | DUP RPD | MS | MSD | MS RPD | LCS | LCS DUP | LCS RPD | LCS LIMITS LOW | HIGH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0776 Benzene | 1. | ug/l | < 1. | ug/l | | 119 | 108 | 10 | 105 | | | 78 | 138 |
| 0777 Toluene | 1. | ug/l | < 1. | ug/l | | 110 | 106 | 4 | 100 | | | 78 | 118 |
| 0778 Ethylbenzene | 1. | ug/l | < 1. | ug/l | | 108 | 106 | 1 | 98 | | | 77 | 119 |
| 0779 Total Xylenes | 3. | ug/l | < 3. | ug/l | | 111 | 102 | 8 | 98 | | | 76 | 116 |

SURROGATE SUMMARY

| | TRIAL ID | SURROGATE | RECOVERY % | SURROGATE LIMITS LOW | HIGH |
|---|---|---|---|---|---|
| 8208 BTEX (8020) | | TFT | 85 | 70 | 130 |

LABORATORY CHRONICLE

| CAT NO | ANALYSIS NAME | METHOD | TRIAL | ID | ANALYSIS DATE AND TIME | ANALYST |
|---|---|---|---|---|---|---|
| 8208 | BTEX (8020) | SW-846 8020A | 1 | | 01/03/98 0429 | Barry R. Shoemaker |

1 COPY TO GES-NY ATTN: Mr. Brian Carey

Questions? Contact your Client Services Representative
De Brooks at (717) 656-2300
07:26:31 D 0001 2 130271 596755
547 0.00 00003100 ASR000

Respectfully Submitted
Michele McClarin, B.A.
Manager, Volatiles

MEMBER ACIL

# Mobil Eastern Region Analysis Request/Chain of Custody

**Lancaster Laboratories**
A division of Thermo Analytical Inc.

Acct # 9593 LL # 2849233, 34

Please print. Instructions on reverse side correspond with circled numbers.

SCR#:

Mobil Consultant: GES
Consultant Project Manager: BRIAN CAREY
Consultant Phone #: 716-873-4021 Fax #: 716-873-4175
Location Code #: 31010 PRCA/AFE#: 951061
Commitment Code #:
Phase Code: SL
Site Address: 625 ELK ST State: NY
Sampler: BRIAN CAREY
Mobil Engineer: MIKE LAMARRE

Matrix: Potable ☐ NPDES ☐

Analyses Requested — List total number of containers in the box under each analysis.

| Sample Identification | Date Collected | Time Collected | Grab | Composite | Soil | Water | Oil ☐ Air ☐ | BTEX 602☐ +MTBE☐ +NAPH☐ +TBA☐ | BTEX 8020☒ +MTBE☐ +NAPH☐ +TBA☐ | TPH API GRO☐ DRO☐ | TPH Mobil DRO☐ MRO☐ | TPH 418.1☐ | BTEX 8021☐ MTBE☐ NAPH☐<br>STARS GAS☐ STARS FUEL☐ | 8270 BNA☐ STARS PAH☐ | TPH MA VPH☐ MA EPH☐ | | | | | | | Remarks | Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYS-INF | 12/29/97 | 11:30 | X | | | X | | | 3 | | | | | | | | | | | | | PRESERVED HCl | |
| SYS-EFF | 12/29/97 | 11:45 | X | | | X | | | 3 | | | | | | | | | | | | | PRESERVED HCl | |
| | | | | | | | | | | | | | | | | | | | | | | | 4.0°C |

Turnaround Time Requested (TAT) (please circle):
[✓ MOBIL STD. TAT] 72 hour 48 hour
24 hour other ____ day

Data Package Options (please circle if requested)
QC Summary GLP
Type I (Tier I) Other
Type II (Tier II) Disk
Type III (NJ Red. Del.)
Type IV (CLP)
Type VI (Raw Data)

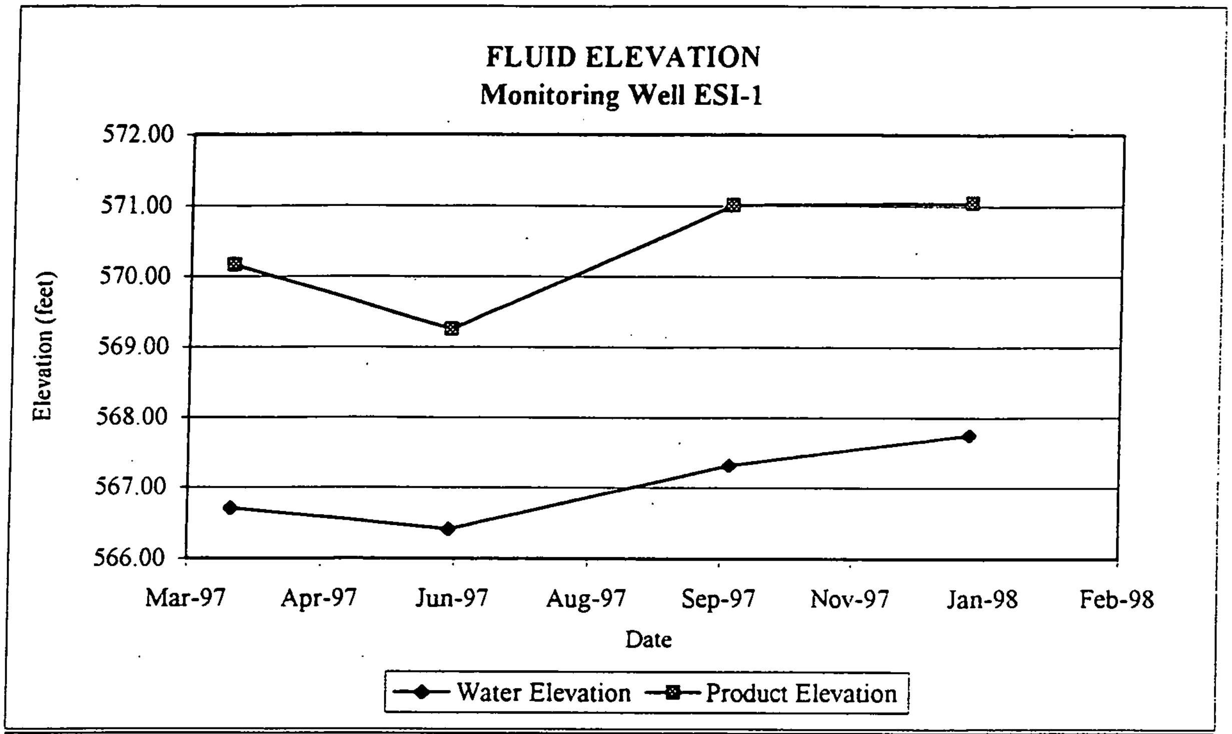
SDG Complete? Yes No

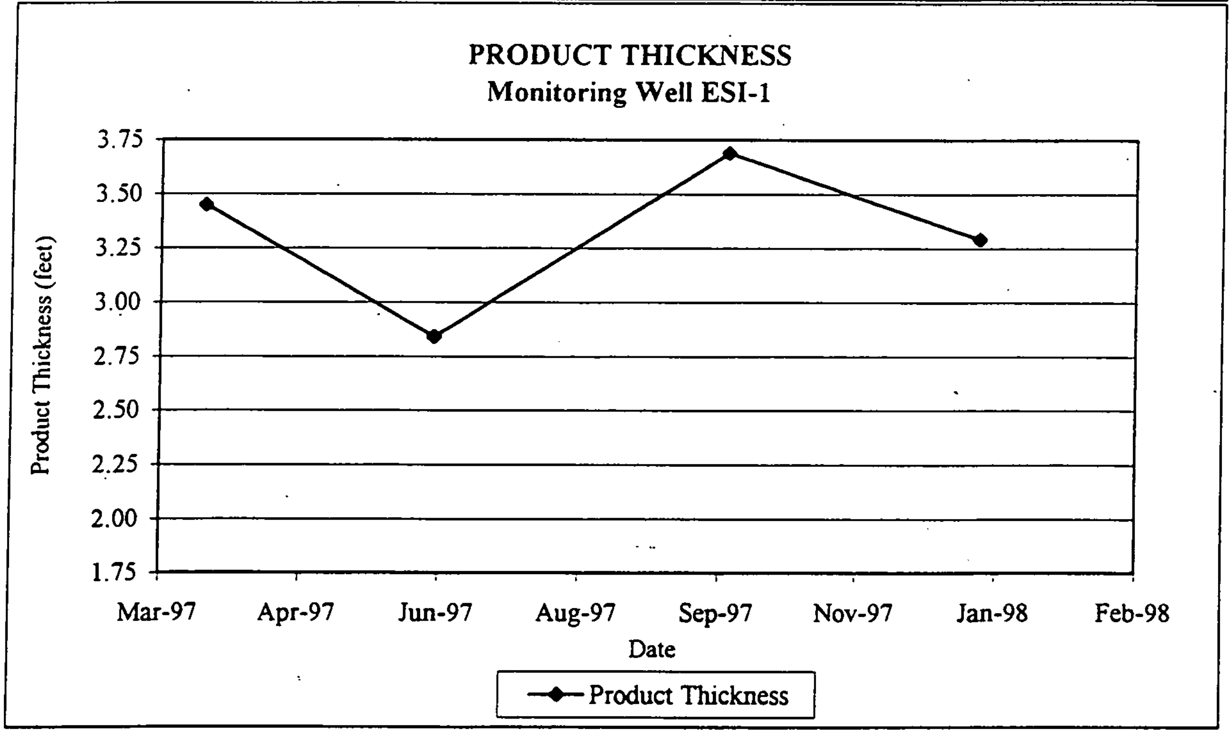
Site-specific QC required? Yes No (If yes, indicate QC sample and submit triplicate volume.)

Internal Chain of Custody required? Yes No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Brian Carey | 12/29/97 | 15:00 | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | 12/30/97 | 08:35 |

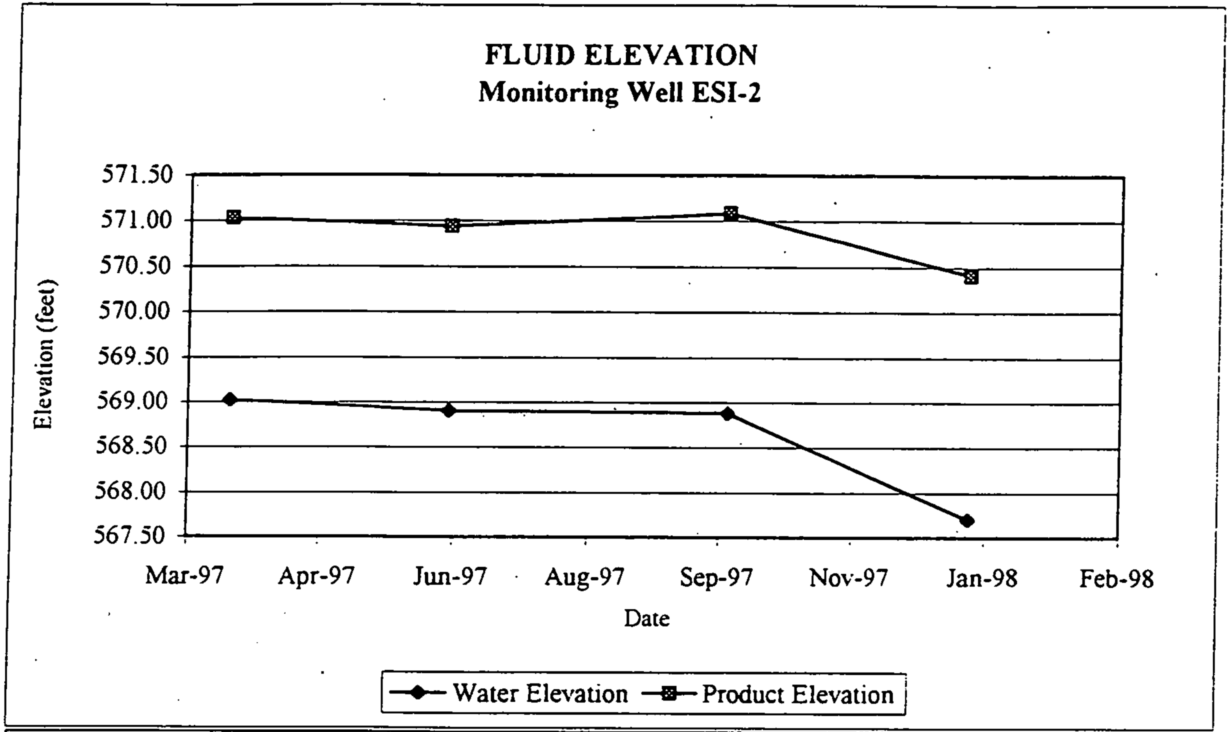
**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

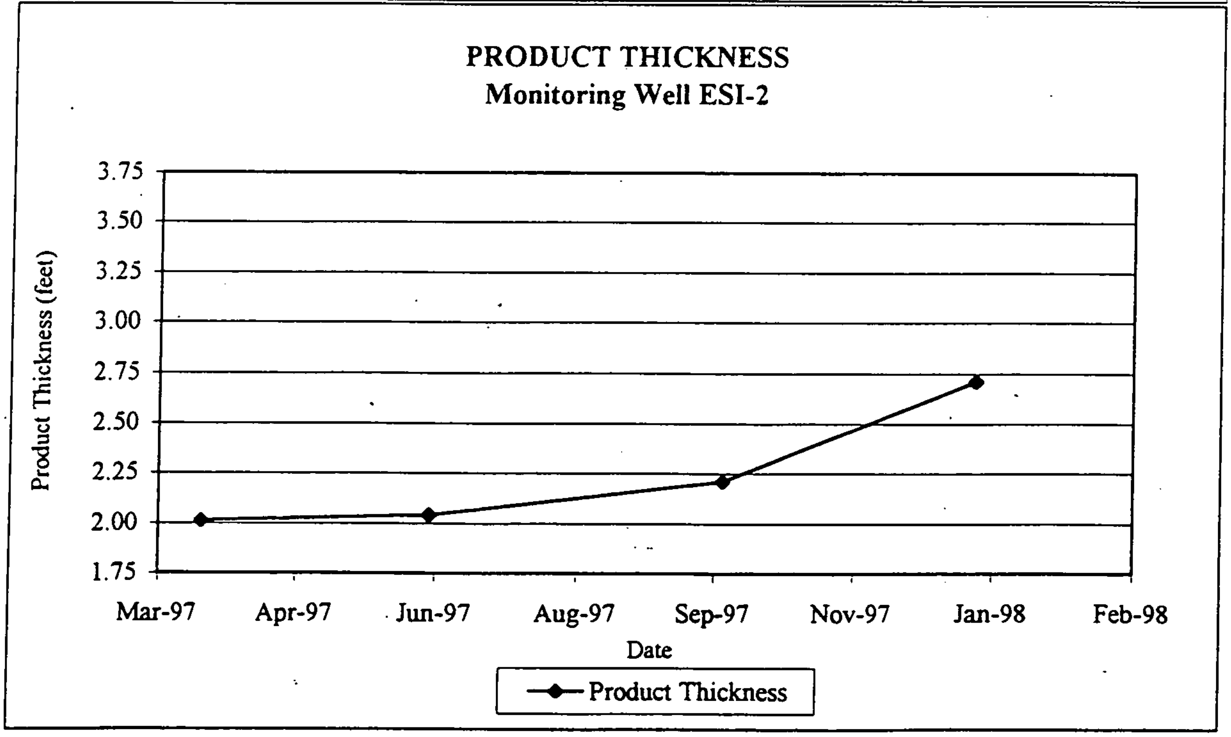




Top of Casing Elevation = 586.98

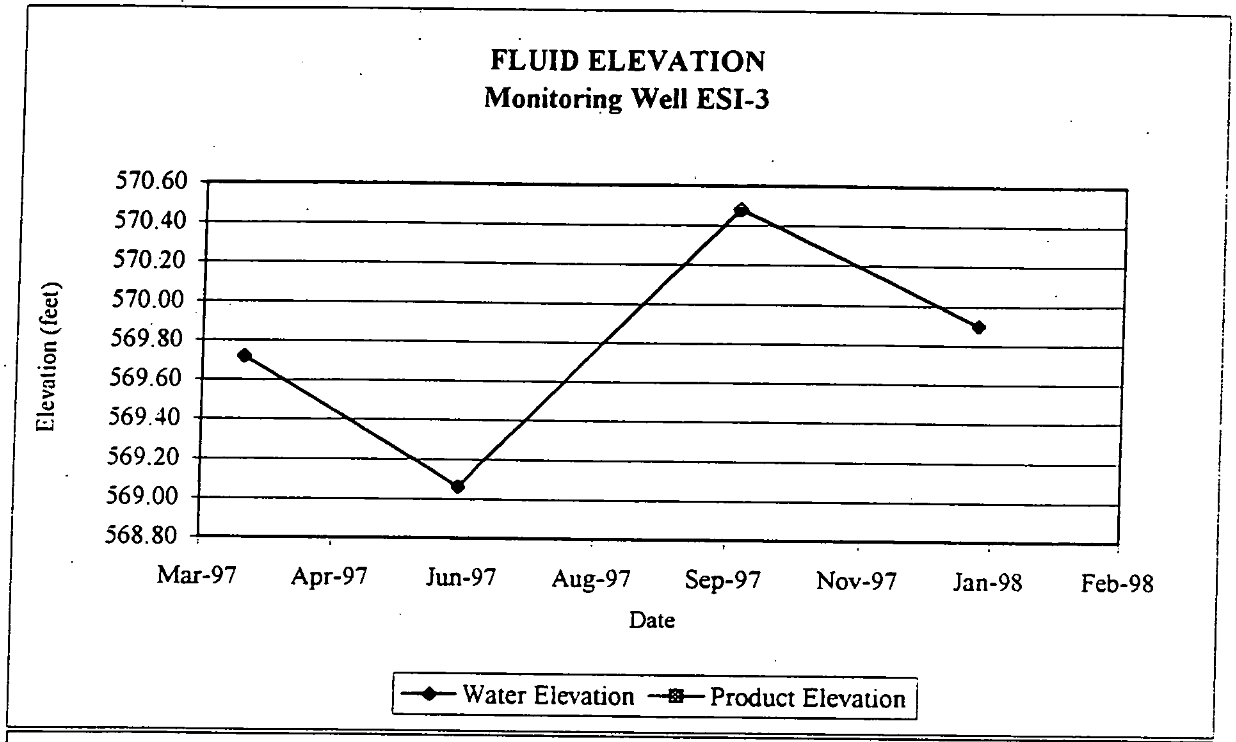
**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

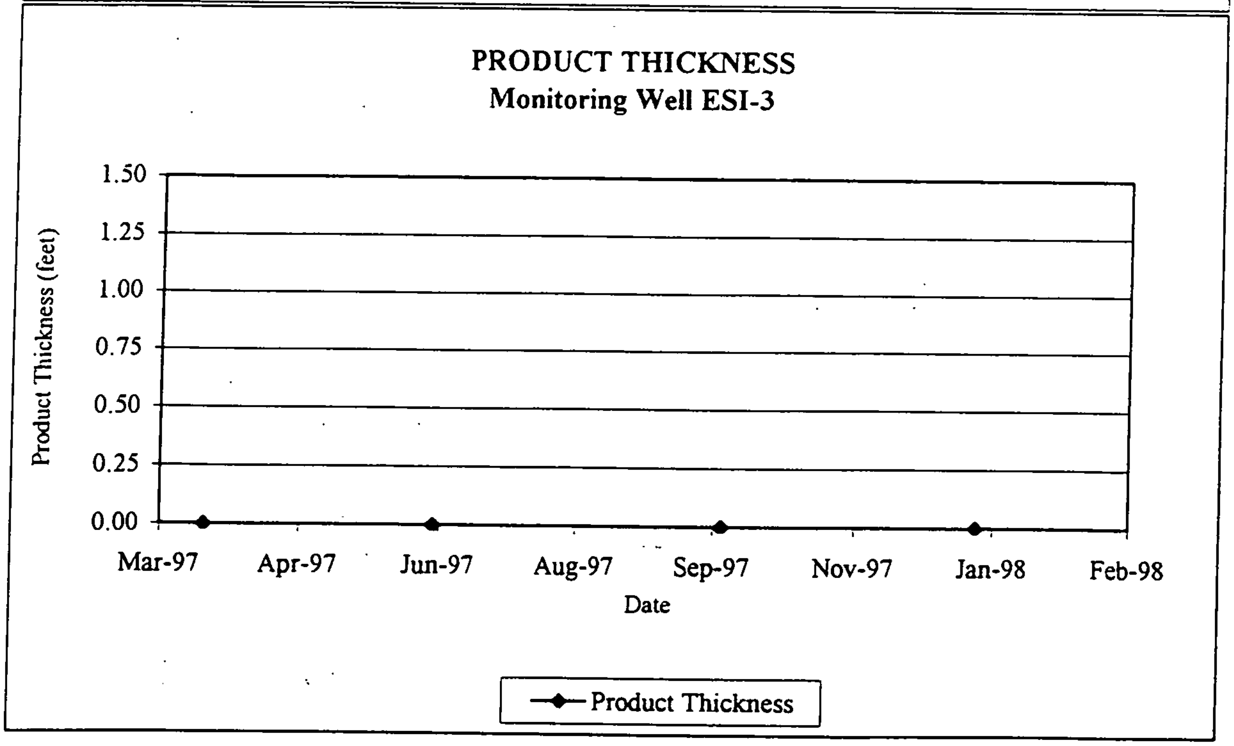




Top of Casing Elevation = 586.66

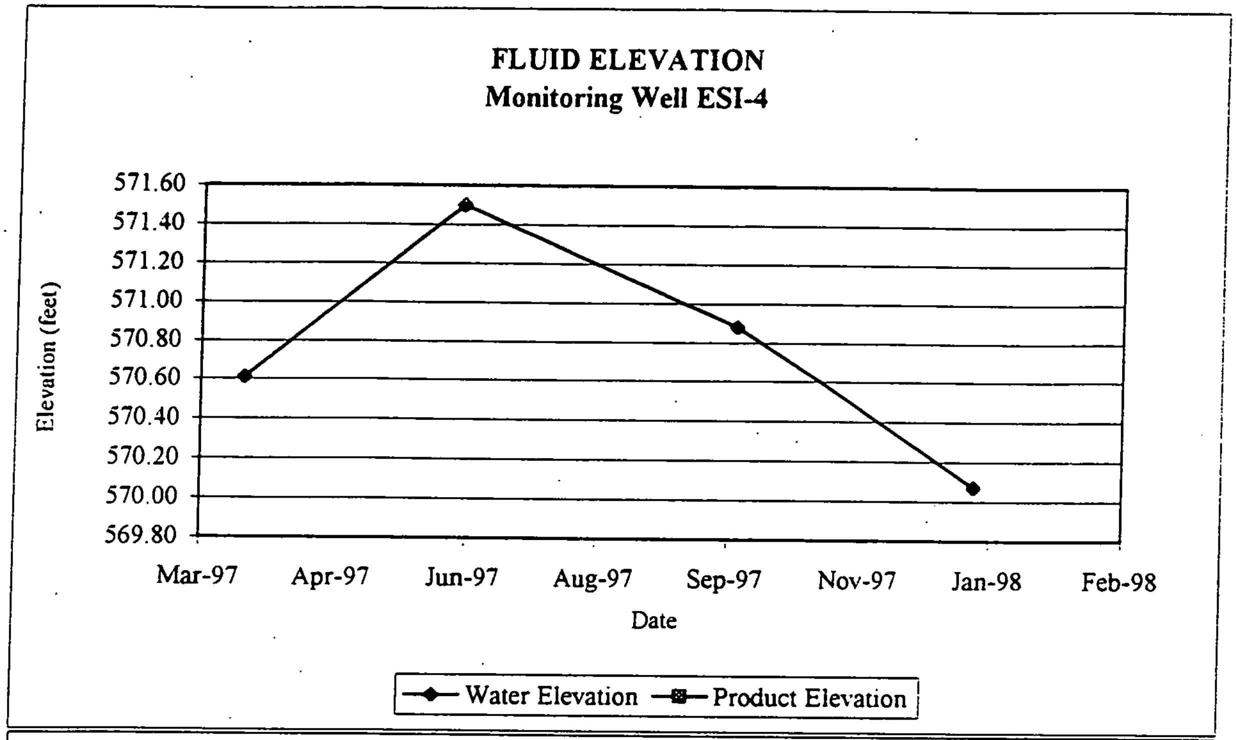
## Mobil Oil Corporation
## Buffalo Terminal #31-010
625 Elk Street
Buffalo, New York

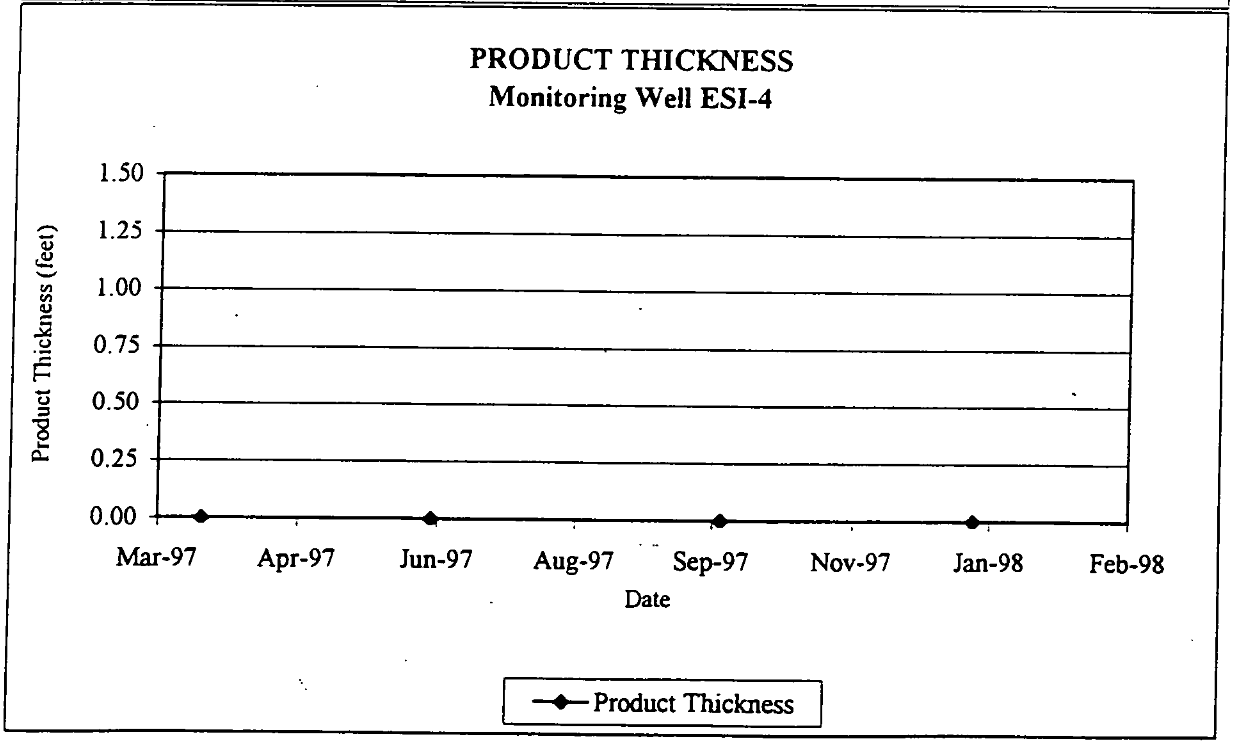




Top of Casing Elevation = 588.68

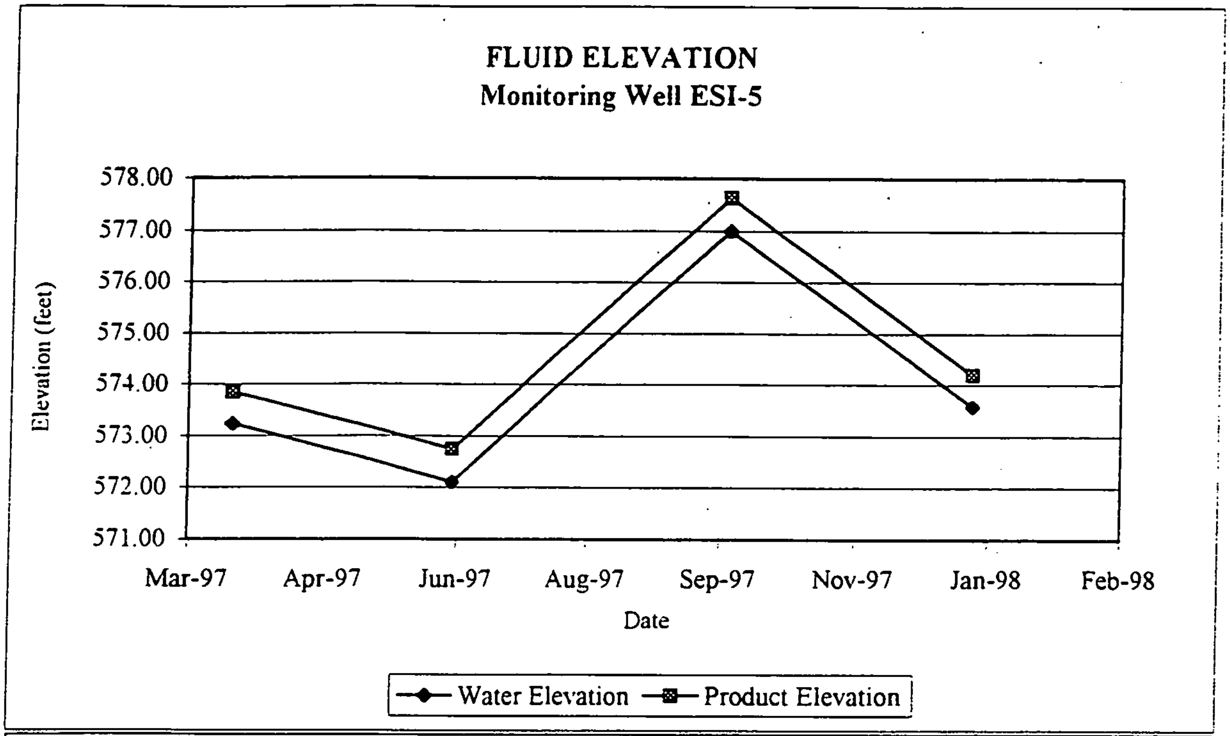
## Mobil Oil Corporation
## Buffalo Terminal #31-010
625 Elk Street
Buffalo, New York

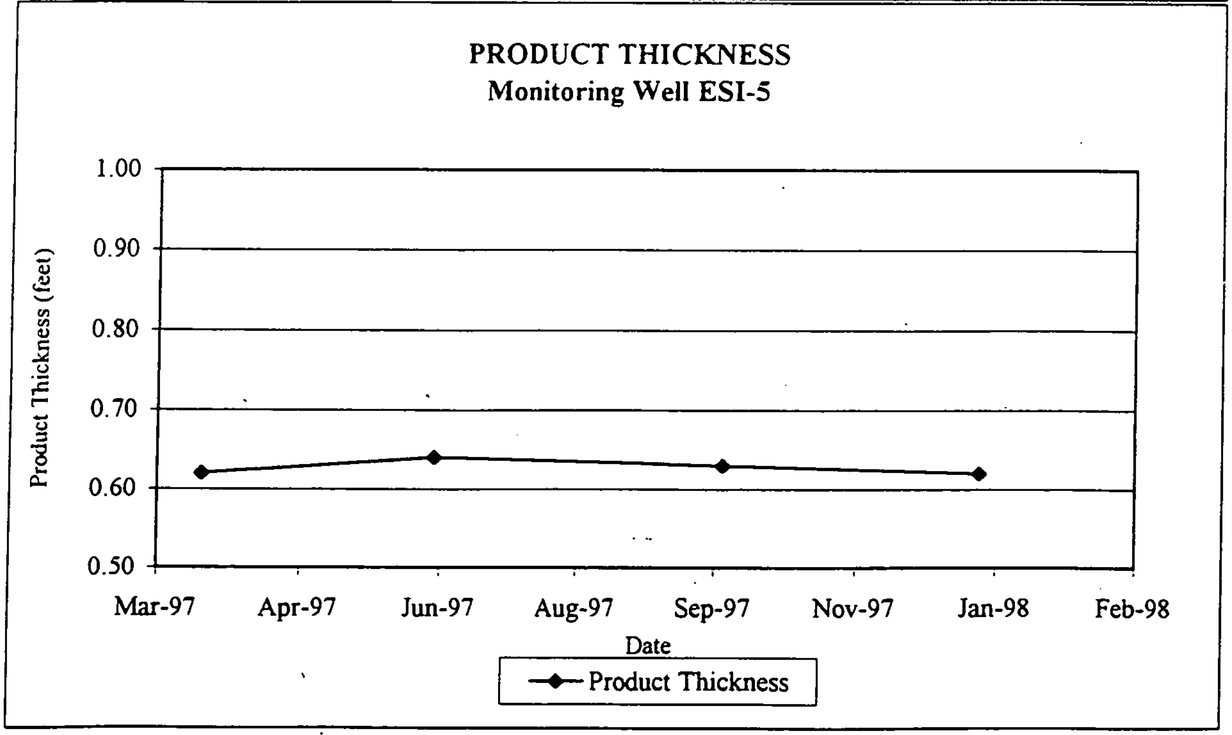




Top of Casing Elevation = 587.06

**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

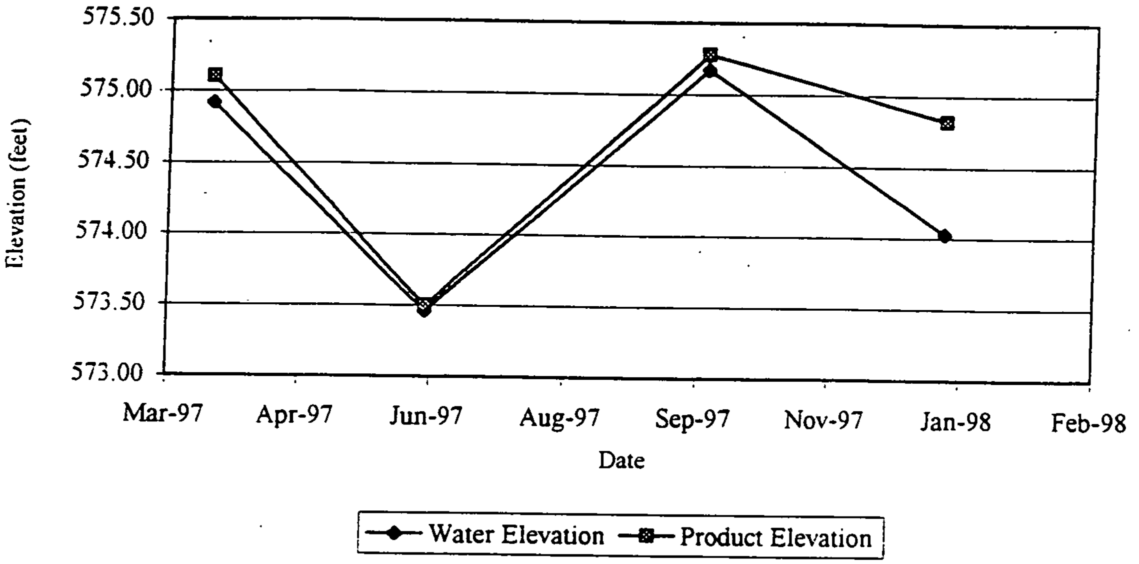




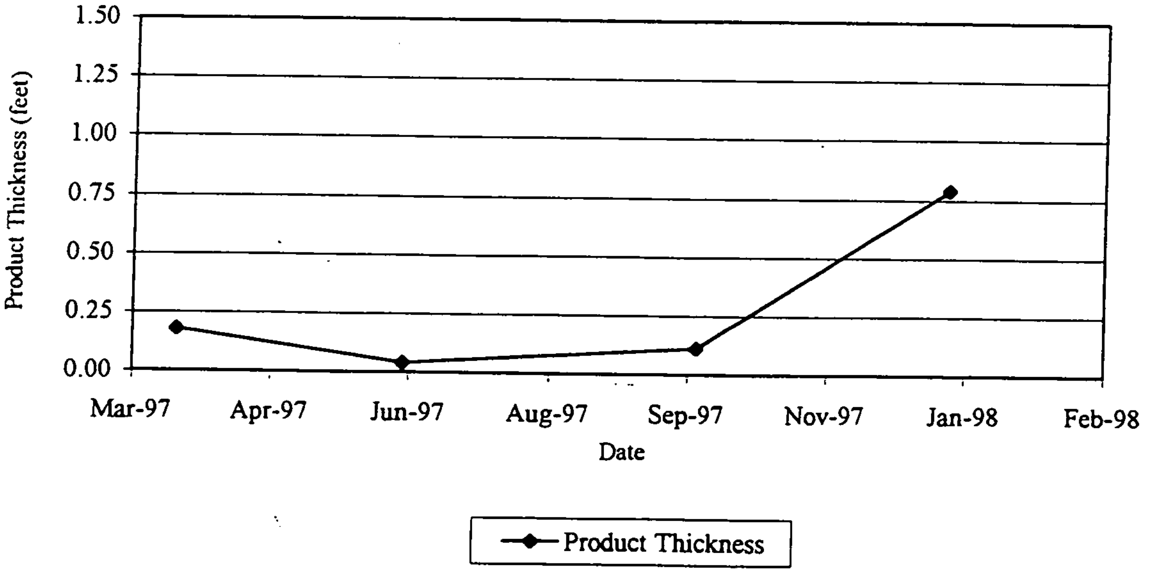
Top of Casing Elevation = 587.06

**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

FLUID ELEVATION
Monitoring Well MW-6

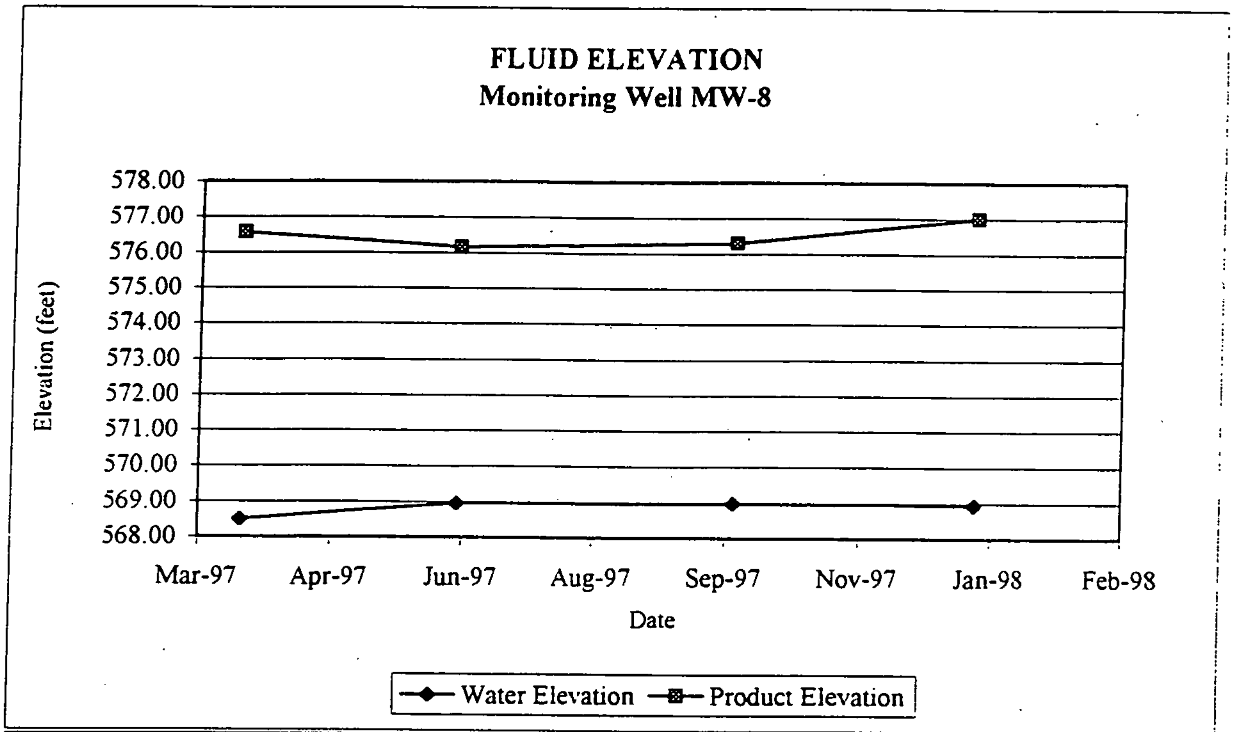


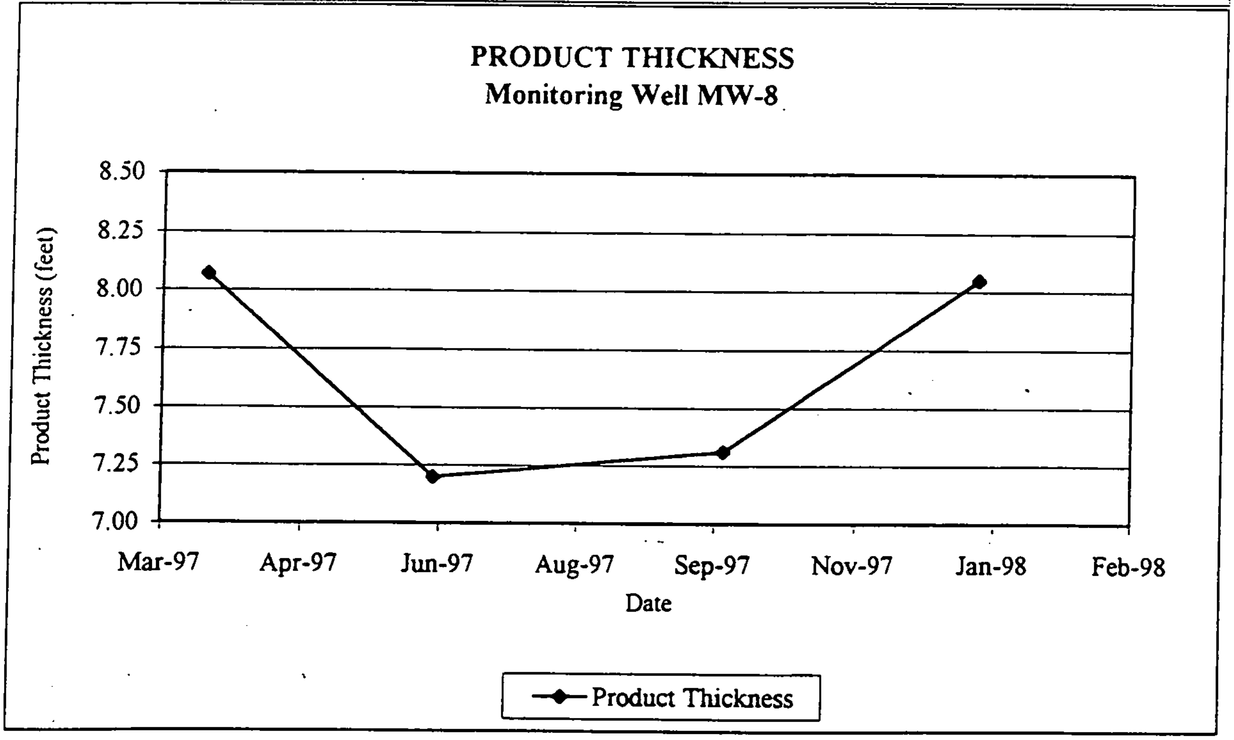
PRODUCT THICKNESS
Monitoring Well MW-6



Top of Casing Elevation = 586.18

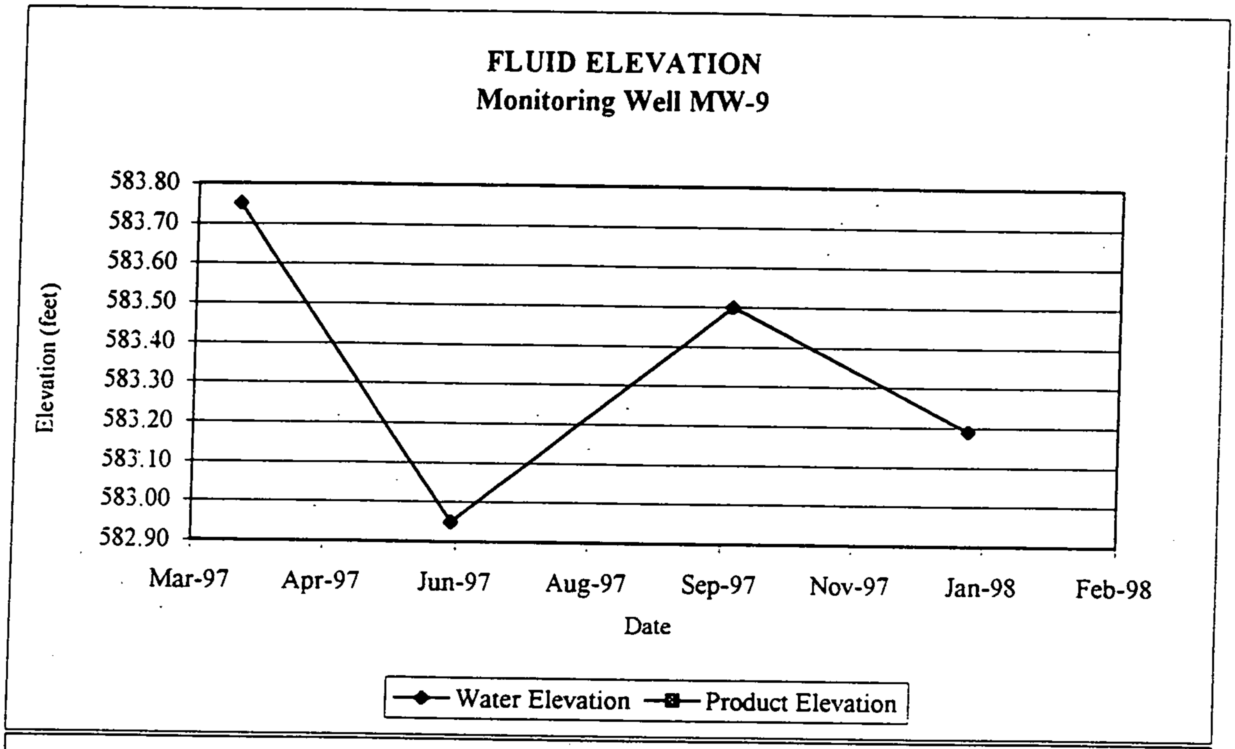
## Mobil Oil Corporation
## Buffalo Terminal #31-010
## 625 Elk Street
## Buffalo, New York

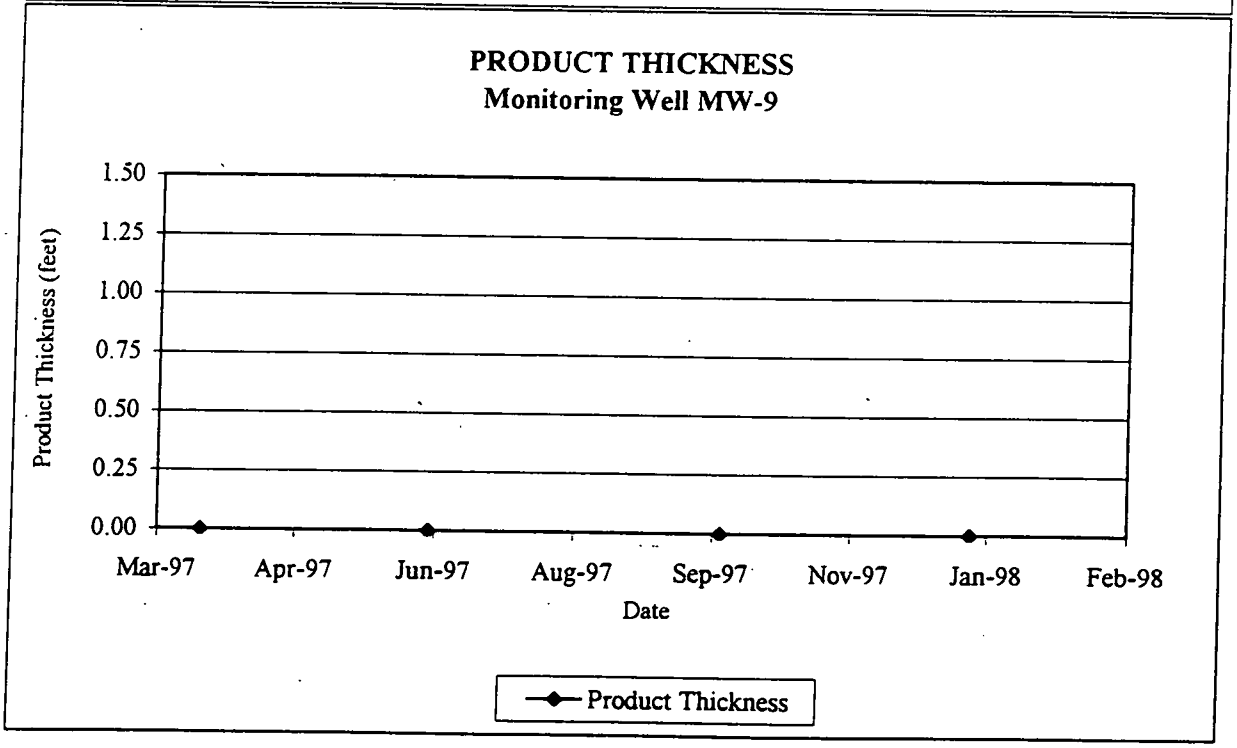




Top of Casing Elevation = 587.28

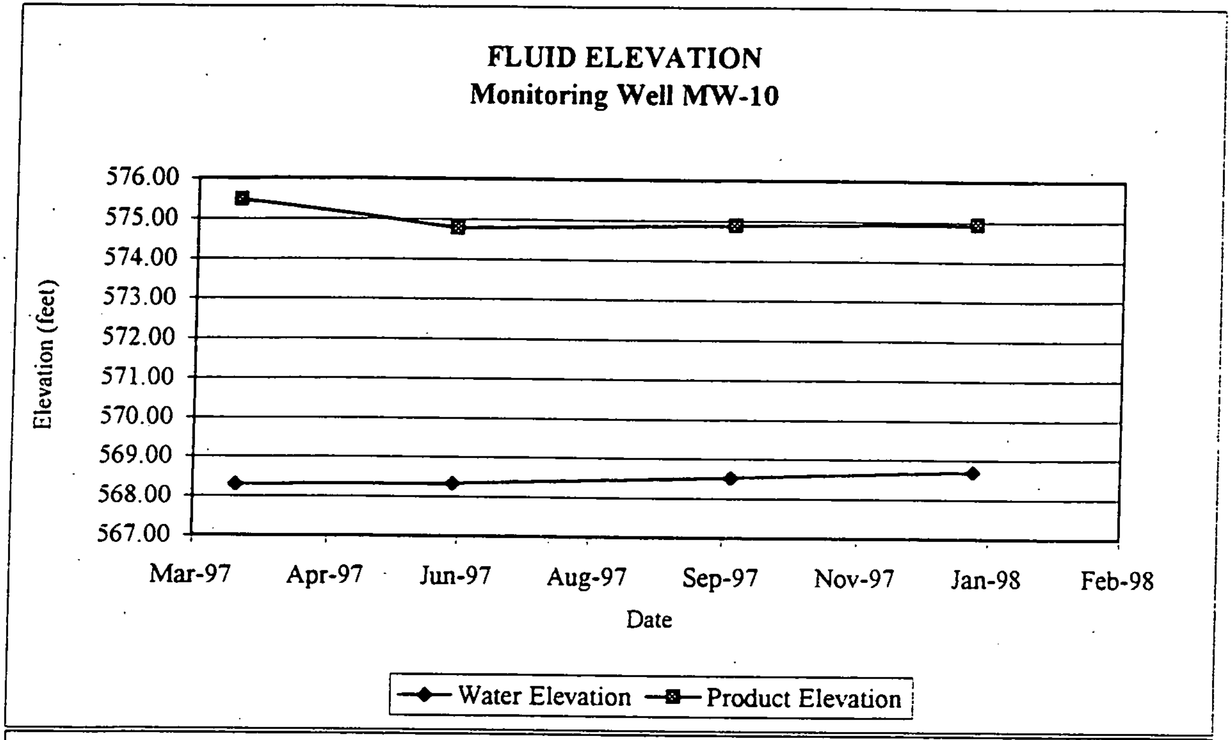
**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

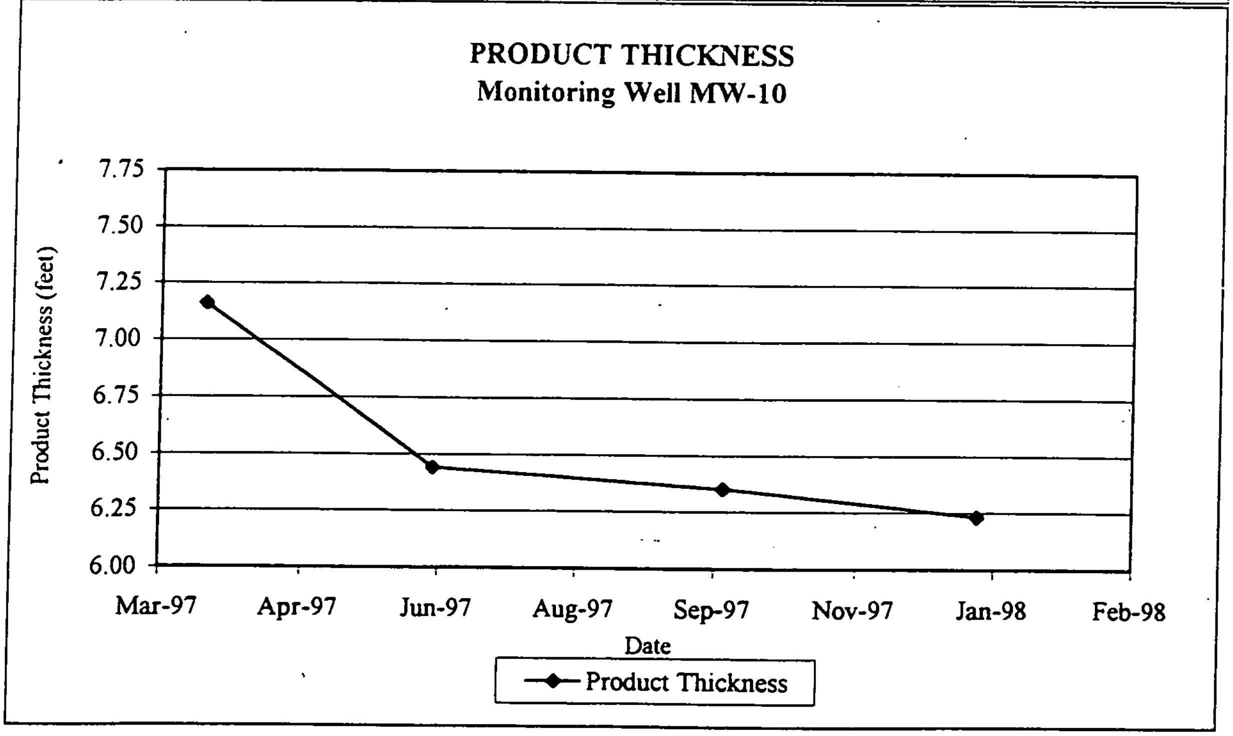




Top of Casing Elevation = 588.13

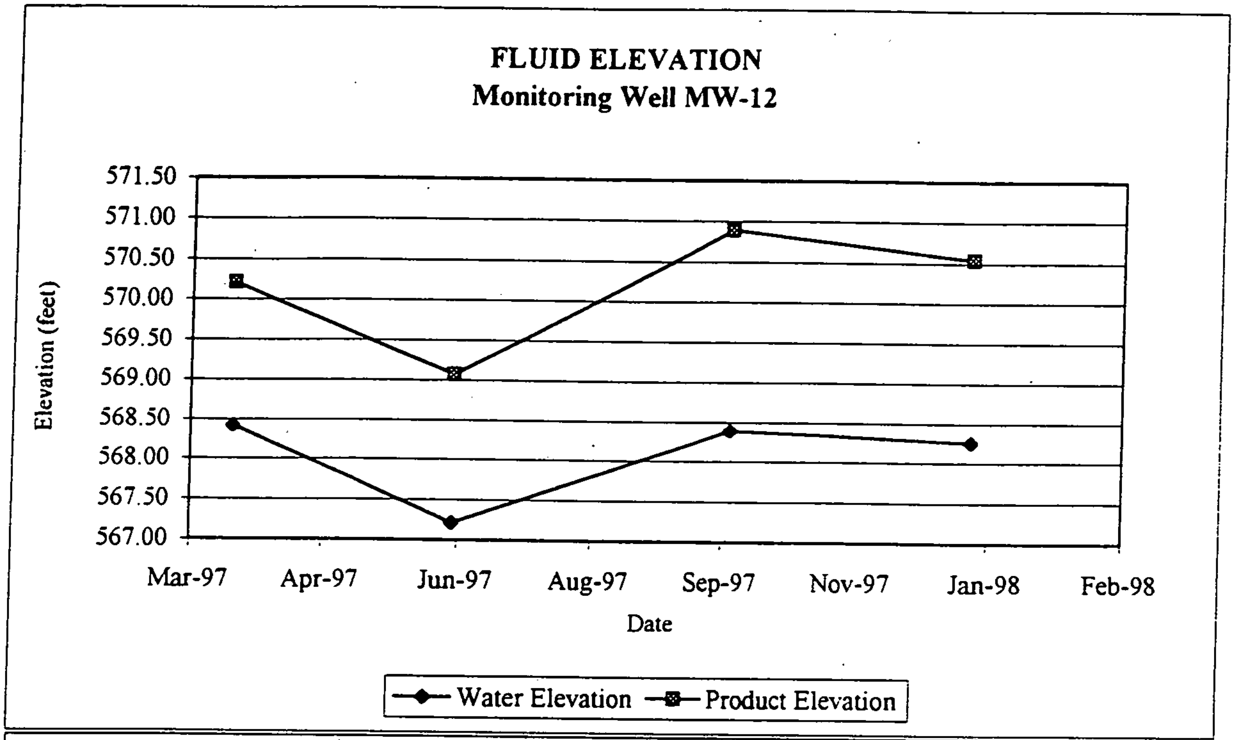
**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**



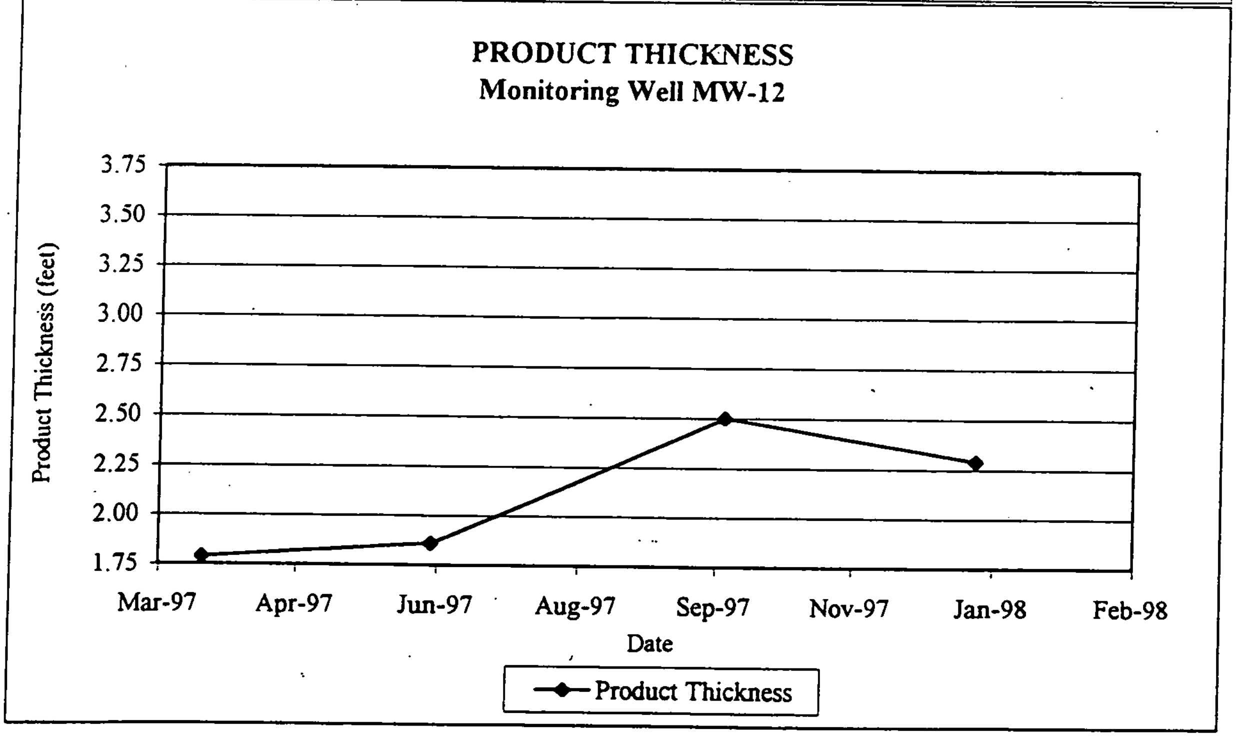


Top of Casing Elevation = 584.88

**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**



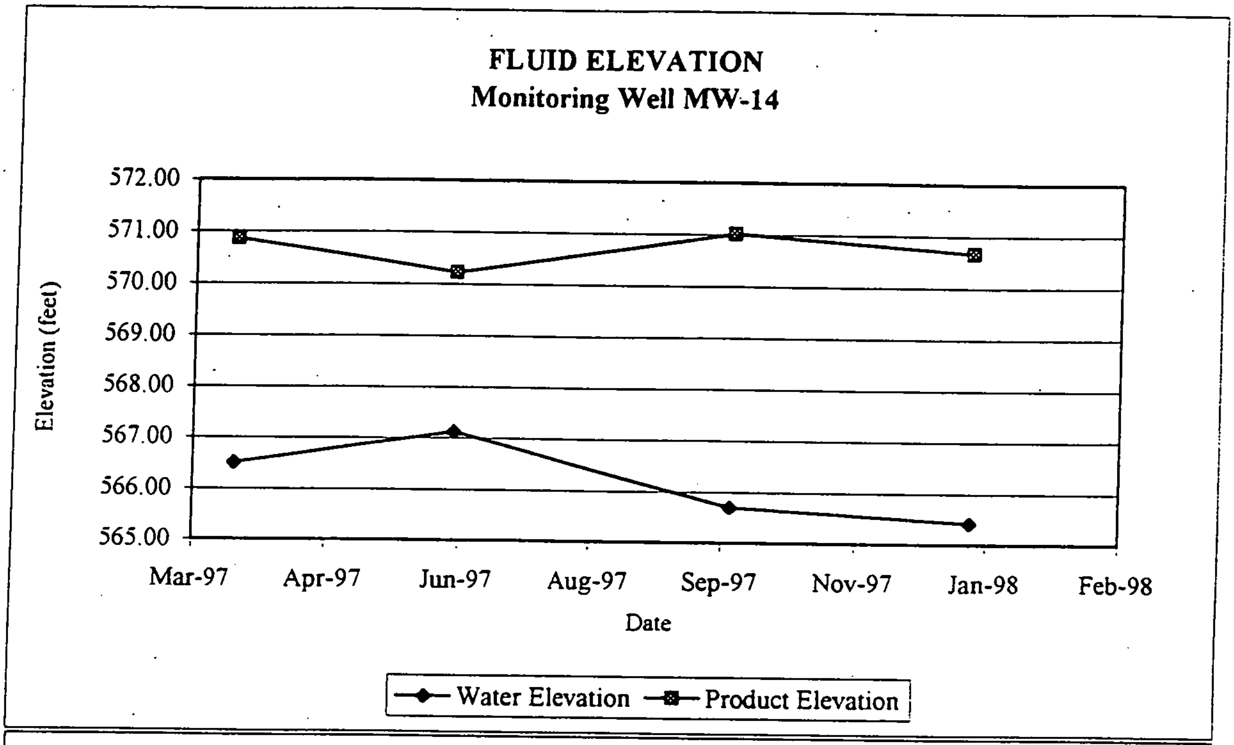
FLUID ELEVATION
Monitoring Well MW-12

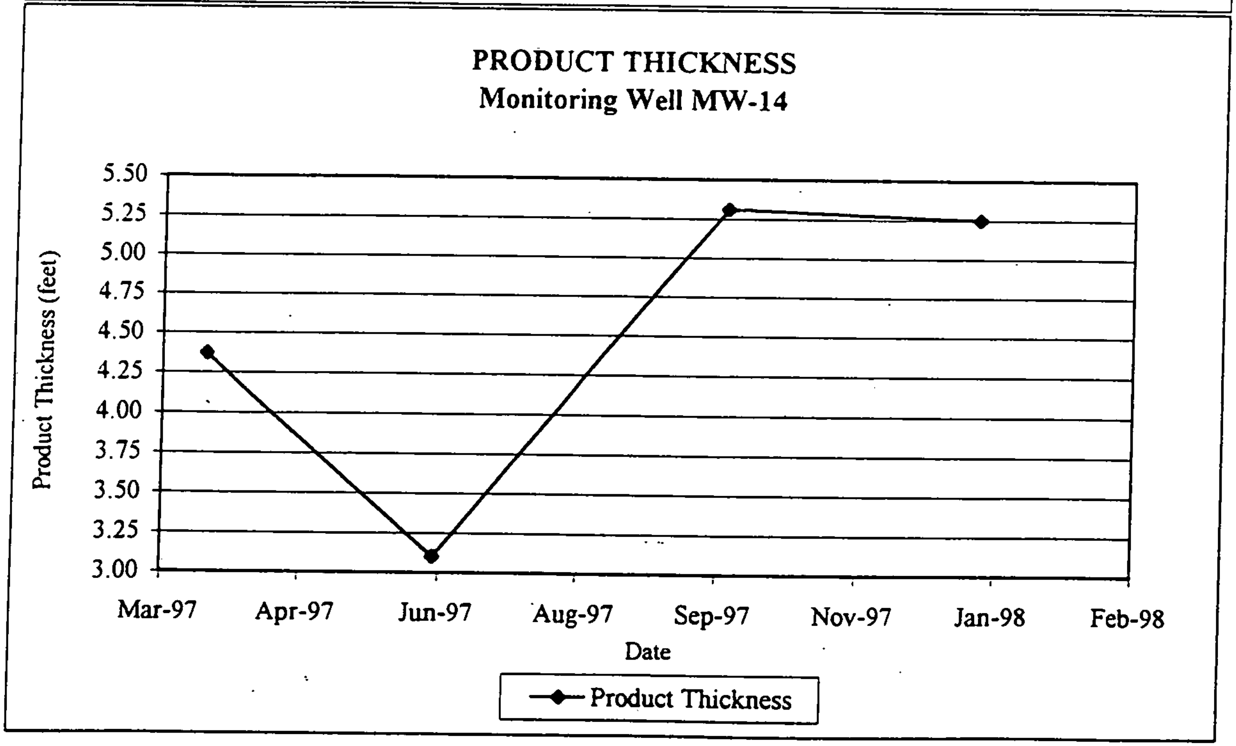


PRODUCT THICKNESS
Monitoring Well MW-12

Top of Casing Elevation = 586.99

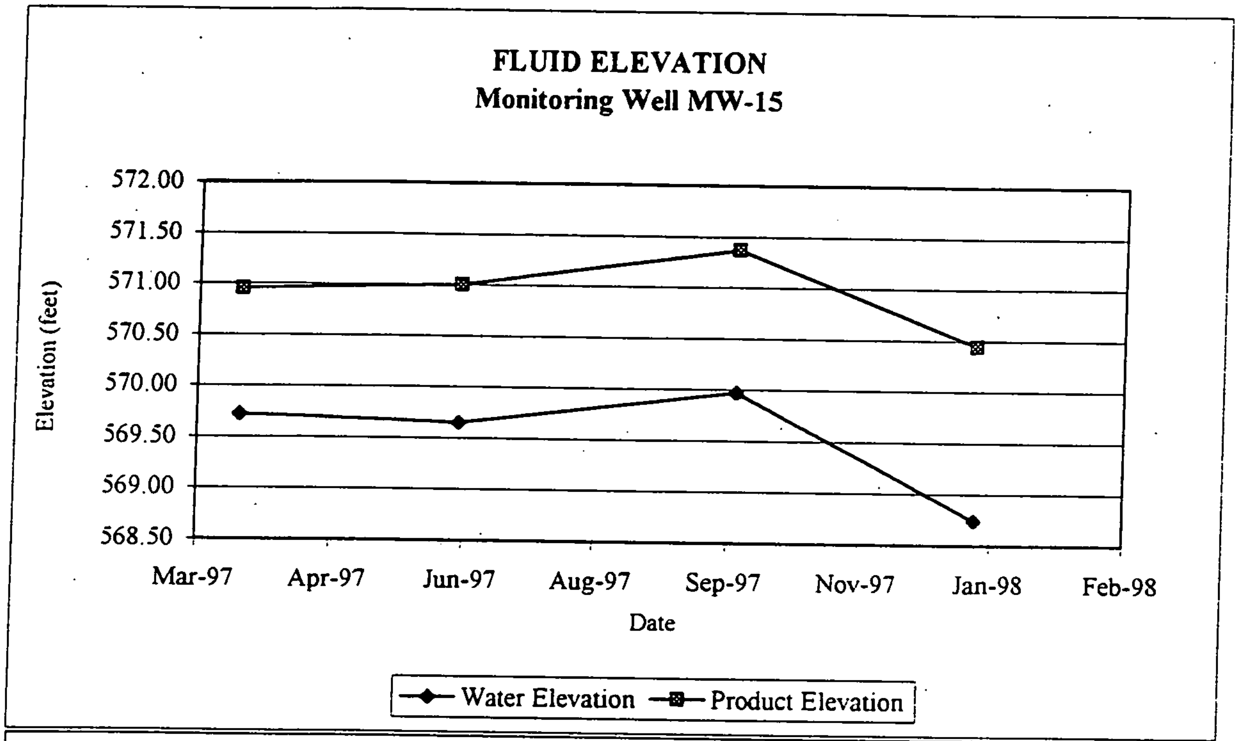
# Mobil Oil Corporation
Buffalo Terminal #31-010
625 Elk Street
Buffalo, New York

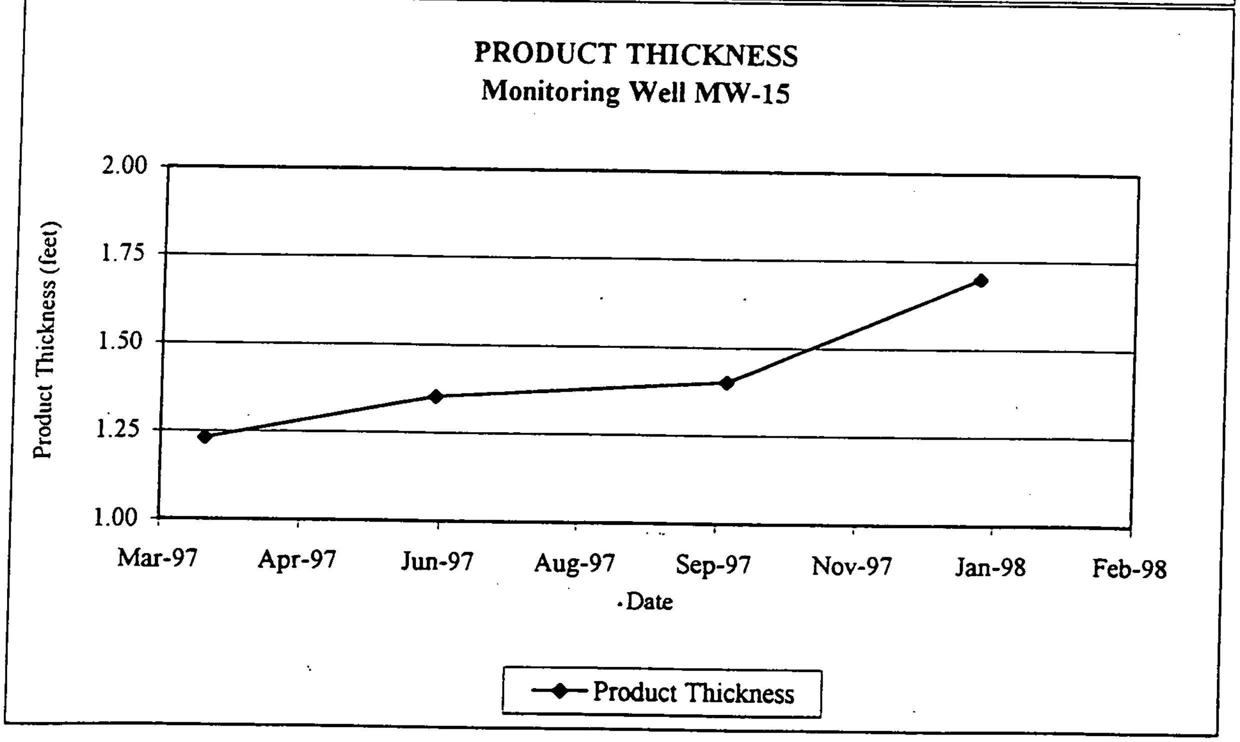




Top of Casing Elevation = 586.96

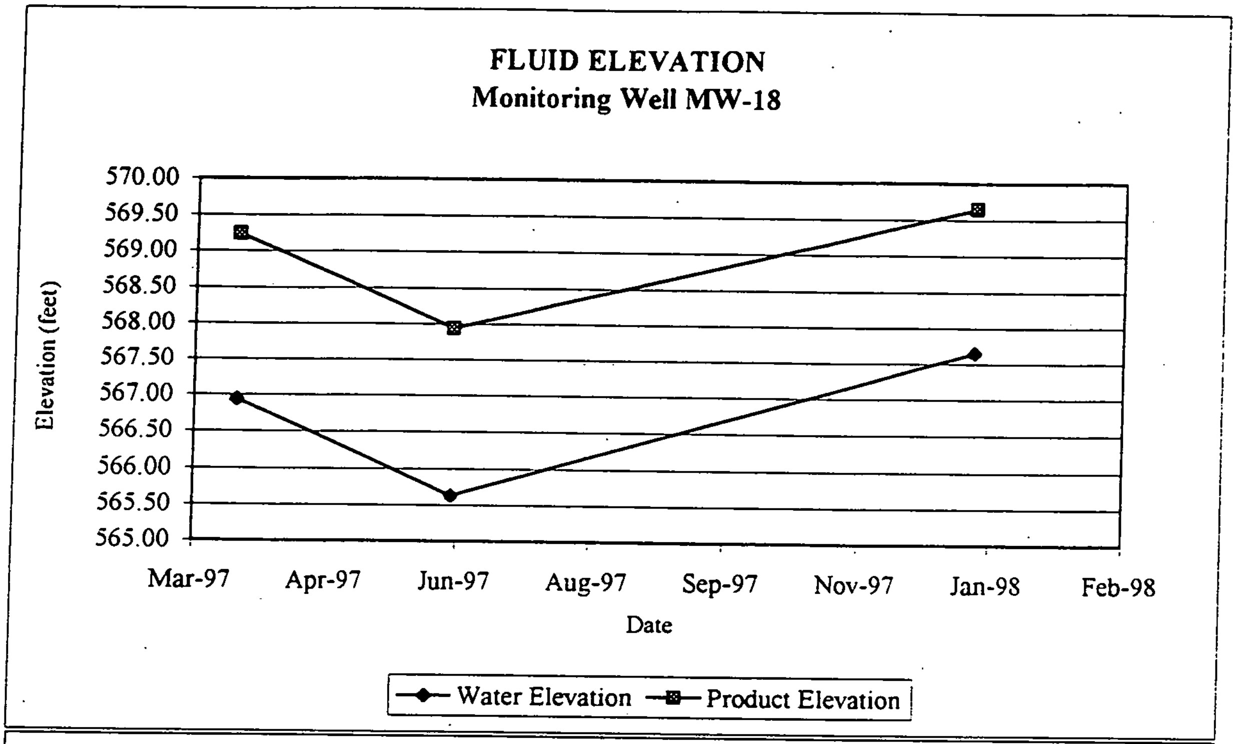
## Mobil Oil Corporation
## Buffalo Terminal #31-010
## 625 Elk Street
## Buffalo, New York

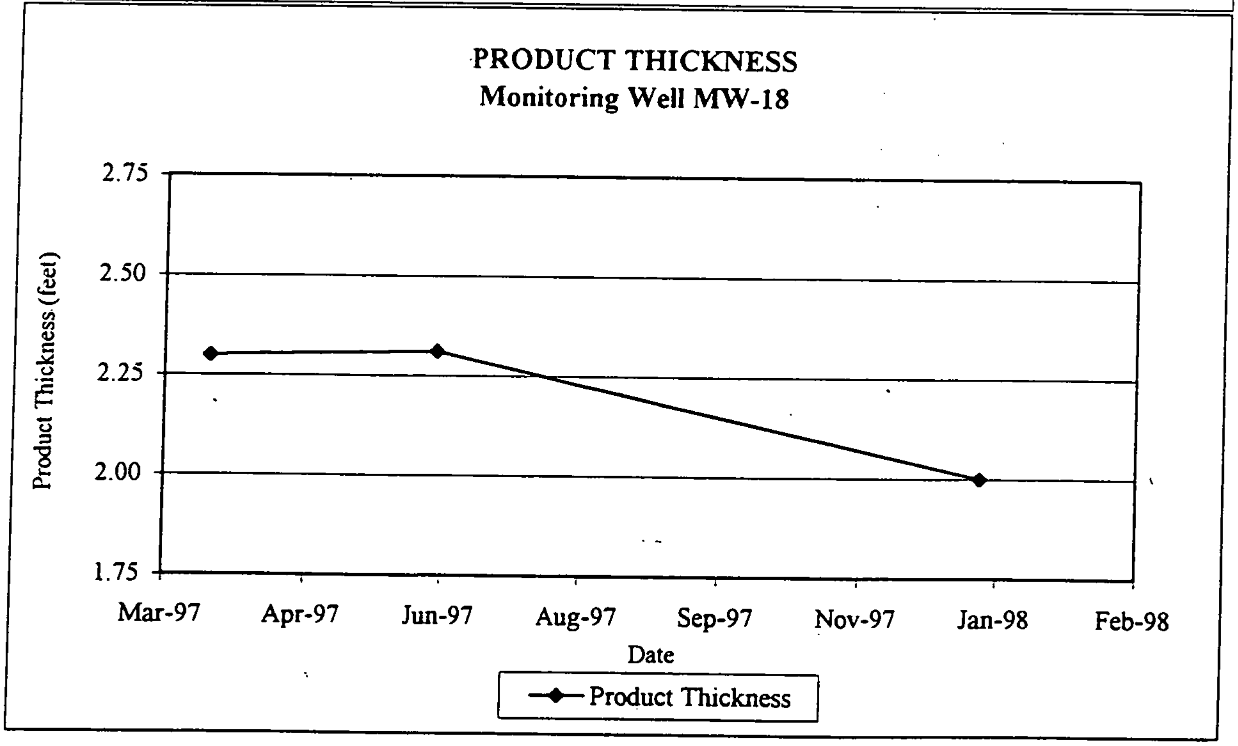




Top of Casing Elevation = 586.81

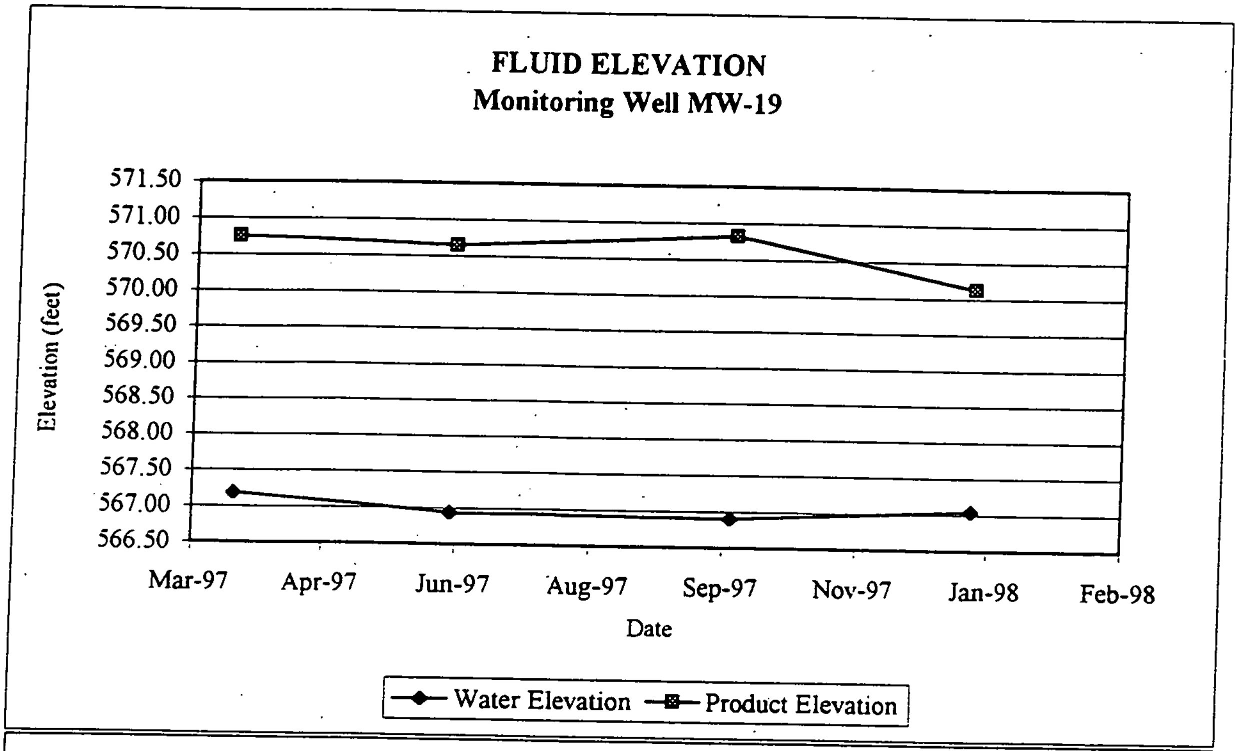
**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

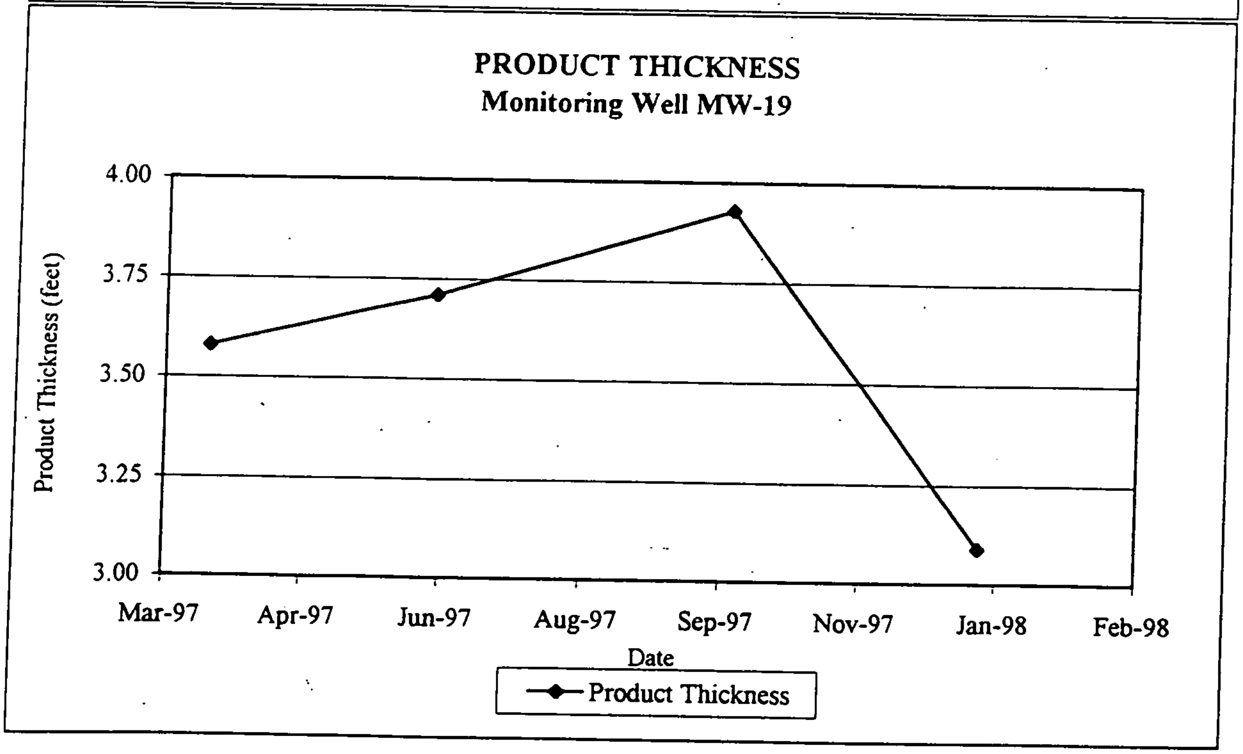




Top of Casing Elevation = 582.33

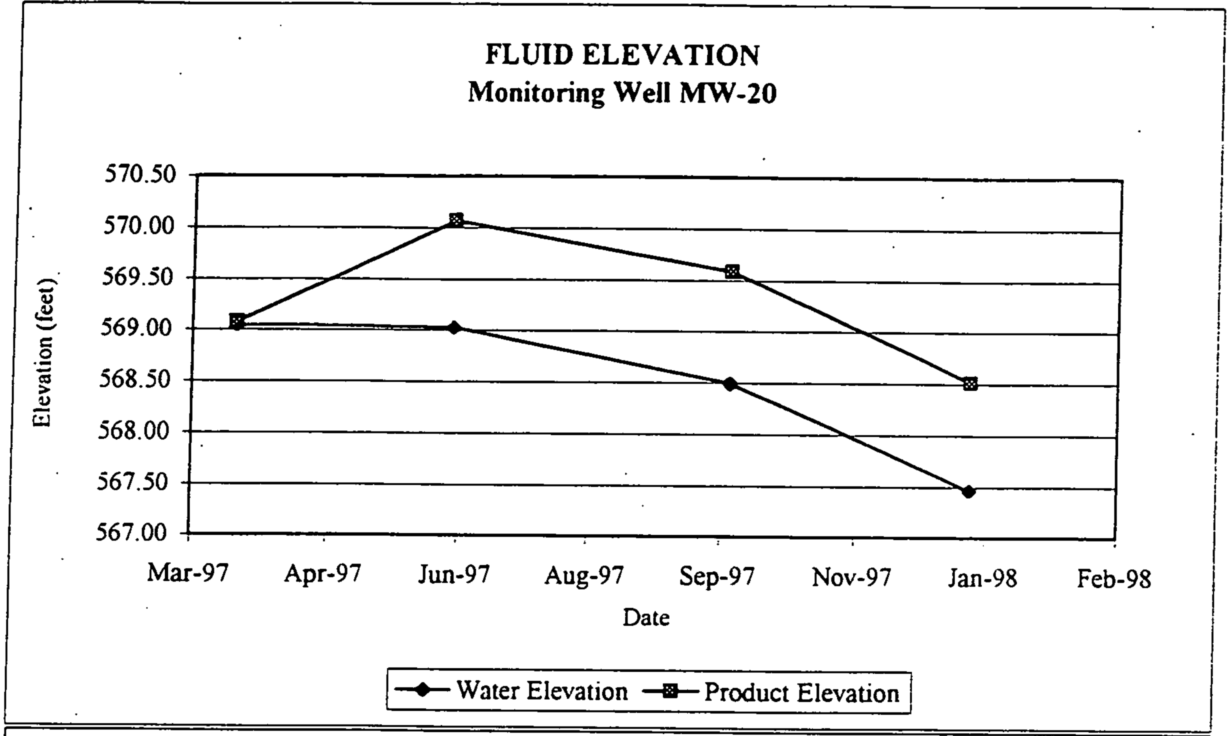
## Mobil Oil Corporation
## Buffalo Terminal #31-010
## 625 Elk Street
## Buffalo, New York

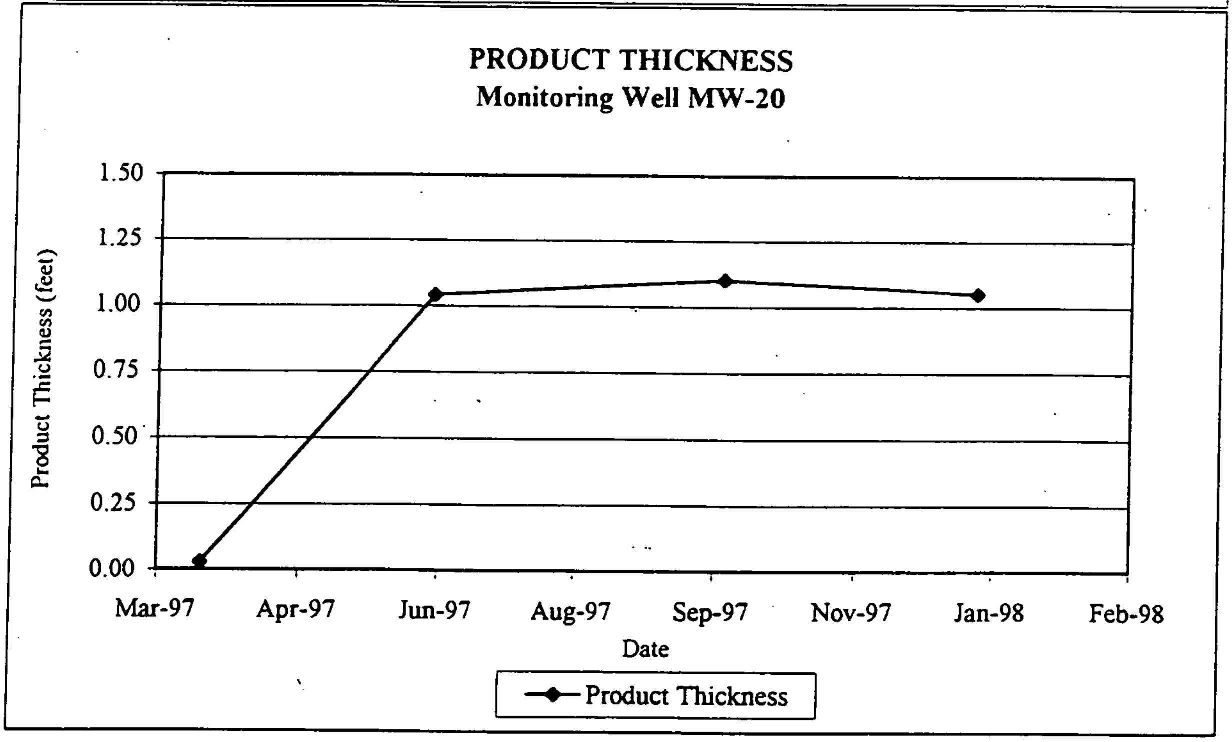




Top of Casing Elevation = 585.28

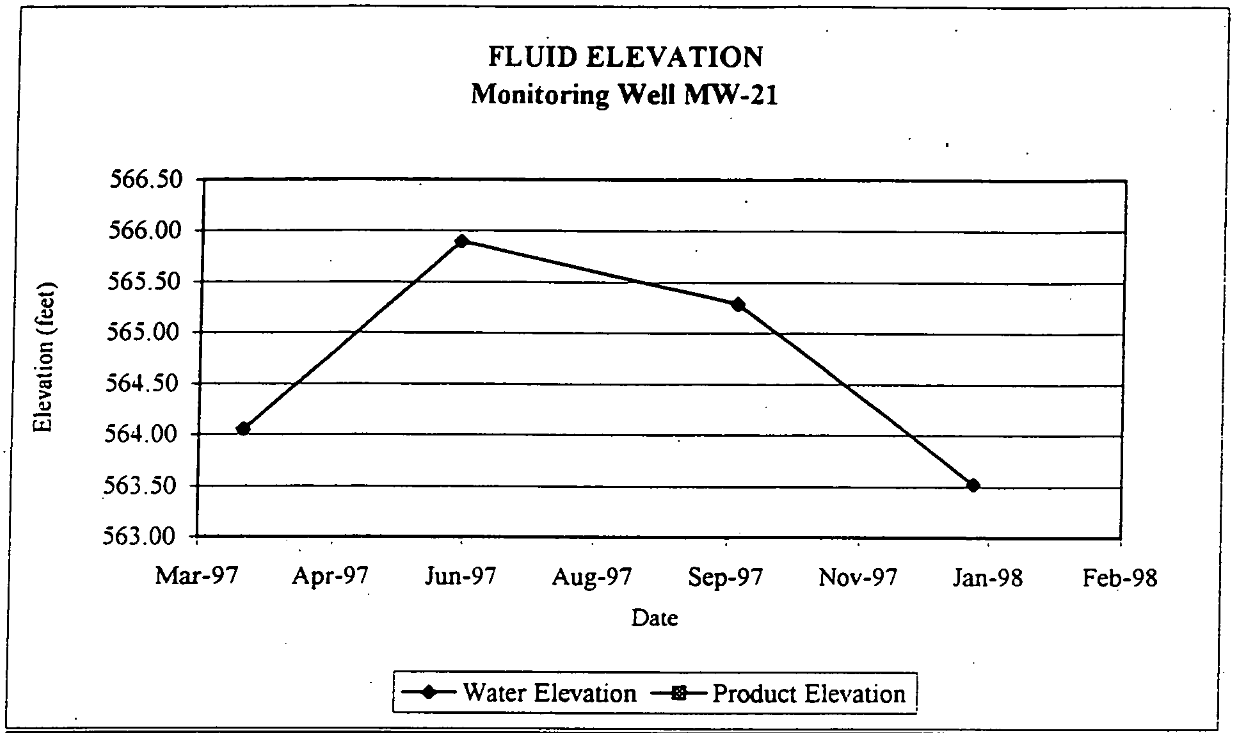
**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

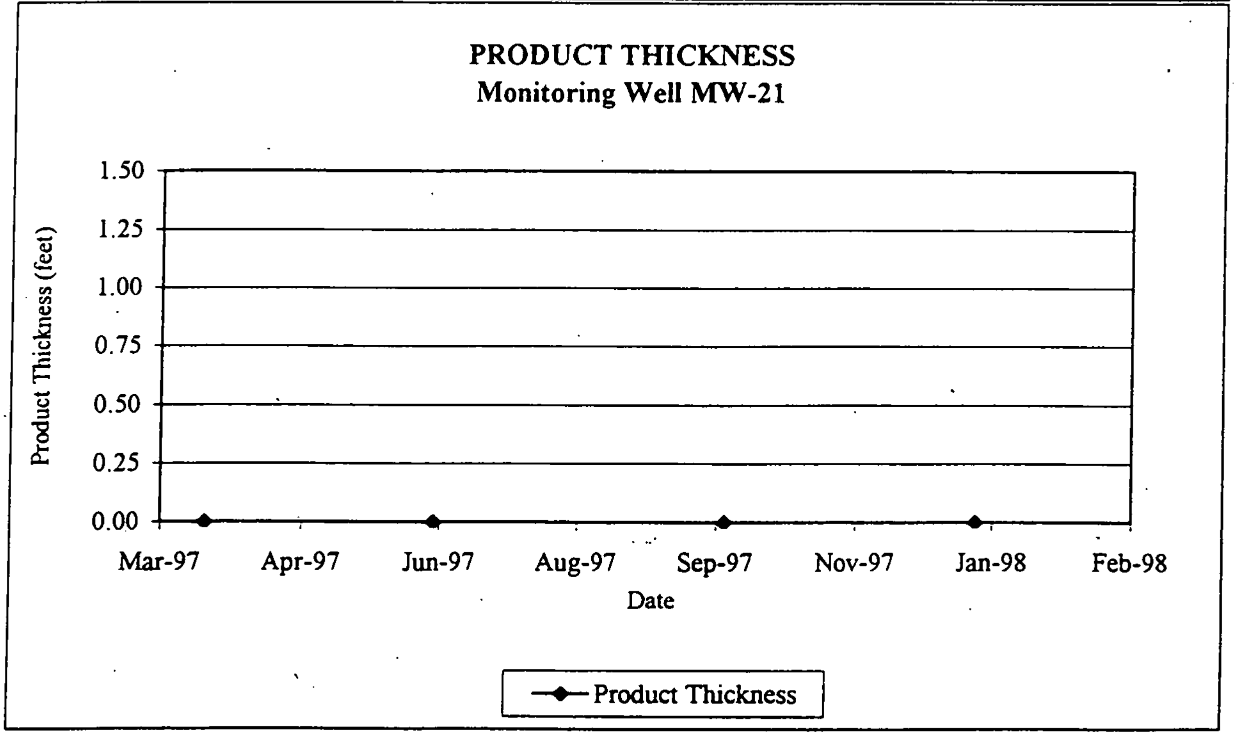




Top of Casing Elevation = 585.86

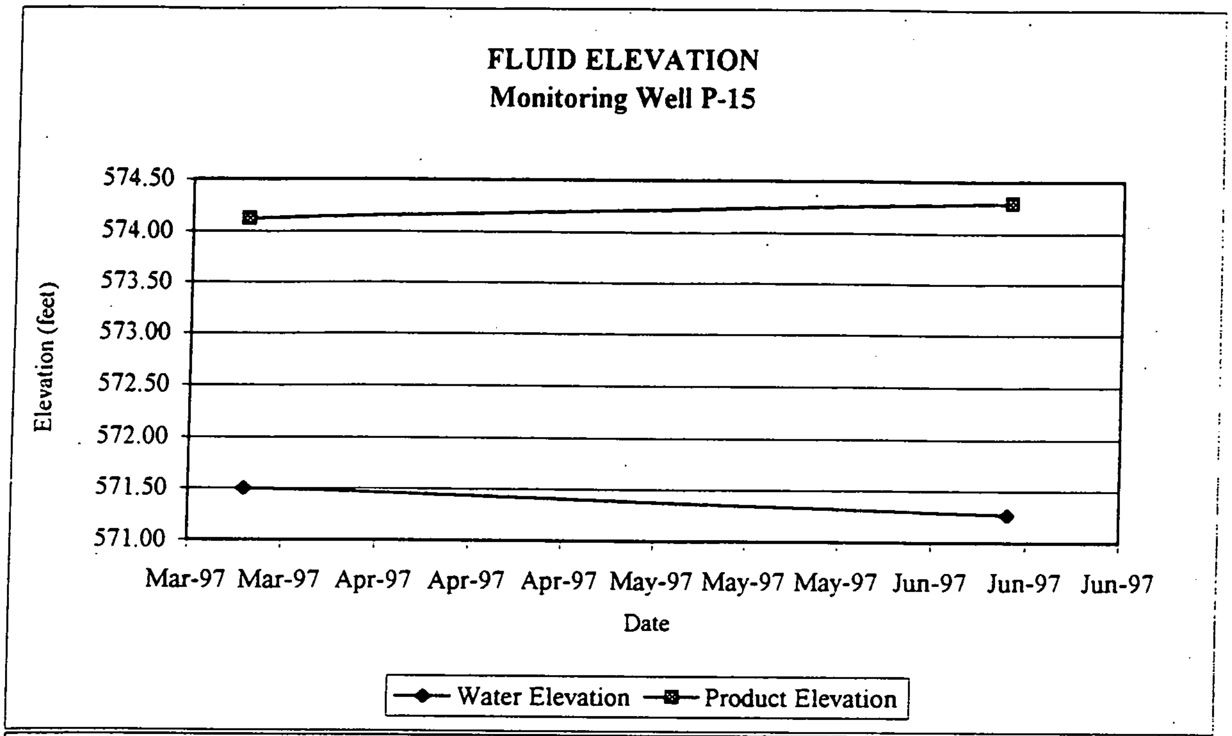
**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**

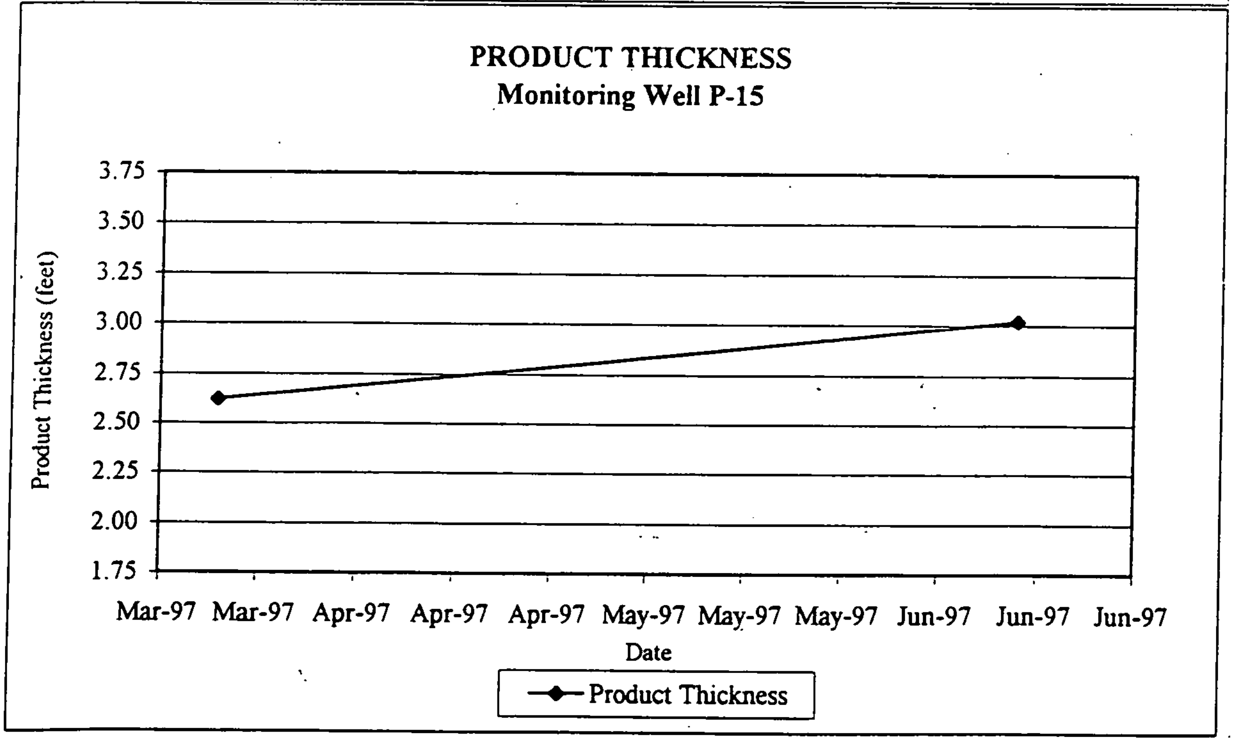




Top of Casing Elevation = 582.68

**Mobil Oil Corporation**
**Buffalo Terminal #31-010**
**625 Elk Street**
**Buffalo, New York**





Top of Casing Elevation = 597.03

# MONTHLY OPERATIONS STATUS REPORT
## Ground Water and Product Recovery System
## Table___

**Mobil Terminal #31010**
625 Elk Street
Buffalo, NY

**Reporting Month:**

**Reporting Period Dates:** / / thru / /

## RECOVERY WELL DATA

| **WATER RECOVERY** | **RW-1** | **RW-2** | **RW-3** | **RW-4** | **RW-5** | **RW-6** | **WELL POINT SYSTEM** | **STORM SEWER SUMP** | **TOTAL** |
|---|---|---|---|---|---|---|---|---|---|
| Total Water Flow (gal) | | | | | | | | | |
| Average Flow Rate (gpm) | | | | | | | | | |
| Cumulative flow since 9-23-93: | | | | | | | | | |
| **PRODUCT RECOVERY** | | | | | | | | | |
| Total Product Flow (gal) | | | | | | | | | |
| Average (gpd) | | | | | | | | | |
| Cumulative flow since 9-23-93: | | | | | | | | | |
| **Low Probe Depth Settings** | | | | | | | | | |
| At Start of Period | | | | | | | | | |
| At End of Period | | | | | | | | | |
| **Estimated Run Time** | | | | | | | | | |
| Water Pump Run Time (days in report period) | | | | | | | | | |
| *Percent Up-Time* | | | | | | | | | |
| Product Pump Run Time (days in report period) | | | | | | | | | |
| *Percent Up-Time* | | | | | | | | | |

**Days in Report Period for Recovery Wells:**

**Days in Report Period for Well Point System:**

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# PERMIT COMPLIANCE

## Mobil Buffalo Terminal Groundwater Recovery System

NYSDEC Spill #s: 88-08982, 93-05522

Sample Date:________

Site Name: Mobil Buffalo Terminal Job Number:____________

System Type: Air Sparge Tank (3 in parallel)

Permit Type: NYS DEC Division of Air, Certificate to Operate

Permit Number: 9-1402-00600/00024-0

Permit Approval Date: 04/18/96

Permit Expiration Date: 06/30/00

### SPARGE TANK EMISSIONS

| WATER | Benzene | Toluene | Ethylbenzene | Xylene |
|---|---|---|---|---|
| Influent Conc. (ug/L): | | | | |
| Effluent Conc. (ug/L): | | | | |
| Total Flow (gal.) for Period: | | | | |
| (Period = #days x 1440) | | | | |
| Ave. Flow Rate (gal./min.): | | | | |
| | | | | |
| AIR | | | | |
| Stripper Efficiency: | | | | |
| Emission Rate (lb/hr): | | | | |
| Discharge Limits (lb/hr): | | | | |

Notes:

1. Average flow rate is based on total flow for the period/(#days in period) x 1440).
2. Air Stripper Emission Rate = (Avg. Influent conc. - Avg. Effluent conc.) x (flow rate) x (conversion factor). If analytes are ND, then the detection limits are used to calculate emission rates.
3. Conversion factor = (1L/.2642 gal.)(1 g/1,000,000 ug)(1 lb/454 g)(60 min./hr) = 5.002E-07.

# Appendix E

# SYSTEM- DOWN NOTIFICATION FORM
# MOBIL BUFFALO TERMINAL

NYSDEC Spill #s 88-08982, 93-05522

This form communicates a reportable system-down status as follows:

Well Point System

24-Hour Downtime Notice

Dual-Phase Recovery System

3-day Consecutive Downtime

5-day Cumulative Monthly Downtime

**Downtime Details:**

Dates:

Problem Description:

Is problem recurring? ________

Is system modification recommended? __________

**Corrective Measures:**

Dates:

Corrective Measures Taken

## SYSTEM MODIFICATION FORM
## MOBIL BUFFALO TERMINAL
NYSDEC Spill #s: 88-08982, 93-05522

This form communicates and documents all modifications to the systems.

Modified System:

Date:____________

| | |
|---|---|
| Well Point System | Storm Sewer Lift Station |
| Dual-Phase Recovery System | Water Treatment System |

Nature of Modification:

| | |
|---|---|
| Proposed | Implemented |
| Operational/Procedure | Equipment |

Reason for Modification:

Expected Result/Justification:

Effect on System Operation/Compliance:

Authorized by:____________________________

# RECURRING OPERATIONAL PROBLEM RESOLUTION FORM
# MOBIL BUFFALO TERMINAL
## NYSDEC Spill #s: 88-08982, 93-05522

This communicates proposed or implemented remedy to recurring operational problem.

| | |
|---|---|
| Associated System: | Date:____________ |
| Well Point System | Storm Sewer Lift Station |
| Dual-Phase Recovery System | Water Treatment System |

**Nature of Recurring Problem:**

Event Dates and Description:

**Discussion of Operational Remedy:**

| | |
|---|---|
| Proposed | Implemented |

**Gauging and Reporting Performance of Remedy:**