Operation and Maintenance Manual

Ground Water Remedial Action Program

Canonie Environmental

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OPERATION AND MAINTENANCE MANUAL
GROUND WATER REMEDIAL ACTION PROGRAM
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK

1.0 INTRODUCTION

1.1 Background Information

Fairchild Semiconductor Corporation's (Fairchild's) Wappingers Falls facility is located approximately 60 miles north of New York city in Dutchess County, New York. The plant is situated on approximately 10 acres of a 60-acre parcel owned by Fairchild. Semiconductors were manufactured at the facility which had become part of Fairchild's Digital Products Division shortly before the facility was closed due to economic reasons in 1985.

Construction excavations during 1984 at the Fairchild facility revealed the potential presence of solvents and other hydrocarbons in the soil and ground water, proximate to underground storage tanks. Fairchild retained Canonie Environmental Services Corp. (Canonie) to perform analytical analyses of soil and water samples obtained from the excavation area, and subsequently, to conduct a field investigation of the site in January, 1985. The results of the investigation were submitted to the New York State Department of Environmental Conservation (NYSDEC) in an engineering data report entitled "Hydrocarbon Investigation", dated May, 1985.

In January, 1986, Canonie prepared an action plan for remediation of the Fairchild site, predicated on the information obtained during the field investigations. The remedial action plan was submitted to, and subsequently approved by, the NYSDEC. Implementation of the remedial action plan began in March, 1986, and an Administrative Consent Order (Case #3-1152/8602) between Fairchild and the state

of New York for remediation of the site was signed, and became effective, on October 7, 1986. The construction phase of the remedial action plan was concluded in June, 1987 with final certification of backflow prevention devices installed on the city water main which supplies the Fairchild facility.

In March of 1986, Canonie commenced work on the hydrocarbon remedial action plan. Two ground water interceptor/extraction trenches were constructed to purge the ground water from the affected water-bearing zones and preclude further migration of chemical analytes. A granular activated carbon adsorption system was installed to remove the hydrocarbons from the ground water prior to discharge through Fairchild's State Pollutant Discharge Elimination System (SPDES) Outfall 001.

1.2 Purpose

The purpose of this manual is to provide a reference for the operation and maintenance of the ground water remediation program at the Fairchild facility in Wappingers Falls, New York. This manual describes the following subjects:

- Permits and Regulations;
- Treatment Processes and Associated Equipment;
- Process Sampling and Monitoring;
- Emergency Action Items.

The ground water extraction system is discussed in Section 2.0, and Section 3.0 describes the ground water treatment system. Remediation monitoring requirements are identified in Section 4.0, and emergency response procedures are presented in Section 5.0.

The remedial action program implemented at the Fairchild facility consists of specific tasks including operation and maintenance of the extraction trenches and treatment

system, monitoring of Outfall 001 in accordance with SPDES permit requirements, and maintaining the approved monitoring program developed to evaluate progress of remedial activities. While the remedial efforts will be initiated by Fairchild, the specific tasks themselves may be performed by:

- Fairchild personnel;
- New ownership personnel (should the facility be sold);
- Private firms contracted to complete the tasks.

2.0 GROUND WATER EXTRACTION SYSTEM

Two extraction trenches have been constructed to purge ground water from the affected water bearing zones. The lower extraction trench extends 768 feet along an approximate 350-foot radius from the primary source area (underground storage tank area). The depth of the lower trench ranges from 8.0 to 34.0 feet below grade, and utilizes two collection sumps for ground water removal. This trench primarily serves to prevent further migration of hydrocarbon constituents toward Fairchild's property boundary to the east/southeast. The location of the lower extraction trench is indicated on Figure 1.

The upper extraction trench was installed to intercept the highest solvent concentrations emanating from the underground storage tank area, as well as drawing in ground water from the area previously containing subsurface wastewater treatment tanks. The upper trench extends 62.0 feet along its north-south branch and 68.0 feet along its east-west branch, for a total length of 130.0 feet. Both branches of the upper trench drain into a common collection sump for ground water extraction. Excavations for the upper trench ranged from 18.0 feet below grade along the trench line, to 28.0 feet below grade at the collection sump. As shown on Figure 1, the upper extraction trench is located within 150.0 feet downgradient of the primary source area.

The materials and methodology of construction were identical for both the upper and lower extraction trenches. The trench excavations were lined with a non-woven, polyester filter fabric, and a six-inch-diameter perforated polyvinyl chloride (PVC) pipe was installed in the trench bottom to direct ground water to the collection sumps. A gravel backfill, consistent with No. 467 American Society for Testing and Materials (ASTM) gradation, was placed over the collection pipe and filter fabric, filling the excavation to within four feet of grade surface. The filter fabric was then draped over

the top of the gravel backfill, and a clean clay cap compacted over the remainder of the excavation. Original topsoil was placed over the clay cap for final grading and landscaping. Two-inch-diameter PVC electrical conduits and two-inch-diameter PVC collection sump discharge lines were installed leading from the three collection sumps to the ground water treatment facility.

Ground water permeating from the source area to the east/southeast is intercepted by either the upper trench or the lower trench. The ground water passes through the filter fabric, percolates down through the gravel pack, enters the perforated collection pipe, and flows hydrostatically to the trench collection sumps. Discharge of ground water from the collection sumps is accomplished by a single, float controlled, submersible pump installed in each sump. The float controls are set to activate the pump when the water level in the sump rises to approximately one foot above the perforated collection pipe. Ground water is discharged from the sump through the two-inch-diameter PVC discharge line which runs to the treatment facility. The float control then deactivates the pump when the water level in the sump drops below the perforated collection pipe.

Motor starter, control switches, and status and alarm lights for each of the collection sump pumps are contained in a single control panel mounted in the laboratory building of Fairchild's former wastewater treatment facility. A high water alarm panel is also mounted at the guard station along the south side of the manufacturing facility (Fairchild retains a 24-hour security service at the site). Operation and maintenance details of the collection sump pumps and associated controls are included in Appendix A.

3.0 GROUND WATER TREATMENT SYSTEM

The ground water treatment system consists primarily of a carbon adsorption process designed to remove organic compounds from the purged ground waters. Two carbon adsorption units manufactured by Adsorption Systems, Inc. (ASI) are housed in a concrete block structure constructed at the northeast corner of Fairchild's former wastewater treatment facility, as shown on Figure 1. Ground water is continuously collected in the upper and lower extraction trenches and pumped to the carbon units for treatment. The treated ground water is then discharged through Fairchild's permitted SPDES Outfall 001. A piping and instrumentation diagram (PID) of the treatment process is presented on Figure 7, along with the equipment used in the treatment system. Operation and maintenance details of the treatment equipment are also included in Appendix A.

Based on anticipated infiltration rates into the upper and lower extraction trenches, the ground water treatment system has been designed for an average flow rate of 20 gallons per minute (gpm). As shown on the PID (Figure 7), influent to the treatment system from the upper and lower extraction trenches is combined into one stream for pre-filtration through a bag strainer which removes silt and fines from the ground water. The filtered ground water then flows through a rotor wheel flow meter used to monitor the influent rate to the carbon adsorption vessels. Each ASI "Rapid Response Unit" contains 2,000 pounds of granular activated carbon and is capable of treating up to 60 gpm. The two adsorption vessels are arranged in series, each receiving the average 20 gpm flow. The units are operated in series to provide backup removal capability of any breakthrough concentrations from the primary unit, resulting in a final effluent quality consistent with SPDES discharge requirements.

The flow stream leaving the secondary carbon adsorption vessel then passes through a rotor wheel flow totalizer/recorder which generates a monthly log of total flow

through the treatment system. The influent flow indicator and the effluent flow totalizer/recorder are both housed in a single control panel, mounted on the wall in the ground water treatment building. The effluent stream then enters a 30-gallon reservoir tank which supplies a Manning automatic sampler for collection of weekly 24-hour composite effluent samples in accordance with the SPDES permit. Grab samples for effluent discharge quality are also collected from a second tap on the reservoir. The reservoir overflows by gravity and the treated effluent is discharged through Fairchild's SPDES permitted Outfall 001.

The carbon adsorption system utilizes granular activated carbon to remove the soluble organic compounds from the water requiring treatment. Adsorption is a physical process in which the compounds adhere to the surface of the carbon particle. The large surface area contained within the internal pore structure of the granular carbon particle provides the carbon adsorption system with a substantial capacity for the removal of organic compounds. The carbon adsorption system provides exposure of the ground water to a quantity of granular activated carbon, providing the required removal efficiencies to achieve an effluent quality in accordance with the SPDES permit requirements. At an influent flow rate of 20 gpm, each adsorption unit will provide a contact time of approximately 30 minutes.

The influent and effluent of the primary carbon unit will be periodically monitored to detect when breakthrough occurs. When the concentration of hydrocarbons in the effluent equals the influent concentration, the carbon unit has been saturated with the maximum organic loading possible. When this occurs, the primary carbon unit will be removed from service, and the carbon regenerated in accordance with the manufacturer's recommendations (Appendix A). The secondary carbon unit will be shifted into the primary position, and the regenerated carbon unit installed in the secondary position. This rotation sequence will provide maximum protection against hydrocarbon constituents passing through the treatment system and into the effluent stream.

4.0 MONITORING REQUIREMENTS

4.1 Treatment System Monitoring Requirements

The influent and effluent of the primary carbon unit will be periodically monitored to determine when the activated carbon has become saturated with organics. Influent and effluent samples are to be collected on a quarterly basis throughout the remedial program, and analyzed for halogenated volatiles (EPA Test Method 601), purgeable aromatics (EPA Test Method 602), and xylenes (modified EPA Test Method 602). The samples are to analyzed by a New York state approved laboratory facility. Test results shall be used to determine when regeneration of the primary carbon adsorption unit is necessary. Samples shall be collected and handled in compliance with the Ground Water Sampling Protocol presented in Appendix B.

4.2 SPDES Monitoring Requirements

Effluent from the ground water treatment facility is discharged through Outfall 001 into the wetland area directly east of the Fairchild facility. Treated discharge to Outfall 001 is regulated by the NYSDEC utilizing the SPDES discharge permit system. Fairchild's SPDES permit for Outfall 001 dictates the effluent quality required to allow discharge of the treated water into the wetlands. The SPDES discharge criteria for Fairchild's Wappingers Falls facility is presented in Table 1. Fairchild's SPDES permit Facility Identification Number is NY-006-1026. The SPDES permit also regulates allowable effluent quality from a second discharge location, Outfall 002. Discharges from Outfall 002 are comprised of non-contact cooling water and stormwater runoff. The SPDES discharge criteria for Outfall 002 are also included in Table 1.

In accordance with SPDES permit requirements, a continuous permanent record of effluent quantity must be recorded, 24-hour composite sampling is required for

inorganic compounds, and grab samples are required for analyses of organic compounds. A rotor wheel flow totalizer/recorder installed on the discharge line from the carbon adsorption system provides the permanent record of treated effluent quantity. Composite samples and grab samples are both taken from a 30-gallon reservoir installed on the effluent line from the treatment system, prior to discharge to Outfall 001. Composite samples are collected automatically at preset intervals over a 24-hour period utilizing a Manning automatic composite sampler. The composite sampler discharges directly into a two-gallon sample container housed inside a refrigerated unit to preserve the sample. The weekly samples are to be analyzed by Nanco Labs, Inc. of Hopewell Junction, New York, or another NYSDEC approved analytical laboratory.

4.3 Remediation Monitoring Requirements

In January, 1986 Canonie submitted to the NYSDEC a ground water monitoring program which was subsequently approved and incorporated into the Consent Order for remediation of the site. All ground water samples are to be analyzed for the following constituents in accordance with the prescribed procedure:

Analytes	EPA Test Method
Halogenated Volatiles	601
Purgeable Aromatics	602
Xylenes	Modified 602
Phenols	604

To evaluate the performance of the extraction trenches and remedial progress in general, seven of the hydrocarbon monitoring wells were sampled quarterly throughout the first year of cleanup activities, and are to be sampled semi-annually during the succeeding year. After two years, the monitoring program and sampling frequency will be re-evaluated and modified, if necessary. Ground water samples will

be extracted from Wells W-12, W-13, W-14, W-17, W-18, W-20 and W-21 and analyzed for halogenated volatiles, purgeable aromatics, xylenes and phenols. Most of these wells exhibited the highest analyte concentrations detected during the Hydrocarbon Investigation, and were selected on that basis.

All sampling is to be conducted in conformance with the Ground Water Sampling Protocol included in Appendix B of this manual, and samples are to be analyzed by a NYSDEC approved analytical facility.

In addition to monitoring the seven wells upgradient from the lower extraction trench, five monitoring wells located downgradient from the lower extraction trench will also be monitored. Wells W-10, W-24, W-25, W-26, and W-27 are to be sampled quarterly for a period of two years to ensure that hydrocarbon migration does not occur beyond the lower trench. At the end of the two-year period, the monitoring program beyond the lower trench will be re-evaluated and modified, if necessary. Again, ground water samples will be analyzed for hydrocarbon constituents and used to evaluate the necessity for further remediation beyond the present approach.

Post-remedial action monitoring will be performed to substantiate the progress and effectiveness of cleanup operations. Wells W-10, W-12, W-13, W-14, W-17, W-18, W-20, W-21, W-24, and W-26 will be sampled quarterly during the first year following completion of the site remediation, and sampled semi-annually during the succeeding years. The duration of the post-remedial action monitoring program will depend upon the results of the ground water analyses, and will be re-evaluated after the second year of monitoring is completed. Samples will be tested in accordance with EPA Test Methods 601, 602, Modified 602, and 604 for halogenated volatiles, purgeable aromatics, xylenes, and phenols, respectively. Contingent remedial measures will be developed and initiated should hydrocarbon analyte concentrations increase during the post-remedial action monitoring period.

In addition to the analytical monitoring requirements, ground water elevations will also be monitored and reported on a quarterly basis. Field forms for recording water levels in monitoring wells, as well as the cleanouts and collection sumps of the extraction trenches, are included in Appendix B. The trench cleanouts and collection sumps have been assigned station designations (i.e. ST-1) for the purpose of identification. The locations of the monitoring wells and trench monitoring stations are identified on Figure 1.

4.4 Sample Custody and Handling

An established program of sample chain-of-custody procedures, that is followed during sample collection and handling activities in both the field and laboratory operations, is to be utilized during the remediation activities associated with the Fairchild site. The program is designed to assure that each sample is accounted for at all times. To maintain the highest degree of control in sample handling for the remediation of the Fairchild site, labels will be utilized so that all necessary information is retained with the sample, and chain-of-custody records and shipping manifests will be employed to maintain control over access to and destination of samples after shipment from the location of sample collection. Additionally, proper completion of field sample logs and analytical logs by appropriate field and laboratory personnel provide for thorough monitoring of the sample from collection through analysis and final report generation.

The objective of sample identification, custody, and monitoring procedures is to assure that:

- All samples collected are uniquely labeled for identification purposes throughout the analytical process;

- Samples are correctly analyzed and that results are traceable to field records;

- Important characteristics are preserved;

- Samples are protected from loss, damage, and tampering;

- Any alteration of samples (e.g., damage due to shipment or other processes) is documented;

- A record of sample integrity and analytical fate is established for legal purposes.

The use of the indicated forms listed above accomplishes one or more of the specific objectives of sample custody, identification, or control. The use of each of the listed forms is discussed below.

4.4.1 Sample Log

The sample log is completed in the field by the individual physically in charge of the sample collection. The sample log correlates the assigned sample bottle designation to a specific sample location or other distinguishing feature or attribute (i.e., dummy sample, replicate sample, etc.). The sample log also contains information concerning date and time of sampling, type, location, depth, procedures utilized to preserve the sample for analysis, and the sequence in which sampling was completed. Other relevant information, such as weather conditions, may also be included. The sample log is attached to the chain-of-custody record and shipped with the samples to the laboratory. A sample log is presented in Appendix B.

4.4.2 Chain-of-Custody

The chain-of-custody record is completed in the field by the individual physically in charge of the sample collection. The chain-of-custody record may be completed contemporaneously with the sample log or prior to the shipment of samples to the laboratory. The chain-of-custody record contains information on the date of sample collection, the sampler, the project name and number, laboratory project number, the number of containers of each sample being shipped, and an itemization of the analyses requested for each sample together with any remarks about the sample prior to shipment. The chain-of-custody record is enclosed with the samples after it has been signed by the sampler. The record is then signed each time possession of the sample changes, with the signature of the person relinquishing and receiving the sample, as well as the time of exchange being indicated on the record. A sample copy of the chain-of-custody form is set forth in Appendix B.

4.4.3 Packing and Shipping

In addition to sample collection and preservation requirements, especially the maintenance of sample temperature at four degrees Centigrade until extraction or analysis, samples should be packed and shipped properly to maintain the health and safety of sample transporters. Guidelines for packing and shipping of samples are included in Appendix C.

5.0 OPERATIONAL PROCEDURES

The ground water treatment system has been designed to operate with a minimum of operator assistance. Currently (as of 23 October 1992), the treatment plant is inspected once a week in accordance with the checklist provided in Table 3. This checklist summarizes the routine operational and maintenance items required under normal operating conditions.

The Fairchild contact at the facility is Mr. William J. Blatt, and he is responsible for the weekly operational and maintenance requirements of the system. Mr. Elmer Wilday will be responsible for addressing any daily operational and maintenance requirements and any alarm conditions occurring during operation of the treatment system.

5.1 Integrated Control System (ICS), Data Logger (Scada System) and Instrumentation

5.1.1 General Description

The control system for the Ground Water Treatment System is an Integrated Control System (ICS)/SCADA Monitor Model #53110-0 manufactured by AGM Electronics, Inc.

The ICS provides monitoring, control, data logging and communication for the ground water recovery and treatment system. The ICS accomplishes those tasks through the following procedures:

- Monitoring of the system through the use of level, flow and pressure sensors (described below);

- Control of the system by digital and analog signals to various control devices, a.k.a. solenoid valves, turning on automatic sampler;

- Data logging through the AGM SCADA system data logger;

- Communication from the system through the use of an auto dialer and a 2400 baud modem.

The ICS is a microprocessor-based programmable controller capable of processing 8 analog and 16 digital system inputs. Additional expansion capacity is available.

Treatment system operating parameters and setpoints are indicated in Table 5.

Panel Layout

The ICS front panel is segregated into five modes (see Figure 8). These five modes are:

- Display;
- Setpoints;
- Control/Status;
- Alarms and;
- Calibration.

The following sections describe each mode:

Display Mode

The display mode is entered upon power up, or by pressing the "DISPLAY" switch; the flowrate light or total light will be on in this mode. Use the "SELECT" switch to

select between the flow rate or total flow display. The filter pressures can be displayed by again pressing the select switch and sequencing through the different pressures with an "a,b,c,d" next to the value corresponding to filter pressures 1,2,3,4 respectively. To exit the display mode, enter the setpoint or calibration mode.

Setpoint Mode

The setpoint mode is entered by pressing the "SETPOINT" switch; the light immediately to the right will be on in this mode. To move through the setpoint mode, use the "SELECT" switch. To enter a setpoint, select the correct pointer light using the select switch and use the "INC/DEC" switch to increment or decrement the displayed value. Use the "ENTER" switch to save the displayed value; a flashing setpoint light indicates an unsaved value while a constant light denotes a saved value. Use the "START TIME" light to set start day of week (01-07 for Sunday-Saturday) and time of day (HR:MN) to start auto-sampler and use the "RUN TIME" light to set run time in hours. Lights "FILTER 1+2" and "FILTER 3+4" indicate the current pressure setpoints for filter 1 and filter 3 and can be changed by using the "INCDEC" switch. Use the "FLOW RATE" light and "TOTAL" light when in setpoint mode to set current day of week (01-07), time (HR:MN) and date (MO:DY:YR).

Alarm Mode

Alarms will show "HIGH LEVEL" using "UPPER", "SUMP" and "LOWER" lights, filter 1 high pressure with "FILTER 1+2" light, filter 3 high pressure with "FILTER 3+4" light and treatment building flood alarm with the "FLOOD" light. Alarms will come on flashing and will be steady if acknowledged and still present or if the alarm was active but is no longer present. Alarms are acknowledged with the "ALARM ACK"switch.

Calibration Mode

To enter the calibration mode for calibrating the incoming analog signal to engineering display units press the "CALIBRATION" mode select switch. The calibration mode pointer light immediately to the right will turn on.

To calibrate:

- Use the "SELECT" switch to select the "0%" light;
- Apply 0% analog signal to analog input;
- Use the "INC/DEC" switch to set the display for desired 0% units;
- Press the "ENTER" switch to save the 0% calibration;
- Use the "SELECT" switch to select the "100%" light;
- Apply 100% analog signal to analog input;
- Use the "INC/DEC" switch to set the display for desired 100% units;
- Press the "ENTER" switch to save the 100% calibration;
- Repeat steps 1 - 8 for all used analog inputs, using the "FLOW RATE", "TOTAL", "PUMP RUN" and "FILTER 1+3" lights as pointer lights for each input.
- Calibration complete, press the "DISPLAY" switch to enter normal mode.

Monitoring, Control and Communication

The ICS is programmed to monitor and log the following:

- Digital inputs (D1 - D8):
  - D1 - Upper Trench Alarm;
  - D2 - Lower Trench 1 Alarm;
  - D3 - Lower Trench 2 Alarm;
  - D4 - Flood Alarm;
  - D5 - Pump 1 Run;
  - D6 - Pump 2 Run;
  - D7 - Pump 3 Run;
  - D8 - Manhole Pump Fail.
- All digital outputs (R1 - R12):
  - R1 - Sampler Valve;
  - R2 - Filter 1 - 2 Pressure;
  - R3 - Spare;
  - R4 - Common Alarm;
  - R5 - Filter 3 - 4 Pressure;
  - R6 - Common Alarm;
  - R7 - Spare;
  - R8 - Data Transfer;
  - R9 - Spare;
  - R10 - Trench Level High Alarm;
  - R11 - High Filter Pressure Alarm;
  - R12 - High Sump Level Alarm.

- Variables (16, 65, 67, 68, 69, 70):

  - 16 - Total Flow to Display;
  - 65 - Influent Flow;
  - 67 - Filter 1 Pressure;
  - 68 - Filter 2 Pressure;
  - 69 - Filter 3 Pressure;
  - 70 - Filter 4 Pressure.

5.2 Alarms

There are four alarm conditions which could occur. These conditions are:

1. A pump malfunction in one of the trench collection sumps (SCP 1 through 4) allowing the water level in the trench to increase to above normal operating levels. A high water level float alarm would be activated, should this situation arise.

2. A water detection sensor (manufactured by Liebert Corporation, Appendix A) has been installed on the floor in the ground water treatment building. Should a vessel or line rupture, or a rupture disk break due to excessive pressures in the carbon units, the water detection sensor would activate an alarm.

3. High pressure alarm at Filter Bag #1. If the pressure reaches 25 psi, the ICS closes the Filter Bag #1 isolation solenoid valve and opens the by-pass solenoid valve to Filter Bag #3. This is an alarm condition and the ICS signals the auto-dialer to notify maintenance personnel to change out the filter.

4. High pressure alarm of Filter Bag #3. If the pressure reaches 25 psi, the ICS shuts the system down (by turning off the pumps) and signals the auto-dialer to notify maintenance personnel to change the filters.

The alarm panel is located as indicated on Figure 9. Fairchild maintains a local presence at the site on an on-call basis. Should an alarm condition arise, the auto-dialer will contact the following personnel in the order listed below:

Mr. Elmer Wilday
20 Dose Road
Wappingers Falls, NY 12590
(914) 297-9344

Mr. William Blatt
RR1 Box 233
Cold Brook, NY 13324
(315) 826-7619

They will in turn, contact the following personnel:

Mr. William Ryan or George Cressman
Canonie Environmental Services Corp.
500 North Gulph Road, Suite 315
King of Prussia, PA 19406
(215) 337-2551

Mr. Thomas Jones
Schlumberger Technology Corp.
441 N. Whisman Road Bldg. 23
Mountain View, CA 94043
(415) 960-0844

Manufacturer's operation and maintenance recommendations for individual equipment items are included in Appendix A.

TABLE 1

SPDES PERMIT DISCHARGE CRITERIA AND SAMPLING FREQUENCY
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK

Outfall Number & Effluent Parameter	(Gross) Discharge Limitations Daily Average	Daily Maximum	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type	Analytical Method (2)
001 Treated Ground Water Pumped From Collection Treches:						
Flow	Monitor	Monitor	gpd	Continuous	Recorded	N/A
Solids, Total Suspended	Monitor	10	mg/l	Monthly	24 hr. comp.	160.2
Nitrogen, Ammonia (as N)	Monitor	3	mg/l	Monthly	24 hr. comp.	350.1
BOD, 5-Day	Monitor	5	mg/l	Monthly	24 hr. comp.	405.1
Fluoride, Total	15	Monitor	lb/d	Monthly	24 hr. comp.	340.2
Fluoride, Total	Monitor	15	mg/l	Monthly	24 hr. comp.	340.2
Oil & Grease	Monitor	15	mg/l	Monthly	Grab	413.1
Solids, Settleable	Monitor	0.1	mg/l	Monthly	Grab	160.5
1,1-Dichloroethane	Monitor	0.004	lb/d	Monthly	Grab	601
1,1-Dichloroethylene	Monitor	0.02	lb/d	Monthly	Grab	601
1,2 (cis)-Dichloroethane	Monitor	0.02	lb/d	Monthly	Grab	601
1,2' (trans)-Dichloroethylene	Monitor	0.02	lb/d	Monthly	Grab	602
1,1,1-Trichloroethylene	Monitor	0.004	lb/d	Monthly	Grab	601
Trichloroethylene	Monitor	0.004	lb/d	Monthly	Grab	602
Dichlorobenzenes	Monitor	0.004	lb/d	Monthly	Grab	602
Tetrachloroethylene	Monitor	0.004	lb/d	Monthly	Grab	602
Benzene	Monitor	0.004	lb/d	Monthly	Grab	601
Toluenes	Monitor	0.004	lb/d	Monthly	Grab	420.2
Xylenes	Monitor	0.004	lb/d	Monthly	Grab	601
Ethylbenzene	Monitor	0.004	lb/d	Monthly	Grab	601
Vinyl Chloride	Monitor	0.004	lb/d	Monthly	Grab	601
Phenolics, Total	0.0046	Monitor	lb/d	Monthly	Grab	602

002 Non-Contact Cooling Water and Stormwater Runoff:

Flow - intermittent - no monitoring required (1)

NOTES:

1. Effective July 3, 1992 as per letter from NYSDEC stating modifications to permit.
2. All analytical methods comply with approved EPA methods.

TABLE 2

GROUND WATER SAMPLING FREQUENCY CRITERIA
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK

Well	Sampling Frequency	Analysis (3)
W-10	Quarterly	EPA Method 601
W-12	Semi-Annually	EPA Method 601
W-13	Semi-Annually	EPA Method 601
W-14	Semi-Annually	EPA Method 601
W-17	(2)	(2)
W-18	(2)	(2)
W-18A (1)(2)	Quarterly	EPA Method 601
W-19 (1)	Quarterly	EPA Method 601
W-20	Semi-Annually	EPA Method 601
W-21	Semi-Annually	EPA Method 601
W-24	Quarterly	EPA Method 601
W-25	Quarterly	EPA Method 601
W-26	(5)	(5)
W-26D (5)	Quarterly	EPA Method 601
W-27	Quarterly	EPA Method 601
Wetland (4)	Quarterly	EPA Method 601
Carbon Unit Influent (4)	Quarterly	EPA Method 601
Carbon Unit Effluent (4)	Quarterly	EPA Method 601

NOTES:

1. Wells W-18A and W-19 added to quarterly sampling (8/90).
2. Well W-18A replaced damaged Wells W-17 & W-18 (9/90).
3. EPA Method 602 analysis no longer required by NYSDEC (9/90).
4. Wetland surface water (downgradient of W-26) and Carbon Unit (CU) Influent and Effluent samples required by NYSDEC (9/90).
5. Well W-26D replaced W-26 as a result of Remedial Action (7/92).

TABLE 3

O&M CHECKLIST
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK
Week Ending / /

EXTERIOR ITEMS TO CHECK

1. Site Security?

- were all gates closed and locked?	☐ Yes	☐ No
- were all doors/windows closed and locked?	☐ Yes	☐ No
- are all wells, buildings, and needed areas accessible (mowed, weeds cut, etc.)?	☐ Yes	☐ No

2. From visual inspection, are the floats operating properly?

Sump #1	☐ Yes	☐ No
Sump #2	☐ Yes	☐ No
Sump #3	☐ Yes	☐ No

3. From visual and auditory inspection, is the pump operating properly?

	Water Levels		
Sump #1	_____	☐ Yes	☐ No
Sump #2	_____	☐ Yes	☐ No
Sump #3	_____	☐ Yes	☐ No
Manhole Pump	_____	☐ Yes	☐ No
Well W-26 Pump	_____	☐ Yes	☐ No

4. Note any malfunction that occurred during the last week (i.e., high level alarm, gates unlocked). Specify date, nature of problem, and when Canonie was contacted:

_____

_____

_____

GROUND WATER TREATMENT BUILDING ITEMS TO CHECK

BAG FILTER

1. Has the bag filter been replaced this past week? ☐ Yes ☐ No

2. If yes, on what date(s)? _____

TABLE 3(CON'T)

O&M CHECKLIST
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK
Week Ending / /

GROUND WATER TREATMENT BUILDING ITEMS TO CHECK (cont.)

Hoses

1. Is the hose from the sampling reservoir to the sampler free of scale and sediment? ☐ Yes ☐ No

2. If it was cleaned this past week, on what date did this occur? _____

Sampler

1. Is the sampling chamber and sample container free of scale and sediment? ☐ Yes ☐ No

2. If they were cleaned this past week, on what date did this occur? _____

Data Recorder

1. Is it working properly? ☐ Yes ☐ No

2. Has all the info, according to 'TABLE 4', been recorded? ☐ Yes ☐ No

3. Note any malfunction that occurred during the last week (i.e. power failure). Specify date, nature of problem, and when Canonie was contacted. _____

SPDES PERMIT REQUIREMENTS TO CHECK

Samples

1. Was the manning composite sampler activated on Thursday morning to collect the 24-hour composite sample? ☐ Yes ☐ No

2. Was the sample picked up for analysis on Friday afternoon? ☐ Yes ☐ No

3. Was the monthly Outfall 001 sample collected this week? ☐ Yes ☐ No

4. Was all of the information required for the monthly SPDES report sent to Schlumberger this week? ☐ Yes ☐ No

TABLE 3 (CON'T)

O&M CHECKLIST
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK
Week Ending / /

SPDES PERMIT REQUIREMENTS TO CHECK (cont.)

5. If yes, on what date? _____

COMMENTS: _____

_____

_____

_____

SIGNED: _____ DATE: _____

TABLE 4

DATA FROM NEW GROUND WATER TREATMENT BUILDING
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK

	Totalizer			Pressures				Alarms On? (Y or N)					
								High Level			Filters		Other
Date - Time	New	Old	Flowrate	A	B	C	D	Upper	Sump	Lower	1+2	3+4	Flood

TABLE 5

TREATMENT PLANT SENSORS, OPERATING PARAMETERS AND SET POINTS
FAIRCHILD SEMICONDUCTOR CORPORATION
WAPPINGERS FALLS, NEW YORK

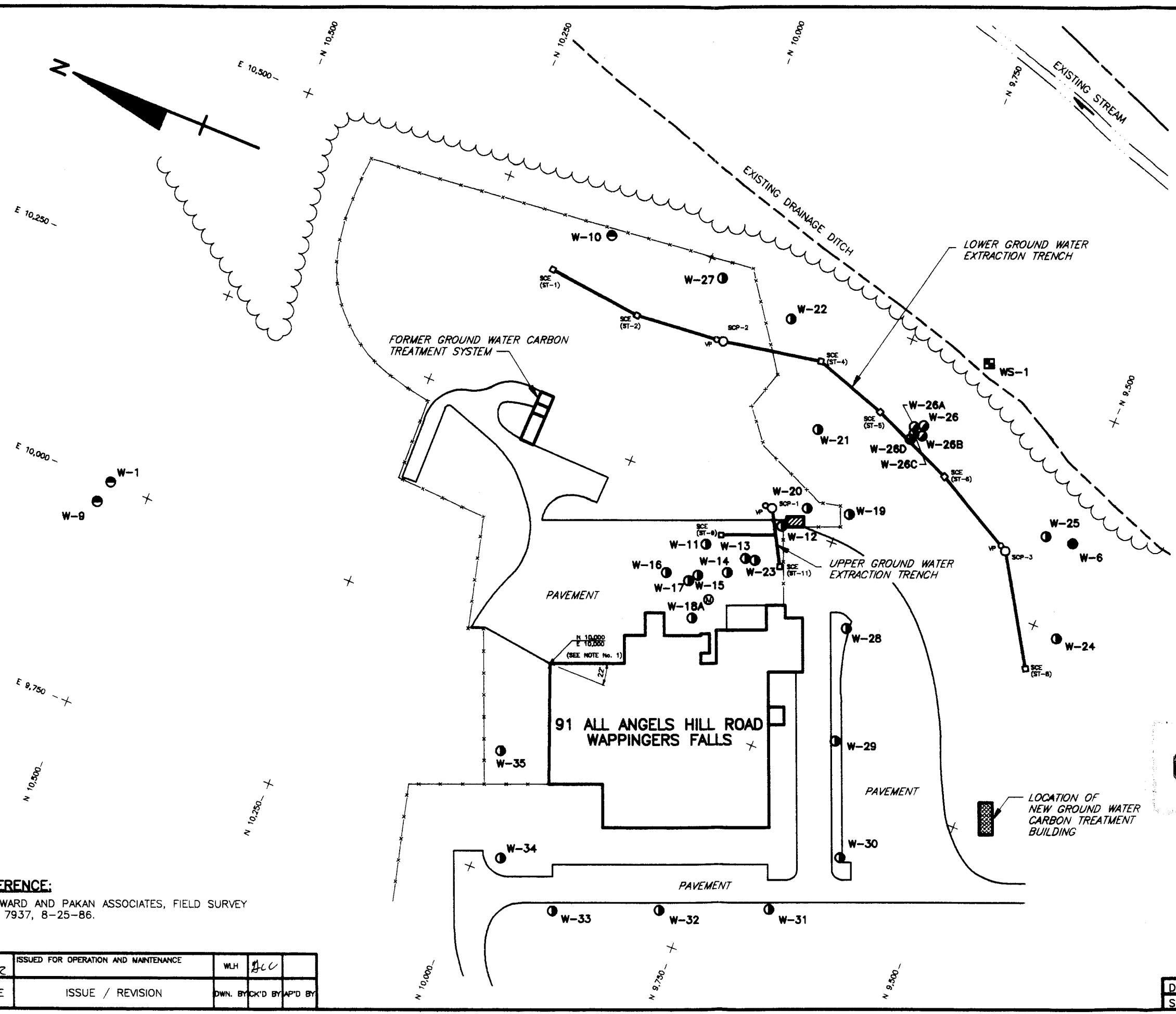
P&ID Symbol	Sensor Description	Operating Range	Setpoint	Function
LAH1-1	Upper trench SCP1 high level alarm	N/A	9.3 feet (1)	Alarms, dials out & gets logged
HEL-1	Upper trench SCP1 pump on level	N/A	7.7 feet (1)	Turns pump on
LEL-1	Upper trench SCP1 pump off level	N/A	6.1 feet (1)	Turns pump off
LAH1-2	Lower trench SCP2 high level alarm	N/A	14.2 feet (1)	Alarms, dials out & gets logged
HEL-2	Lower trench SCP2 pump on level	N/A	8.8 feet (1)	Turns pump on
LEL-2	Lower trench SCP2 pump off level	N/A	7.2 feet (1)	Turns pump off
LAH1-3	Lower trench SCP3 high level	N/A	6.6 feet (1)	Alarms, dials out & gets logged
HEL-3	Lower trench SCP3 pump on level	N/A	4.0 feet (1)	Turns pump on
LEL-3	Lower trench SCP3 pump off level	N/A	2.4 feet (1)	Turns pump off
LAH1-4	Treatment building flood	N/A	1/4" off floor	Alarms, dials out & gets logged
LAH1-5	SCP4 high level alarm	N/A	0.5 feet (2)	Alarms, dials out & gets logged
HEL-5	SCP4 pump on level	N/A	0.5 feet (2)	Turns pump on
LEL-5	SCP4 pump off level	N/A	-1.0 feet (2)	Turns pump off
PIT1	Pressure indicating transmitter filter bag #1	0 - 60psi	25psi	Switches over to bag filter #3 from filters 1 and 2
PIT2	Pressure indicating transmitter filter bag #2	0 - 60psi	25psi	
PIT3	Pressure indicating transmitter filter bag #3	0 - 60psi	25psi	Indicates clogged filter #3 log and dial out
PIT4	Pressure indicating transmitter carbon unit	0 - 60psi	25psi	

NOTES:

1. Set points for level alarms are measured from bottom of sump up.
2. Set points for level alarms are measured from bottom of sump (as datum) to sensors on pump in well.

Figures

DRAWING NUMBER 90-128-B66



LEGEND:

- FENCE
- PROPERTY LINE
- DIRECTION OF FLOW
- EDGE OF WOODED AREA
- W-9 — MONITORING WELL INSTALLED BY OTHERS
- W-26 — HYDROCARBON INVESTIGATION BORING AND MONITORING WELL INSTALLED BY CANONIE ENVIRONMENTAL SERVICES CORP.
- W-6 — WELL ABANDONED IN PLACE
- W-26B — WELL ABANDONED AND REMOVED
- WS-1 — WETLAND SAMPLE
- SCP-3 — TRENCH COLLECTION PIT
- VP — VALVE PIT
- SCE (ST-8) — TRENCH CLEAN OUT
- M — MANHOLE SUMP

NOTES:

1. THE PLANT COORDINATE SYSTEM IS BASED ON A LINE PROJECTED FROM THE NORTH CORNER OF THE PLANT BUILDING (N 10,000 E 10,000) TO MONITORING WELL No. 1.
2. NEW GROUND WATER TREATMENT CARBON TREATMENT BUILDING LOCATION EFFECTIVE JULY 7, 1992.

REFERENCE:

-HAYWARD AND PAKAN ASSOCIATES, FIELD SURVEY No. 7937, 8-25-86.

SCALE: 50 0 50 100 FEET

DRAFT

NOV 09 1992

SITE PLAN
FAIRCHILD FACILITY
WAPPINGERS FALLS, NEW YORK

PREPARED FOR

FAIRCHILD SEMICONDUCTOR CORP.

Canonie Environmental

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1	11/9/92	ISSUED FOR OPERATION AND MAINTENANCE	WLH	JLC	

DATE: 11-4-92	FIGURE 1	DRAWING NUMBER 90-128-B66
SCALE: AS SHOWN		

1

Appendix A

APPENDIX A

EQUIPMENT OPERATION AND MAINTENANCE INFORMATION

GRANULAR ACTIVATED CARBON ADSORPTION SYSTEMS AND REACTIVATION SERVICE

SYSTEMS ENGINEERING WITH ACTIVATED CARBON

ADSORPTION SYSTEMS, INC.
P.O. Box 387
Millburn, NJ 07041
(201) 762-6304

Carbon Adsorption System
Fairchild Semiconductor Corporation
Wappingers Falls, New York

Process Description

Ground water is pumped through dual fixed bed contactors operating in series and in downflow mode. The adsorbers are each skid mounted and easily moved utilizing a forklift. Each adsorber contains 2,000 pounds of virgin granular activated carbon (8 x 30 mesh) to provide for a contact time of 60 minutes at an average flow rate of 10 gpm. This contact time is excellent for adsorption of most organic contaminants. The adsorbers are manufactured of 304 stainless steel complete with internals, gauges, inlet and outlet valves. Each unit is rated for 14 psig service at 130 F.

Spent Carbon Change-out

In order to determine when each adsorber becomes spent, a water sampling and analysis program is suggested. These reports will also be necessary for ASI spent carbon acceptance. Each adsorber unit is fitted with two sample ports, one for influent and one for effluent. Samples collected from these ports and analyzed at periodic intervals will reveal when carbon bed break-through occurs. Break-through of the lead bed is when contaminants begin to pass through the lead bed and into the secondary unit.

Once break-through has occurred, the spent carbon in the adsorber must be removed, thermally reactivated, and replaced for reuse. Contingent upon ASI spent carbon approval, reactivation can be handled at ASI's off-site reactivation facility.

The primary method of spent carbon transport is by shipping the entire adsorber. The spent adsorber must first be drained prior to transport. Pressure draining can be affected by terminating system influent and introducing 10 psig pressure at 50 scfm to the air inlet port on the adsorber influent header. A 1/2-inch ball valve has been provided for this purpose.

Once the adsorber is drained, a forklift (capable of lifting 5,000 pounds) can be used to load the adsorber onto a truck for transport. Each adsorber is certified in accordance with D.O.T. Specification 57, and certain steps must be taken by the owner to ensure compliance with this standard. Flange covers must be securely fastened over the four influent and effluent nozzles. The rupture disk assembly must be intact and operational. The 10-inch inspection port and the 2-inch carbon outlet nozzle must be tightly capped. The tank must be free of leaks, dents or other abnormalities suggesting possible rupture. The main benefit of this transport method is that no carbon handling is required by the user, minimizing possible harmful or hazardous exposure.

Another method of shipping carbon for reactivation is to slurry the carbon from the adsorber unit into another suitable vessel for transport. Each adsorber is equipped with a carbon outlet line. Through this line, spent carbon may be pressure transferred in slurry form to D.O.T approved 55-gallon drums or other approved spent carbon transport vessels. These vessels can be shipped to ASI's off-site facility for reactivation and return. The procedure for transferring the carbon slurry is as follows:

1. First, a 2-inch ball valve must be attached to the plugged carbon outlet line. It is recommended that the user fit the valve prior to system start-up. If it is not, the unit must be pressure drained as previously described. Still, the quantity of contaminated water in the tank dish bottom and some spent carbon will spill when the plug is removed. This situation should be avoided, if possible.

2. The carbon outlet valve should be closed and the adsorber filled with water to enable a slurry transfer. Attach a suitable flexible hose to the ball valve for spent carbon transfer.

3. Next, connect a compressed air line to the air inlet port on the adsorber influent header. Pressurize the tank to 10 psig, man the carbon outlet hose, and open the carbon outlet valve. The carbon should transfer in slurry form into your transportation vessels.

4. Excess water must then be drained from the transport vessels. This water will be contaminated and must be collected and returned to the system for treatment, once the system is restarted.

   Extreme care should be taken to avoid contact with contaminated carbon and water. Proper protective gear and emergency equipment should be available and utilized as necessary. Applicable regulations should be adhered to.

5. Finally, the adsorber should be rinsed inside to avoid a residual heel of contaminated carbon which may remain after carbon transfer. Any contaminated carbon residual could adversely effect the accuracy of future effluent analyses.

If on-site carbon transfer has been carried out, the adsorber must be refilled with fresh carbon. Virgin or reactivated carbon can be shipped to your site in 1,000 pound bulk sacks or in 50 pound bags. The carbon can be loaded through the 10-inch top hatch via forklift or by hand. Precautions must be taken to avoid carbon dust inhalation. Respirators should be worn for this operation.

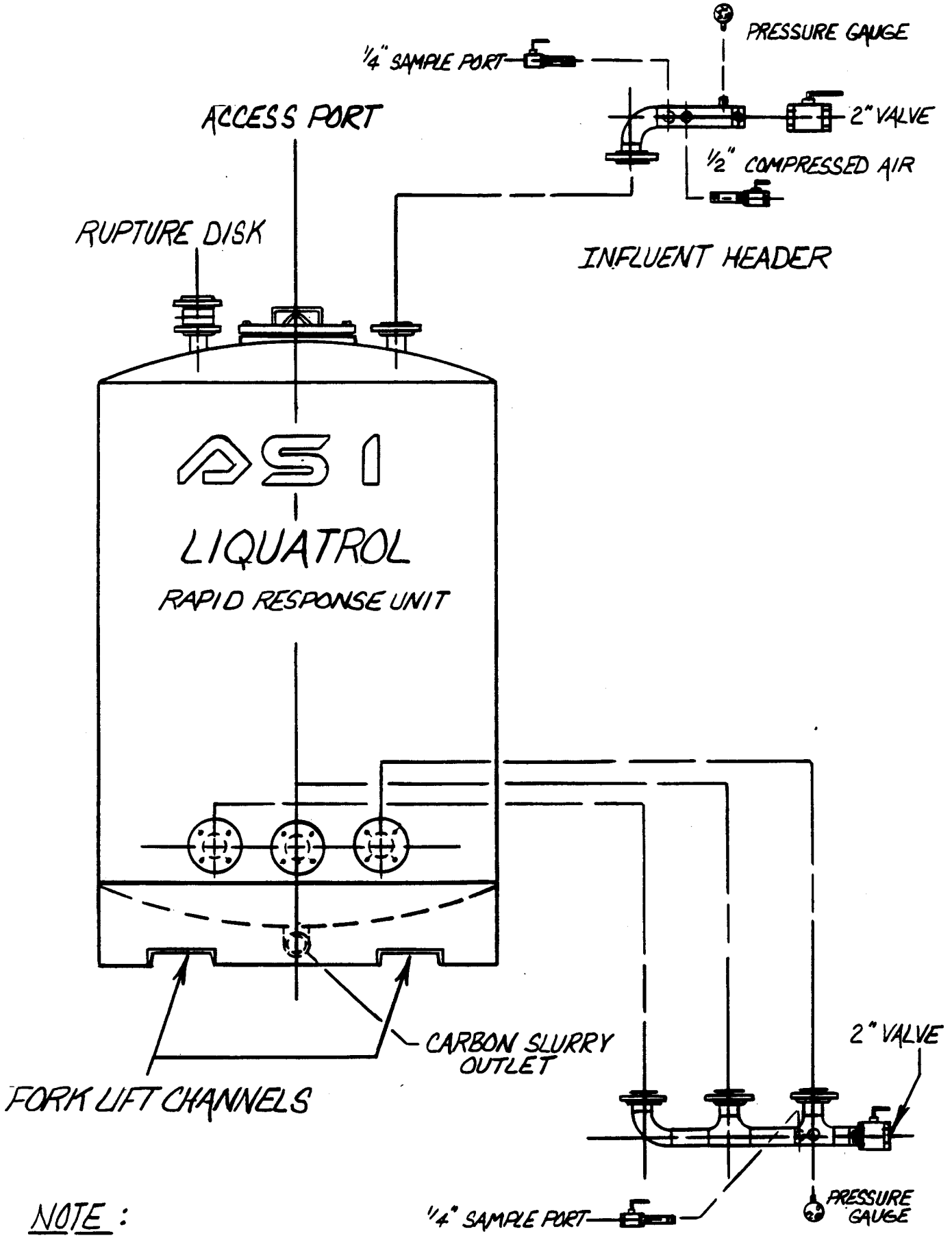
Warranties

ASI warrants that the adsorption system provided will meet the prescribed operating conditions and hydraulically process the influent. ASI warrants for one year from the date of installation, the manufactured adsorption system to the extent that ASI will replace free of expense to owner any equipment or part having proven defects in material or workmanship when used for the purpose and in the manner detailed in ASI's operating instructions.

This is ASI's sole warranty unless otherwise agreed to in writing. ASI makes no other warranty of any kind, expressed or implied, and all implied warranties of merchantability and fitness for a particular purpose which exceed ASI's aforestated obligation are hereby disclaimed by ASI and excluded from this warranty. In no event, shall ASI be liable for any incidental or consequential damages arising out of it's performance of obligations as herein defined.

Equipment Specifications

Number of Adsorbers	Two (2)
Capacity of Adsorber	2,000 Pounds of Carbon
Flow Mode	Downflow
Flow per Adsorber	10 gpm
Pressure Drop @ 10 gpm	2 psig (max.)
Contact Time	60 Minutes
Material of Construction	304 Stainless Steel
Pressure Rating	14 psig @ 130 F
Process Piping	2-inch, 304 Stainless Steel
Gauges	Inlet and Outlet
Valves	2-inch Ball Valves
Internals	Stainless Steel Flanged Septas
Sample Ports	1/4-inch Sample Taps - 2 per Vessel
Nozzle Schedule	2-inch Inlet, Threaded 2-inch Outlet, Threaded 3/4-inch Air Connection 2-inch Carbon Outlet, Threaded and Capped 1/4-inch Sample Connections 10-inch Top Access Way (Carbon)
Dimensions per Adsorber	48-inch Diameter by 72-inch Straight Side



NOTE :

A. TO CONFORM WITH D.O.T SPEC 57 REQUIREMENTS, COVERS MUST BE INSTALLED ON INFLUENT AND EFFLUENT NOZZLES PRIOR TO SHIPMENT.

B. ALL NOZZLES 2", 150# CLASS

Installation and Maintenance Instructions for

FIKE Rupture Disc Assemblies

Assemble rupture disc flanges to existing piping or companion flanges, using good pipe fitting practice. Flow arrows on flanges must point downstream.

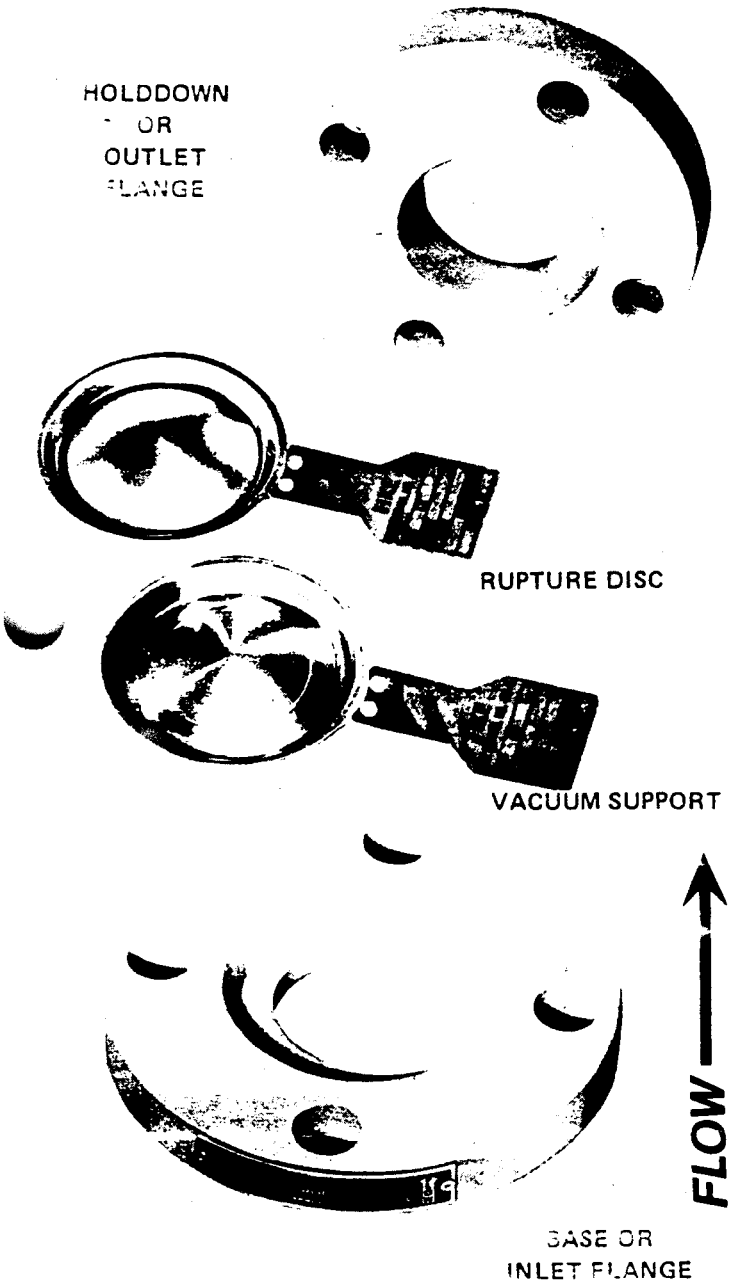


ILLUSTRATION OF THE BOLTED TYPE FLANGE ASSEMBLY

WARNING: Do not locate rupture disc assembly where people are exposed to the discharge of the area above the rupture disc.

This precaution applies to a rupture disc assembly having a free outlet even though it has a baffle to absorb thrust.

Vent toxic or inflammable fumes and liquids to a safe place.

Brace piping to absorb shock when disc breaks.

To install a new rupture disc or to replace an old rupture disc, check the following steps:

1. FLANGE PREPARATION:

For bolted type flanges, remove bolting and part flanges. (For union type flanges and screw type flanges, unscrew the holddown nut and disassemble.) Do not damage seating surfaces. Remove old or ruptured disc. Clean seating surfaces of flanges. If seating surfaces of flanges will not wipe clean, use solvent, steel wool or fine emery cloth. Grit and dirt on seating surfaces may damage rupture disc and cause premature failure.

2. RUPTURE DISC PREPARATION:

CAUTION: Handle rupture disc with extreme care. Do not bend, poke or in any way distort the rupture disc.

Clean the new rupture disc if foreign material is present. It is very important that the entire surface of the rupture disc be perfectly clean. Even finger prints on the disc that may come in contact with material in the system may, in some cases, cause premature corrosion of the disc due to the combination of certain acids inherent in the fingerprint and the material contained in the system.

3. INSTALLING A RUPTURE DISC:

If the rupture disc is to be used with a vacuum support, the serial number of the vacuum support must correspond to the serial number of the rupture disc.

CAUTION: The vacuum support must be placed under the rupture disc. Not On Top Of Rupture Disc.

Rupture disc and vacuum support (if used) must be placed between the rupture disc flanges so that the crown of the disc is downstream, i.e. the crown of the rupture disc must go into the outlet (holddown flange).

We do not recommend installing a rupture disc whose pressure-temperature rating is greater than the flange pressure-temperature rating.

4. ASSEMBLE:

After positioning the rupture disc, lower the holddown flange (or the ring for screw type flanges) onto the rupture disc. For bolted type flanges replace studs and nuts. Clean threads on studs and nuts if excessive foreign material is present. Wire brushing is usually sufficient. (For union type flanges and screw type flanges replace the holddown nut.) In clamping the rupture disc between the flanges, it is important that an even pressure is brought to bear on the disc, keeping the facing surfaces of the base (inlet) and holddown (outlet) flanges as near parallel as possible during the assembly operation. It is not necessary to use an excessive amount of pressure to clamp the disc securely between the flanges since the 30° angular seating gives a decided advantage in clamping pressure.

WARNING: Excessive tightening may damage surfaces of flanges and can easily shatter thin cast rupture discs.

PREVENTIVE MAINTENANCE:

Under normal operating conditions the rupture disc should be replaced yearly or at rupture. Severe operating conditions may require that the disc be replaced more often. Instructions and precautions contained herein should be carefully followed.

Fike METAL PRODUCTS CORP. 704 South 10th Street, Blue Springs, Missouri 64015 • 816-229-3405

Recommended Torque Values for Fike 30° Seat and Poly S-D Rupture Discs in Insert or Full Bolting Type Flanges.

TABLE 16

	NOMINAL PIPE SIZE															
	1/2"	3/4"	1"	1-1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
Max. Load L.L.	6000	9000	15000	18000	40000	55000	108000	125000	210000	247000	265000	280000	305000	390000	475000	560000
Max. Load H.L.	11000	28000	38000	50000	105000	145000	220000	300000								
150 (ASA) ANSI																
Reqd. Load	2189	6497	8746	11482	34818	46700	46066	58702	137227	172641	197660	227877	258915	246676	271829	322136
Max. Press.	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
Min. Torque	4.5	13.5	18.2	24	90	122	60	91	214	209	240	317	270	290	255	335
Max. Torque	12.5	19	31	38	104	143	141	195	328	300	322	398	318	457	445	583
Type Lip	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL
300 (ASA) ANSI																
Reqd. Load	2189	6497	8746	11482	34818	46700	46066	58702	137227	172641	197660	227877	258915	246676	362065	486865
Max. Press.	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720
Min. Torque	4.5	13.5	23	36	45	73	72	91	167	209	240	317	270	266	314	507
Max. Torque	12.5	23	39	56	52	86	169	130	255	257	311	262	318	339	412	583
Type Lip	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL	LL
600 (ASA) ANSI																
Reqd. Load	2240	6497	8746	12459	34818	53396	68390	99609	192071							
Max. Press.	1440	1440	1440	1440	1200	11440	1440	1440	1440							
Min. Torque	4.7	13.5	23	39	45	83	125	138	300							
Max. Torque	12.5	23	39	56	52	86	197	174	328							
Type Lip	LL	LL	LL	LL	LL	LL	LL	LL	LL							
600 (ASA) ANSI																
Reqd. Load					47997											
Max. Press.					1440											
Min. Torque					63											
Max. Torque					137											
Type Lip					HL											
900 (ASA) ANSI																
Reqd. Load	7570	19486	17452	33343	71992	79985	149308	288137								
Max. Press.	2160	2160	2160	2160	2160	2160	2160	2160								
Min. Torque	24	60	63	139	131	146	350	450								
Max. Torque	34	75	138	167	191	264	515	469								
Type Lip	HL	HL	HL	HL	HL	HL	HL	HL								
1500 (ASA) ANSI																
Reqd. Load	10515	27065	24239	46293	99998	111241	188318									
Max. Press.	3600	3600	3600	3600	3600	3600	3600									
Min. Torque	33	84	88	192	182	261	490									
Max. Torque	34	88	138	208	191	264	515									
Type Lip	HL	HL	HL	HL	HL	HL	HL									

L.L. = Light Lip H.L. = Heavy Lip

All Torque Values shown are in foot pounds. All pressure and load requirements are in PSIG and 72°F. Maximum pressure ratings are for 304 SST.

All torque values based on new free running studs coated with light oil. Stud material ASTM A193-B7, nuts ASTM A194-2H. Flanges of carbon steel ASTM A105 or A181 and stainless steel flanges of similar tensile material.

It is suggested, after initial start up and system is brought to working pressure and temperature, studs be retorqued to values shown due to material relaxing.

Care must be taken during installation that flange faces are brought down at an equal rate and that flange faces are parallel.

Rupture disc and flange seating surfaces must be clean and free of any rust and foreign matter.

1. The torque values shown in Table 16 apply to standard prebulged, "HO" and "HOV" (with metal seal), "CPV", "CPV-C" and standard prebulged with vacuum support construction, calculated for the following disc materials:
   - Stainless Steel
   - Inconel
   - Monel
   - Nickel
   - Aluminum
   - Hastelloy
2. For copper, silver, gold, lead lined discs and other ductile materials, minimum and maximum values are to be reduced by 50%.
3. For "HO", "HOV", "PL-HO", "PL-HOV" discs with plastic seals, it is recommended that 50% of the minimum torque values shown on Table 16 be used for the minimums and the minimums be used as maximum torque values and the seats of the base flange and disc be coated with silicon grease where possible.
4. For teflon, vinyl or epon coated discs (on process side), minimum torque value should be half way between minimum and maximum values given and the maximum torque value remain as shown. Teflon, vinyl and epon are slick substances, therefore more torque is required to hold disc and keep from slipping.

It should be understood that the values shown on Table 16 are based on optimum conditions. Many various things can affect torque and seat of disc in flanges. For example, rusty studs and/or nuts can increase torque required by as much as 3 times, any scratch or gouge in the seating area of either the disc or base flange will result in leakage, also not bringing flange faces down parallel at an equal rate. It should be understood that maximum values should not be used except as a last resort, in any case, never exceed maximum value as this will cause permanent deformation to rupture disc flanges, possibly affecting burst pressure and seal of disc in flanges.

Printed in U.S.A.

GROUND WATER EXTRACTION PUMP SYSTEM

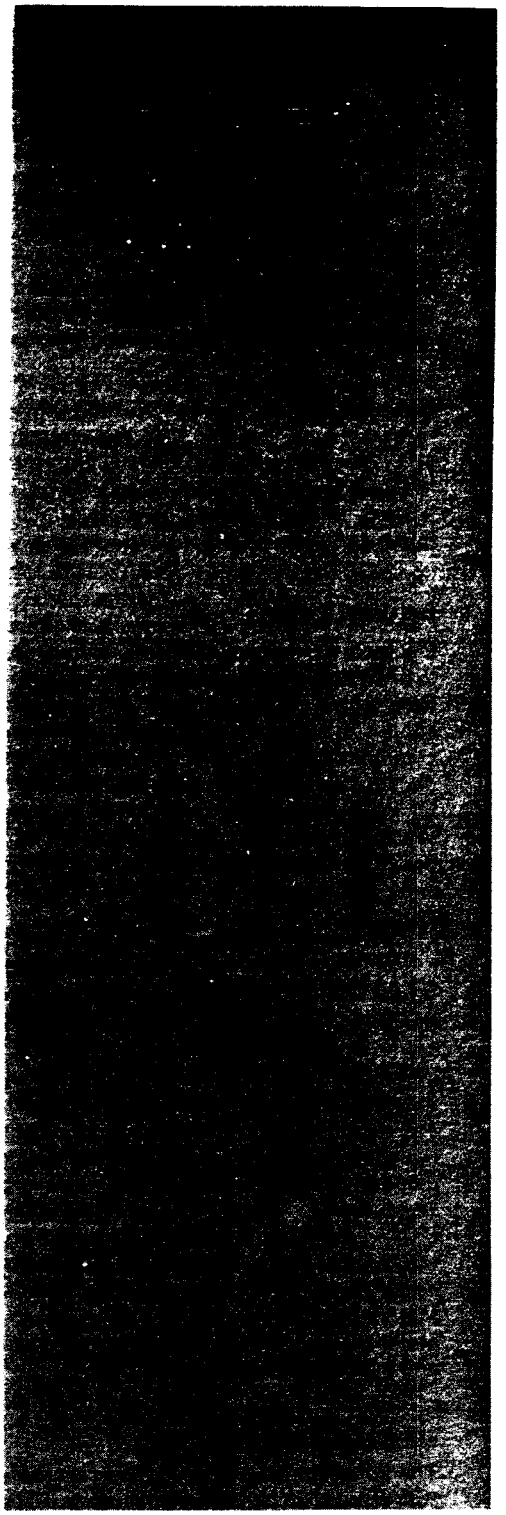
Specifications For

HEAVY DUTY SUBMERSIBLE SEWAGE PUMPS CONTROLS AND SYSTEM OPERATION

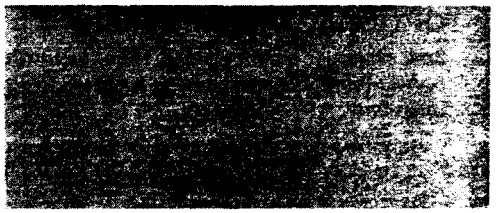
Non Clog Impeller Design ☐
Recessed Impeller Design ☒

Pump Model

☐ S & SH	☐ S4L
☒ S3HRC	☐ S4LRC
☐ S4HRC	☐ S6L
☐ S4N	☐ S8F
☐ S4NRC	☐ S8L
☐ S4M	☐ S12L
☐ S4MRC	



HYDROMATIC PUMPS
A Marley Pump Company



SUBMERSIBLE PUMP CONSTRUCTION

Each pump shall be of the sealed submersible type, model S3HRC. Pump volute, motor and seal housing are to be high quality gray cast iron. All external mating parts shall be machined and O-ring sealed. All fasteners exposed to the pumped liquid shall be statinless steel. Impeller is to be two-vane, enclosed, so that the impeller diameter may be trimmed to meet various specific conditions of head and capacity while still retaining factory balance. Pump shall be capable of handling a one inch spherical solid. Case wearing ring shall be bronze to minimize impeller wear and shall be easily replaceable in the field.

As an alternate to the enclosed, two-vane impeller, pump models S4N, S4M and S4L can be furnished with a semi-open, multi vane *recessed type* impeller. The impeller can be trimmed to meet various conditions while still retaining factory balance. The volute case will not have a wearing ring. Pump models will be S3HRC, S4HRC, S4NRC, S4MRC, and S4LRC. All impellers shall have pump out vanes on the back shroud.

POWER CORD

Electrical power cord shall have an outer jacket which is resistant to oil and other materials normally found in sewage. Power cord is to be sealed, not only by use of a cord grip, but shall have individual conductors sealed into the cord cap assembly with epoxy sealing compound. This epoxy seal shall be repeated where the conductors enter the motor from the connection box which is mounted on top of the motor housing. The cord cap and connection box shall each be sealed with an O-Ring. This will provide a double-sealed, water-tight power cord entry through which liquid cannot enter the motor by following individual conductors inside the insulation.

STATOR WINDINGS

The stator winding, rotor and bearings are to be mounted in a sealed submersible type housing. This is filled with high-dielectric oil to give superior heat transfer and longer bearing life. (The thermal conductivity of oil is seven times better than air.) The pump and motor are to be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped. The pump should not require cooling water jackets. Dependence upon, or use of, water jackets for supplemental cooling should be avoided. Stators shall be securely held in place with a removable end ring and threaded fasteners so that it may be easily removed in the field without the use of heat or a press. Stators must be capable of being repaired or rewound by local motor service station. No special tools shall be required for pump and motor disassembly.

MECHANICAL SEALS

The pump shall have two mechanical seals, mounted in tandem, with an oil chamber between the seals. Rotating seal faces shall be carbon and stationary seal faces to be ceramic. The lower seal must be replaceable without disassembly of the seal chamber.

OPTIONAL — MECHANICAL SEAL

Outboard seal next to impeller may be provided with tungsten-carbide faces for exceptionally gritty conditions. This is normally not required for the upper seal which is running only in clean oil.

Required [ ] Not Required [XXX]

OPTIONAL — SEAL SENSOR

Seal chamber shall be fitted with electrode probe. A separate or panel mounted alarm shall be supplied to indicate water in the seal chamber.

Required [ ] Not Required [XXX]

OPTIONAL — HEAT SENSOR

Motor shall be supplied with heat sensing units attached to motor winding. Heat sensing units shall trip starter in the event of motor overheating.

Required [ ] Not Required [XXX]

Furnish 5 HYDR-O-MATIC submersible sewage pumps, model S3HRC operating at 3500 RPM. Each pump shall deliver a capacity of 40 GPM/LPS at 56 feet/meters TDH. Pump motor shall be rated 5 horsepower, 3 phase 60 hertz and 460 volts. Pump complete performance curve, giving efficiency, shall be as shown on curve number .

Pump outline drawing number _____

CONTROL PANEL

Control shall be Nema 3R, rainproof enclosure with separate removable inside base plate to mount all components. The outside door shall have provisions for locking. A circuit breaker shall be provided for the pump and a magnetic starter with 3 leg overload protection for three-phase operation, or 2 leg overload protection for single phase operation. An alternating relay shall be provided to alternate pumps on each successive cyle of operation. Starters shall have auxiliary contacts, where necessary (3-phase), to operate both pumps on over-ride condition. If one or both pump circuit breakers trip, power will still be available, and maintained, for the control circuit. H-O-A switches and run lights shall be supplied for each pump. Terminal strip shall be provided for connecting control wires. Additional terminals shall be provided to connect alarm, heat sensors and seal sensor wires. The panel will include a transformer, where necessary, to reduce control voltage.

Control panel drawing number _____

Phase/hertz/volts	Type	Panel #
3 / 60 / 460	Simplex/Duplex XXXXXXXXXX	

SUMP LEVEL CONTROLS

Sealed float type mercury switches shall be supplied to control sump level and alarm signal. The mercury tube switches shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire shall have heavy Neoprene jacket and a weight shall be attached to cord above the float to hold switch in place in sump. Weight shall be above the float to prevent sharp bends in the cord when the float operates under water. The float switches shall hang in the sump supported only by the cord that is held to the Nema 4 junction box or the wiring channel. In a duplex system, three float switches shall be used to control level. One for pump turn-on, one for pump turn-off and one for both pumps turn-on. A fourth switch shall be provided for alarm control.

OPTIONAL — ALARM

Alarm flashing light, bell, horn or telemetering a function to a remote location can be supplied in a separate, Nema 3 or Nema 4 enclosure. The alarm can also be incorporated within the control panel.

Type	Required
flashing light	[XX]
bell	[ ]
horn	[ ]
other	[ ]
none	[ ]

OPERATION OF SYSTEM

On sump level rise lower mercury switch shall first be energized, then upper level switch shall next energize and start lead pump. With lead pump operating, sump level shall lower to low switch turn-off setting and pump shall stop. Alternating relay shall index on stopping of pump so that lag pump will start on next operation. If sump level continues to rise when lead pump is operating, the override switch shall energize and start lag pump. Both lead and lag pump shall operate together until low level switch turns off both pumps. If level continues to rise when both pumps are operating, alarm switch shall energize and signal the alarm. If one pump should fail for any reason, the second pump shall operate on the override control and if level rises above override control, alarm shall signal. All level switches shall be adjustable for level setting, from the surface.

Alternately, the alarm float can be located between the lead and lag floats to give early warning of lead pump malfunction.

HYDR-O-MATIC (FIVE-YEAR) WARRANTY

Hydr-O-Matic Pumps, A Marley Company, warrants its pumps, used in permanent Hydr-O-Rail installations, to the original owner against defects in workmanship and material.

The warranty period shall be five years from date of shipment except that the following parts will be replaced within five years of date of shipment upon payment of the applicable percentage of the list price of each part in effect at the time of the replacement.

	Months After Shipment			
	0-18	19-31	32-45	46-60
Mechanical Seal ...	0%	25%	50%	75%
Impeller	0%	30%	50%	80%
Pump Housing	0%	30%	50%	80%
Wear Ring	0%	50%	80/5	100%
Ball Bearings	0%	50%	80%	100%
Rotor & Stator	0%	40%	80%	100%

(1) Months after shipment shall be determined by date of receipt of defective product by Hydr-O-Matic or Hydr-O-Matic's authorized distributors.

(2) Stator — Warranted only when used with Hydr-O-Matic authorized electric control panels.

(3) This warranty is limited to pumping noncorrosive liquids defines as follows:

pH range from 6 to 9
Specific gravities from 0.9 to 1.1
Viscosity range from 28 to 35SSU
Liquid Temperature to maximum of 140° F.

(4) Parts of products, or accessories, manufactured by others are warranted only to the extent of the original manufacturer's warranty.

Hydr-O-Matic pumps warrants to the original purchaser that any part except those listed in paragraph (2) above which proves to be defective in material or workmanship will be replaced at no charge with a new or remanufactured part, F.O.B. factory. Purchaser shall assume all responsibility and expense for removal, reinstallation, and freight. Any item designated as manufactured by others shall be covered only by the express warranty of the manufacturer thereof. This warranty does not apply to damage resulting from accident, alteration, misuse or abuse.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT.

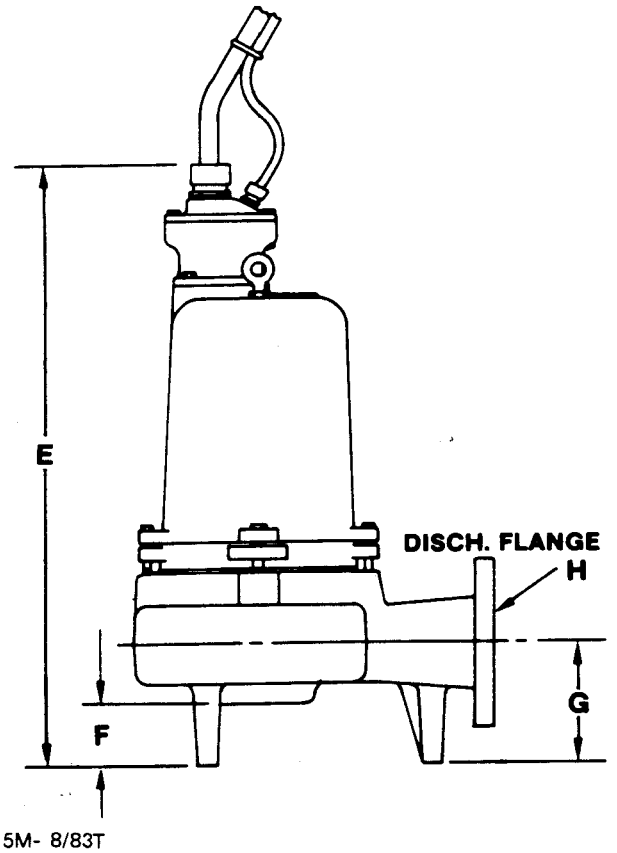
This warranty is a LIMITED warranty. Anything in the warranty notwithstanding, IMPLIED WARRANTIES FOR A PARTICULAR PURPOSE AND MERCHANTABILITY SHALL BE LIMITED TO THE DURATION OF THE EXPRESS WARRANTY. MANUFACTURER EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY.

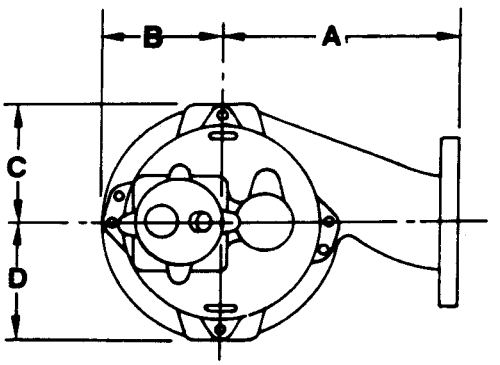
HYDR-O-MATIC Pumps RESERVES THE RIGHT TO CHANGE SPECIFICATIONS OF MATERIALS USED IN ITS PRODUCTS WITHOUT NOTIFICATION.

Pump Model	A	B	C	D	E	F	G	H
* S	7-3/4	5-13/16	6-3/8	5-3/8	25-5/16	2-1/2	8-5/8	4" STD Pipe
* SH	9-1/4	7-3/16	7-5/8	6-5/16	26-5/8	3	9-3/4	4" STD Pipe
S3HRC	7-3/4	4-3/16	9-15/16	4-15/16	26	2-3/16	4-1/2	3" 125# Flg.
S4HRC	12-1/2	6-5/16	6-5/16	6-5/16	32-11/16	3-1/8	6-1/2	4" 125 Flg.
S4N	12-1/2	6-5/16	6-3/8	7-9/16	29-9/16	3-1/8	6-1/2	4" 125 Flg.
S4NRC	12-1/2	5-3/4	5-3/4	5-3/4	28-15/16	3-11/16	6-1/2	4" 125 Flg.
S4M	12-1/2	7	7-7/8	6-5/16	32-3/8	3-1/8	6-1/2	4" 125 Flg.
S4MRC	12-1/2	6-5/16	6-5/16	6-5/16	33-3/8	3-1/8	6-1/2	4" 125 Flg.
+ S4L	12-1/2	10-1/4	10-1/4	10-1/4	37-7/8 / 42-5/8	4	7-3/4	4" 125 Flg.
+ S4LRC	12-1/2	10-1/4	10-1/4	10-1/4	39-1/4 / 44	4	7-3/4	4" 125 Flg.
+ S6L	15	10-15/16	12-1/16	10-1/4	37-3/8 / 42-5/8	4	7-3/4	6" 125 Flg.
+ S8F	19	11	12	9-1/2	40-5/16 / 45-1/16	6	11	8" 125 Flg.
S8L	19	12-1/2	13-7/16	11-9/16	54-7/16	5-3/16	11	8" 125 Flg.
S12L	23	13-3/4	16-1/8	11-1/4	69-3/8	9-5/8	25-5/16	12" 125 Flg.

* From pump centerline of vertical discharge - column A
From pump base to face of discharge - column G

\+ Up to 20 HP / 25-35 HP - column E





HYDROMATIC PUMPS
A Marley Pump Company
Claremont & Baney, P.O. Box 327
Ashland, OH 44805 419/289-3042

SUBJECT TO CHANGE WITHOUT NOTICE

HYDR-O-RAIL SYSTEMS MODULAR PRICING

Effective Date: January 1, 1981

Supersedes Page Dated May 1, 1980

MODULE DESCRIPTION

To price a HYDR-O-RAIL system, the following modules must be considered:

I.	Pumps and Controls	Use Form H157A
II.	Piping	Use Form H157B
III.	Components	Use Form H157B
IV.	Tank	Use Form H157B
V.	Optional Accessories	Use Form H157B

Select a unit price from each module and the sum of the units equal the system price. Refer to the following module descriptions for instructions and/or pricing. All pricing is f.o.b. factory, Ashland, Ohio.

I. PUMPS AND CONTROLS MODULE

A. Refer to catalog sections 420, S-Series or 430 RC-Series for all pump selections and pricing. Follow all instructions in section selected.

B. System may be Simplex, Duplex, Triplex, etc. Refer to factory for Triplex or larger.

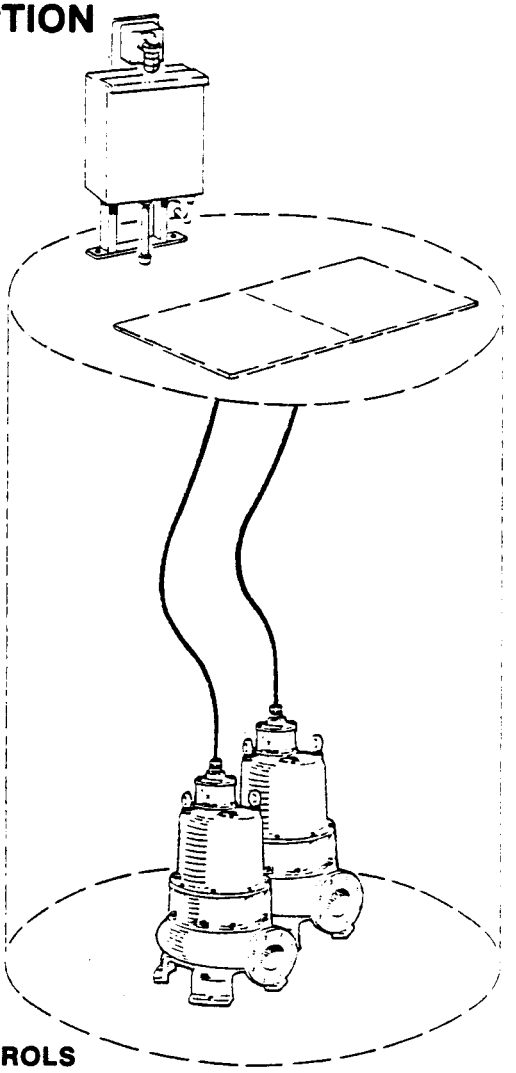
C. Use Form H157A and tabulate pumps, panels, floats, alarms and related extras.

II. PIPING MODULE

Select the piping module to suit the station requirements from one of the following categories:

1. HRVO — Concrete tank, valves outside
2. HRVS — Concrete tank, valves inside
3. FBHRVO — Steel tank, valves outside
4. FBHRVS — Steel tank, valves inside

Use Form H157B to compute HYDR-O-RAIL package.



PUMPS AND CONTROLS MODULE I

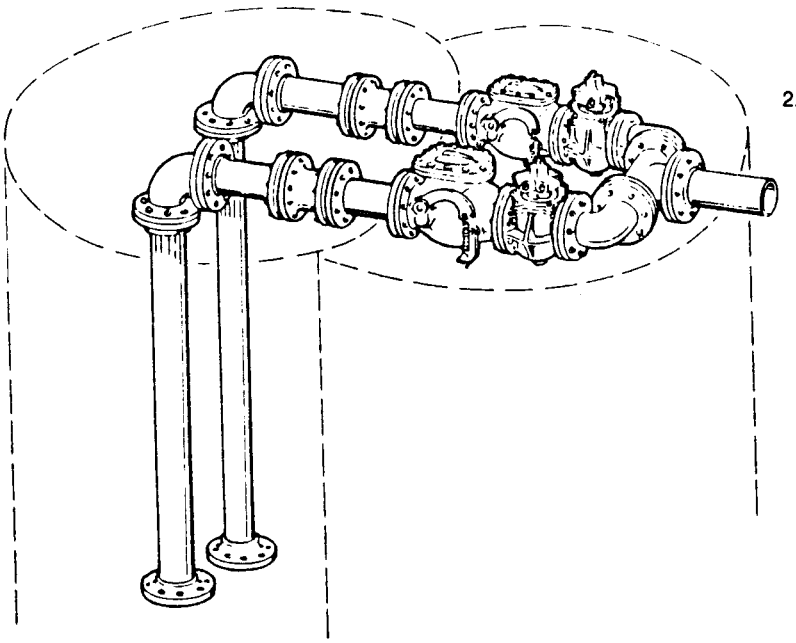
HYDROMATIC PUMPS
A Marley Pump Company
Claremont & Baney, P.O. Box 327
Ashland, OH 44805 419/289-3042

SUBJECT TO CHANGE WITHOUT NOTICE

Supersedes Page Dated May 1, 1980

A. HRVO or HRVS (Concrete)

1. A piping module for this category is optional and the unit price and equipment may be omitted from the HYDR-O-RAIL system package. If omitted, these components must be supplied by others.



PIPING MODULE II

2. The piping module for the concrete category (HRVO or HRVS) starts with the lower flange on the riser pipes and includes the pipe and fittings plus check valve(s) and plug valve(s) as indicated in the sketches. The module also includes the pump guide rails. For an exact listing of the items included for duplex installations, check the appropriate drawing listed in the following table.

NOTE:
Piping shown is with the valves outside in a separate concrete or steel valve box (HRVO or FBHRVO).

Duplex HYDR-O-RAIL Drawings for Concrete Stations				
	HRVO, Duplex		HRVS, Duplex	
Pump Selection	Drawing No.	Literature No.	Drawing No.	Literature No.
S-Series	9205	614.23	9206	614.24
S4-Series	8510	614.27	8831	614.28
S6-Series	8875	614.31	8830	614.32
S8-Series	8801	614.35	8833	614.36
S12-Series	10363	—	Not Recommended	

3. Refer to factory for drawings for Simplex, Triplex, etc.

4. HRVS systems only available in Simplex or Duplex configuration.

5. Select unit price from chart, paragraph IIC, page 610.4.

HYDROMATIC PUMPS
A Marley Pump Company
Claremont & Baney, P O Box 327
Ashland, OH 44805 419/289-3042

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Supersedes Page Dated May 1, 1980

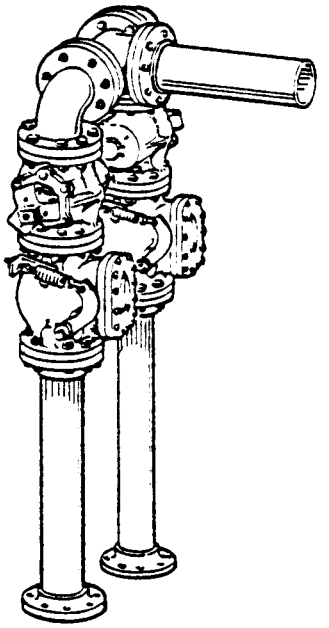
MODULE DESCRIPTION (Continued)

B. FBHRVO or FBHRVS (Steel)

1. The piping module in this category is not optional and must be included in the system pricing.

2. The piping module for the factory-built (steel) category starts with the lower flange on the riser pipe(s) and includes the pipe and fittings plus check valve(s) and plug valve(s) as indicated in the sketches. The module also includes the pump guide rails. For an exact listing of the items included for duplex installations, check the appropriate drawing listed in the following table:

NOTE:
Piping shown is with the valves inside the wet well (HRVS or FBHRVS).



PIPING MODULE II

	Duplex HYDR-O-RAIL Drawings for Steel Stations			
	FBHRVO, Duplex		FBHRVS, Duplex	
Pump Selection	Drawing No.	Literature No.	Drawing No.	Literature No.
S-Series	9205-1	614.21	9206-1	614.22
S4-Series	8510-1	614.25	8831-1	614.26
S6-Series	8775-1	614.29	8830-1	614.30
S8-Series	8801-1	614.33	8833-1	614.34
S12-Series	10363-1	—	Not Recommended	

3. Refer to factory for drawings for Simplex, Triplex, etc.

4. FBHRVS systems only available in Simplex or Duplex configuration.

5. Select unit price from chart, paragraph IIC, page 610.4.

HYDROMATIC PUMPS
A Marley Pump Company
Claremont & Baney, P.O. Box 327
Ashland, OH 44805 419/289-3042

SUBJECT TO CHANGE WITHOUT NOTICE

MODULE DESCRIPTION (Continued)

IV. TANK MODULE

A. Concrete tanks are furnished by others and built on the job. DO NOT include a price for this module if any HRVO or HRVS system has been selected. However, do refer to minimum tank diameter chart to be certain that the customer provides at least the minimum diameter to suit the pumps selected.

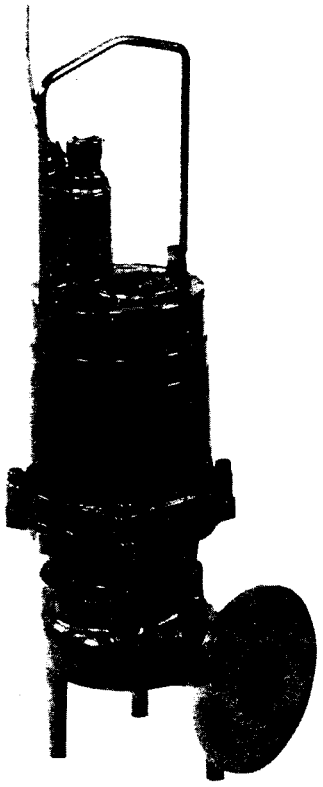
B. Steel tanks are furnished by HYDR-O-MATIC and must be priced from the price table in this module. First select the pumps and piping and then select the tank diameter to equal or exceed diameters as indicated in the following table:

Minimum Tank Diameter[1]							
Pump Selection	Piping Module	Simplex		Duplex		Triplex	
		VS[2]	VO[3]	VS	VO	VS	VO
S3HRC	3″ 4″	4′0″ 4′6″	4′0″ 4′6″	5′0″ 5′0″	4′6″ 5′0″	Not Recommended	5′6″ 5′6″
*S-Series	4″ 6″	4′0″ 4′6″	4′0″ 4′6″	5′0″ 6′0″	5′0″ 6′0″		7′6″ 7′6″
S4-Series	4″ 6″ 8″	4′0″ 4′6″ 5′6″	4′0″ 4′6″ 5′6″	5′0″ 6′0″ 7′0″	5′0″ 6′0″ 7′0″		7′6″ 7′6″ 8′0″
S6-Series	6″ 8″	5′6″ 5′6″	5′6″ 5′6″	7′0″ 7′0″	7′0″ 7′0″		9′0″ 10′0″
S8-Series	8″ 10″	6′0″ 6′0″	6′0″ 6′0″	8′0″ 8′0″	8′0″ 8′0″		10′0″ 10′0″
S12-Series	12″ 14″ 16″	Not Yet Available		N/A N/A N/A	10′6″ 10′6″ 10′6″		N/A N/A N/A

*Using new 4″ standard bases and hatch.

[1]Larger tanks required if trash basket is used. Refer to factory.
[2]Valves inside.
[3]Valves outside.

BULLETIN 430.0



S3HRC (3-inch)

RC Series Recessed Impeller Heavy-Duty Submersible Sewage Pumps

HYDROMATIC PUMPS
A Marley Pump Company

HYDROMATIC recessed impeller pumps answer a broad range of sewage and waste handling situations which require high head/low flow and large solids handling ability. These pumps are capable of continuous operation without damage; are low in noise level at any point on the operating curve; and are not subject to radial load problems which can occur with conventional non-clog designs under high head/low flow circumstances.

The recessed impeller creates a liquid vortex in the volute which directs all spherical solids, slurry, sludge and stringy or fibrous material through the pump.

Depending upon the pump size and power required, HYDROMATIC RC submersible pumps are suitable for a variety of applications in liquid temperatures up to 140°F.

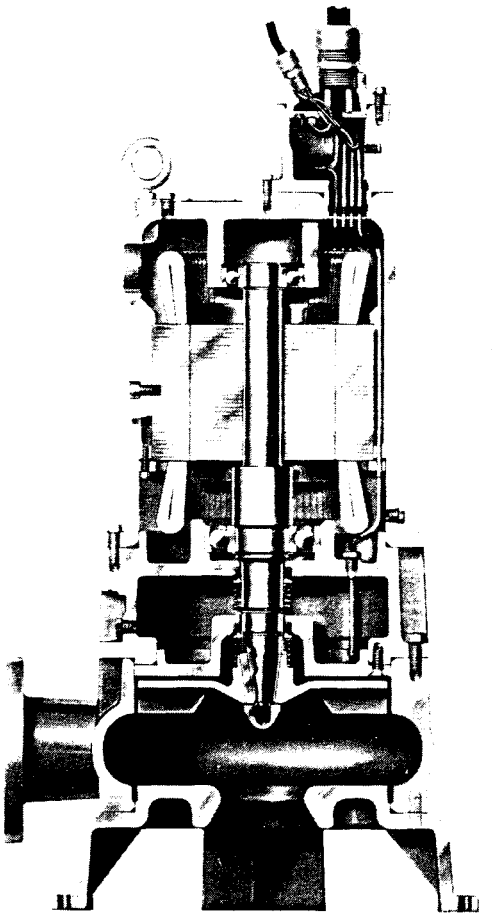
- **S3HRC**—2 to 5 HP, 3-inch discharge. Handles solids to 2 inches. Heads to 75 feet. Capacities to 240 gpm.
- **S4HRC**—7½ to 15 HP, 4-inch discharge. Handles solids to 3 inches. Heads to 95 feet. Capacities to 430 gpm.
- **S4NRC**—1 to 6 HP, 4-inch discharge. Handles solids to 3 inches. Heads to 48 feet. Capacities to 440 gpm.
- **S4MRC**—3 to 12 HP, 4-inch discharge. Handles solids to 3 inches. Heads to 68 feet. Capacities to 630 gpm.
- **S4LRC**—5 to 35 HP, 4-inch discharge. Handles solids to 3¼ inches. Heads to 140 feet. Capacities to 950 gpm.

Features and Performance

1. Fully recessed cast iron non-clog impeller.
2. Double ball bearing construction. Two heavy-duty ball bearings rigidly support shaft and motor rotor for reduced vibration and wear.
3. Type 303 stainless steel shaft, tapered and keyed, provides positive impeller drive and permits easy removal. All outside fasteners 18-8 stainless steel.
4. Dual mechanical shaft seal. Oil lubricated with carbon rotating and ceramic stationary seal faces mounted in tandem. Other materials available.
5. Seal failure probe to detect water in seal chamber is available as an option.
6. Oil-filled ball bearing motors provide long life and quiet operation through full pumping range. Pure dielectric insulating oil lubricates motor and effectively dissipates heat. If excessive heat does build up in housing, heat sensors installed in motor winding automatically cut off motor.
7. Pump case of heavy cast iron. ASTM A48-C25.
8. Electrical Data: All RC pumps are available in three phase; the S3HRC, S4NRC, and S4MRC are also available with single phase motors. 208, 230V 1ϕ; 208, 230/460, 575V 3ϕ.

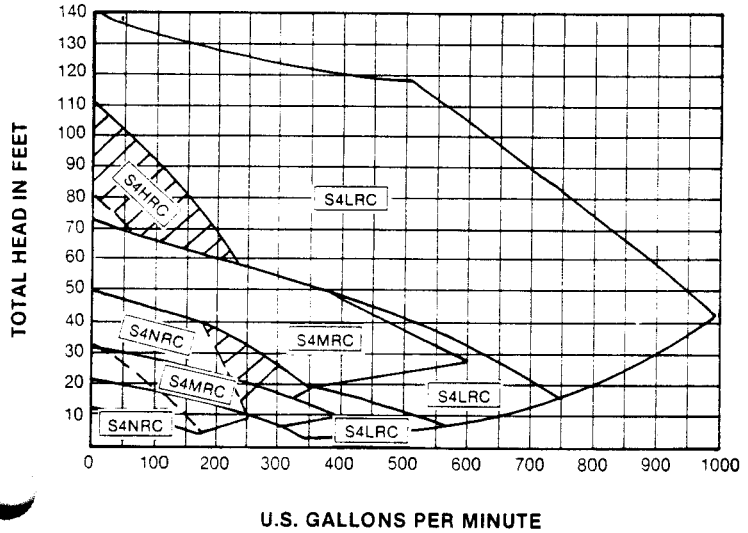
SYSTEMS AND CONTROLS

All RC Series pumps are designed for either manual or automatic operation. Totally integrated control and alarm systems are available employing the HYDROMATIC 3900 liquid level controls and control panels. Pumps may be purchased separately or as part of a HYDR-O-RAIL® factory packaged pump station, which includes controls and a ready-to-install coated steel tank. Components are also available for on-site installation in concrete sumps. Either configuration offers the patented* HYDROMATIC self-sealing flange and guide system. **Patent #3,592,564*



RC 4" Cutaway

General Performance Coverage Chart



U.S. GALLONS PER MINUTE

Distributed by

MARLEY	THE MARLEY PUMP COMPANY
HP	HYDROMATIC PUMPS

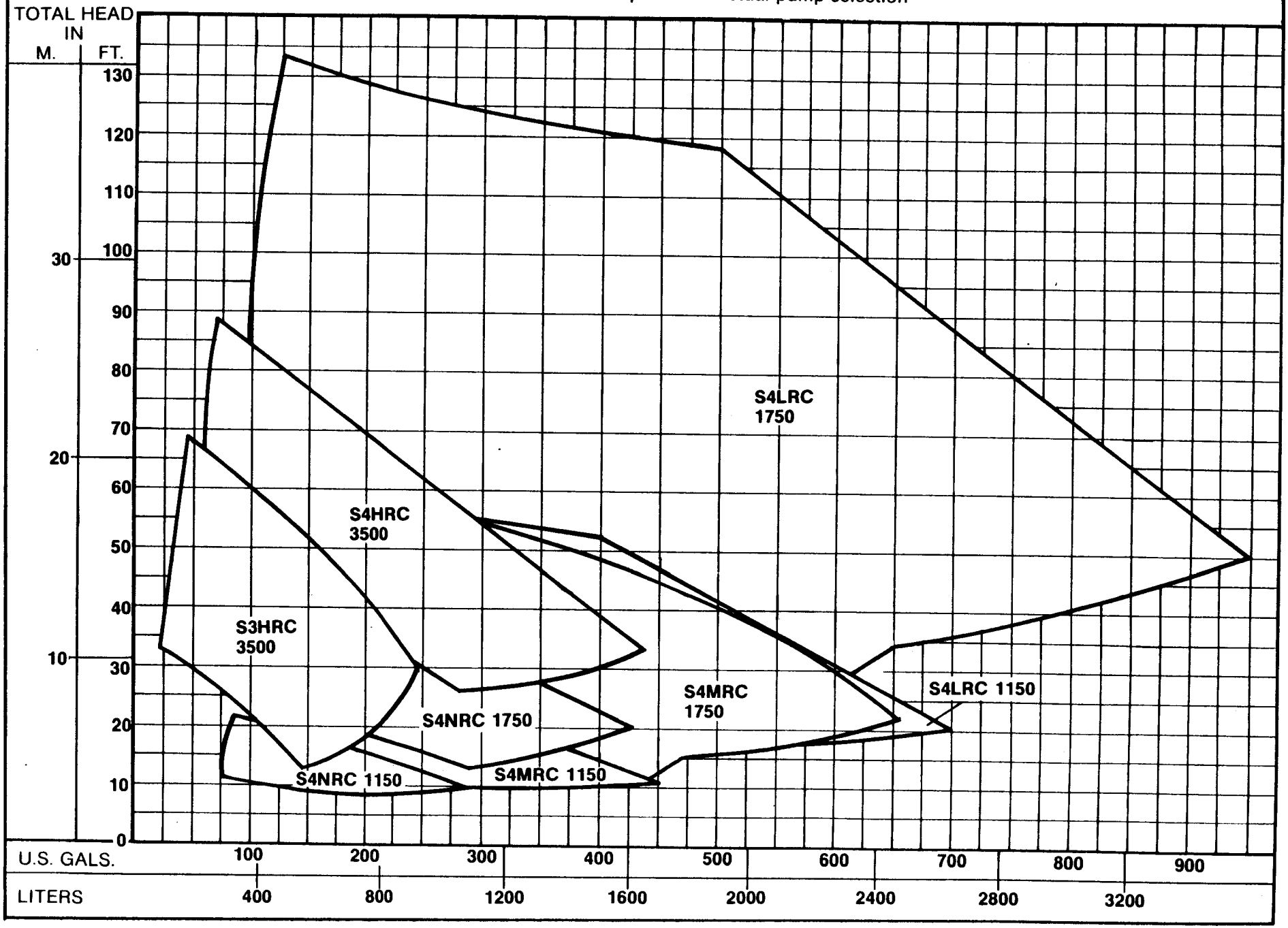
Bulletin 430.0
Revised 4/84
LITHO IN U.S.A.

Box 327. Ashland. Ohio 44805 (419) 289-3042
In Canada - Marley Fluid Systems. 126 East Dr., Brampton. Ontario L6T 1C2
International Sales - Mission. KS Telex 716875045 MARLY UW

Non Clog Submersible Sewage Pump General Performance Coverage Chart

Lit. No. 234.0

NOTE: See SECTION 430 for price and actual pump selection



HYDROMATIC PUMPS
A Marley Pump Company

Post Office Box 327, 419/289-3042
Claremont & Baney Roads, Ashland, Ohio 44805

Supersedes Page Dated May 1, 1980

PUMP AND SYSTEM EXPLANATION

Pump accessories and special charges, page 421.9 and 421.10.
Control panel description — page 421.11.
Testing — page 421.14 and 421.15.
Sensors and mechanical seals — page 421.15.
ALL ARE APPLICABLE TO THE RECESSED IMPELLER PUMP LINE — SECTION 431

1. PUMP MODELS AND MODEL DESIGNATION

A. **S3HRC, S4HRC, S4NRC, S4MRC, S4LRC:** Heavy duty submersible solids handling non-clog sewage pumps with recessed impellers.

HP range	— 2 to 35
capacity range	— up to 950 GPM
head range	— up to 140 feet
solids handling ability	— 2" to 3¼" sphere (depending on model)
electrical	— 1 phase — 200/230 volt (single phase available in 5 HP and below) 3 phase — 200/230/460/575 volt (200 volt limited to 15 HP and below) voltages listed all 60 cycle (consult factory for 50 cycle)

B. **Model Designations:** Model numbers are set up to indicate pump model, HP, type of pump, electrical and speed.

pump models	— S3HRC, S4HRC, S4NRC, S4MRC, S4LRC
HP	— 200 (2 HP), 500 (5 HP), 2000 (20 HP), etc.
type of pump	— M-manual pump — no control
electrical	— 7 - 200 volt, 1 phase — 2 - 230 volt, 1 phase — 6 - 200 volt, 3 phase — 3 - 230 volt, 3 phase — 4 - 460 volt, 3 phase — 5 - 575 volt, 3 phase
speed	— 6 - 1150 RPM — 4 - 1750 RPM — 2 - 3500 RPM

EXAMPLE: S4MRC 1000 M 3-4

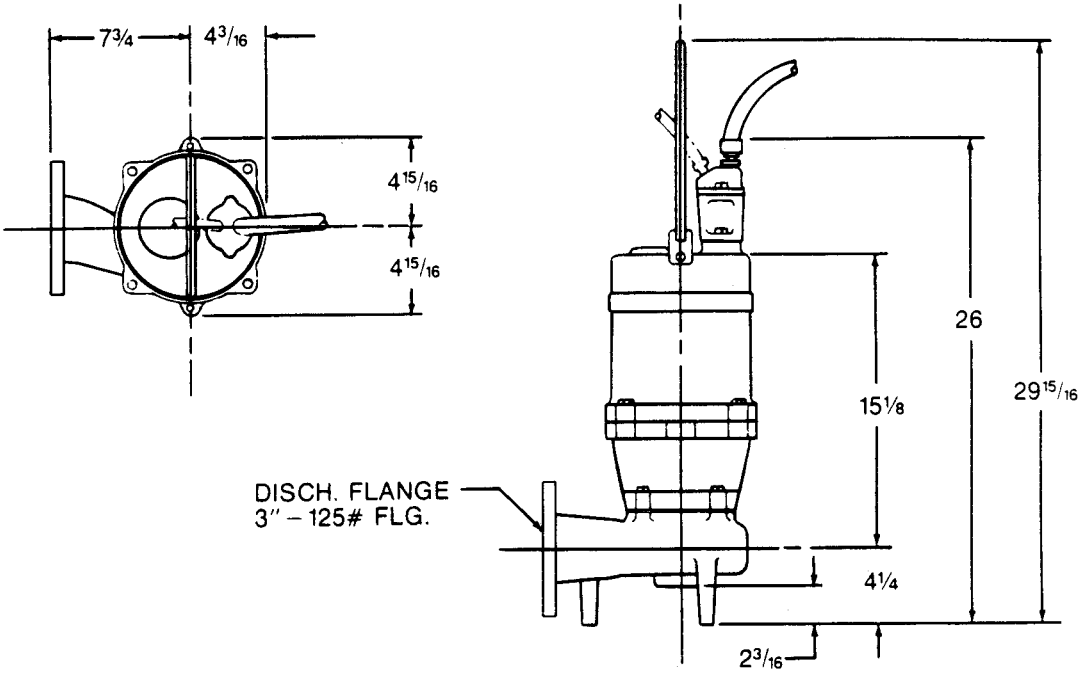
Pump Model	HP	Type of Pump	No. of Pumps	Electrical	Speed
S4MRC (Submersible Recessed Impeller)	1000 (10 HP)	M Manual Pump	One (10 HP)	3 (3 PH, 230 V)	4 (1750 RPM)

NOTE:
1. When quoting/ordering, select pump(s) and control panel(s) — determine cord size and fill in all required conditions of service and other requested data on HYDROMATIC Form H-157A. For example problem — see page 421.12 and 421.13.
2. All pump models are 60 cycle. Pumps are equipped with 15 foot power cable as standard.
3. For pump extras see Page 421.9 and 421.10.
4. For panel modifications and extras see section 700.
5. For pump and control description see page 421.11.
6. Consult factory for 575 volts or 50 cycle.

Pricing is for standard control panel.

MODEL: S3HRC – SUBMERSIBLE SEWAGE PUMPS

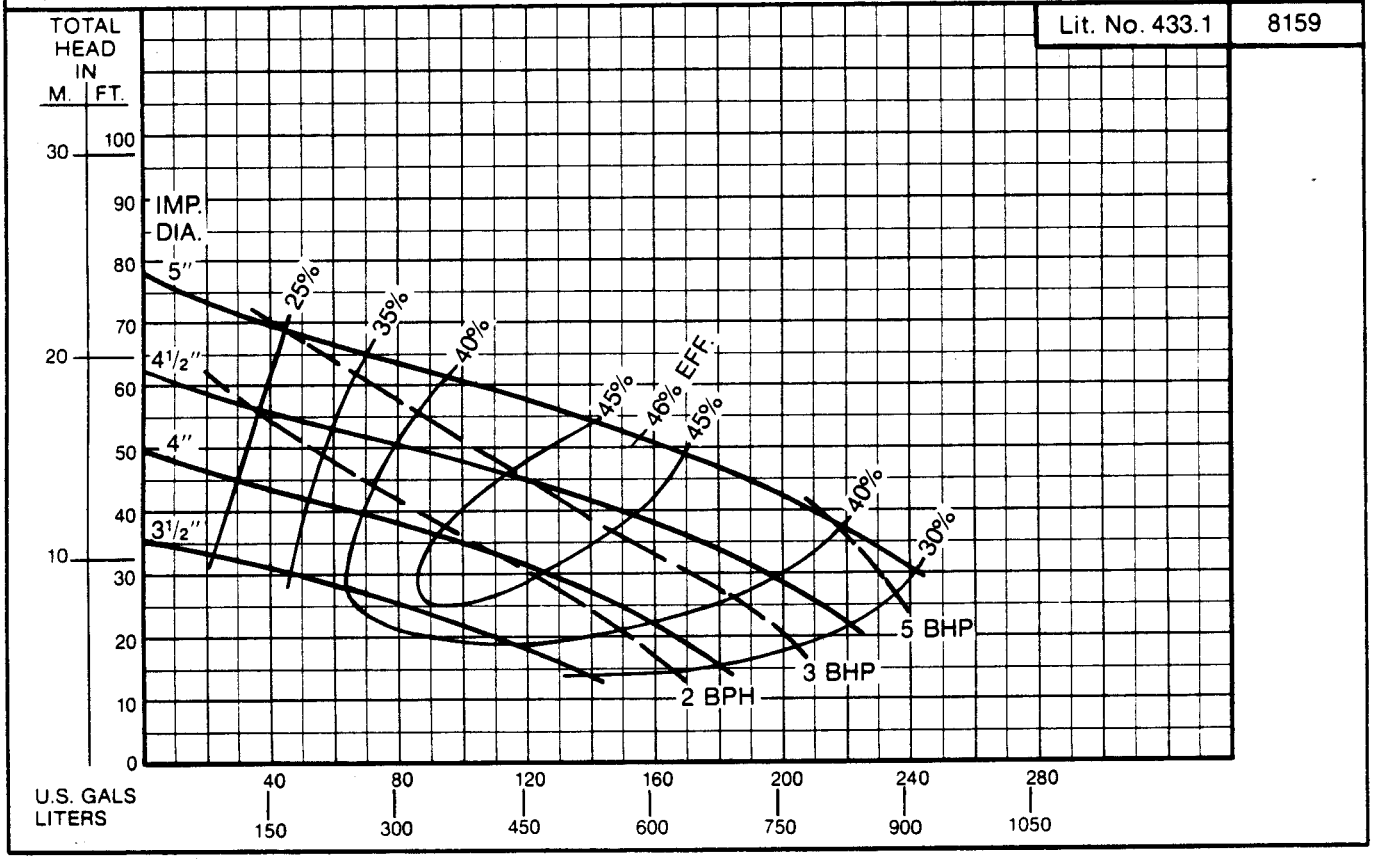
Lit. No. 436.1 | 8321



NOTE: CASTING DIM. MAY VARY ± ⅛"

MODEL: S3HRC SUBMERSIBLE SEWAGE PUMP – MAX. SOLIDS: 2" SPHERE – 3500 RPM

Lit. No. 433.1 | 8159



TERMS AND CONDITIONS OF SALE

Your assent to these terms and conditions of sale shall be presumed from your acceptance of any part of the goods to which this contract relates. Any proposals, negotiations and representations regarding this transaction made prior to the date hereof are merged herein. The Marley Pump Company is not bound by any terms on Buyer's order blanks which attempt to impose any conditions at variance with The Marley Pump Company's terms and conditions of sale which are included herein or stated on The Marley Pump Company's packages, invoices or technical data sheets. The Marley Pump Company's failure to object to provisions contained in Buyer's order blanks shall not be deemed a waiver of the provisions of The Marley Pump Company's terms and conditions which shall constitute the entire contract between the parties.

1. **TRANSPORTATION.** If transportation charges from point of origin of the shipment to a designated point are included in the prices herein named or heretofore quoted, any change in such transportation charges shall be for the account of the Buyer. Except as otherwise stated in The Marley Pump Company's quotation, The Marley Pump Company shall not be responsible for switching, spotting, handling, storage, demurrage or any other transportation or accessorial service, nor for any charges included in the applicable tariff freight rate from shipping point to the designated point.
2. **TAXES.** Any taxes which The Marley Pump Company may be required to pay or collect under any existing or future law, upon or with respect to the sale, purchase, delivery, storage, processing, use or consumption of any of the material covered hereby, including taxes upon or measured by the receipts from the sale thereof, shall be for the account of the Buyer, who shall promptly pay the amount thereof to The Marley Pump Company upon demand.
3. **DELAY.** The Marley Pump Company shall be excused for any delay in performance due to acts of God, war, riot, civil disorder, embargoes, acts of civil or military authorities, fires, floods, accidents, quarantine restrictions, mill conditions, strikes, differences with workmen, delays in transportation, shortage of cars, fuel, labor or materials, or any circumstances or cause beyond the control of The Marley Pump Company in the reasonable conduct of its business.
4. **RISK OF LOSS.** Risk of loss shall pass to the Buyer upon shipment by The Marley Pump Company.
5. **INSPECTION.** If, upon receipt by the Buyer of the material ordered, the same shall appear not to conform to the contract, Buyer shall immediately notify The Marley Pump Company of such condition and alleged nonconformity and afford The Marley Pump Company a reasonable opportunity to inspect the material. No material shall be returned to The Marley Pump Company without The Marley Pump Company's express written consent.
6. **PERMISSIBLE VARIATIONS.** Except in the particulars specified by Buyer and expressly agreed to in writing by The Marley Pump Company, all material shall be produced in accordance with The Marley Pump Company's standard practices. All material, including that produced to meet an exact specification, shall be subject to tolerances and variations consistent with usages of the trade and regular mill practices concerning dimension, weight, straightness, section, composition and mechanical properties, normal variations in surface, internal conditions and quality, deviations from tolerances and variations consistent with practical testing and inspection methods, and regular trade practices concerning over and under shipments.
7. **THE MARLEY PUMP COMPANY LIMITED WARRANTY.** The Marley Pump Company, A Marley Company, warrants to the original purchaser of each of The Marley Pump Company's product(s) that any part thereof which proves to be defective in material or workmanship within one year from date of installation or 18 months from manufacture date, whichever comes first, will be replaced at no charge with a new or remanufactured part, F.O.B. factory. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight. Any item(s) designated as manufactured by others shall be covered only by the express warranty of the manufacturer thereof. This warranty does not apply to damage resulting from accident, alteration, design, misuse or abuse.
8. **BUYER'S REMEDIES.** If the material furnished to the Buyer shall fail to conform to this contract or to any express written warranty, The Marley Pump Company shall replace such nonconforming material at the original point of delivery and shall furnish instructions for its disposition. Any transportation charges involved in such disposition shall be for the Buyer's account. The Buyer's exclusive and sole remedy on account or in respect of the furnishing of material that does not conform to this contract, or to any express written warranty, shall be to secure replacement thereof as aforesaid. The Marley Pump Company shall not in any event be liable for the cost of any labor expended on any such material or for any incidental or consequential damages to anyone by reason of the fact that such material does not conform to this contract or to any express written warranty.
9. **WARRANTY DISCLAIMER AND LIMITATION OF LIABILITY. THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT.**

   MANUFACTURER EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY ARISING IN CONNECTION WITH THIS PRODUCT, INCLUDING WITHOUT LIMITATION, WHETHER IN TORT, NEGLIGENCE, STRICT LIABILITY CONTRACT OR OTHERWISE.

   Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

   This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.
10. **PATENTS.** The Marley Pump Company shall indemnify the Buyer against any judgment for damages and costs which may be rendered against the Buyer in any suit brought on account of the alleged infringement of any United States patent by any product supplied by The Marley Pump Company hereunder, unless made in accordance with materials, designs, or specifications furnished or designated by the Buyer, in which case the Buyer shall indemnify The Marley Pump Company against any judgment for damages and costs which may be rendered against The Marley Pump Company in any suit brought on account of the alleged infringement of any United States patent by such product or by such materials, designs or specifications; provided that prompt written notice be given to the party from whom indemnity is sought of the bringing of the suit and that an opportunity be given such party to settle or defend it as that party may see fit and that every reasonable assistance in settling or defending it shall be rendered. Neither The Marley Pump Company nor the Buyer shall in any event be liable to the other for incidental or consequential damages arising out of or resulting from infringement of patents.
11. **TERMS OF PAYMENT.** Shipments, deliveries and performance of work shall at all times be subjected to the approval of The Marley Pump Company's credit department. The Marley Pump Company may at any time decline to make a shipment or delivery or perform any work except upon receipt of payment or security or upon terms and conditions satisfactory to its credit department. Subject to such reserved right, terms of payment are as shown on the face side hereof and shall be effective from date of invoice. Cash discounts shall not be allowed on any transportation charges included in delivered prices.
12. **COMPLIANCE WITH LAWS.** The Marley Pump Company intends to comply with all laws applicable to its performance of this Agreement.
13. **INTERPRETATION.** This Agreement shall be governed by and interpreted under the Uniform Commercial Code as in effect in the state from which the goods are shipped to Buyer.
14. **NONWAIVER BY THE MARLEY PUMP COMPANY.** Waiver by The Marley Pump Company of a breach of any of the terms and conditions of this Agreement shall be without prejudice to its legal rights and shall not be deemed a waiver of any other breach.
15. **TIME FOR BRINGING ACTION.** Any action for breach of this Agreement must be commenced within two years after the cause of action has accrued.
16. **SECURITY INTEREST.** The Marley Pump Company reserves a security interest in the goods as security for the performance of this Agreement. Notwithstanding any other terms of this Agreement, should Buyer default in the payment of the purchase price hereunder or fail to comply with this Agreement, The Marley Pump Company shall have the right upon ten (10) days written notice to remove and/or repossess the goods and to take such other action as permitted by law; it being understood that the remedies contained in this section are cumulative and in addition to all other rights and remedies of The Marley Pump Company under this Agreement, by operation of law or otherwise.

H-212
Rev. 9/10/82
Printed in U.S.A.

MARLEY	THE MARLEY PUMP COMPANY
HP	HYDROMATIC PUMPS

A Marley Company
P.O. Box 327
Claremont & Baney Roads
Ashland, Ohio 44805
419/289-3042

LIMITED WARRANTY

THE MARLEY PUMP COMPANY LIMITED WARRANTY. The Marley Pump Company, A Marley Company, warrants to the original purchaser of each of The Marley Pump Company's product(s) that any part thereof which proves to be defective in material or workmanship within one year from date of installation or 18 months from manufacture date, whichever comes first, will be replaced at no charge with a new or remanufactured part, F.O.B. factory. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight. Any item(s) designated as manufactured by others shall be covered only by the express warranty of the manufacturer thereof. This warranty does not apply to damage resulting from accident, alteration, design, misuse or abuse.

BUYER'S REMEDIES. If the material furnished to the Buyer shall fail to conform to this contract or to any express written warranty, The Marley Pump Company shall replace such nonconforming material at the original point of delivery and shall furnish instructions for its disposition. Any transportation charges involved in such disposition shall be for the Buyer's account. The Buyer's exclusive and sole remedy on account or in respect of the furnishing of material that does not conform to this contract, or to any express written warranty, shall be to secure replacement thereof as aforesaid. The Marley Pump Company shall not in any event be liable for the cost of any labor expended on any such material or for any incidental or consequential damages to anyone by reason of the fact that such material does not conforr this contract or to any express written warranty.

WARRANTY DISCLAIMER AND LIMITATION OF LIABIL THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTI WARRANTIES EXPRESSED OR IMPLIED, AND ALL PLIED WARRANTIES OR MERCHANTABILITY A FITNESS FOR A PARTICULAR PURPOSE WHICH EXCI THE AFORESAID EXPRESSED WARRANTIES ARE HERI DISCLAIMED AND EXCLUDED FROM THIS AGREEMEN

MANUFACTURER EXPRESSLY DISCLAIMS AND CLUDES ANY LIABILITY FOR CONSEQUENTIAL OR CIDENTAL DAMAGES FOR BREACH OF ANY EXPRESS IMPLIED WARRANTY ARISING IN CONNECTION W THIS PRODUCT, INCLUDING WITHOUT LIMITATI(WHETHER IN TORT, NEGLIGENCE, STRICT LIABIL CONTRACT OR OTHERWISE.

Some states do not allow the exclusion or limitation of cidental or consequential damages, so the above limitat or exclusion may not apply to you. Some states do not all limitations on how long an implied warranty lasts, so above limitation may not apply to you.

This warranty gives you specific legal rights, and you m also have other rights which vary from state to state.

H-213
Rev. 9/82
Printed in U.S.A.

THE MARLEY PUMP COMPANY
HYDROMATIC PUMPS

A Marley Company
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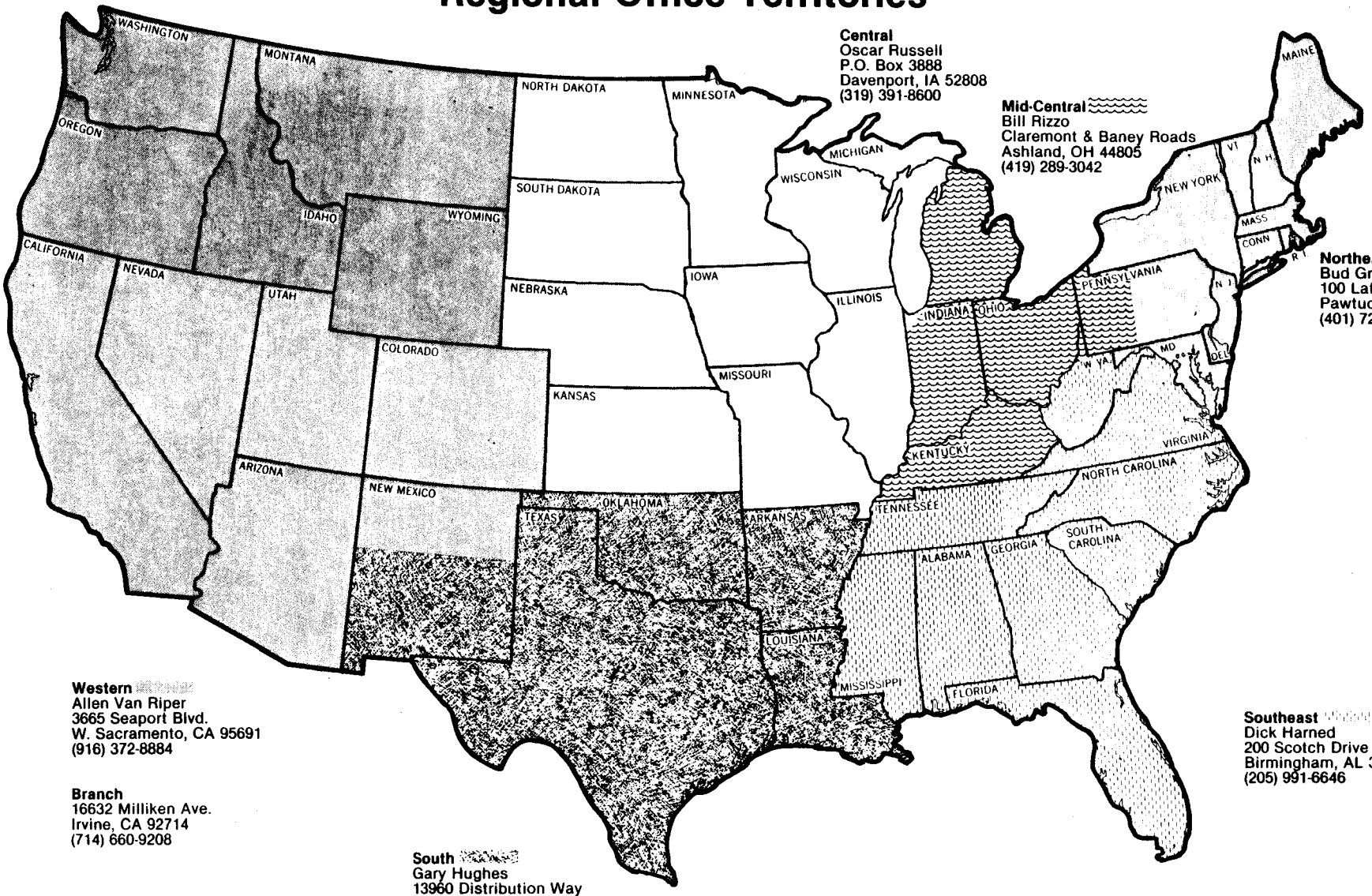
The Marley Pump Company
Regional Office Territories



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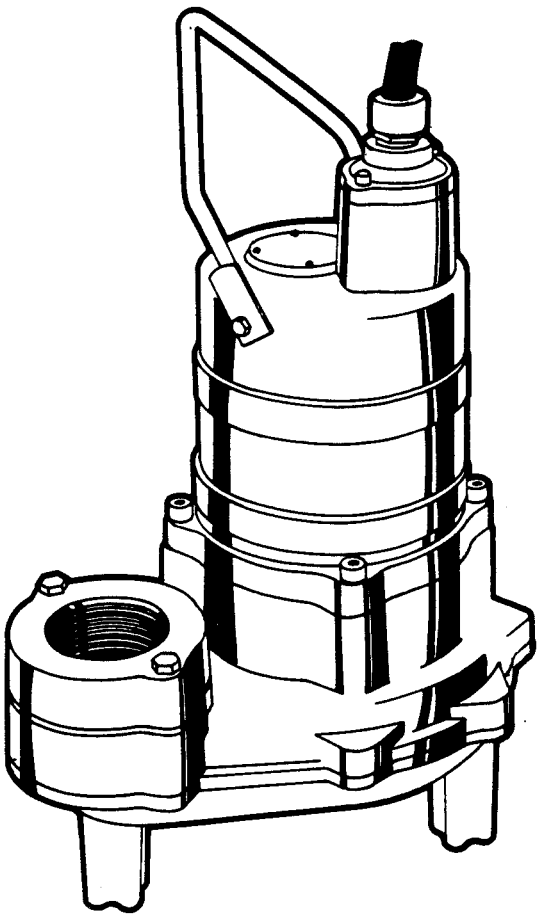
MPC-28

BULLETIN 428.1



INSTALLATION AND SERVICE MANUAL

Model: S, SH
S4HRC & S3HRC

HYDROMATIC PUMPS
A Marley Pump Company

WARNING: Before handling these pumps and controls, always disconnect the power first.
Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.

Before operation — Read the following instructions carefully. Reasonable care and safe methods should be practiced. Check local codes and requirements before installation.

CONTENTS

GENERAL INFORMATION

SHIPPING

When unpacking unit check for concealed damage. CLAIM FOR DAMAGE MUST BE MADE AT THE RECEIVING END THROUGH THE DELIVERING CARRIER. DAMAGE CANNOT BE PROCESSED FROM THE FACTORY.

SEAL FAILURE — OPTIONAL

An electrode probe is installed in the seal chamber so if any water enters the chamber through the first seal the electrode will be energized and a signal will be transmitted to the sensing unit at ground surface causing an alarm function to energize.

In operation the seal failure unit indicates only that there is some water in the seal chamber. The pump will continue to operate without damage but the seal should be checked within 30 days after failure is indicated.

PUMP

The S, SH, S3HRC and S4HRC submersible pumps are supplied for 1 and 3 phase and for 208, 230, 460 or 575 volts. Pump is supplied with 15 feet of power cord and/or 15 feet of auxiliary control cord. Longer cable lengths can be furnished but must be specified at time of order. Power cable is 4 wire with the green wire for ground. Be sure green wire is connected to a good ground such as a water pipe or ground stake. The auxiliary cable for seal failure and heat sensors is also 4 wire color coded.

HEAT SENSORS — OPTIONAL

All motors have heat sensor units embedded in the motor winding to detect excessive heat. The heat sensors are set to trip at 105° C. so will operate if dangerous heat occurs. The sensors automatically reset when motor cools to safe temperature.

The sensors are connected in series with the motor starter coil so that the starter is tripped if heat sensor opens. The motor starter is equipped with overload heaters so all normal overloads are protected by the starter.

IMPORTANT

If Hydromatic electrical starting equipment is not supplied the heat sensor circuit must be connected in series with the starter coil or warranty on motor is void. Connection diagram is included in this manual.

SUMP LEVEL CONTROL

Sump level is controlled by Hydromatic 3900 mercury switch controls. The 3900 control is a mercury tube switch sealed in a solid polyurethane float. The float is held in position in the sump by a weight attached to the power cord above the float. The cord supports the float and is adjusted for height from the surface.

Typical duplex systems use three controls: one set at turn-off, one set at turn-on for one pump, and one set for turn-on for two pumps. Pumps alternate operation on each successive cycle.

Two pumps operate together only if sump level rises to the third or override control. The override control also brings on the second pump in case of failure of the first pump. Extra floats with appropriate controls can be supplied for alarm functions. Triplex systems use four controls: one set at turn-off, one set at turn-on for one pump, one set at turn-on for two pumps, and one set at turn-on for three pumps. Pumps alternate each successive cycle.

Three pumps operate together only if sump level rises to the fourth control (second override). This control also brings on the third pump in case of failure of either or both of the first two pumps.

ALARM CONTROLS

The alarm level is usually set above the override level so the alarm will signal only if the override level is exceeded. However, some engineers prefer to have the alarm level set below the override level as it is possible for one pump to fail and the other pump to operate on the override level with the sump level never reaching the alarm level. This is particularly true in cases of low inflow capacity.

ELECTRICAL CONTROL PANEL

It is recommended that the HYDROMATIC control panel be used with all pumps as proper starter heaters and connections for heat sensor wires are furnished.

IMPORTANT

If HYDROMATIC electrical controls are not used and the motor fails because of improper components or if the heat sensors are not properly connected the motor guarantee is void.

HYDROMATIC electrical equipment is installed in a weatherproof NEMA 3R enclosure. The electrical equipment includes a main circuit breaker for each pump, a magnetic starter with overload protection for each pump, a H-O-A switch and run light for each pump, an electric alternator and a transformer to provide appropriate control for control circuit and alarms.

OVERLOAD HEATERS

If the HYDROMATIC electrical panel is not used, starters with 3 leg overload protection must be supplied. On 3 phase pumps the heaters must be sized in accordance with the nameplate amps on the motor housing. The amp draw on these submersible motors is slightly higher than a corresponding horsepower surface motor so heaters must be sized by the nameplate rating.

Single phase pumps with capacitor start have a run and a start winding each drawing a different current. To adequately protect these windings with the appropriate heaters consult the factory.

IMPORTANT

If other than HYDROMATIC starters are used be sure the heat sensor wires are connected in series with the starter coil circuit. Typical wiring diagrams are included.

HYDR-O-RAIL

If the pump or pumps are to be used with HYDR-O-RAIL system the pumps will be equipped with guide brackets and hydraulic sealing flange.

SERVICING INSTRUCTIONS

IMPORTANT—READ ALL DIRECTIONS BEFORE REPLACING ANY PARTS.

WARNING: BEFORE HANDLING THESE PUMPS AND CONTROLS, ALWAYS DISCONNECT THE POWER FIRST.

DO NOT SMOKE OR USE SPARKABLE ELECTRICAL DEVICES OR FLAMES IN A SEPTIC (GASEOUS) OR POSSIBLE SEPTIC SUMP.

FIELD SERVICE ON MOTOR

All submersible motors can be serviced (out of warranty) in the field by any reliable motor service shop. Any pump (in warranty) must be returned to the factory for service or repaired in an authorized HYDROMATIC service shop. Charges will not be allowed if (in warranty) pump is taken to a motor repair shop that is not authorized.

When field service is performed on a pump these instructions should be carefully followed.

REPLACING STATOR

If motor winding is burned or shortened it can be rewound or replaced with new factory wound stator. Refer to sectional drawing of pump and motor and use following steps to remove and replace stator.

1. If stator only is damaged it may not be necessary to completely dismantle pump as stator and housing can be lifted from pump without disturbing seals or bearings.
2. Drain all oil from upper housing, remove from upper housing, remove drain plug in bottom of stator housing and remove plug in top of housing to allow air to enter.
3. After chamber is drained, remove hold down bolts and lift off. Use care in lifting as the seal failure connecting wire must be disconnected before housing is completely removed. See sectional drawing.

4. Set assembly on bench and remove connection box. When box is lifted off connection wires to motor will be exposed. These wires will probably be burned but each wire is tagged with a metal marker giving wire number. Cut the wires.

   If the leads to the connection box are burned, a complete new connection box with new wire must be used. The wires are potted in with sealing compound and a new unit must be obtained from the factory.
5. The stator is held in the housing with a bolted-in clamp ring.
6. After ring is removed turn housing upright and bump on hardwood blocks. This should jar the stator loose and allow it to drop out.
7. Thoroughly clean housing before replacing new stator. Replace stator and make all wire connections to connection box before replacing housing on pump. This is important as leads must be tucked behind the windings by using hands up through rotor core.

IMPORTANT

Use only compression type insulated connectors on the wires.

DO NOT TAPE LEADS AS OIL WILL DETERIORATE THE TAPE AND CAUSE DAMAGE TO STATOR AND BEARINGS.

8. Drain oil from seal chamber. If oil is clean and no water is present, seals can be considered satisfactory to reuse.
9. Check top bearing. If clean and does not turn rough, bearings can be reused and it is not necessary to completely dismantle pump to change bearings. If bearings are damaged with dirt or heat they must be replaced. See additional instructions on replacing seals and bearings. Remember to reinstall the upper bearing load spring.
10. Replace stator housing onto seal chamber and bolt in place. **BE SURE SEAL FAILURE WIRE IS CONNECTED BEFORE HOUSING IS ASSEMBLED.**

    Be sure O-ring seal has been replaced. If O-ring is nicked or cut replace with new rings. This applies to all O-rings used in assembly.
11. After all leads are reconnected in the connection box make a high voltage ground test on each wire. The only wire that should show ground is the green power lead and the ground lead in the auxiliary control cable.
12. For safety, complete pump should be air checked under water for leaks. If seals were O.K. refill seal chamber with oil. Lay pump on side for this oil filling with oil fill hole upright. Do not completely fill, leave oil about 1 inch below plug hole. Use only #10 Non-detergent automobile oil or regular HYDROMATIC submersible oil in this chamber. Replace plug, use permatex on threads. Install air valve in top plug opening of motor housing and charge housing with about 10 PSI of air. Be sure air is dry. Do not use air line where water may be trapped in the line. Submerge complete unit under water and check for leaks.
13. Refill motor chamber with oil. Use high grade transformer oil or HYDROMATIC special submersible oil. Fill chamber until oil covers top of windings. Leave air space in top for expansion. Use permatex on plug threads.

REPLACING SEALS AND BEARINGS

1. Drain all oil from motor chamber and seal chamber as described.
2. Remove motor housing as described.
3. Remove bolts that hold seal chamber to pumphousing. Use back off screws to break loose. With hard wood block, tap end of impeller to loosen from shaft. When free, remove impeller from shaft.
4. Lift rotating assembly (rotor, shaft and impeller) from pump case and place horizontally on bench.
5. **Impeller removal**
   Hold motor and remove bolt and washer from impeller end of shaft. Impeller is threaded to the shaft so tap face of impeller with hard wood block to free threads. Holding rotor, turn impeller counter-clockwise as thread is right hand.
6. Shaft sleeves are not used.
7. Remove lower seal spring and pry out seal with screwdriver.
8. To remove seal housing, take out socket head bolts and using bolts in back of holes, pry plates loose. This will force out lower seal if not already removed.
9. Remove snap ring that holds upper seal. Pull seal if it is free. If not free, it can be forced off when shaft is removed.
10. Remove 4 bolts that hold bearing housing in place. Set assembly in upright position and bump end of shaft on hardwood block. This will push the bearing from housing and will force upper seal from shaft.
11. Use bearing puller to remove bearings. Replace with new bearings. Press only on inner race of bearing when replacing. Pressing on outer race can damage the bearing. Bearings are standard size that can be obtained from any bearing supply house or can be obtained from HYDROMATIC factory.
12. **IMPORTANT — DO NOT USE ANY OF THE OLD SEAL PARTS. REPLACE WITH ALL NEW SEALS.**
13. Thoroughly clean all castings before replacing seals. One grain of dirt between the seal faces can cause failure.
14. Be sure seal washers are replaced under heads of 4 bolts that hold bearing cap in place. Examine all O-rings for nicks before reusing.
15. Be sure key is in place in notch of shaft sleeve to prevent sleeve from turning.
16. Use Locktite on socket head locking screw in end of shaft.
17. Before refilling chamber with oil, air test as described above.
18. Refill both chambers with oil as described above.
19. Always check all leads with high voltage or with megger for grounds before operating the pump.

INSTALLATION INSTRUCTIONS

INSTALLING PUMP IN SUMP

Before installing pump in sump lay it on side and turn impeller with fingers. Impeller may be slightly stuck due to factory test water so it must be broken loose with small bar or screw driver in edge of vanes. The impeller should turn freely.

Clean all trash and sticks from sump and connect pump to piping.

A check valve must be installed on each pump. A gate or plug valve in each pump discharge line is also recommended. This valve should be installed on the discharge side of the check valve so if necessary to service the check valve the line pressure can be cut off. Single pump systems are sometimes installed without a check valve where it is desirable to self-drain the discharge line to prevent freezing. This can be done only with short discharge lines otherwise water will return to the sump and cause short cycling of the pump.

POWER CORD

If power cord and auxiliary control cord are not long enough due to an error in ordering, the cords can be spliced. If a spliced joint is made all connections must be thoroughly taped to make a waterproof connection. Splicing is only a last resort in an emergency. We recommend that proper cable length be ordered from the factory. The cords are potted into the conneciton box cap with sealing compound so if longer cord is necessary, the connection box cap must be furnished. The original connection box cap and cord can be returned to the factory for credit.

NEMA 4 JUNCTION BOX

If electrical control panel is to be set remote from the pump sump a NEMA 4 junction box should be used to make power and control connections. The HYDROMATIC Nema 4 junction box is provided with compression connectors for sealing all wires. No sealing compound is needed to make connections waterproof. A terminal block is provided giving numbers for all power and control wires.

Wiring diagrams are provided with panel for making connections. An extra set of diagrams are included so that one set can be used in the sump when making connections. The size wire to use from panel to sump depends on motor size and distance in feet.

Be sure each wire is checked out so that wrong connection will not be made. An ohmmeter or Megger can be used to check wire continuity. Attach one side of meter to ground and other side to one side at control panel then have man in sump touch one wire to ground. If wire is correct meter will show reading. If some distance exists between sump and panel a Walkie-Talkie radio is useful. (See Fig. 1)

INSTALLING 3900 MERCURY SWITCH CONTROLS

The controls are supported by a mounting bracket that is attached to sump wall or cover or to the NEMA 4 junction box.

Cord snubbers are used to hold the cord in place. Control lever can be changed at any time by loosening the snubber and re-adjusting cord length.

In either simplex or duplex system the lower or turn-off control is set just above the top of volute so the the volute will always be submerged during the pumping cycle. The second or turn-on control is set about 24 inches above the lower turn-off control.

More distance between turn-on and turn-off controls can be used but sewage may become septic and excessive solids may collect for the pump to handle. A frequent pumping cycle is recommended for best operation.

If an alarm system is used this control is usually set about 6 inches above the override control.

Some engineers as described previously prefer to have the alarm control set below the override control.

MAKING ELECTRICAL CONNECTIONS

All electrical wiring must be in accordance with local code, and only competent electricians should make the installations. A set of prints is included for use in making the installation. All wires should be checked for grounds with an ohmmeter or Megger after the connections are made. **THIS IS IMPORTANT, AS ONE GROUNDED WIRE CAN CAUSE CONSIDERABLE TROUBLE.** (See Fig. 2)

NEMA IV JUNCTION BOX THROUGH 12hp

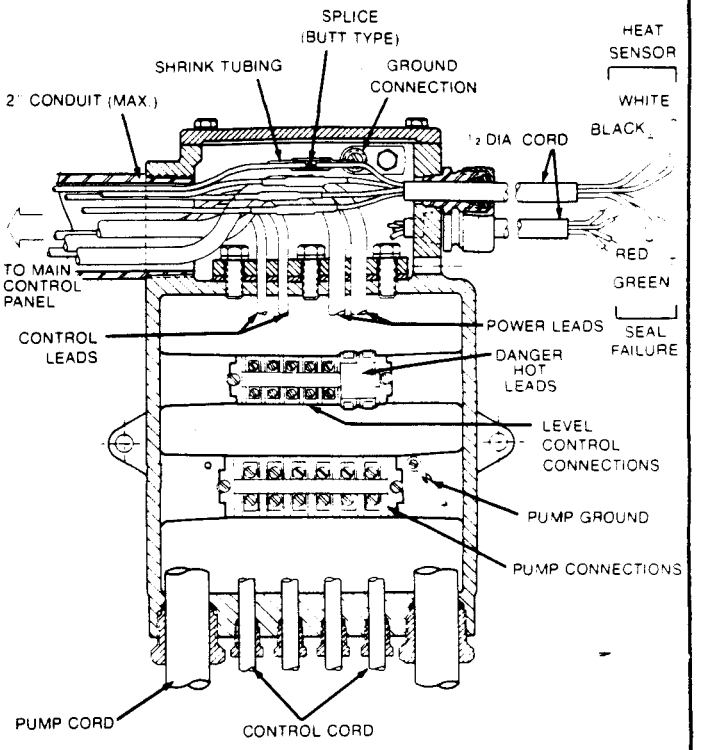


Fig. 1

WIRE SIZE TABLE

FOR REMOTE LOCATION OF CONTROL PANEL LENGTHS ARE BASED ON A VOLTAGE DROP OF TWO PERCENT

Maximum length in feet from NEMA 4 Junction Box to control panel. For 3 phase only and for power lines only. All control wires can be = 14-16 or 18 gage wire. If power lines are for 460 or 575 volts insulation of control wires must be for this voltage if used in conduit with power lines.

	Volts	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575	230	460	575
Wire Size	Motor HP	3	3	3	5	5	5	7½	7½	7½	10	10	10	15	15	15	20	20	20	25	25	25	30	30	30	35	35	35
12		110	450	700	90	370	580																					
10		180	720	1120	140	550	370	90	360	560	50	220	340															
8		270	1100	1650	220	900	1400	175	700	1100	105	420	650		320	500		230	360		180	280						
6		400	1600	2500	350	1400	2200	220	900	1400	150	600	930	105	420	650	90	370	570		360	560		320	500		230	360
4								370	1500	2300	230	950	1450	175	700	1100	140	550	850	125	500	800	100	400	620	90	360	560
2											370	1500	230	270	1100	1700	220	900	1400	210	820	1250	200	800	1250	150	600	930

*Special Junction Box required for wire sizes larger than #4.

NUMBER OF CONDUCTORS REQUIRED BETWEEN CONTROL PANEL AND NEMA 4 JUNCTION BOX

System Type	Number of Control Wires	Number of Power Lines	Number of Ground Wires #8	HEAT SENSOR & SEAL FAILURE	
				Number of Sensor Wires	Number of Ground Wires
Simplex	3	3	1	3	1
Simplex With Alarm	5	3	1	3	1
Duplex	5	6	1	6	2
Duplex With Alarm	7	6	1	6	2

CONNECTION DIAGRAM FOR LEADS IN MOTOR AND CONNECTION BOX

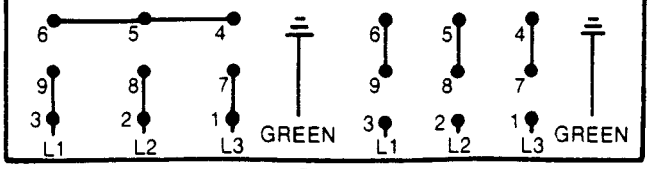


Fig. 2

IMPORTANT

If equipment is not properly wired and protected as recommended, the motor guarantee is void.

HEAT SENSORS AND SEAL FAILURE CONNECTIONS

Be sure that heat sensor wires are connected in series with the starter coil. Connections are provided on the terminal strip; see wiring diagram.

If seal failure unit is used, connect as shown with seal failure system. If seal failure unit is not used, the two seal failure wires are left open. **DO NOT CONNECT POWER TO THESE LINES AT ANY TIME.** (See Figure 3 and 4)

HEAT SENSORS AND SEAL FAILURE CONNECTIONS FOR ANY VOLTAGE MOTOR

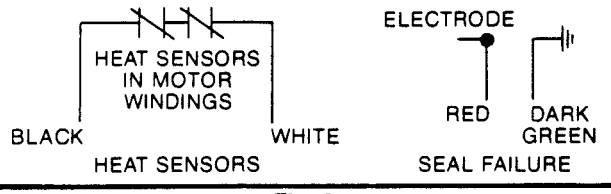


Fig. 3

WARNING

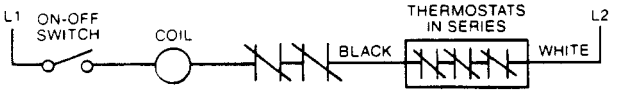
WARRANTY IS VOID IF HEAT SENSORS ARE NOT CONNECTED AS SHOWN (IN SERIES WITH CONTACTOR OIL)

DESIGNATION FOR OPTIONAL SEAL FAILURE & HEAT SENSOR CORD

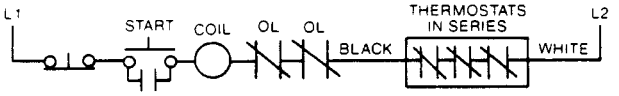
COLOR	PURPOSE
DARK GREEN	SEAL FAILURE
RED	SEAL FAILURE
BLACK	HEAT SENSOR
WHITE	HEAT SENSOR

See Wiring Diagram of seal failure unit #4673 or 4674 for connecting dark green and red wires. If seal failure unit #4673 or 4674 is not used, leave dark green and red wires open.

TWO WIRE CONTROL OFFERING AUTOMATIC RESET



THREE WIRE CONTROL OFFERING MANUAL RESET



IN CERTAIN APPLICATIONS THE **NEC** MAY REQUIRE THREE OVERLOAD RELAYS

Fig. 4

OPERATION

STARTING SYSTEM

1. Turn H-O-A switch to off-position then turn on main circuit breakers.
2. Open all discharge valves and allow water to rise in sump pump.
3. Turn H-O-A switch to Hand position on one pump and notice operation. If pump is noisy and vibrates rotation is wrong. To change rotation interchange any two line leads to motor. DO NOT INTERCHANGE MAIN INCOMING LINES. If duplex system, check second pump in same manner.
4. Now set both H-O-A switches to Auto position and allow water to rise in sump until one pump starts. Allow pump to operate until level drops to turn-off point.
5. Allow sump level to rise to start other pump. Notice run lights on panel, pumps should alternate on each successive cycle of operation.
6. Turn both H-O-A switches to off position and allow sump to fill to the override control level.
7. Turn both switches to Auto position and both pumps should start and operate together until level drops to turn-off point.
8. Repeat this operation cycle several times before leaving job.
9. Check voltage when pumps are operating and check the amp draw of each pump. Check amps on each wire as sometimes a high leg will exist. One leg can be somewhat higher 5 to 10% without causing trouble. For excessive amp draw on one leg the Power Company should be consulted.

MAINTENANCE

As the motors are oil filled no lubrication or other maintenance is required.

If a seal failure unit is used no attention is necessary as long as the seal shows satisfactory operation.

If seal failure is not used the pump should be lifted once every two years and the oil be drained from the seal chamber to check for water.

If the pump is used on a HYDR-O-RAIL system it should be lifted once every six months and checked for corrosion and wear.

Generally these pumps give very reliable service and can be expected to operate for years on normal sewage pumping without failure.

LIGHTNING

In some areas where considerable lightning occurs, it is recommended that a lightning arrestor be installed at the control panel.

Complete data on lightning arrestors and cost is available from the factory. Lightning arrestors are good insurance against damage to an expensive motor.

WARNING: Before handling these pumps and controls, always disconnect the power first.

Do not smoke or use sparkable electrical devices or flames in a septic (gaseous) or possible septic sump.

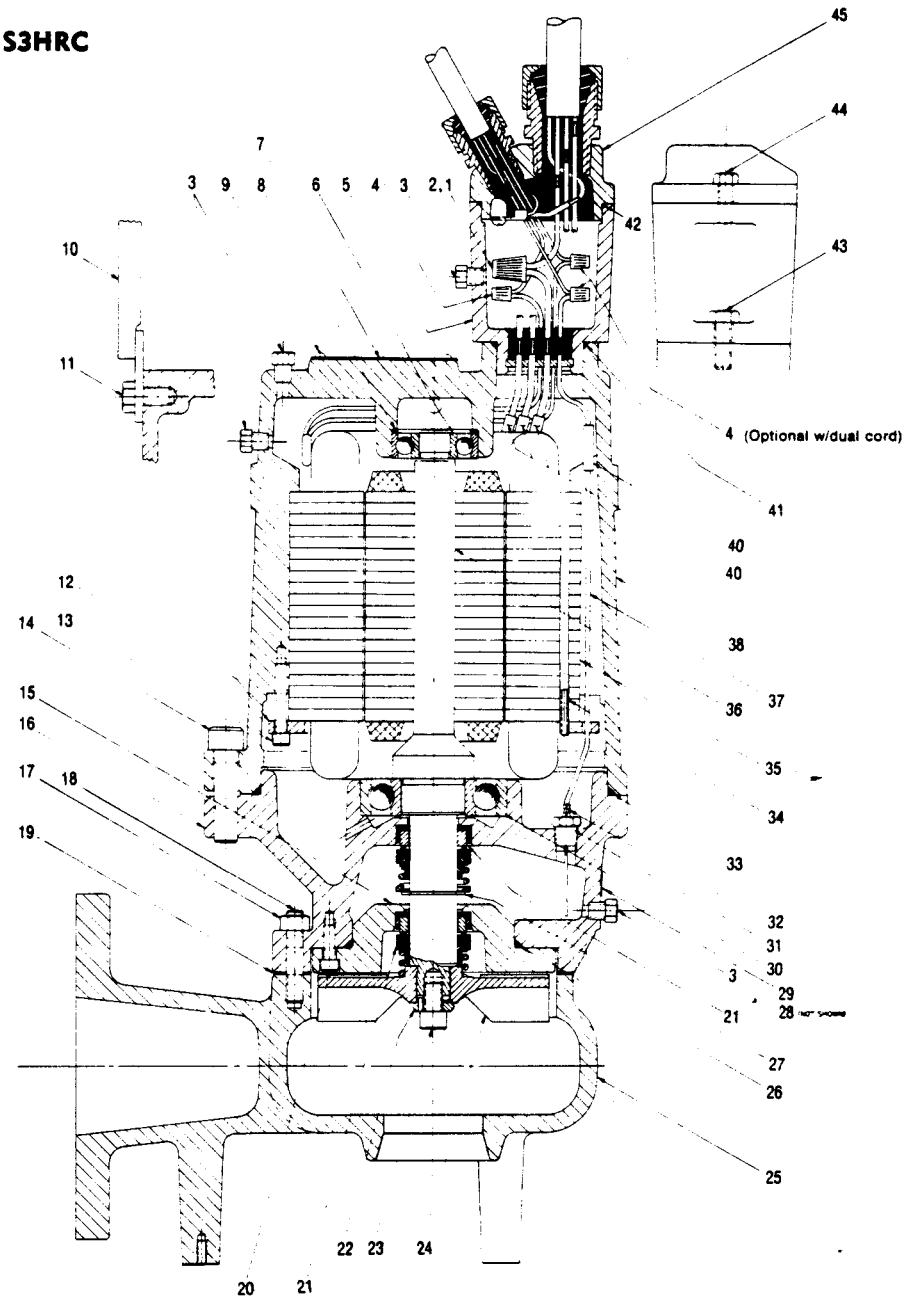
TROUBLE CHECK LIST

Below is a list of common problems and the probable causes:

CAUSE	PROBABLE CAUSE
Pump will not start	1. No power to the motor. Check for blown fuse or open circuit breaker. 2. Selector switch may be in the off position. 3. Control circuit transformer fuse may be blown. 4. Overload heater on starter may be tripped. Push to reset.
Pump will not start and overload heaters trip	1. Turn off power and check motor leads with megger or ohmmeter for possible ground. 2. Check resistance of motor windings. All 3 phases should show the same reading. 3. If no grounds exist and the motor windings check O.K. remove pump from sump and check for clogged or blocked impeller.
Pump operates with selector switch in hand position but will not operate in auto position	1. This indicates trouble in the float level control or the alternator relay. 2. To check for defective float control put selector switch in auto-position and turn off main power. Put a jumper wire on terminal strip. Turn on power and if pump starts trouble is in float control. Replace control.
Pump runs but will not shut-off	1. Pump may be air locked. Turn pump off and let set for several minutes then restart. 2. Lower float control may be hung-up in the closed position. Check in sump to be sure control is free. 3. Selector switch may be in the Hand Position.
Pump does not deliver proper capacity	1. Discharge gate valve may be partially closed or partially clogged. 2. Check valve may be partially clogged. Raise level up and down to clear. 3. Pump may be running in wrong direction. Low speed pumps can operate in reverse direction without much noise or vibration. 4. Discharge head may be too high. Check total head with gage when pump is operating. Total head is discharge gage pressure converted to feet plus vertical height from water level in sump to center line of pressure gage installed in discharge line. Gage should be installed on pump side of all valves. Multiply gage pressure in pounds by 2.31 to get head in feet. 5. If pump has been in service for some time and capacity falls off, remove pump and check for wear or clogged impeller.
Motor stops and then restarts after short period but overload heaters in starter do not trip	1. This indicates heat sensors in the motor are tripping due to excessive heat. Impeller may be partially clogged giving a sustained overload but not high enough to trip overload heater switch. 2. Motor may be operating out of liquid due to a failed level control. All Hydr-O-Matic S, SH, S3HRC and S4HRC submersible motors can operate for extended periods out of water without burning up the winding but the heat sensors give motor prolonged life by controlling winding temperature. 3. Pump may be operating on a short cycle due to sump being too small or from water returning to sump due to a leaking check valve.

Ref. No.	Description	Qty.
1	Wire Connector 200/230V 1ø 5 HP	3
1	Wire Connector 230V 3ø All HP	4
2	Wire Connector 460V 3ø All HP	6
3	Pipe Plug	4
4	Wire Connector	3
5	Wire Connection Box Assy. 200/230/1/60 3HP; 200/575/3/60 HP	1
5	Wire Connection Box Assy. 230/460/3/60 All HP; 200/230/1/60 5 HP	1
6	Upper Bearing	1
7	Nameplate	1
8	Load Spring	1
9	Drive Screw	3
10	Handle Assy.	1
11	Bolt	2
12	Stator Ring	1
13	Bolt 2,3,5, HP 1ø, 5 HP 3ø	3
13	Bolt 2 & 3 HP 3ø	3
14	Bolt	4
15	Seal Housing	1
16	Bearing Housing	1
17	Nut	4
18	Stud	4
19	Gasket	1
20	Bolt	3
21	Seal (Ceramic)	2
21	Seal (Carbide)	2
22	Washer	1
23	Bolt	1
24	Impeller S3HRC (Consult Dist. For Dia.)	1
25	Volute Case	1
26	O-Ring	1
27	Snap Ring	1
28	Instruction Plate	1
29	Instruction Plate	1
30	Lower Bearing	1
31	Seal Failure Assy.	1
32	Shrinkable Tubing	1 Ft
33	O-Ring	1
34	Spring Pin	1
35	Stator 3 HP 200/1/60 3450 RPM	1
35	Stator 3 HP 230/1/60 3450 RPM	1
35	Stator 3 HP 200/3/60 3450 RPM	1
35	Stator 3 HP 230/460/3/60 3450 RPM	1
35	Stator 3 HP 575/3/60 3450 RPM	1
35	Stator 5 HP 200/1/60 3450 RPM	1
35	Stator 5 HP 230/1/60 3450 RPM	1
35	Stator 5 HP 200/3/60 3450 RPM	1
35	Stator 5 HP 230/1/60 3450 RPM	1
35	Stator 5 HP 575/3/60 3450 RPM	1
36	Rotor & Shaft Assy. 3 HP 200/230/1/60	1
36	Rotor & Shaft Assy. 3 HP 200/230/460/575/3/60	1
36	Rotor & Shaft Assy. 5 HP 200/230/1/60	1
36	Rotor & Shaft Assy. 5 HP 200/230/460/575/3/60	1
37	Wire w/Terminal	1
38	Motor Cover 3 HP 3ø Only	1
38	Motor Cover All Others	1
*39	Stator Spacer Ring 3 HP 200/230/1/60	1
*39	Stator Spacer Ring 3 HP 200/230/1/60	1
*39	Stator Spacer Ring 5 HP 200/230/460/575/3/60	1
39	Stator Spacer Ring 5 HP 200/230/1/60	None
40	Wire Connector 3 HP Single ø & 200/575/3/60	6
40	Wire Connector 5 HP 1ø 230/460/3/60	12
40	Wire Connector 5 HP 1ø	3
41	O-Ring	3
42	O-Ring	1
43	Bolt	2
44	Bolt	2
45	Single Cord & Cap Assy. 15' Cord 10-4	1
45	Single Cord Cap Assy. #8-4	1
45	Single Cord Cap Assy. #6-3 W/G	1
45	Dual Cord & Cap Assy. 15' Cord 10-4	1
45	Dual Cord Assy. #8-4	1
45	Dual Cord Assy. #6-3 W/G	1
*50	Gal. Oil	1

S3HRC



LIMITED WARRANTY

THE MARLEY PUMP COMPANY LIMITED WARRANTY. The Marley Pump Company, A Marley Company, warrants to the original purchaser of each of The Marley Pump Company's product(s) that any part thereof which proves to be defective in material or workmanship within one year from date of installation or 18 months from manufacture date, whichever comes first, will be replaced at no charge with a new or remanufactured part, F.O.B. factory. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight. Any item(s) designated as manufactured by others shall be covered only by the express warranty of the manufacturer thereof. This warranty does not apply to damage resulting from accident, alteration, design, misuse or abuse.

BUYER'S REMEDIES. If the material furnished to the Buyer shall fail to conform to this contract or to any express written warranty, The Marley Pump Company shall replace such nonconforming material at the original point of delivery and shall furnish instructions for its disposition. Any transportation charges involved in such disposition shall be for the Buyer's account. The Buyer's exclusive and sole remedy on account or in respect of the furnishing of material that does not conform to this contract, or to any express written warranty, shall be to secure replacement thereof as aforesaid. The Marley Pump Company shall not in any event be liable for the cost of any labor expended on any such material or for any incidental or consequential damages to anyone by reason of the fact that such material does not conform to this contract or to any express written warranty.

WARRANTY DISCLAIMER AND LIMITATION OR LIABILITY. THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT.

MANUFACTURER EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY ARISING IN CONNECTION WITH THIS PRODUCT, INCLUDING WITHOUT LIMITATION, WHETHER IN TORT, NEGLIGENCE, STRICT LIABILITY CONTRACT OR OTHERWISE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Bulletin 428.1
Rev. 12-84
PRINTED IN U.S.A.

THE MARLEY PUMP COMPANY
HYDROMATIC PUMPS
Box 327, Ashland, Ohio 44805 (419) 289-3042
In Canada - Marley Fluid Systems, 126 East Dr., Brampton, Ontario L6T 1C2
International Sales - Mission, KS Telex 716875045 MARLY UW

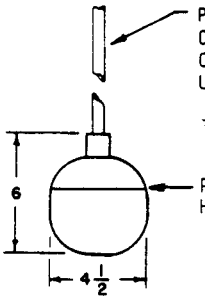
GENERAL DESCRIPTION:

THE ROTO-FLOAT IS A DIRECT ACTING FLOAT SWITCH. EACH ROTO-FLOAT CONTAINS A SINGLE POLE MERCURY SWITCH WHICH ACTUATES WHEN THE LONGITUDINAL AXIS OF THE FLOAT IS HORIZONTAL, AND DEACTUATES WHEN THE LIQUID FALLS 1" BELOW THE ACTUATION ELEVATION.

THE FLOAT IS A CHEMICAL RESISTANT POLPROPYLENE CASING WITH A FIRMLY BONDED ELECTRICAL CABLE PROTRUDING. ONE END OF THE CABLE IS PERMANENTLY CONNECTED TO THE GLASS ENCLOSED MERCURY SWITCH AND THE ENTIRE ASSEMBLY IS ENCAPSULATED TO FORM A COMPLETELY WATER TIGHT AND IMPACT RESISTANT UNIT.

ROTO-FLOATS CAN BE MOUNTED ON A SUPPORT PIPE, (TYPE P); OR SUSPENDED FROM ABOVE, (TYPE S). ADVANTAGES OF THE ROTO-FLOAT ARE LOW COST, SIMPLICITY AND RELIABILITY. VARIOUS CIRCUIT CONFIGURATIONS, OTHER THAN THE ONES LISTED BELOW, ARE AVAILABLE.

SPECIFICATIONS:



PVC TYPE STO, 2- • 18 AWG 41 STRAND 600V, 60°C CONDUCTORS 20', 30', 40' LENGTHS STANDARD. OTHER LENGTHS AVAILABLE. UL & CSA LISTED.

TEMP LIMIT 50°C

POLYPROPYLENE CASING CONTAINS HERMETICALLY SEALED MERCURY SWITCH.

USE: N.O. FOR PUMP OUT
N.C. FOR PUMP IN

- UL LISTED, IND. CONT. EQ.
  PILOT DUTY
  4.5 AMPS 120 VAC
  2.25 AMPS 240 VAC
- FLOAT COLOR
  N.O., BLACK
  N.C., RED
- MOUNTING ARRANGEMENT
  TYPE P - PIPE MOUNTED MODEL INCLUDES POLYPROPYLENE CLAMP

  TYPE S-SUSPENDED MODEL WITH STABILIZING WEIGHT.

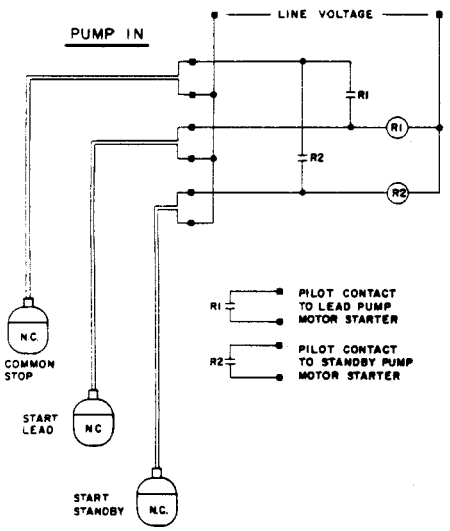
MODELS:

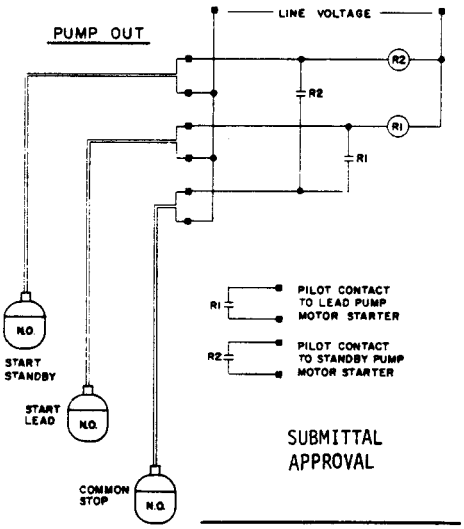
SWITCH ARRANGEMENT	CABLE LENGTH	SUSPENDED TYPE S		PIPE MOUNTED TYPE P	
		MODEL NO.	SHIP WT.	MODEL NO.	SHIP WT.
NORMALLY OPEN	20	S20NO	4#	P20NO	2#
	30	S30NO	4 ½#	P30NO	2 ¾#
	40	S40NO	5 ¼#	P40NO	3 ½#
NORMALLY CLOSED	20	S20NC	4#	P20NC	2#
	30	S30NC	4 ½#	P30NC	2 ¾#
	40	S40NC	5 ¼#	P40NC	3 ½#

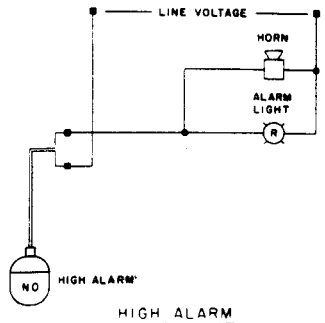
APPLICATIONS:

FOR USE IN CONTROLLING PUMPS OR OTHER MACHINES AND MEASURING ALARM LEVELS IN WATER, SEWAGE AND MANY OTHER LIQUIDS. ROTO-FLOATS MAY BE USED FOR PUMP IN OR PUMP OUT CONTROL, FOR LOW LEVEL CUTOUT, OR FOR LOW AND HIGH LEVEL ALARMS.

TYPICAL 2 PUMP CIRCUITS







HIGH ALARM

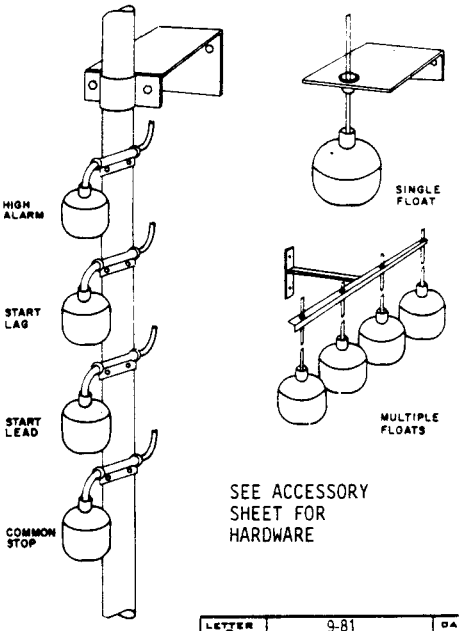
IMPORTANT NOTE: Use in accordance with local electrical code and authority having jurisdiction. Do not use Roto-Floats in gasoline, volatiles or other combustibles.

SUBMITTAL APPROVAL

NAME

DATE

TYPICAL MOUNTING



SEE ACCESSORY SHEET FOR HARDWARE

LETTER	REVISIONS	DA
B	9-81	

DWN BY	DATE	
PD	1-9-74	
CKD BY	DATE	
JA	1-9-74	
APPD BY	DATE	
DS	4-30-76	
PROJECT NAME		
ROTO-FLOAT		

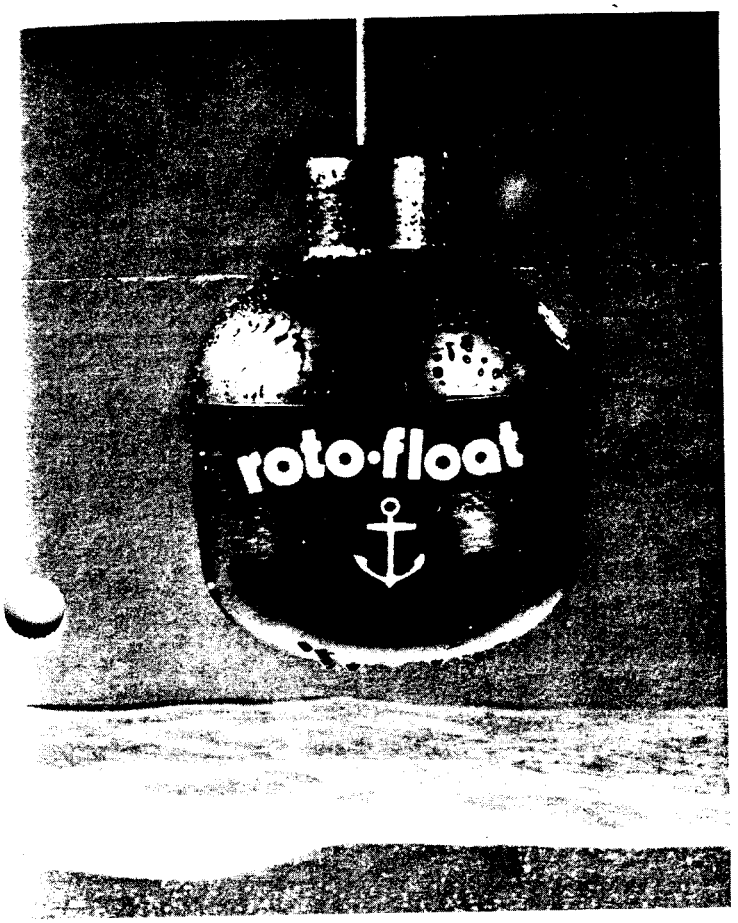
anchor scientific inc.
Box 378, Long Lake, MN 55356
612/473-7115

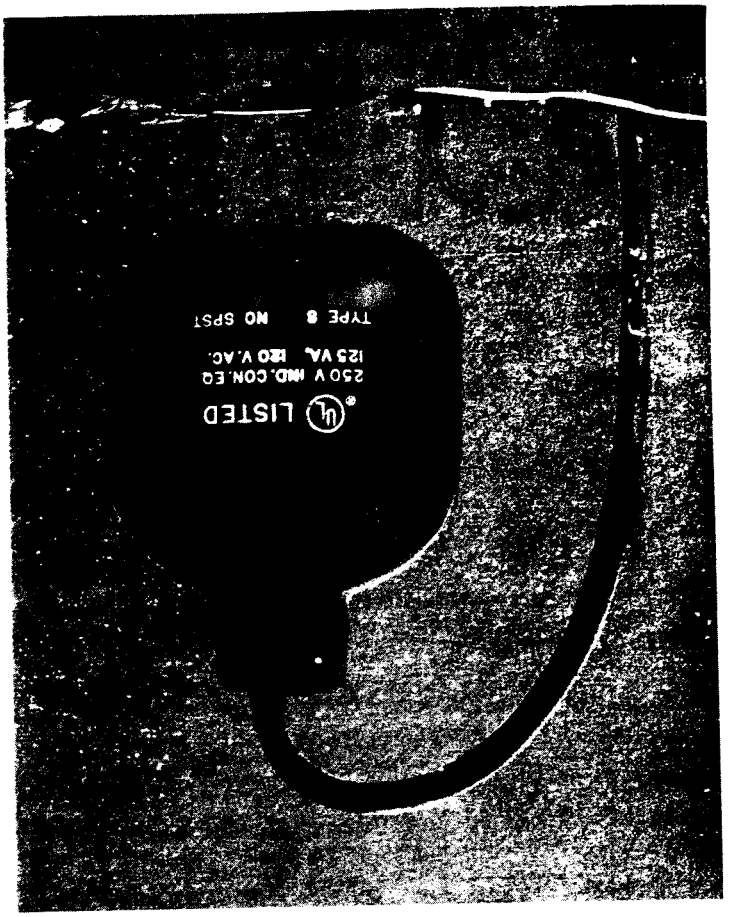
SPECIFICATION DATA SUBMITTAL AND INSTRUCTION SHEET

anchor scientific inc.
Box 378, Long Lake, MN 55356 / 612-473-7115 / FAX 612-473-6002

roto-float
Type S - Suspended
Form 2700-A

TYPE S





The ROTO-FLOAT is a direct acting float switch. Each ROTO-FLOAT contains a single pole mercury switch which actuates when the longitudinal axis of the float is horizontal, and deactuates when the liquid level falls 1" below the actuation elevation.

The float is a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable is permanently connected to the enclosed mercury switch and the entire assembly is encapsulated to form a completely water tight and impact resistant unit. Type S — Suspended has built in weight.

ROTO-FLOATS can be mounted on a support pipe (type P) or suspended from above (type S). Advantages of the ROTO-FLOAT are low cost, simplicity and reliability.

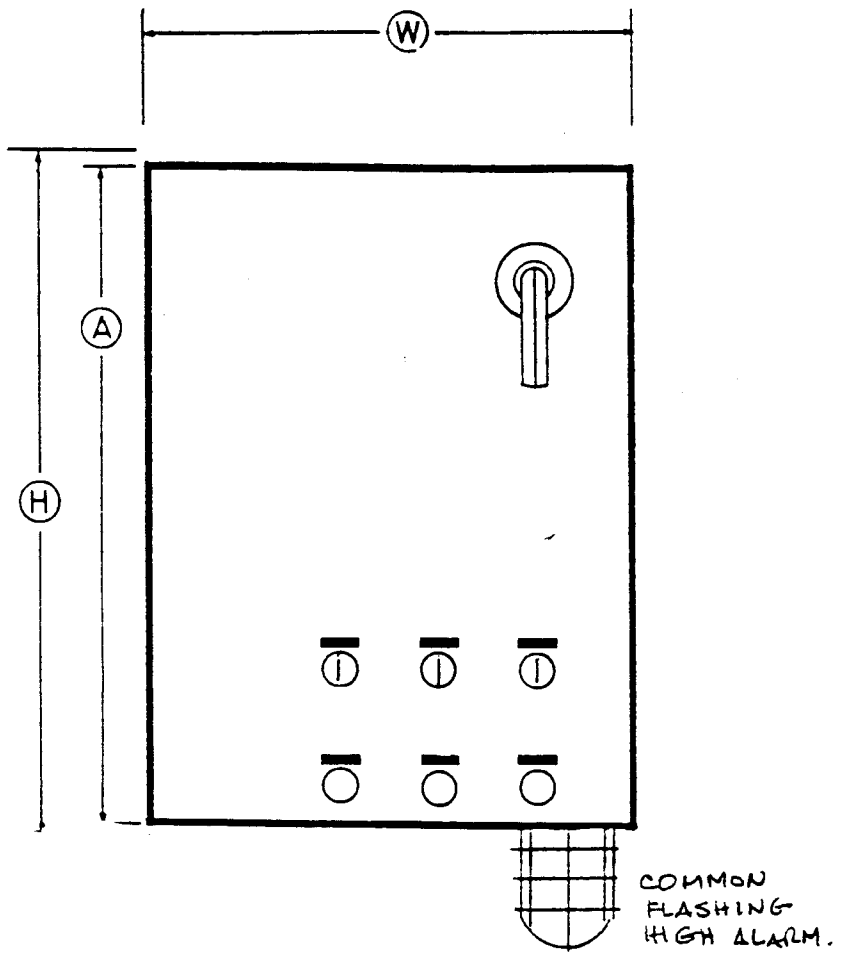
UL Listed

- Pilot Duty
- Industrial Control Equipment

CABLE

.V.C. type STO #18 conductors (41 strand) ated 600 volts • Various lengths available • See table of models • Non-standard lengths also available on special order.

Switch Arrangement	Cable Length	Suspended Type S Model No.	Ship. Wt.
Normally Open	20	S20NO	4#
	30	S30NO	4 1/2#
	40	S40NO	5 1/4#
Normally Closed	20	S20NC	4#
	30	S30NC	4 1/2#
	40	S40NC	5 1/4#



CONTROLLER MODEL NO. SB3-1-FD1

QTY	UNIT I.D. #	VOLTS	HP	PH
1	SUBM.	460V	5	3
			EA.	

A. TYPE OF EQUIPMENT CONTROLLED:

- ☐ Simplex ☐ Duplex ☑ Triplex
- ☐ Condensate return
- ☐ Boiler feed/makeup
- ☐ Sump/Sewage
- ☑ Submersible
- ☐ Rooftank fill pumps
- ☐ Pressure booster
- ☐ Condenser or chilled water
- ☐ Other

FIELD CONNECTIONS:

PUMP #1 ON FLOAT:	C &	0
" " OFF "	C &	1
" " HIGH "	C &	2
" " ON "	C &	3
" " OFF "	C &	4
" " HIGH "	C &	5
" " ON "	C &	6
" " OFF "	C &	7
" " HIGH "	C &	10
HIGH LEVEL AUX CONTACT, N.O., COMMON TO ALL 3 PITS	70 &	71.

B. TYPE OF MOTOR STARTING:

- ☑ Across-the-line
- ☐ Autotransformer
- ☐ Wye-Delta (open transition)
- ☐ Wye-Delta (closed transition)
- ☐ Part winding
- ☐ Other (specify):

C. ENCLOSURE TYPE:

NEMA 1 . 24 H x 16 W x 7 D

D. INTEGRAL MOTOR SHORT-CIRC. PROTECTION:

- ☑ Internal fuseclips (fuses by others)
- ☐ Circuit breakers or motor protectors
- ☐ None supplied. Protection by others.

SEQUENCE OF OPERATION: (EACH PUMP, TYP. FOR 3)

pump ON by: ON FLOAT SW.

pump OFF by: OFF FLOAT SW.

OPTIONAL FEATURES SUPPLIED:

- ☑ Main panel disconnect means with door interlock
- ☐ Individual motor disconnect means with door interlocks
- ☐ Other: HIGH LEVEL LIGHTS.

DES BY	ISSUE	A	CHKD	B	CHKD
DWN BY	DATE				

FRANK A. KRISTAL ASSOCIATES, INC.
CONTROL SYSTEMS DIV.

JOB NAME	CANONIE ENGRG	DWG NO	SB3-1-CP047.
CUST NAME		TITLE	
CUST PO NO			
OUR JOB NO	K85-10303	SHEET 1 OF 3 SHEETS	

NOTES:

NOTES:

1. SMALL NUMBERS ABOVE OR BELOW A LINE INDICATE A WIRE NO.
2. SMALLER NO. NEXT TO EMPTY DOT INDICATES COMPONENT
3. UNLESS OTHERWISE SHOWN CONTROL WIRE IS NO.16 RED 600V
4. WIRING FOR DRY AUX. CKTS. IS NO.16 YELLOW 600V
5. NUMBERS IN SQUARES INDICATE TERMINAL BLOCK NO.'S
6. ALL CONTACTS SHOWN IN THE POWER OFF/ZERO WATER LEVEL POS.
7. PANEL INSTALLATION MUST CONFORM TO N.E.C. (NFPA-90)
9. HEAVY DASHED LINES INDICATE WIRING TO PILOT DEVICE BY FACTORY
10. LIGHT DASHED LINES INDICATE WIRING TO PILOT DEVICE BY OTHERS
11. GND. LUG BY CUST. PER N.E.C.
12. Motor Fuses Indicates

QTY	UNIT ID #	VOLTS	HP	PH
1	Sub#1	440 V	5 HP	3

FRANK A. KRISTAL ASSOCIATES, INC.
CONTROL SYSTEMS DIV.

DWG NO SB2SC129-M-2

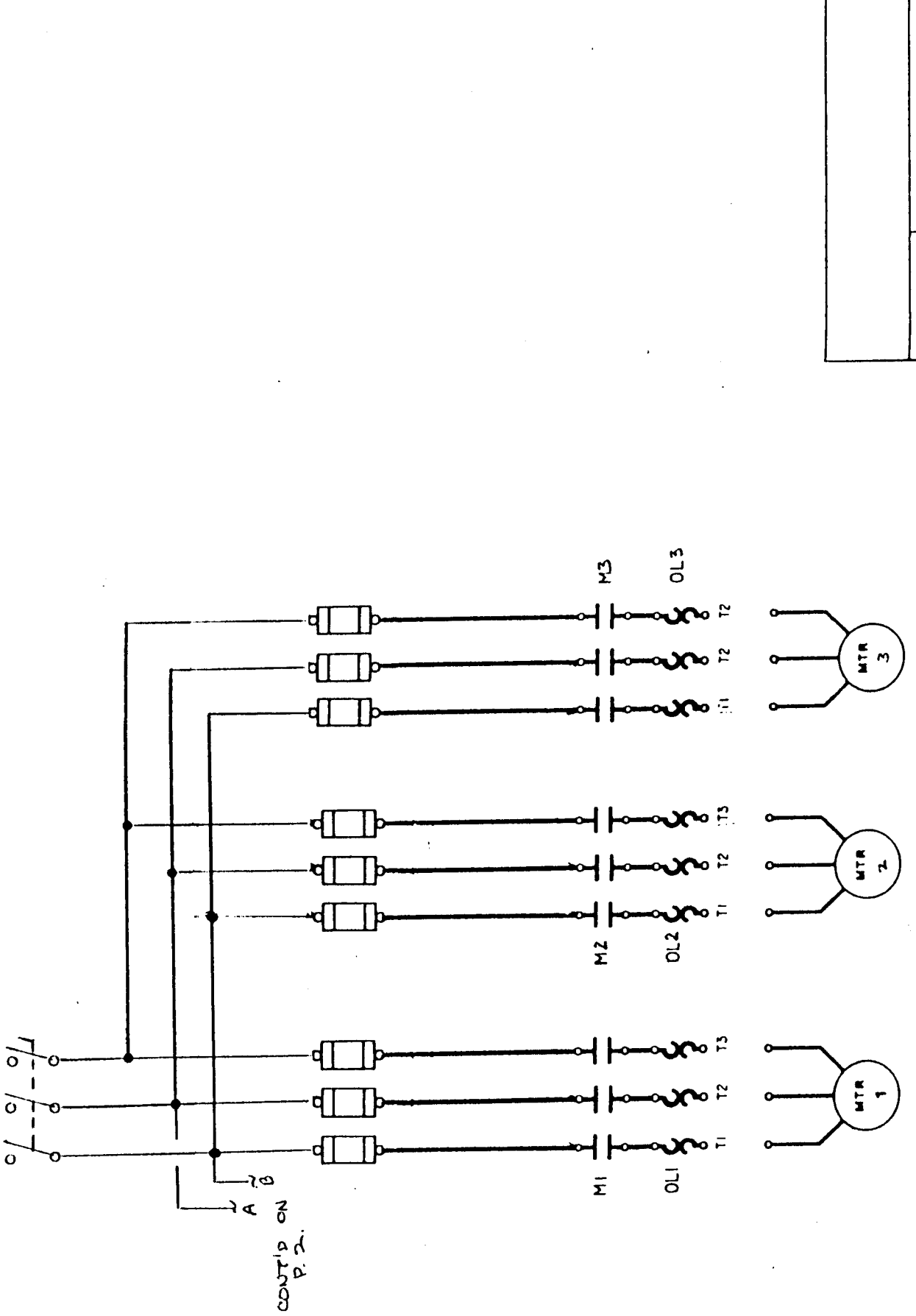
TITLE POWER FEED & MOTOR SECTION

SHEET 2 OF 3 SHEETS

JOB NAME	CANCELLED
CUST NAME	
CUST PO NO	—
OUR JOB NO	11383

INCOMING FEED:

☐ 220/230/240 VAC 3 PHASE
☒ 440/460/480 VAC 3 PHASE
☐ 380 3 PHASE 380 VAC 3 PHASE 60 HZ.



DWN BY	SP	DATE	5-83					
DES BY	D	ISSUE	A	CHKD	B	CHKD		

NOTES

1. SMALL NUMBERS ABOVE OR BELOW A LINE INDICATE A WIRE NO.
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7. PANEL INSTALLATION MUST CONFORM TO N.E.C. (NFPA-90)
9. HEAVY DASHED LINES INDICATE WIRING TO PILOT DEVICE BY FACTORY
10. LIGHT DASHED LINES INDICATE WIRING TO PILOT DEVICE BY OTHERS
11. GND. LUG TO BE GROUNDED BY CUST. PER N.E.C.

QTY	UNIT ID #	VOLTS	HP	PH
1	SUB-D	460	40	3

DWG NO TPSS-388F20/fp

TRIPLEX BOOSTER CONTROL SYSTEM

SHEET OF SHEETS

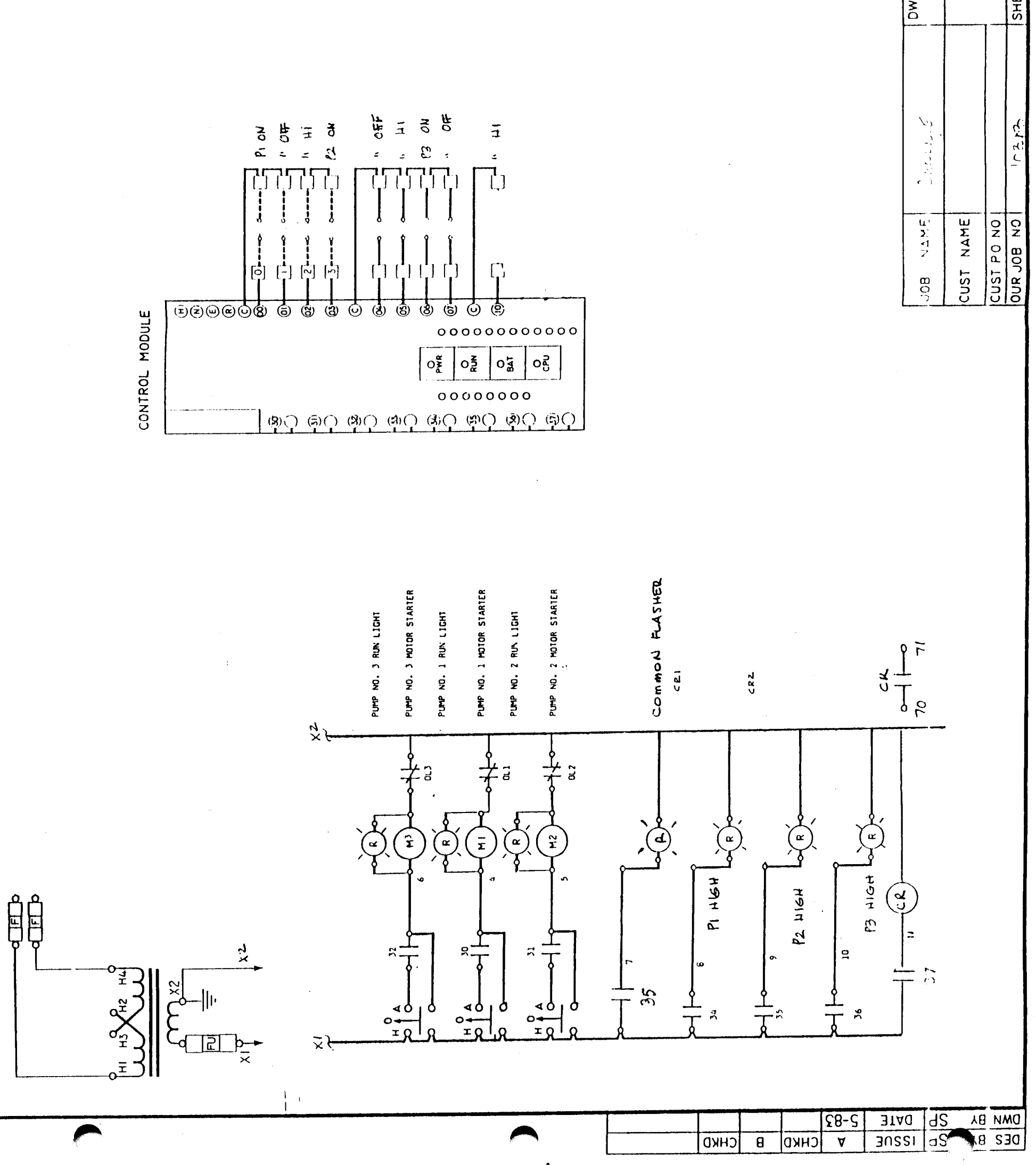
JOB NAME

CUST NAME

CUST PO NO

OUR JOB NO 10282

CONTROL MODULE



DES BY	SP	ISSUE	DATE	CHKD	B	CHKD
DWN BY	SP	A	5-83			

DES BY	ISSUE	A	CHKD	B	CHKD	
DWN BY	DATE					

DRAWING NO. ALI-ϕ-115NC

SHEET 1 OF 1 SHEETS

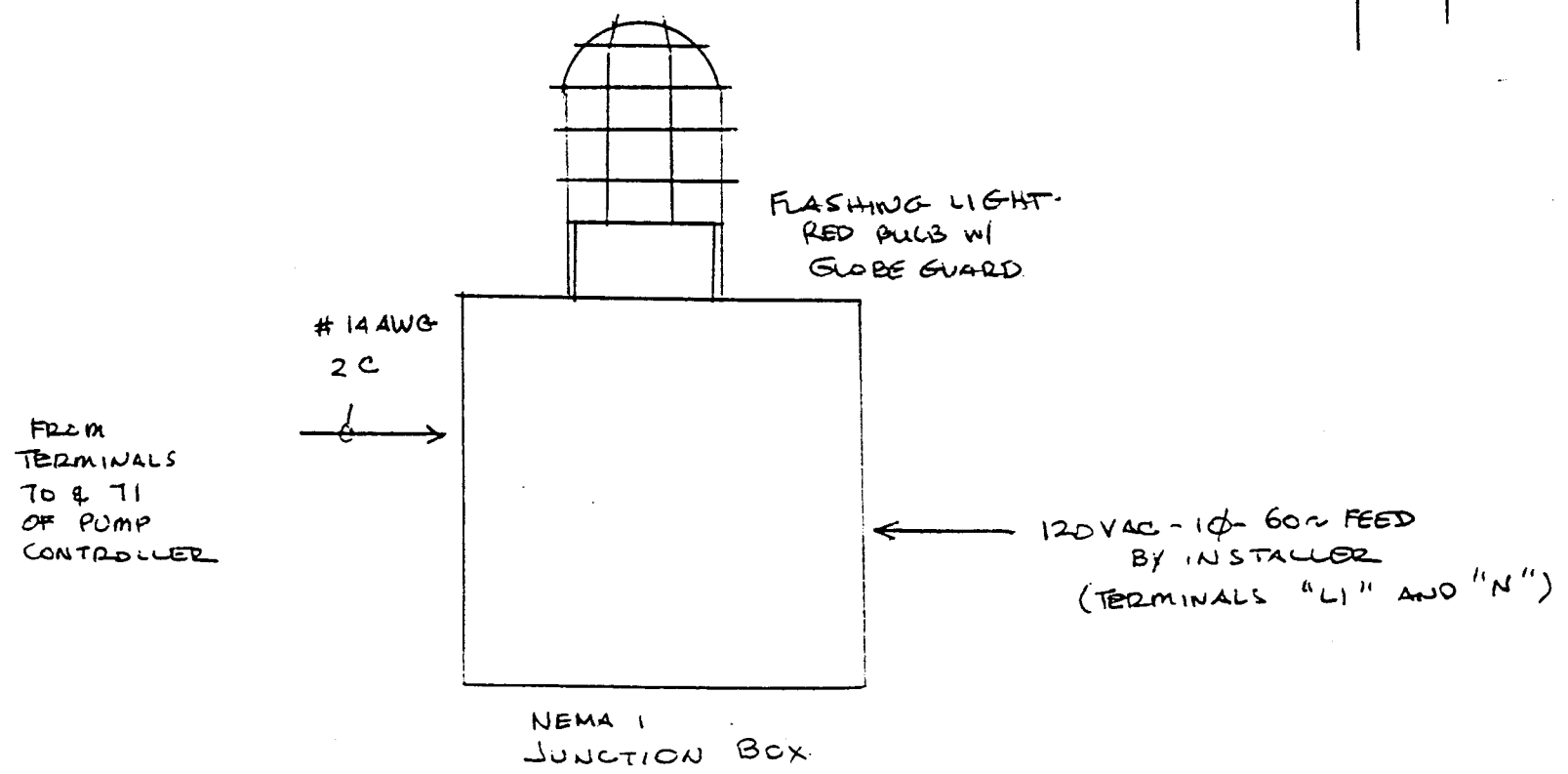
ALARM PANEL

CANONIE - FAK10303

FRANK A. KRISTAL ASSOCIATES INC.

PROCESS CONTROL SYSTEMS GROUP

ISSUE	REVISION	DATE
A		6/86

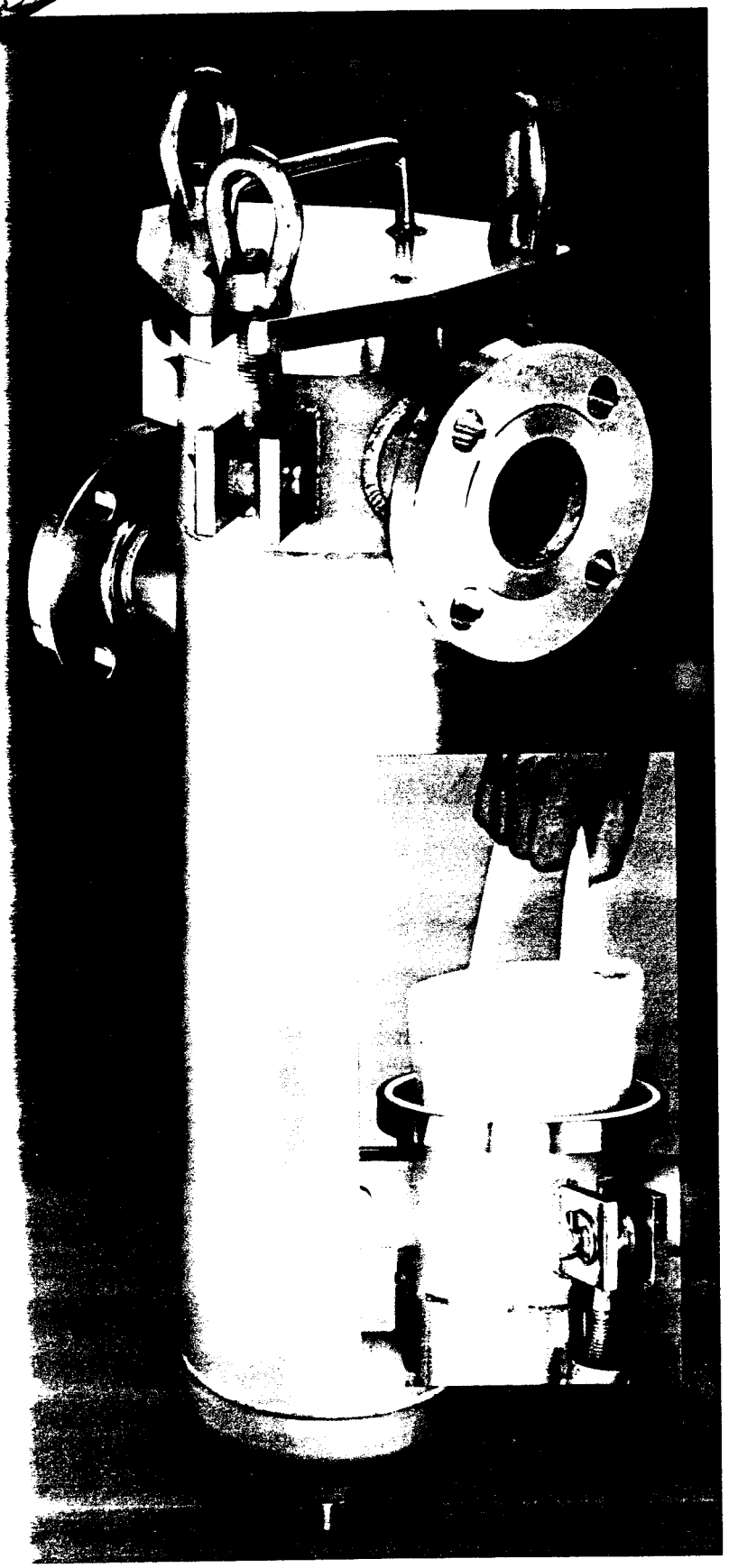


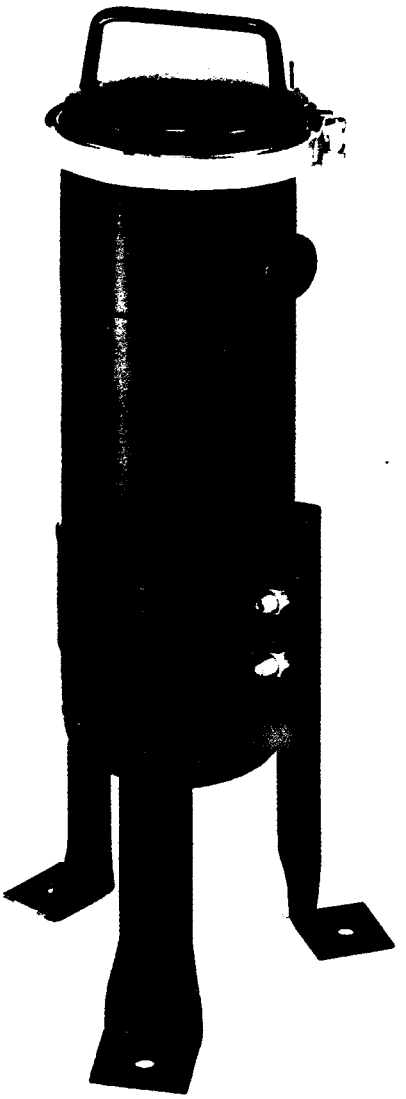
ROSEDALE BAG FILTER

UNIQUE SIZE

Rosedale Model 6

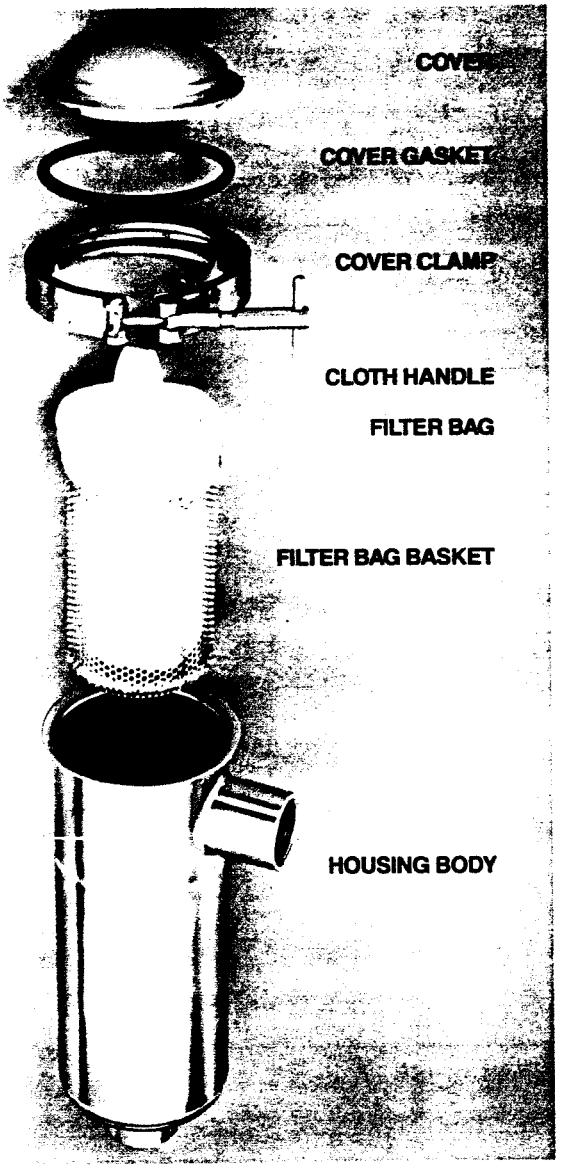
High-Capacity Basket Strainers
High-Capacity Bag Filters

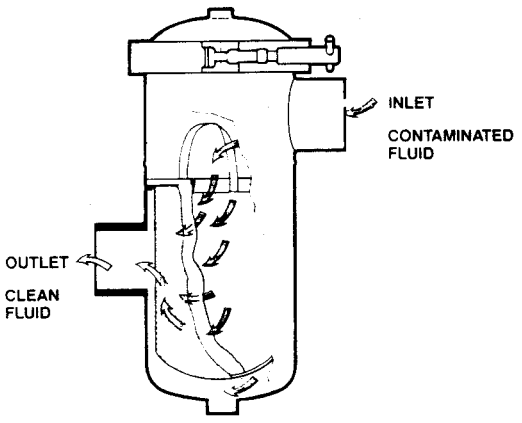




THE ROSEDALE MODEL 6—

Unique size basket strainers and bag filters, with new benefits





The Rosedale Model 6 represents one of today's greatest values in liquid straining and filtering. It features a 6-inch diameter housing, the first such size made in this industry. In an 18-inch basket depth, the Model 6 boasts a full two square feet of basket or bag surface area, previously available only in larger diameter vessels. This extended liquid cleaning surface comes in a housing where dimensions are such that ASME code requirements do not apply to its construction. This allows the Model 6 to be more reasonably priced, and lower in weight than other strainers and filters of equal capacity, all without compromising convenience or performance.

The Model 6 gives you all these standard features

- Up to 2 square feet of cleaning area, without the extra cost requirement for construction to ASME code
- Light weight
- Permanently piped housings
- Easy servicing, without tools
- Positive cover sealing
- Positive element sealing
- Adjustable-height tripod legs

And these standard options

- Choice of functions: straining or filtering
- Choice of pressure ratings: 100 psi (with quick opening clamp cover) or 150 psi (with eye-nut cover)
- 1, 1-1/4, 1-1/2, 2 or 3-inch connections, female NPT or flanged
- Two basket depths—12 or 18-inch
- Three outlet location styles
- Carbon steel or 304 stainless steel housings
- Four cover gasket materials: Buna N, EPR, Viton® fluoroelastomer and Teflon® fluorocarbon resin
- With or without a liquid displacer to facilitate bag removal and minimize product loss

Plus these special options

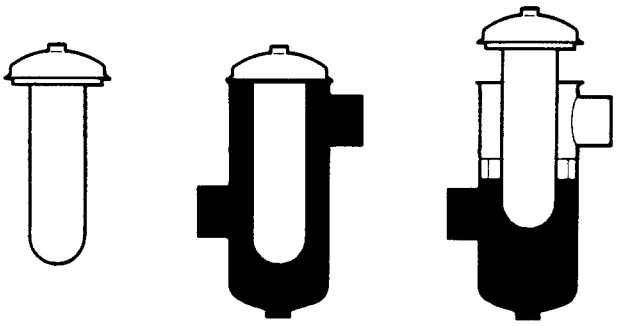
- Sanitary fittings
- Duplex units
- Steam jackets
- Wire mesh lining in filter bag baskets to prevent fiber migration
- Higher pressure ratings

OPERATION

Unfiltered liquid enters the housing above basket or bag and passes through them. Solids are contained inside the basket or bag where they're easily and completely removed when the unit is serviced.

LIQUID DISPLACER

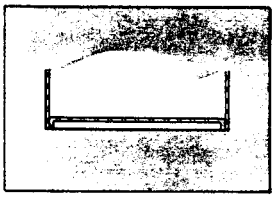
Either type of cover can be supplied with a liquid displacer attached. When in use the displacer (a sealed 304 stainless steel cylinder) is inside the basket, displacing liquid that would otherwise fill the inner space. When the cover and attached displacer are removed, the level of liquid within the basket is materially lowered. This results in product savings, and fast, easy strainer or filter servicing.



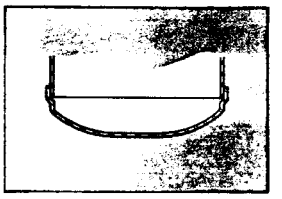
BASKETS

Baskets for straining applications are made of plain perforated metal (in a choice of five perforation diameters) or of wire-mesh lined perforated metal (choice of ten mesh sizes).

Baskets used to hold filter bags are constructed entirely of 9/64-inch diameter perforated (304) stainless steel.



Strainer baskets have flat, non-perforated bottoms.



Filter bag baskets have rounded, perforated bottoms.

CHOOSING A STRAINER OR BAG FILTER

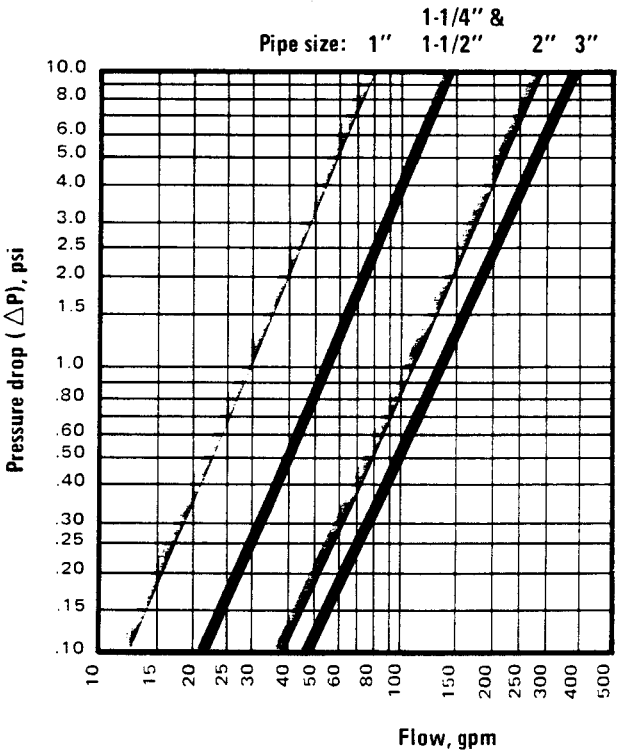
PRESSURE DROP DATA

Basket strainers and bag filters are usually selected so that the pressure drop does not exceed 2 psi, when they are clean. Higher pressure drops may be tolerated when contaminant loading is low.

The pressure drop data is accurate for all Model 6 housings with strainer or filter bag baskets. When filter bags are added, total pressure drop becomes the sum of the pressure drop as determined by the steps below plus the pressure drop through the bag as defined in Rosedale Filter Bag Catalog FB-1.

Follow these easy steps:

1. Using desired pipe size and approximate flow rate, determine the basic pressure drop from the graph.
2. If the viscosity involved is more than 1 cps, multiply the pressure drop obtained in step 1 by the viscosity correction factor found in the accompanying table. This is the adjusted (clean) pressure drop for all 12- or 18-inch baskets, without filter bags.



Viscosity Factors

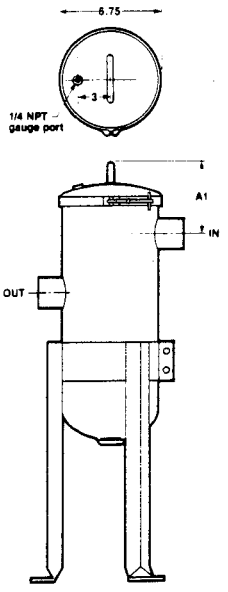
	CPS NUMBER							
1 (H_2O)	50	100	200	400	600	800	1000	2000
.65	.85	1.00	1.10	1.20	1.40	1.50	1.60	1.80

BASKET/BAG DATA

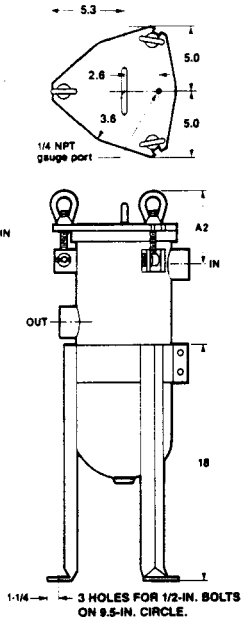
Basket (nominal, inches)	Diameter (inches)	Surface Area (sq. ft.)
12	5	1.3
18	5	2.0

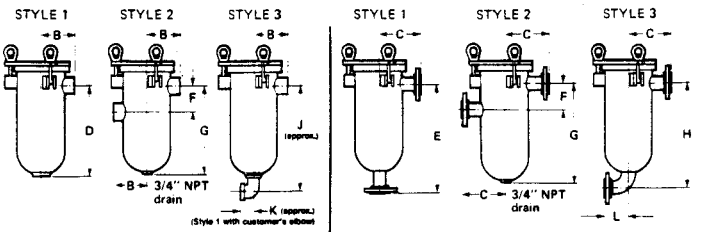
DIMENSIONS
(inches, approximate)

100 psi design



150 psi design





PIPE SIZE		NPT Model 6 12" baskets 1	1-1/4	1-1/2	2	3	FLANGED Model 6 18" baskets 1	1-1/4	1-1/2	2	3
A1	100 psi design	5.6	5.4	6.1	5.5	6.3	5.6	5.4	6.1	5.5	6.3
A2	150 psi design	5.8	5.6	6.3	5.7	6.5	5.8	5.6	6.3	5.7	6.5
B	Carbon steel	4.3	4.4	4.5	4.6	5.5	4.3	4.4	4.5	4.6	5.5
	Stainless steel	3.9	3.9	3.8	4.0	5.5	3.9	3.9	3.8	4.0	5.5
C		6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
D	Carbon steel	15.2	15.4	15.5	15.9	16.5	21.2	21.4	21.5	21.9	22.5
	Stainless steel	15.6	15.9	16.1	16.5	17.3	21.6	21.9	22.1	22.5	23.3
E		18.0	18.1	18.3	18.5	19.0	24.0	24.1	24.3	24.5	25.0
F		2.9	3.5	3.9	4.8	6.6	2.9	3.5	3.9	4.8	6.6
G	Carbon steel	15.2	15.3	15.4	15.7	16.2	21.2	21.3	21.4	21.7	22.2
	Stainless steel	15.5	15.7	15.8	16.1	16.5	21.5	21.7	21.8	22.1	22.5
H		16.2	16.8	17.3	18.3	20.3	22.2	22.8	23.3	24.3	26.3
J	Carbon steel	16.8	17.2	17.5	18.4	20.0	22.8	23.2	23.5	24.4	26.0
	Stainless steel	17.0	17.7	18.1	19.0	20.8	23.0	23.7	24.1	25.0	26.8
K		1.5	1.8	1.9	2.3	3.1	1.5	1.8	1.9	2.3	3.1
L		1.7	2.1	2.5	3.3	4.8	1.7	2.1	2.5	3.3	4.8

HOW TO ORDER MODEL 6 BASKET STRAINERS AND BAG FILTERS

Build an ordering code as shown in this example.

EXAMPLE: 6 18 2P 1 150D C B – M 80

MODEL NO.
6 = 6

HOUSING SIZE
12-in. = 12
18-in. = 18

PIPE SIZE AND CONNECTION
1-in. female NPT = 1P
1-1/4-in. female NPT = 1-1/4P
1-1/2-in. female NPT = 1-1/2P
2-in. female NPT = 2P
3-in. female NPT = 3P
1-in. 150-lb. ANSI = 1F
1-1/4-in. 150-lb. ANSI = 1-1/4F
1-1/2-in. 150-lb. ANSI = 1-1/2F
2-in. 150-lb. ANSI = 2F
3-in. 150-lb. ANSI = 3F

OUTLET STYLE
Bottom = 1
Side = 2
Bottom elbow = 3

PRESSURE RATING
100 psi (clamp cover) = 100
100 psi (clamp cover with liquid displacer) = 100D
150 psi (eye-nut cover) = 150
150 psi (eye-nut cover with liquid displacer) = 150D

BASKET MEDIA SIZE
Perforation diameters (for type P baskets)
1/4, 3/16, 9/64, 3/32, 1/16
Mesh sizes (for type M and BM baskets)
20, 30, 40, 50, 60, 70, 80, 100, 150 or 200

BASKET TYPE
P = Perforated strainer
B = Filter bag
M = Mesh lined strainer
BM = Mesh lined filter bag
HWM = Heavy wire mesh filter bag

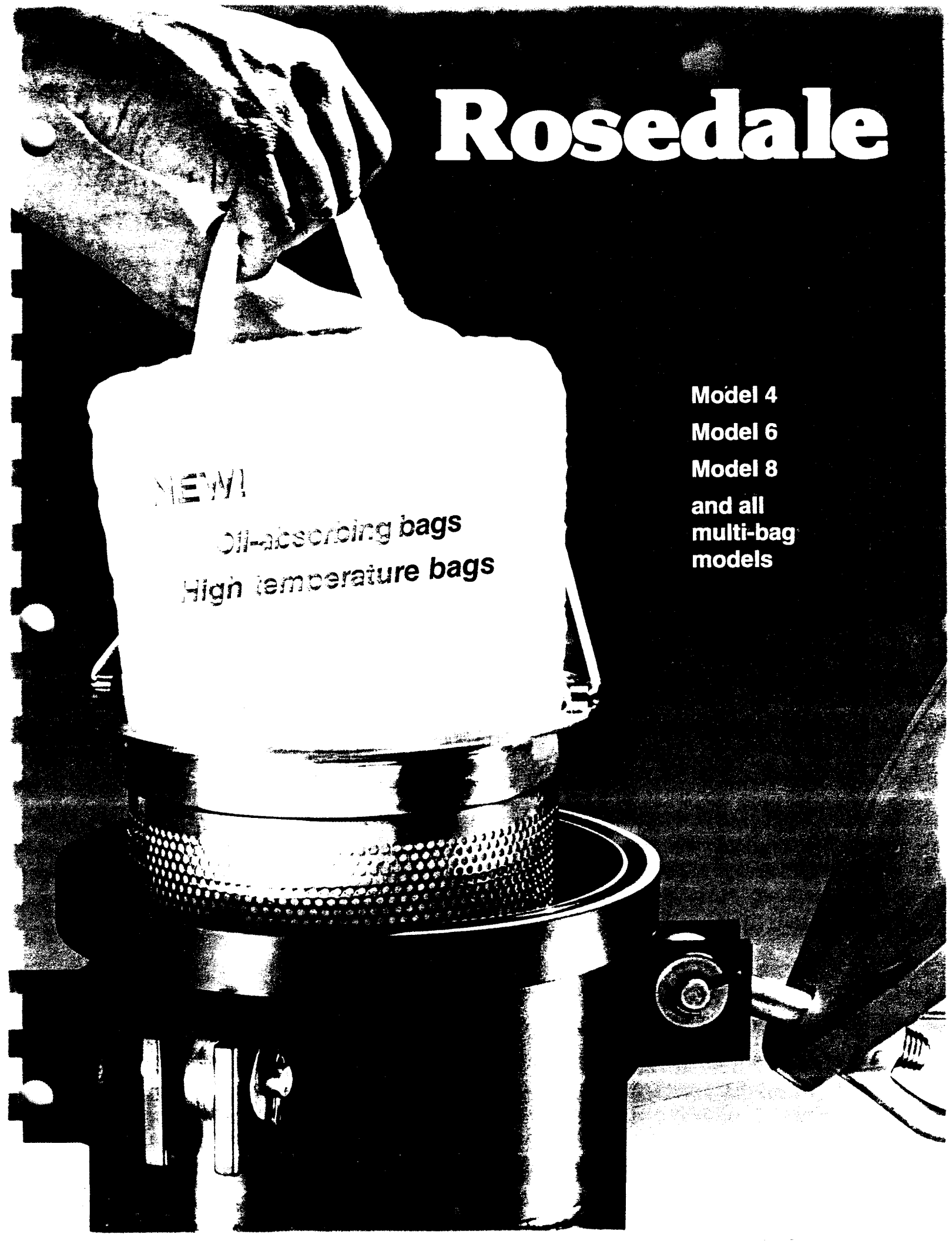
COVER GASKET
B = Buna N
E = Ethylene Propylene
V = Viton® fluoroelastomer
T = Teflon® fluorocarbon resin

HOUSING MATERIAL
C = Carbon steel
S = 304 stainless steel

FILTER BAGS. Filter bags should be specified separately.
See Rosedale Products Filter Bag Catalog FB-1.

ROSEDALE PRODUCTS, INC.
(Associated with Flow Ezy Filters, Inc.)
Box 1085, Ann Arbor, Michigan 48106
313-665-8201

Catalog M6 Litho in USA 10M983


Rosedale
Model 4
Model 6
Model 8
and all multi-bag models
NEW!
Oil-absorbing bags
High temperature bags

HIGH-CAPACITY FILTER BAGS FOR ALL ROSEDALE BAG FILTERS

CONSTRUCTION

Felt Bags

Felt construction is generally chosen where smaller particle retention is required, in the 1 to 100 micron range. It offers higher solids loading capacity than mesh. **General-purpose** felt bags are offered in polyester and polypropylene materials. **Special-purpose** felt bags include **high temperature service** (to 500°F) bags of Nomex nylon or Teflon. For **removal of oil**, bags made of special felted polypropylene microfibers, known as Oil-Absorb, are available. A size 2 Oil-Absorb bag will remove approximately a half-pound of oil from a water-oil liquid. It is only available with a 25 micron rating.

If finer filtration is needed in an oil removal task, Rosedale Model 8 filters can be fitted with two bags in series. The inner one an Oil-Absorb bag and the outer one a finer standard bag. Installed this way, true two-stage filtration is achieved. (Two-stage filtering can be done for longer intervals between servicing.)

Mesh Bags

Mesh is a woven construction, generally used where micron ratings of 5 to 800 (660 to 20 mesh) are required.

Two types are offered. The **multifilament mesh** is a low cost, disposable material, offered in polyester or nylon. **Monofilament mesh** has higher strength, and is available in polypropylene or nylon. (It should be considered cleanable.)

FELT BAG FINISHES & COVERS

Standard finish. Plain, as manufactured, without treatment or covers.

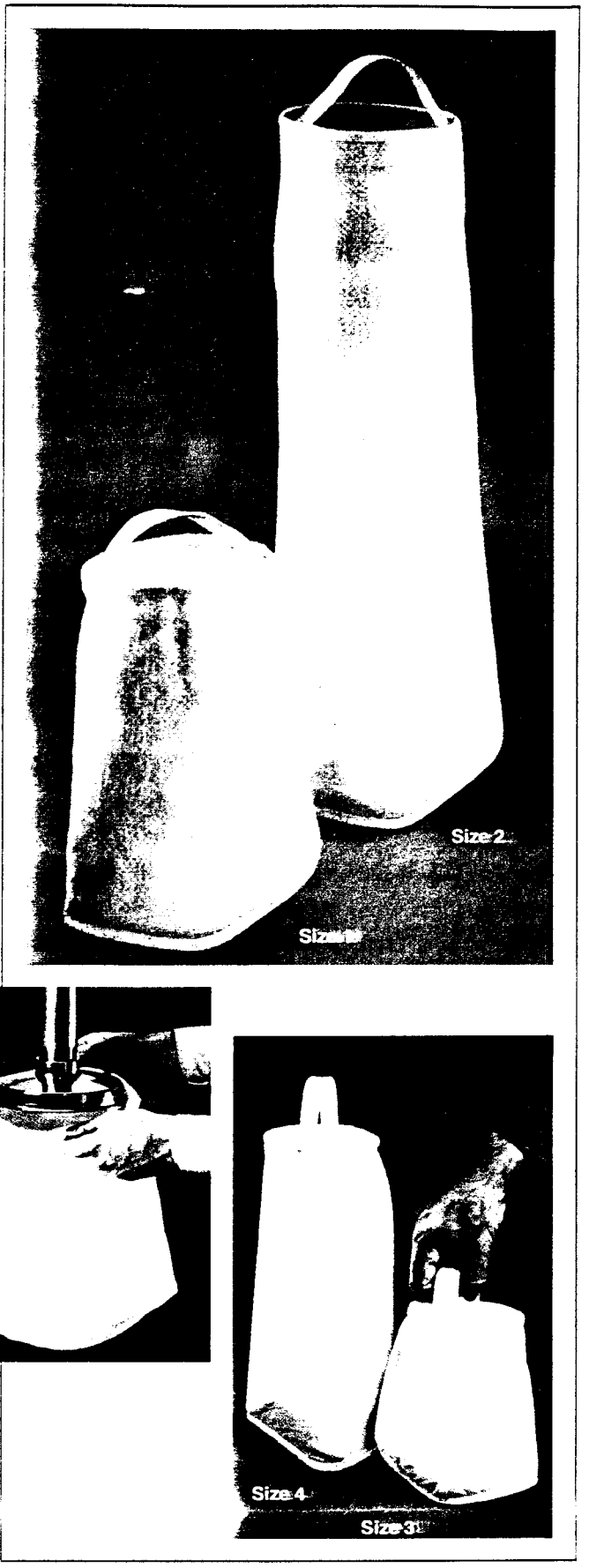
Glazed finish. The outermost surface fibers are melted by the momentary application of high heat. This bonds them to one another and effectively reduces the possibility of their breaking off. (Not available on high-temperature bags.)

Mesh covers. Covers are available that completely encase the bag. Made of woven polyester mesh, nylon mesh, spun-bonded nylon (Cerex), or spun-bonded polyester (Remay), they act to contain any fibers that may separate from the filter bag.

DESIGN DETAILS

All Rosedale filter bags have a metal retaining ring at their openings. Standard ring material is cadmium-plated carbon steel, with 316 stainless steel optional.

Heavy-duty handles, sewn to the reinforced bag lip, are a standard feature. They make bag removal faster and easier.



COMPARATIVE PARTICLE SIZE

U.S. MESH	INCHES	MICRONS
3	.265	6730
3½	.223	5660
4	.187	4760
5	.157	4000
6	.132	3360
7	.111	2830
8	.0937	2380
10	.0787	2000
12	.0661	1680
14	.0555	1410
16	.0469	1190
18	.0394	1000
20	.0331	841
25	.0280	707
30	.0232	595
35	.0197	500
40	.0165	420
45	.0138	354
50	.0117	297
60	.0098	250
70	.0083	210
80	.0070	177
100	.0059	149
120	.0049	125
140	.0041	105
170	.0035	88
200	.0029	74
230	.0024	63
270	.0021	53
325	.0017	44
400	.0015	37

STANDARD FIBERS AND MICRON RATINGS

CONSTRUCTION	FIBER	AVAILABLE MICRON RATINGS 1	3	5	10	15	25	50	75	100	125	150	175	200	250	300	400	600	800
	Polyester	•	•	•	•	•	•	•	•	•				•					
	Oil-Adsorb (pp)						•												
Felts	Polypropylene	•	•	•	•		•	•		•									
	Nomex (Nylon)			•	•		•	•		•									
	Teflon				•														
Multifilament meshes	Polyester								•	•	•	•		•	•	•	•		•
	Nylon									•		•							•
Monofilament meshes	Polypropylene															•		•	
	Nylon			•	•		•	•	•	•	•	•	•	•	•	•	•	•	•

COMPATIBILITY AND TEMPERATURE LIMITS FOR STANDARD BAG MATERIALS *

FIBER	COMPATIBILITY WITH ORGANIC SOLVENTS	ANIMAL VEGETABLE & PETRO OILS	MICRO-ORGANISMS	ALKALIES	ORGANIC ACIDS	OXIDIZING AGENTS	MINERAL ACIDS	TEMPERATURE LIMITATIONS (max. deg F)
Polyester	Excellent	Excellent	Excellent	Good	Good	Good	Good	325
Polypropylene	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	225
Nylon	Excellent	Excellent	Excellent	Good	Fair	Poor	Poor	325
Nomex Nylon	Excellent	Excellent	Excellent	Good	Fair	Poor	Poor	475
Teflon	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	500

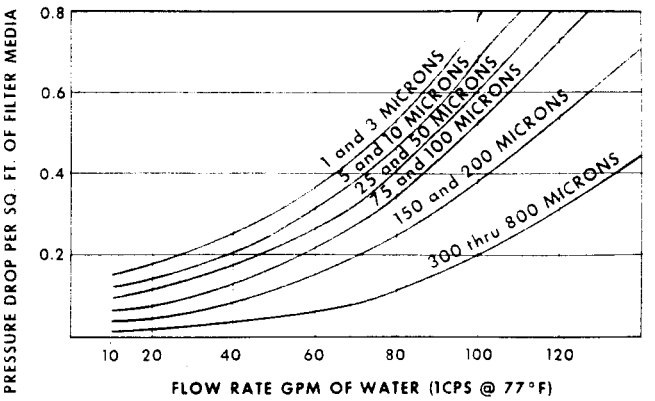
* Chart is to be used as a guide. User should make tests with specific media to assure compatibility.

FILTER BAG SIZES

USED ON ROSEDALE MODEL NO.	BAG SIZE	LENGTH (inches)	DIAMETER (inches)	SURFACE AREA (sq. ft.)	BAG VOLUME (gallons)
4-6	3	8	4.12	0.5	0.5
4-12	4	14	4.12	1.0	1.0
6-12	7	15	5.10	1.3	1.3
6-18	8	21	5.10	2.0	1.5
6-30	9	32	5.10	3.4	2.8
8-15	1	16.5	7.06	2.0	2.1
	1 (inner)	14.5	5.75	1.6	1.7
8-30	2	32	7.06	4.4	4.6
and 16 thru 36	2 (inner)	30	5.75	3.6	3.8

PRESSURE DROP DATA

The graph shows pressure drop through clean filter bag media of various micron ratings. **The curves do not consider pressure drop through the filter housing.**



BAG SIZE CORRECTION

To obtain pressure drop correction for a specific bag size, divide the pressure drop obtained from the graph by the square foot area of the bag.

Bag Size	Surface Area (sq. ft.)
1	2.0
1 (inner)	1.6
2	4.4
2 (inner)	3.6
3	0.5
4	1.0
7	1.8
8	2.0
9	3.4

VISCOSITY CORRECTION

If viscosity is higher than one, multiply the corrected pressure drop as obtained above by the appropriate viscosity correction factor.

Viscosity (cps)	Correction Factor
50	4.5
100	8.3
200	16.6
400	27.7
800	50.0
1000	56.2
1500	77.2
2000	113.6
4000	161.0
6000	250.0
8000	325.0
10000	430.0

SELECTING A ROSEDALE FILTER BAG

1. Determine which type of filter bag material and which fiber best suits your needs.
2. Determine the micron rating you require.
3. Refer to the "How to order" chart below, and build an ordering code.

HOW TO ORDER FILTER BAGS

Build an ordering code as shown in this example:

Example: **PE 25 P 7 S-SS**

FIBER AND MICRON RATINGS

Felt, polyester = **PE**
Microns: **1, 3, 5, 10, 15, 25, 50, 75, 100, 200**

Felt, polypropylene = **PO**
Microns: **1, 3, 5, 10, 25, 50, 100**

Felt, Oil-Adsorb, 25-micron = **OA 25**

Felt, Nomex nylon = **HT**
Microns: **5, 10, 25, 50, 100**

Felt, Teflon, 10-micron = **TE 10**

Mesh, monofilament nylon = **NMO**
Microns: **5, 10, 25, 50, 75, 100, 125, 150, 175, 200, 250, 300, 400, 600 800**

Mesh, monofilament polypropylene = **PMO**
Microns: **300, 600**

Mesh, multifilament polyester = **PEM**
Microns: **75, 100, 125, 150, 200, 250, 300, 400, 800**

Mesh, multifilament nylon (light) = **NM**
Microns: **100, 150**

Mesh, multifilament nylon (heavy) = **HNM**
Microns: **800**

Inner Bags for Model 8 or Multibag Filters

To order inner bags, use a second, separate ordering code. It should be built using the system shown above, but prefixed by the symbol "IN". **Example: IN – PE 25 P 2 S-SS**

ADDITIONAL OPTIONS

SS = Stainless steel ring

BAG STYLE

S = Carbon steel plated ring

BAG DIMENSIONS

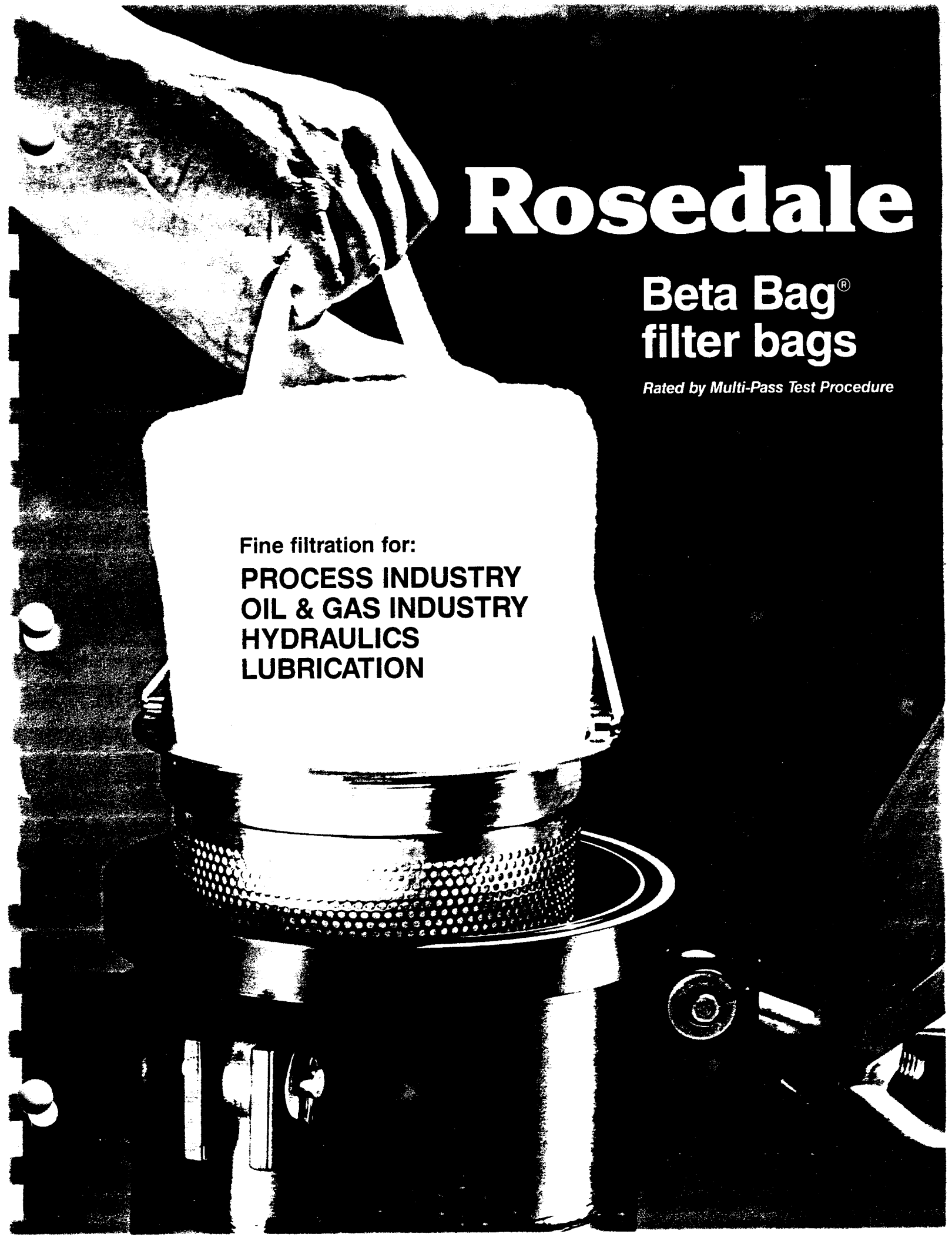
Symbol	Diam. (in.)	Length (in.)	Housing Model
1 =	7-1/16 x	16-1/2	8-15
2 =	7-1/16 x	32	8-30
3 =	4-1/8 x	8	4-6
4 =	4-1/8 x	14	4-12
7 =	5-1/8 x	15	6-12
8 =	5-1/8 x	21	6-18
9 =	5-1/8 x	32	6-30

BAG FINISH OR COVER

P = None
G = Fiber-free glazed finish
PEM = Polyester multifilament mesh cover
NM = Nylon multifilament mesh cover
C = Spun-bonded nylon (Cerex) cover
R = Spun-bonded polyester (Remay) cover

ROSEDALE PRODUCTS, INC.
Box 1085, Ann Arbor, MI 48106
(313) 665-8201

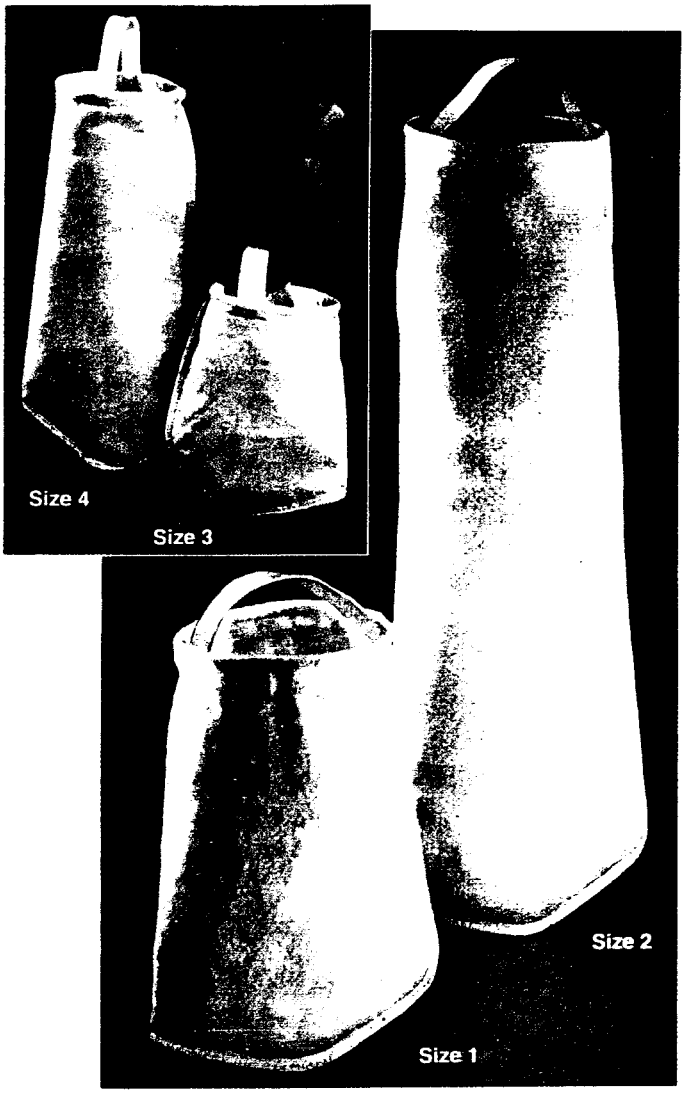
Catalog FB-2 Litho in USA 5M1086


Rosedale
Beta Bag®
filter bags
Rated by Multi-Pass Test Procedure
Fine filtration for:
PROCESS INDUSTRY
OIL & GAS INDUSTRY
HYDRAULICS
LUBRICATION

ROSEDALE BETA BAG FILTERS
New filter bags for fine filtration requirements

After years of supplying filter bag products to the process industries, Rosedale has developed a new filter bag that meets even more exacting requirements, extending their use to finer process filtration and to hydraulic and lubricating fluid filtration. Rosedale Beta Bag filter bags are made of a unique multi-layer polyester felt, encased in spun-bonded nylon to prevent migration of bag material into the fluid stream. They're rated by the multi-pass method of filter performance evaluation, so that direct comparison can be made between Beta Bag filters and cartridges of rigid construction using cellulose or synthetic elements, pleated or non-pleated. They compare very well:

- Dirt carrying capacity is roughly equal for a given flow capacity: A one-square-foot bag replaces a 3-1/2 x 5-in cartridge having 550 square inches of area.
- Because disposable Rosedale Beta Bags are fitted into and supported by perforated-metal baskets, you need not be concerned with filter collapse, flow fatigue or filter end-load problems.
- Beta Bags can be installed and removed from their housings in a fraction of the time required to service rigid cellulose or synthetic element cartridge filters.
- Beta Bags cost less than cylindrical filter cartridges, and they fold flat for more compact storage.
- Polyester/nylon bag materials are more resistant to the chemical additives in today's hydraulic and lubricant fluids (especially the high water base fluids), as well as the chemicals in Table III.
- Filter media migration is prevented by the spun nylon cover.
- They're safe for use with fluid temperatures above 300°F.



Compare filter elements on all counts

Test Sequence	Title and Procedure	Beta Bag Performance
1	Fabrication Integrity ANSI/B93.22-1972 ISO/2942-1974	Not applicable*
2	Material Compatibility ANSI/B93.23-1972 ISO/2943-1974	See Table IV
3	Multi-Pass Test ANSI/B93.31-1973 ISO/DIS 4572	See Table I
4	End-Load Test ANSI/B93.21-1972 ISO/3723-1976	Not applicable*
5	Flow Fatigue ANSI/B93.24-1972 ISO/3724-1976	Not applicable*
6	Burst ANSI/B93.25-1972 ISO/2941-1974	Not applicable*

**These tests are for conditions inherent in rigid filter cartridges, not present in steel basket-supported bags.*

ATTENTION PROCESS INDUSTRIES—

The multi-pass test for evaluation of filter media efficiencies might not be familiar to you, as it was developed for use with hydraulic fluids. Its usefulness need not be restricted to that narrow field.

Evaluation of filter media for retention of particles sized from 1 to around 40 microns is well established by this method. Ratings developed by it provide an exact statement of the percent of particles retained, by particle size. This is a far more precise (and reproducible) method than any currently used in the process industry.

The ratings developed, as listed in Table 1, do not correlate well with the usual, more loosely defined ratings currently in use by process filter manufacturers (ourselves included). To help make these new ratings more instantly understandable, the familiar "nominal" and "absolute" rating designations are parenthetically provided.

We hope that for fine filtering (and prefiltering) media selection, you will utilize this improved rating system.

The Multi-Pass Test Method for evaluating filter element performance

(OSU-F2,ISO 4572, ANSI B93.31-1973, NFPA T3.10.8.8-1973)

In this test procedure ACFTD (Air Cleaner Fine Test Dust) is put into a reservoir ahead of a test filter. The test dust is comprised of many particle sizes (see Table II).

During the test the flow rate through the filter is held constant, and test dust is added continuously. Contaminant not stopped by the filter is recirculated (hence the term "Multi-pass").

At a predetermined pressure drop across the filter, fluid samples are taken upstream and downstream of the filter. Using automatic particle counters (per ANSI B93.28-1973), the samples are analyzed for the number of particles per milliliter greater than a selected size. These counts are used to calculate "Beta ratios". **A Beta ratio is the ratio of the number of particles greater than a given size in the influent fluid to the number of same size particles in the effluent fluid.**

A typical Beta ratio is expressed as B (Beta) 10 (particle size) = 16 (ratio), or $B_{10} = 16$. Table I gives the Beta ratios for the three Beta Bag micron-rated bag materials.

TABLE I
Rosedale Beta Bag Beta Ratios

Developed in Multi-Pass tests at 20 gpm flow, with terminal pressure drop of 15 psi. **Standard sewn bags were tested, in standard housings.**

Beta Bag Micron Rating (nominal)	Mean ACFTD retention size. Equals 50% filter efficiency. (nominal rating)	Effective ACFTD retention size. Equals 95% filter efficiency.	Maximum ACFTD retention size. Equals 98.7% filter efficiency. (absolute rating)
BB-1	$B_1 = 2$ (1 μm nominal)	$B_4 = 20$ (4 μm)	$B_8 = 75$ (8 μm absolute)
BB-10	$B_{10} = 2$ (10 μm nominal)	$B_{16} = 20$ (16 μm)	$B_{20} = 75$ (20 μm absolute)
BB-12	$B_{12} = 2$ (12 μm nominal)	$B_{37} = 20$ (37 μm)	$B_{47} = 75$ (47 μm absolute)

TABLE II ACFTD Composition

Range of particle sizes (micrometers)	Distribution by weight (percent)
0-5	39
5-10	18
10-20	16
20-40	18
40-80	9

Selecting a Rosedale Beta Bag

1. Determine the micron rating needed. *For hydraulic fluids,* the BB-1-rated bags should be considered for high-pressure circuits, the BB-10 for common service, and the BB-12 for low-pressure (under 500 psi) service. *For process liquids,* the BB-1 rated bags are recommended for use as prefilters for membrane filters. Automotive coatings are being successfully filtered with BB-10 & BB-12 rated bags.

2. The Pressure Drop Versus Flow Chart shows specific flow rates achieved through various sizes of Beta Bag micron-rated bags using 32 (water) and 80 SSU viscosity liquids. Pressure drops can be read directly for these viscosity levels.

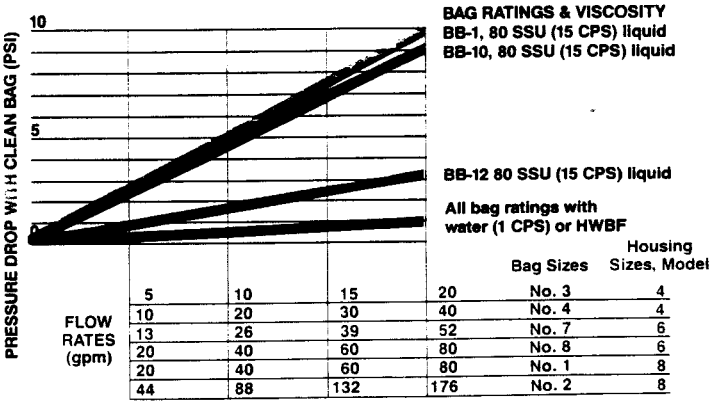
3. If your liquid viscosity level is higher than 80 SSU, you can use a correction factor to determine what your pressure drop will actually be. (Higher viscosity raises pressure drop.)

4. Using Table IV find your actual SSU level and multiply the pressure drop of interest to you by the correction factor shown. You can interpolate easily since the relationship is linear. For example, a viscosity of 280 SSU would have a correction factor of 3.5.

5. Do not specify a filter bag where the *initial* (clean) pressure drop is greater than 20 psi. (All Beta Bags can handle pressure drops to 75 psi.) Example: A clean BB-1 rated No. 8 size Beta Bag at 20 gpm will impose a pressure drop of 2.7 psi (with 80 SSU liquid). For use with 320 SSU oil the pressure drop will be 2.7 times 4 (the correction factor), or 10.8 psi.

TABLE IV

Viscosity SSU	Viscosity CPS	Correction Factor
80	15	1
160	35	2
240	55	3
320	70	4
400	90	5



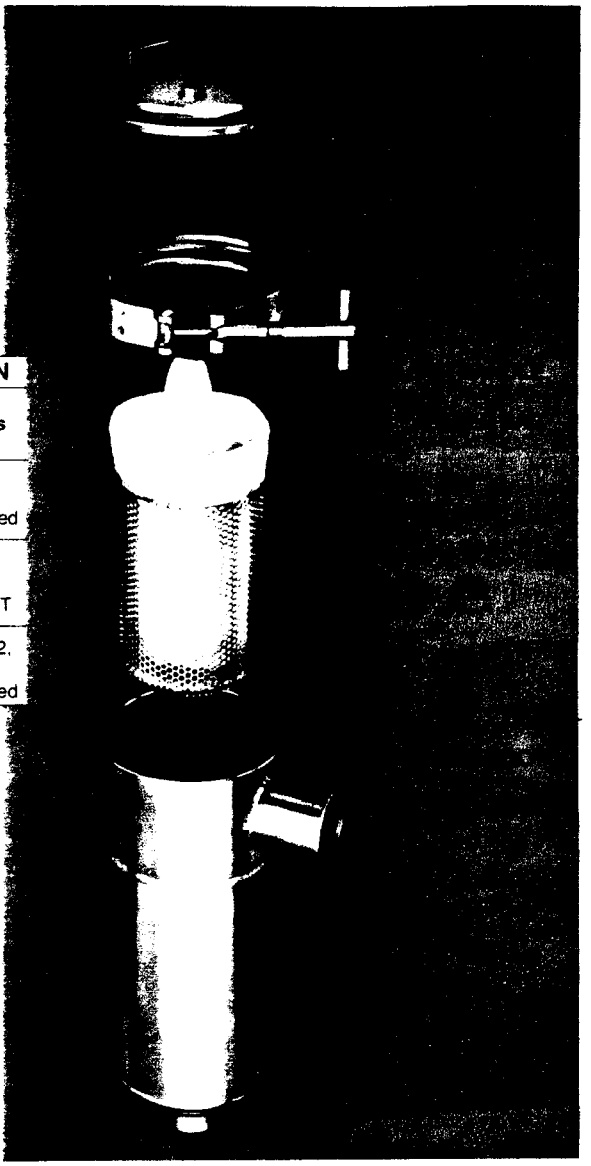
See Rosedale filter catalogs for housing pressure drops. Add the drop for bag and housing to get total △ P.

TABLE III

Bag Materials (Fiber)	COMPATIBILITY WITH Organic Solvents	Animal Vegetable & Petro Oils	Micro Organisms	Alkalies	Organic Acids	Oxidizing Agents	Mineral Acids	Temperature Limitations (max. deg F)
Polyester	Excellent	Excellent	Excellent	Good	Good	Good	Good	325
Nylon	Excellent	Excellent	Excellent	Good	Fair	Poor	Poor	325

Rosedale Filter Housings

Rosedale offers a broad line of housings having filter bag baskets to hold the 6 filter bag sizes. These housings allow easy bag servicing. Covers may be either clamp-on type or with 3 eyebolts: Both open easily without tools. (Flow is from inside out, so all contaminant is caught inside the bag, with no wash-off.) Housings are made of carbon or 304 stainless steel. Two outlet designs are made: On the side opposite the inlet, and in the bottom. The baskets are stainless steel and have 9/64-in. dia. perforations.



BAG INFORMATION					HOUSING INFORMATION		
Size No.	Length (inches)	Dia. (inches)	Surface area (sq. ft.)	Bag Volume (gal.)	Size No.	Max. Pres. (psi)	Inlet and Outlet Sizes (inches)
1	16.5	7.06	2.0	2.1	8-15	150	2, 3 or 4
2	32	7.06	4.4	4.6	8-30		NPT or flanged
3	8	4.12	0.5	0.5	4-6	200 or 300	¾, 1, 1¼,
4	14	4.12	1.0	1.0	4-12		1½ or 2, NPT
7	15	5.50	1.3	1.3	6-12	150	1, 1¼, 1½, 2, 2 or 3,
8	21	5.50	2.0	1.5	6-18		NPT or flanged

Ask for Rosedale catalogs on housing sizes you want.

HOW TO ORDER BETA BAG FILTER BAGS

Build an ordering code as shown in this example:

Example: BB - 10 - 2 - S

Beta Bag

MICRON RATING
(nominal)

1 micron = **1**
10 micron = **10**
12 micron = **12**

BAG SIZE
(dimensions in inches)

Dia. x Length	Symbol
7-1/16 x 16-1/2	**1**
7-1/16 x 32	**2**
4-1/8 x 8	**3**
4-1/8 x 14	**4**
5-1/2 x 15	**7**
5-1/2 x 21	**8**

OPTIONS

Carbon steel ring = **S**
Stainless steel ring = **SS**

Design Details

All Beta Bags have a metal retaining ring sewn in their openings. Standard ring material is carbon steel, with 304 or 316 stainless steel optional. They hold the bag in place and prevent fluid bypassing the element.

Heavy-duty handles, sewn to the reinforced bag lip, are a standard feature. They make bag removal faster and easier.

ROSEDALE PRODUCTS, INC.
Box 1085, Ann Arbor, MI 48106
(313) 665-8201

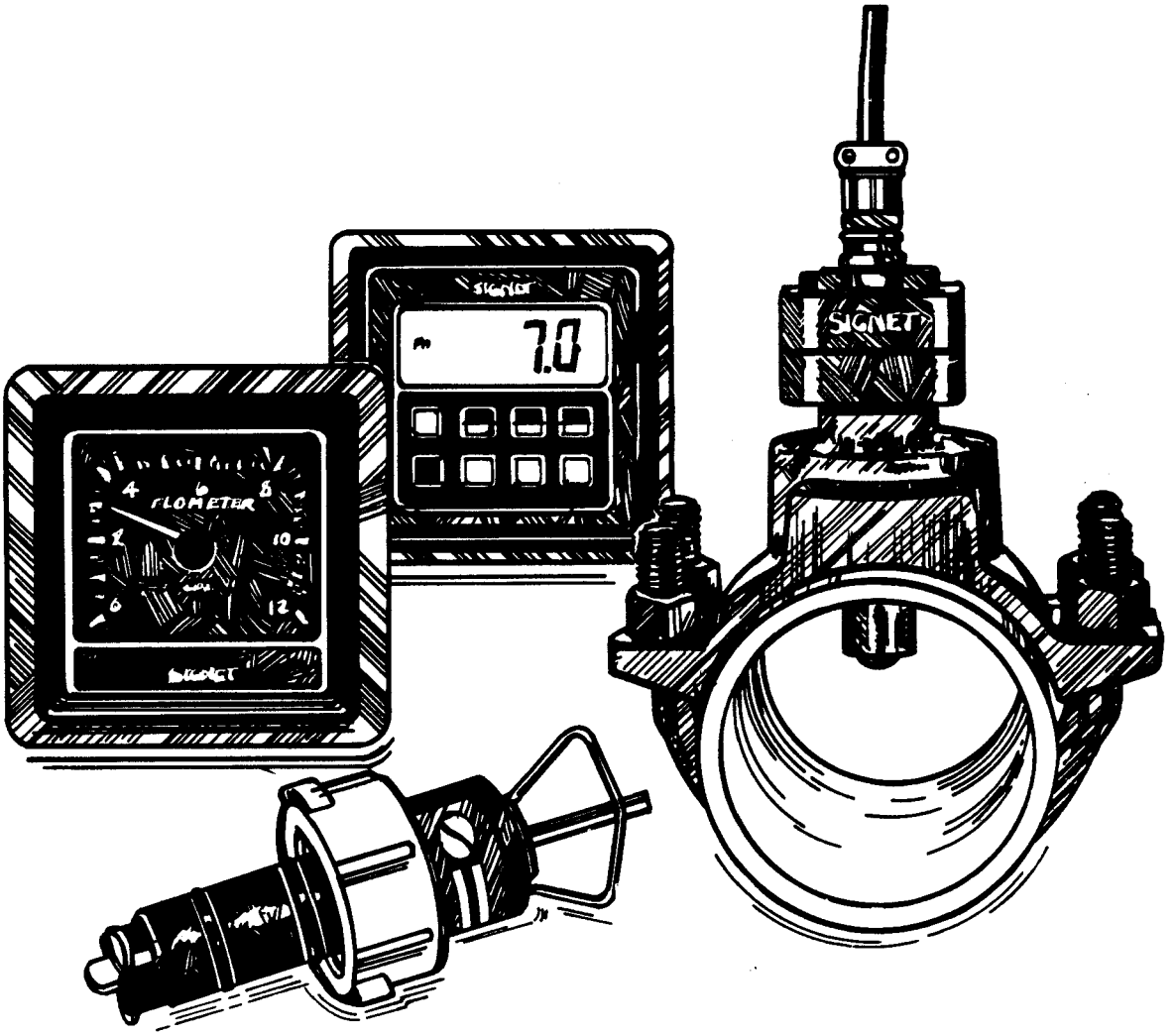
Catalog Beta-100 Litho in U.S.A. 5M785

SIGNET PADDLEWHEEL FLOSENSOR

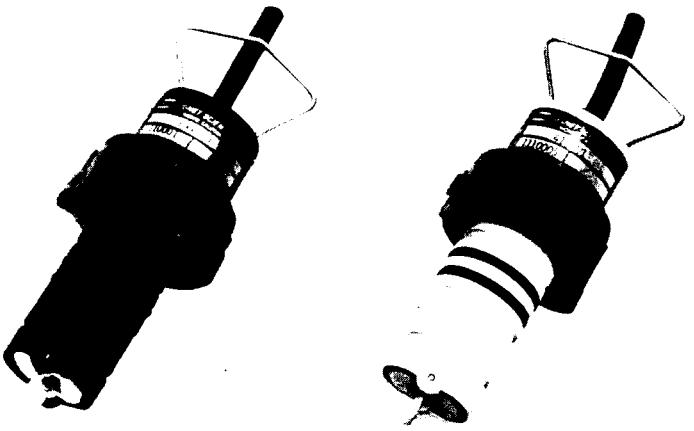
SIGNET SCIENTIFIC

MK 515/415 PADDLEWHEEL FLOSENSORS

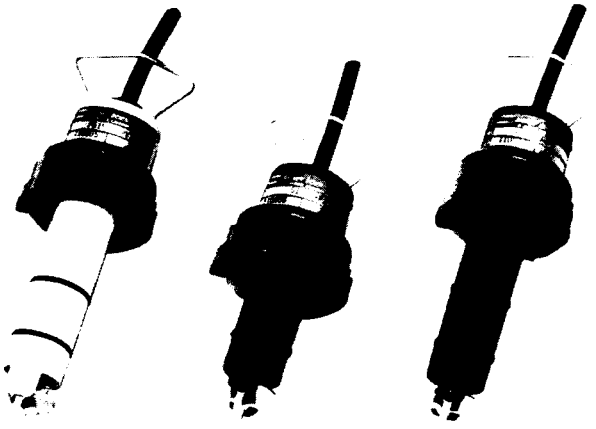
INSTRUCTION MANUAL



MK 515/415 PADDLEWHEEL FLOSENSORS



515 Paddlewheel Flosensor, PVDF (light) and Polypro (dark) shown here in regular and extended housings.



The 415 Hi-Clearance Paddlewheel Flosensor; Polypro (dark) and PVDF (light).

TABLE OF CONTENTS

1.0 INTRODUCTION

This manual contains description, specifications, and instructions for the installation and operation of your Signet MK 515 and 415 Flosensor transducers. PLEASE READ ALL OF THIS INSTRUCTION MANUAL; it will answer most of your questions about these transducers. If you require further assistance, please contact your Signet dealer.

1.1 DESCRIPTION

Your Signet Paddlewheel Flosensor and appropriate Signet indicator measure rate of flow of a liquid in a pipe. The flosensor has a rugged design with no measurable head loss. It is readily removable for inspection and cleaning.

The MK 415 and 515 must be installed in a Signet Installation Fitting for proper operation. The MK 515 is designed for installation in MK 316 fittings or the MK 319 Wet-Tap Assembly. The MK 415 sensor is designed for installation in MK 416 series fittings.

A plug is supplied with each ordered Signet Pipe Fitting to seal the fitting when the flosensor is removed. Both the MK 515 and MK 415 are available with a glass-filled polypropylene or PVDF (polyvinylidene fluoride) housing. The fluid-tight flosensor seal is made with two standard Viton O-rings (see Figure 1) which may be easily replaced. Highly stable corrosion-resistant Kalrez O-rings are available as a separate item. See section 6.1 (Parts List) for specific information. The paddlewheel contains 4 permanent magnets sonically welded into a PVDF paddle.

The MK 515 and MK 415 Flosensors are similar in most respects, with the exception that the MK 415 provides more clearance between the paddlewheel and its surrounding components, to accomodate liquids containing suspended particles comprising up to 10% of the liquid volume. Because of its increased clearance, the MK 415 has a larger body diameter, and must be installed in specially designed Signet MK 416 fittings.

The MK 515 is available in nine versions and the MK 415 in two versions to accommodate various pipe sizes and applications (see Table 1). The -P0, -P1, -P2 polypropylene versions of the MK 515 are for standard applications. The -V0, -V1, -V2 PVDF versions are for severe-environment applications. Housing extensions for all MK 515 flosensors are made from CPVC (Chlorinated Polyvinyl Chloride). The -P3, -P4, -P5 polypropylene specially extended versions are for use with the MK 319 Wet Tap (See Table 2). The Wet Tap is an interface between the sensor and Signet installation fittings. It provides a safe and fast method of removing the flosensor from the pipe fitting, while the pipe is under normal operating pressures up to 100 psig maximum.

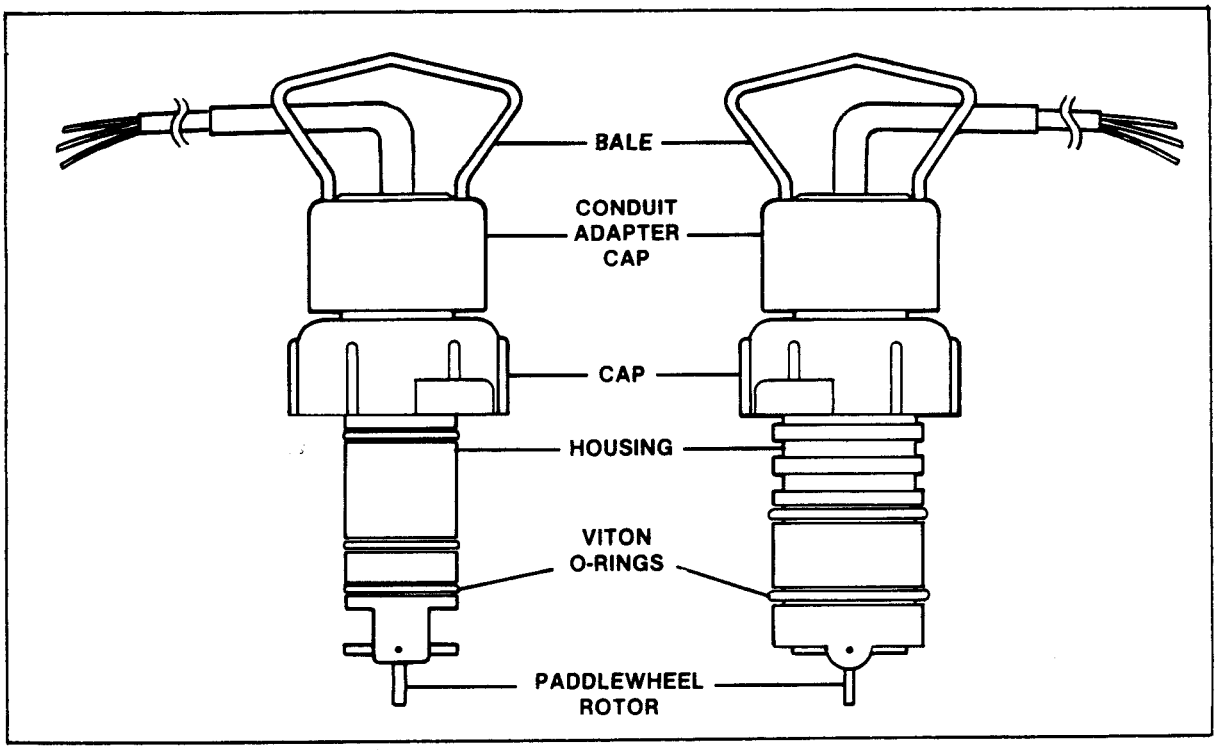


Figure 1. Detailed drawing of the MK 515 (left) and MK 415 (right).

TABLE 1

FLOSENSOR	PART NO.	PIPE SIZE
Standard Polypropylene	MK 515-P0	½" to 4"
Extended Polypropylene	MK 515-P1	5" to 8"
Double Extended Polypropylene	MK 515-P2	10" & up
Standard Polypropylene (for MK 319)	MK 515-P3	½" to 4"
Extended Polypropylene (for MK 319)	MK 515-P4	5" to 8"
Double Extended Polypropylene (for MK 319)	MK 515-P5	10" & up
Standard PVDF	MK 515-V0	½" to 4"
Extended PVDF	MK 515-V1	5" to 8"
Double Extended PVDF	MK 515-V2	10" & up
High-Clearance Polypropylene	MK 415-P0	2" to 12"
High-Clearance PVDF	MK 415-V0	2" to 12"

TABLE 2

MK 515/415 FLOSENSOR MATERIALS AVAILABLE

Model No.	MK 515-0, -1, -2		MK 515-3, -4, -5		MK 415	
Sensor Designation	P	V	P	V	P	V
Part						
Paddlewheel Material	V	V	V	V	V	V
Shaft Material	Ti	H	Ti	H	Ti	H
Main Housing Material	P	V	P	V	P	V
Extension Housing Material (see Note 3)	CP	CP	CP	N/A	N/A	N/A
O-Ring Material	— — — Viton — — —					

Note:

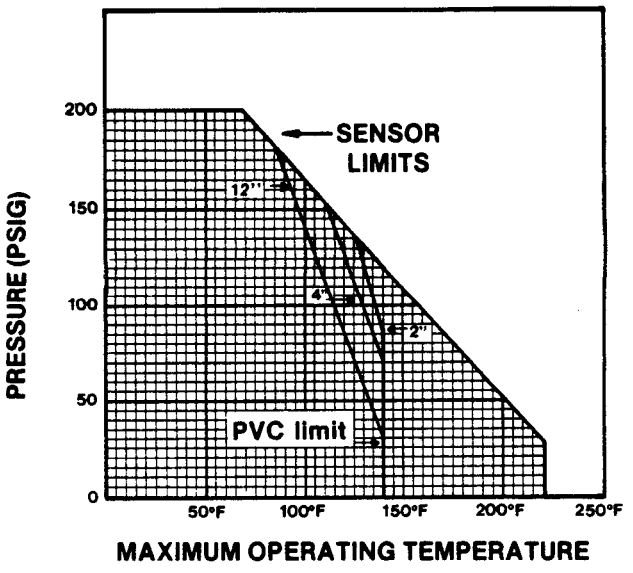
1) P = Polypropylene
V = PVDF (Polyvinylidene Fluoride)
CP = CPVC (Chlorinated Polyvinyl Chloride)
Ti = Titanium
H = Hastelloy

2) Model number and sensor designation must be specified when ordering.

3) -0 version includes main housing material only

1.2 SPECIFICATIONS

	MK 515	MK 415
Output Signal	1 V peak-to-peak per ft/sec.	0.44 V peak-to-peak per ft/sec.
Output Frequency	5-6 Hz per ft/sec.	4-5 Hz per ft/sec.
Source Impedance	8 kilohms	8 kilohms
Flow Rate Range	1 fps to 50 fps	1.5 fps to 50 fps
Linearity	± 1% over full range	± 1% over full range
Output Accuracy	± 1% over full range	± 1% of full range
Repeatability	± 0.5% of full range	± 0.5% of full range
Pressure Rating	200 psig max. @ 20°C (68°F) (see Figure 2); -P3, -P4, and -P5 versions rated @ 100 psig max.	200 psig max. @ 20°C (68°F) (see Figure 2)
Temperature Rating	105°C (220°F) max. @ 25 psig (see Figure 2)	105°C (220°F) max. @ 25 psig (see Figure 2)
Maximum % Solids	1% of fluid volume	10% of fluid volume
Bottom Diameter	1.05	1.36
Standard Cable Length	25 ft.	25 ft.



NOTES: (1) Do not use flosensors in applications where pressure/temperature points are greater than values within the area of the curve. Special fittings may restrict these limits.

(2) To calculate pressure (P) or temperature (T) for any point within the area of the curve, $P = 281.7 - 1.167\,T$, therefore, $T = \frac{281.7 - P}{1.167}$.

Figure 2. Pressure/temperature limitations for Signet flosensor transducers. Note reduced curve for PVC fittings with 2-inch, 4-inch and 12-inch pipes.

2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION

When unpacking your MK 515 or 415 package, be sure you have received everything (see Figure 3). Carefully check each item for any damage incurred during shipment. If damage has occurred, promptly notify your dealer and the shipping carrier.

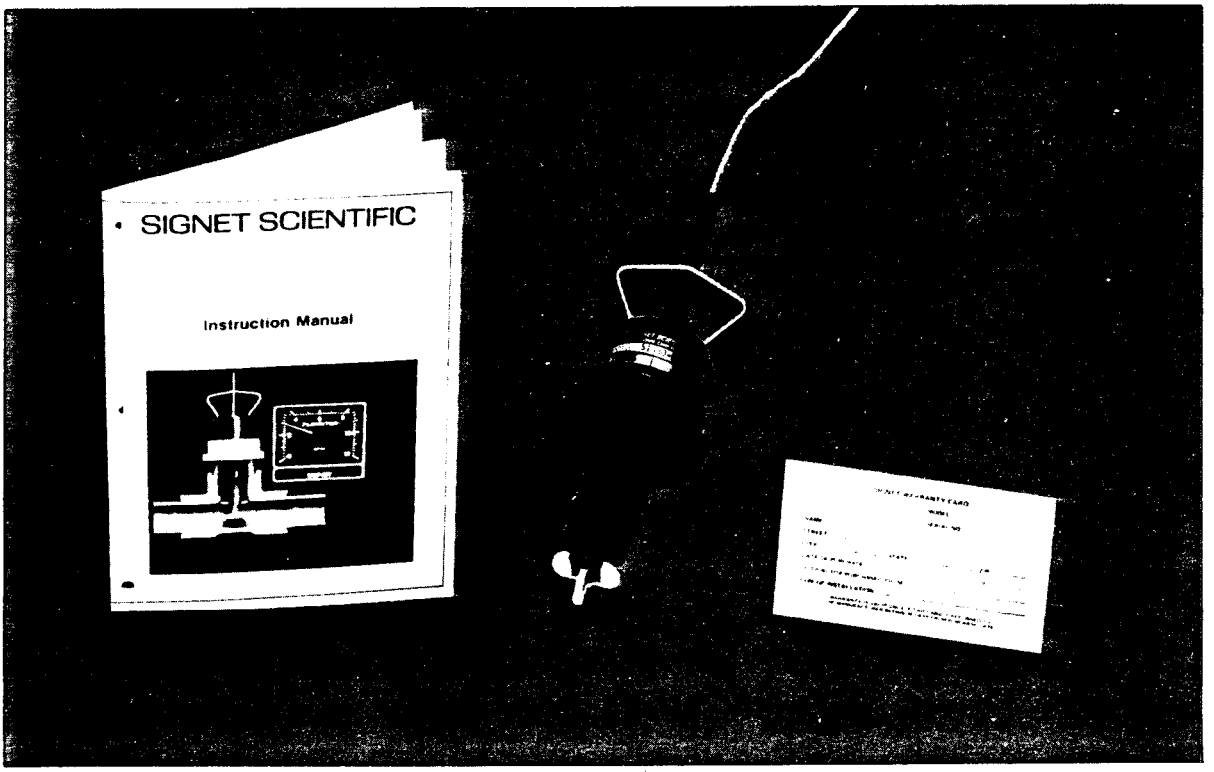


Figure 3.

The following items are included in your flosensor package:

1. MK 515 or MK 415 Flosensor

2. Instruction manual and warranty card

Please fill out and return the warranty card as soon as possible.

2.2 INSTALLATION FITTINGS

Signet Flosensors are designed to measure flow rate in full pipes. To accomplish this, a Signet Pipe Fitting must be installed in the pipe to receive the Flosensor. A wide variety of fittings are available from your dealer for virtually any type and size of pipe.

Side mounting of the fitting and flosensor is most desirable for horizontal pipe runs (see Figure 4A). However, if no suspended particles are present in the liquid, a bottom mounting is best (see Figure 4B). The flosensor may still function adequately in a top or vertically mounted position (see Figure 4B), but there must not be any suspended particles in the liquid and the pipe must be absolutely full.

Vertical mounting of the flosensor runs the risk of having either air bubbles or sediment interfere with the continuous action of the paddlewheel. For vertical pipe runs, the location of any flow disturbance will dictate the best flosensor installation location.

The installation location of the Signet Pipe Fitting and Flosensor must be in a free-flowing straight-run section of the pipe. This section must be at least 10 diameters down-stream of any minor flow changes. There must be at least 5 diameters of free-flowing straight-runs beyond the fitting (see Figure 5). Major up or down-stream obstructions will require longer straight runs. A partially open butterfly valve, for example, may require 50 diameters of free flow for adequate liquid stability at the flosensor.

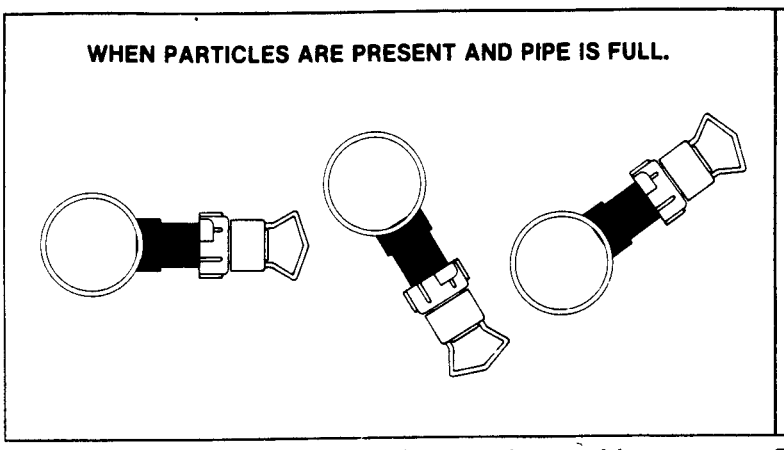


Figure 4A. Some suggested side-mounting positions.

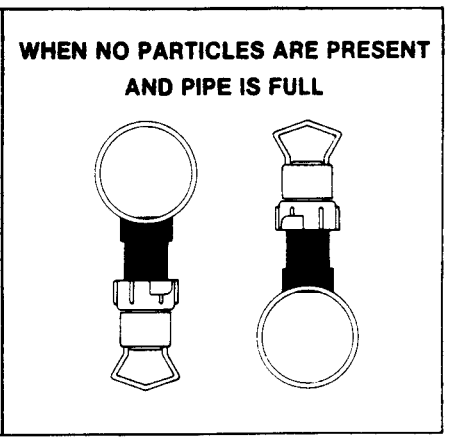


Figure 4B. Bottom and top-mounting positions.

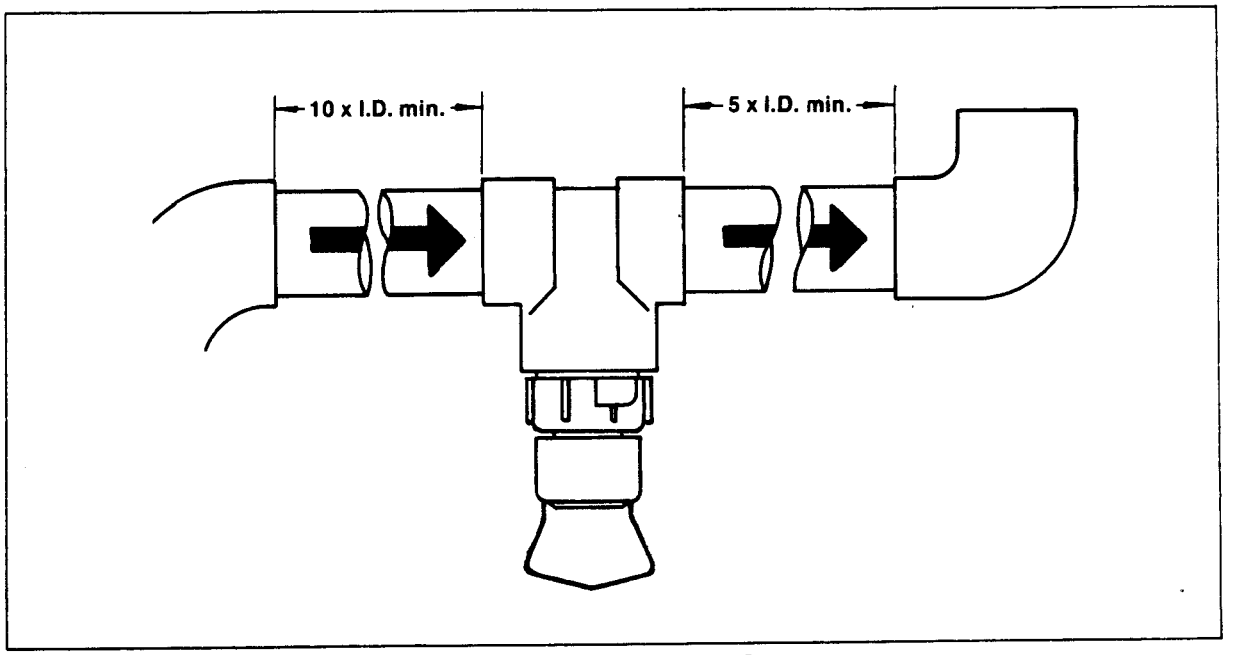


Figure 5. Installation location of the Signet Pipe Fitting & Flosensor.

2.3 INSTALLATION OF SPECIFIC PIPE FITTINGS

The installation of PVC, CPVC, stainless, galvanized, brass, brazolet, and weldolet fittings are covered in this section. Typical pipe-fitting installations are shown in Figure 6.

2.3.1 PVC and CPVC

1. Twist-on PVC and CPVC fittings:
   Wrap threaded pipe ends with Teflon tape and secure fasteners.

2. Tapping saddle for PVC schedule 40 and 80, CPVC; 2 inches to 8 inches:

   A. Select area for fitting installation (see 2.2 Installation Fittings).
   B. Drill a 1-7/16 inch hole in the pipe. For extended flosensors, a 2-¼ inch hole will be needed. This applies to pipes over 4 inches.
   C. Prime the area to be glued with either P-70 PVC primer or P-72 CPVC primer with respect to the fitting material.

(continued)

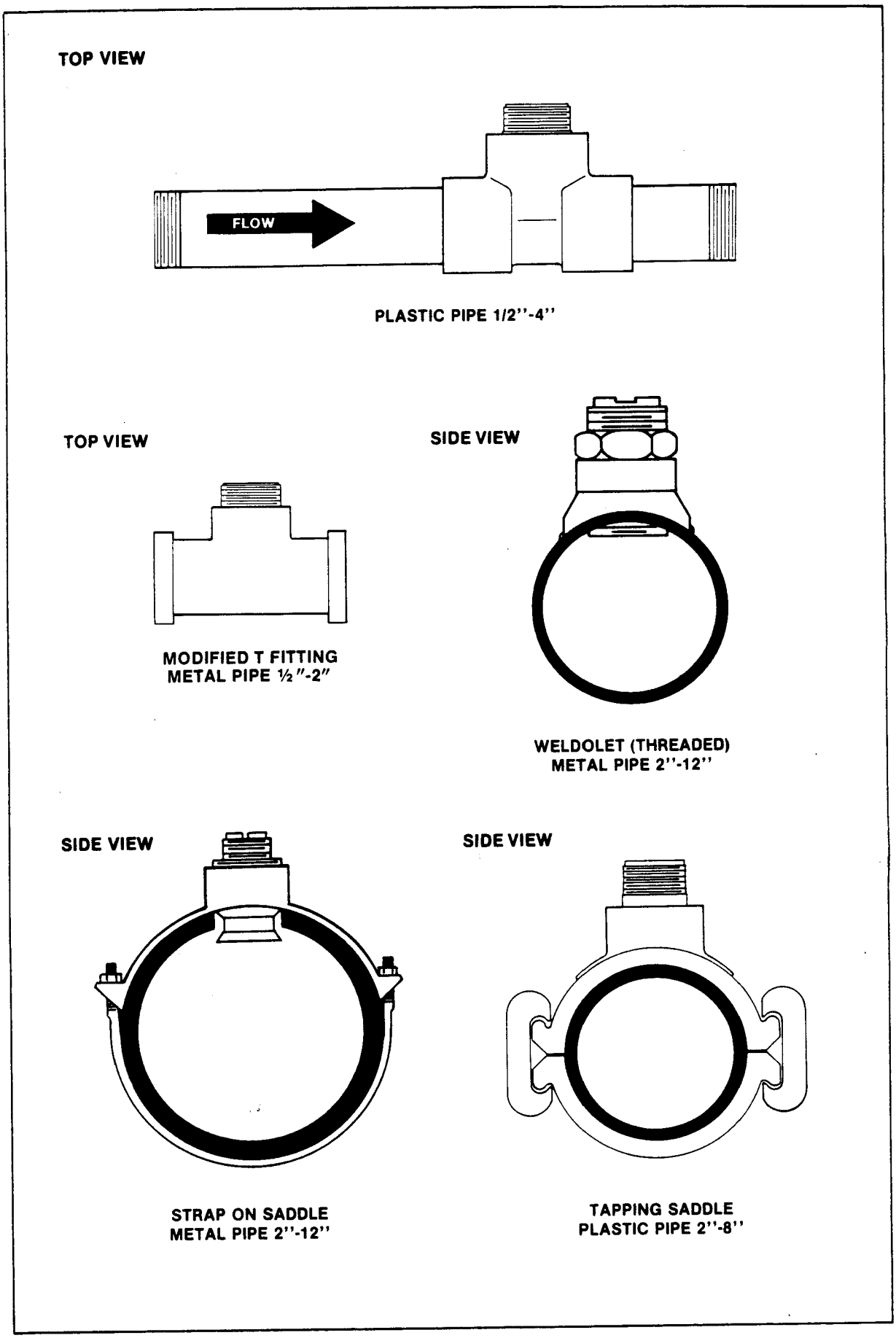


Figure 6. Typical pipe fitting installations.

D. Apply glue (#711 for PVC or #714 for CPVC) to all areas to be glued.
E. Install all fitting pieces so that the insert fits in the hole in the pipe. Put the two saddle pieces around the pipe and alternately tap the wedges over the exposed ears.

> Note: The arrows on the wedges must match the direction of the arrows on the pipe fitting.

3. PVC and CPVC pipe larger than 8 inches must use a strap-on saddle. See 2.3.2 stainless, galvanized, or brass, installation instruction 2, for strap-on saddles.

2.3.2 Stainless, Galvanized, and Brass

1. T fittings:
   Apply Teflon tape to the pipe ends, and install the fitting snugly.

2. Strap-on saddles:

   A. Drill a 1-7/16 inch hole in the pipe. For Extended Flosensors, a 2-¼ inch hole will be necessary. This applies to pipes over 4 inches.
   B. Install the fitting piece so that the insert fits in the hole in the pipe.
   C. Tighten clamping nuts alternately to eliminate any chance of leaks.

2.3.3 Brazolet and Weldolet

1. A certified welder, using the proper techniques, should install these fittings.

   A. Remove the insert (see Figure 7) before installing the fitting.
   B. Drill a 1-7/16 inch hole in the pipe. For Extended Flosensors, a 2-¼ inch hole will be necessary. This applies to pipes over 4 inches.
   C. Deburr the hole. This hole must be completely free of all burrs and projections.
   D. Install the fitting so that the insert will fit into the hole in the pipe.
   E. Teflon-tape the insert.
   F. Reinstall the insert, referring to the "A" dimension in Figure 7.

> NOTE: In all cases, the slots in the plastic insert must be parallel to the liquid flow. DO NOT USE ANY TOOL ON THE PLASTIC INSERT. YOU MAY MAR THE THREADS. HAND-TIGHTEN ONLY. RE-TAPE THE INSERT WITH TEFLON WHEN REMOVED.

REMOVE INSERT BEFORE WELDING.

AFTER INSTALLATION OF WELDOLET USE TEFLON TAPE ON INSERT. "A" DIMENSION SHOULD BE APPROXIMATELY _____.

INSURE THAT SLOTS ARE IN LINE WITH PIPE.

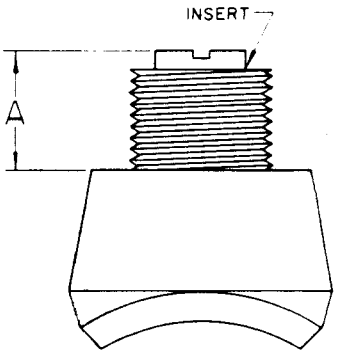


Figure 7. The above Installation Dimension Tag is attached to each fitting.

2.4 FLOSENSOR INSTALLATION

1. Check the paddlewheel. It should rotate freely when flicked with a finger, or by directing a stream of water or air across it to stimulate liquid flow.

2. Insert the flosensor in the Signet Pipe Fitting.

3. Align the bail parallel to the pipe.

4. Make sure that the flosensor is fully seated in the fitting slots. The flosensor will not turn once it is properly installed.

5. Tighten the plastic cap finger-tight to retain the flosensor. DO NOT USE ANY TOOL ON THE CAP. HAND TIGHTEN ONLY TO AVOID DAMAGE.

> NOTE: For cable runs longer than 25 feet, splice additional cable length to the existing flosensor cable, and waterproof the splice with high-quality silicone sealant or the equivalent. Up to 200 feet of total cable length will not affect flosensor operation.

2.5 SENSOR CONDUIT KIT

(See Section 6.2 Optional Accessories)

Signet MK 515/415 Flosensors have a specially designed cap that allows installation of flexible conduiting (Liquitite®). A Signet Sensor Conduit Adapter Kit (MK 515.89) is required for this particular type of installation.

The MK 515.89 Kit consists of two separate adapters. The right angle adapter is designed for insertion in the flosensor, while a straight adapter is included for use with Signet controllers and/or the MK 500.78 waterproof housing. Both adapters are designed for use with ½ inch conduit knockouts. The conduit end accepts 3/8 inch flex conduit.

For correct flexible conduiting installation, first remove the cap-plug as shown in Figure 8. Thread the sensor cable through the right angle adapter, and carefully screw it into the adapter cap. (The rubber boot can be discarded when the conduit adapter kit is used).

Once the right angle adapter is screwed into the cap, attach the section of flexible conduit by threading it into the adapter. Complete the installation by connecting the straight adapter to the conduit. This adapter can then be attached to the appropriate Signet junction box.

NOTE: Special conduiting material can be obtained from your local electrical supplier.

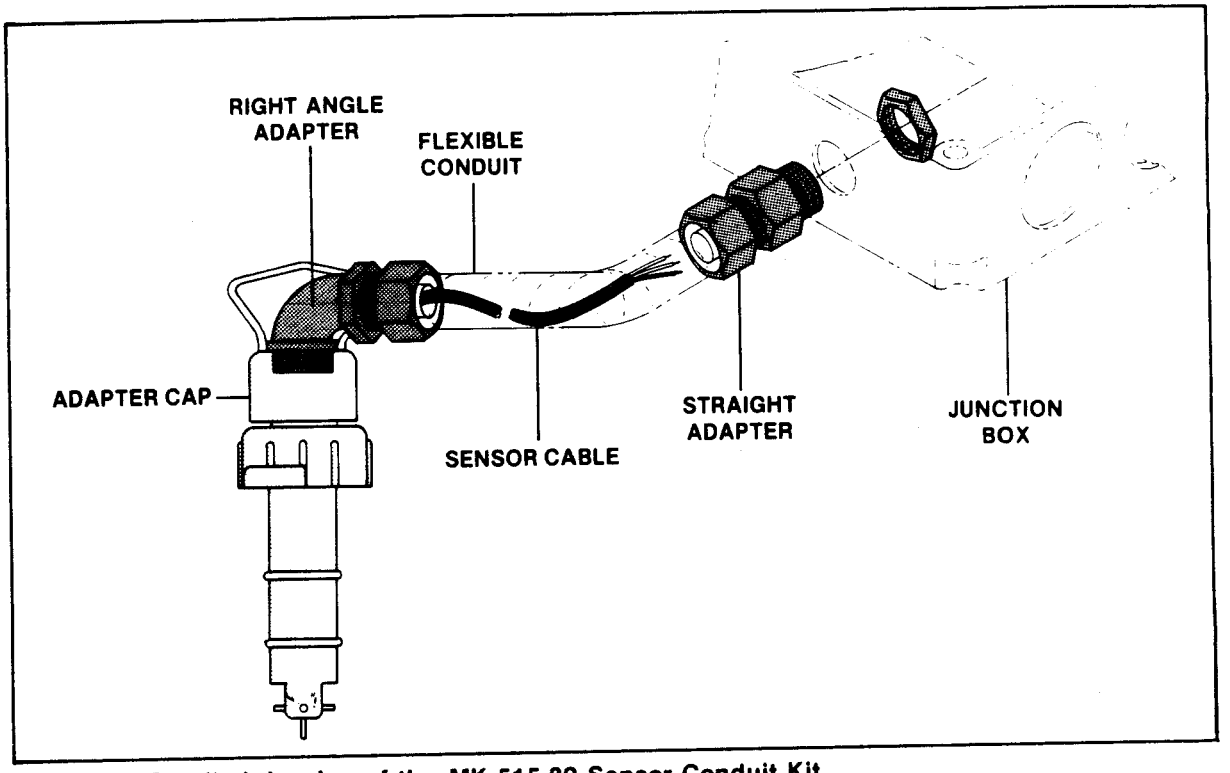


Figure 8. Detailed drawing of the MK 515.89 Sensor Conduit Kit.

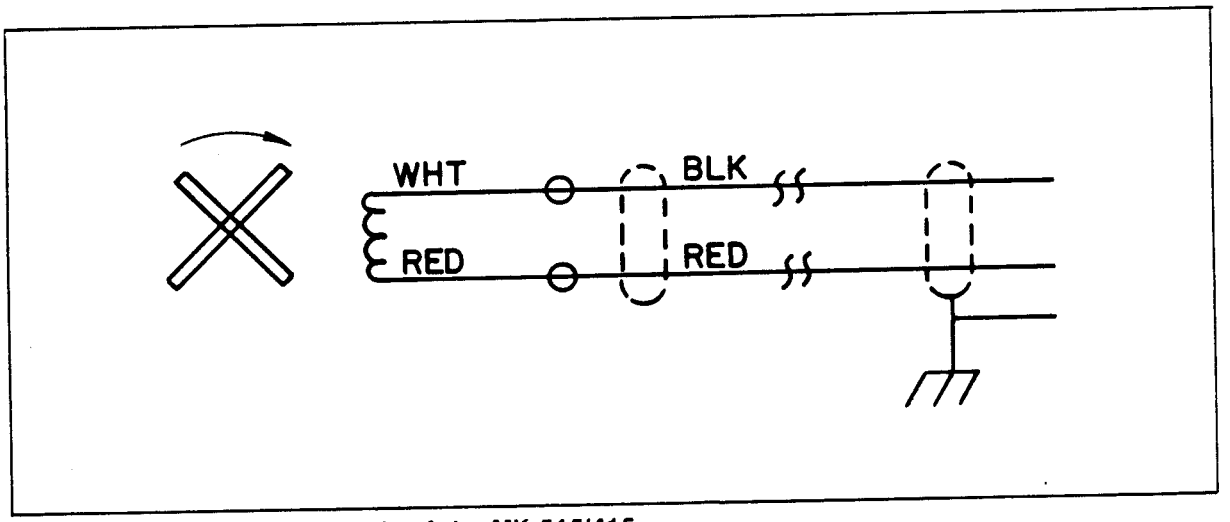


Figure 9. Simplified schematic of the MK 515/415.

3.0 THEORY OF OPERATION

A simplified schematic of the MK 515/415 is shown in Figure 9. The flosensor is installed in a pipe line to measure flow rate. The flow passing by the flosensor paddlewheel rotates the paddlewheel, moving the magnets past a coil in the transducer body. An ac voltage is induced in the coil by the rotating magnets of the paddlewheel.

Both the frequency and the amplitude of the output of the coil are then directly proportional to the velocity of the fluid flow in the pipe. A complete cycle occurs every time two of the paddlewheel blades go by the coil; therefore, two entire cycles are generated for each paddlewheel rotation.

4.0 TROUBLESHOOTING

Major problems with the MK 515/415 can occur when either flosensor is being used for something it was not designed to do, or when it has been improperly installed. The paddlewheel is designed to rotate on the shaft; the shaft should not rotate with respect to the housing. The paddlewheel must turn freely. If it does not, clean the paddlewheel assembly as follows:

1. Remove the flosensor from the pipe and insert the plug into the pipe fitting. Clean any external debris from the paddlewheel.

2. For the MK 515, using a small flat-bladed screwdriver, gently pry one of the paddlewheel mounting ears away from the pin (see Figure 10A). The MK 415 pin does not have a shoulder and may be pressed straight out (see Figure 10B).

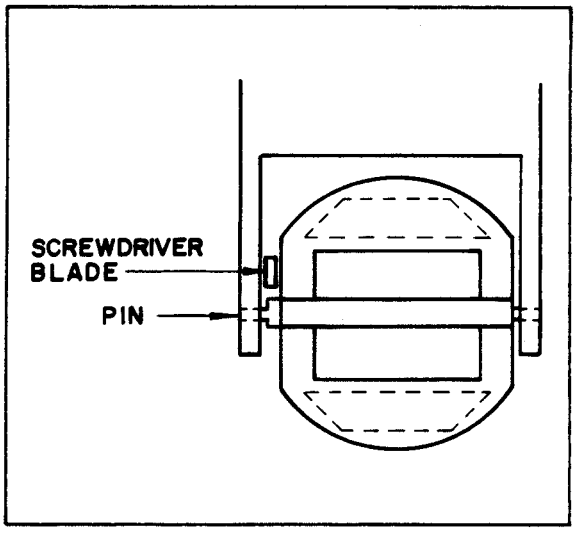


Figure 10A. Removal of MK 515 paddlewheel pin.

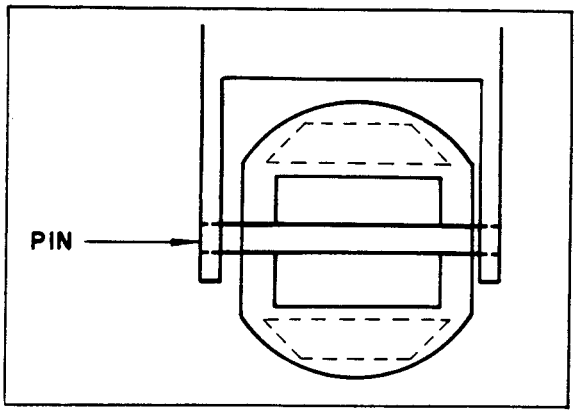


Figure 10B. Removal of MK 415 paddlewheel pin.

3. When one end of the pin is free, gently work the paddlewheel and pin out of the remaining mounting ear.

4. Thoroughly clean the pin, paddle, and pin holes with a wire brush and/or toothpick along with alcohol and/or soap and water.

5. To reinstall the paddlewheel and pin, reverse steps 1, 2, and 3.

6. After cleaning, the paddlewheel should spin freely without binding or sticking.

5.0 CARE AND MAINTENANCE

The MK 515/415 should require minimal care during the life of the flosensor. Periodically, check the O-rings and replace them when necessary. The paddlewheel must always turn freely. Be sure that connections to the Signet indicator and additional cable length, if any, are still intact. Lubricate the barrel and O-rings with G.E. Silicone Compound #G660 every three months. Keep the paddlewheel and pin free of any lubrication. A Spare Rotor Kit consisting of a spare paddlewheel, O-rings, and a pin is available (see 6.2 Optional Accessories). Actual maintenance intervals will have to be determined in operation. It is suggested that you check your flosensor periodically until some history of your specific application can be created.

6.0 APPENDICES

6.1 PARTS LIST

MK 515

Spare Paddlewheel	MK 15.38-1
Titanium Rotor Pin	MK 15.46-1
Hastelloy Rotor Pin	MK 15.46-2
Spare Viton O-rings	PP-1220-0021
Polypropylene Flosensor Cap	MK 515.42

MK 415

Spare Rotor Kit: PVDF paddlewheel, titanium shaft, Viton O-rings (2) ..... MK 415.31

6.2 OPTIONAL ACCESSORIES/ REPLACEMENT PARTS

Tantalum Rotor Pin ..... MK 15.46-3
Stainless Steel Rotor Pin ..... MK 15.46-4
EPR O-Ring PP-1224-0021
Polypropylene Plug ..... MK 315.36-1
PVDF Plug ..... MK 315.36-2
Kalrez O-rings PP-1228-0021

MK 415

Polypropylene Plug ..... MK 415.36
PVDF Plug ..... MK 415.36V

Miscellaneous

Conduit Sensor Kit: one straight and one right-angle ½" NPT adapter for 3/8" conuit ..... MK 515.89
Wet Tap: interface between 515-3, -4, and -5 only and pipe fitting to allow flosensor removal while under operating pressure MK 319
Flow Test Indicator ..... MK 561
Cable Adapter Kit: Flosensor-to-Tester and Tester-to-Flometer adapter cables for the MK 561 MK 561.60
Cable Adapter Kit: MK 515/415 Flosensor to Series 300 Indicator/Controller, adapter cables .. MK 500.61-2

6.3 WARRANTY

SIGNET SCIENTIFIC COMPANY LIMITED TWO-YEAR WARRANTY

Signet Scientific Company warrants its instruments to be free from defects in material and workmanship under normal use for a period of two years from date of purchase by the initial owner, or three years from date of manufacture, whichever comes first, as described in the following paragraphs.

This warranty does not cover defects caused by abuse or electrical damage. Signet will not cover under warranty any instruments damaged during shipment to the factory, less case, or improperly packed. Repair attempts by anyone other than authorized service personnel will void the warranty. Proof of date of purchase will be required before warranty repairs can begin.

Parts which prove to be defective in the first year will be repaired or replaced free of charge including labor, shipped F.O.B. our factory or a designated service center (address furnished upon request).

Only non-moving parts, such as electrical components, which prove defective during the second year are warranted. Meter movements will not be covered. All units qualifying for warranty service after one year are subject to a maximum service charge of $15.00 for replacement of non-moving parts.

Items returned for warranty repair must be shipped prepaid and insured. Warranty claims are processed on the condition that prompt notification of a defect is given to Signet within the warranty period. Signet shall have the sole right to determine whether in fact a warranty situation exists.

The Signet warranty does not cover travel time, mileage expenses, removal, reinstallation, or calibration.

Signet is continually making design changes and improvements that adapt to the original circuit configuration. These will be incorporated as required in older units on a minimal-charge basis while under warranty.

CONSEQUENTIAL DAMAGES

Signet Scientific Company shall not be liable for special consequential damages of any nature with respect to any merchandise or service sold, rendered, or delivered.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

7.0 MANUAL CHANGE INFORMATION

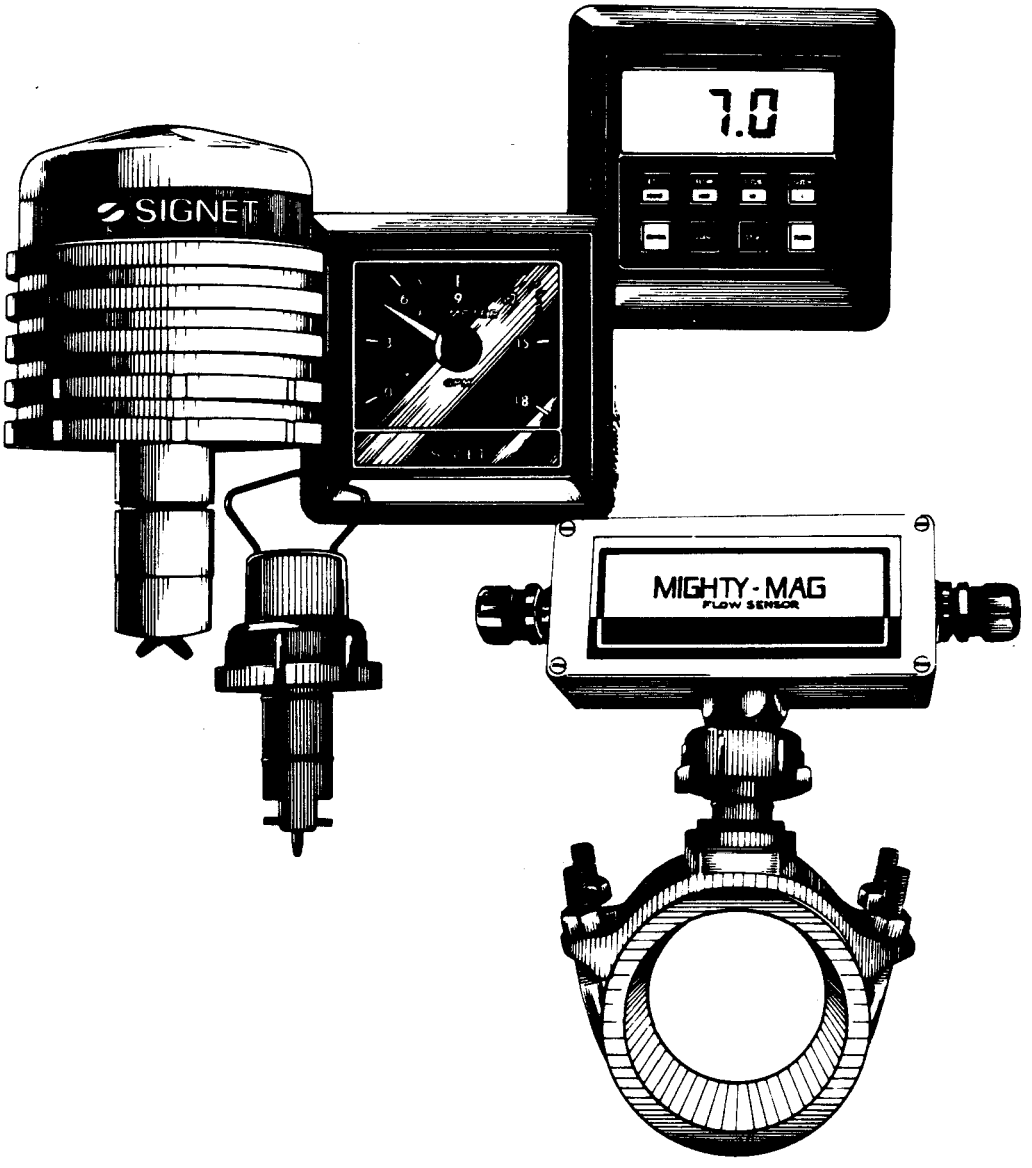
Signet continually strives to keep up with the latest electronic and design developments by adding circuit, component, and design improvements to its instruments as soon as they are developed and tested. Sometimes, due to printing and shipping requirements, we cannot immediately get these changes into printed manuals. Therefore, your manual may contain new change information on the following pages. A single change may affect several sections. Be sure to make all changes within the appropriate sections of this manual.

SIGNET ACCUM-U-FLOW INDICATOR

SIGNET SCIENTIFIC

MK 575/575R
ACCUM-U-FLO

INSTRUCTION MANUAL



MK 575/575R
ACCUM-U-FLO

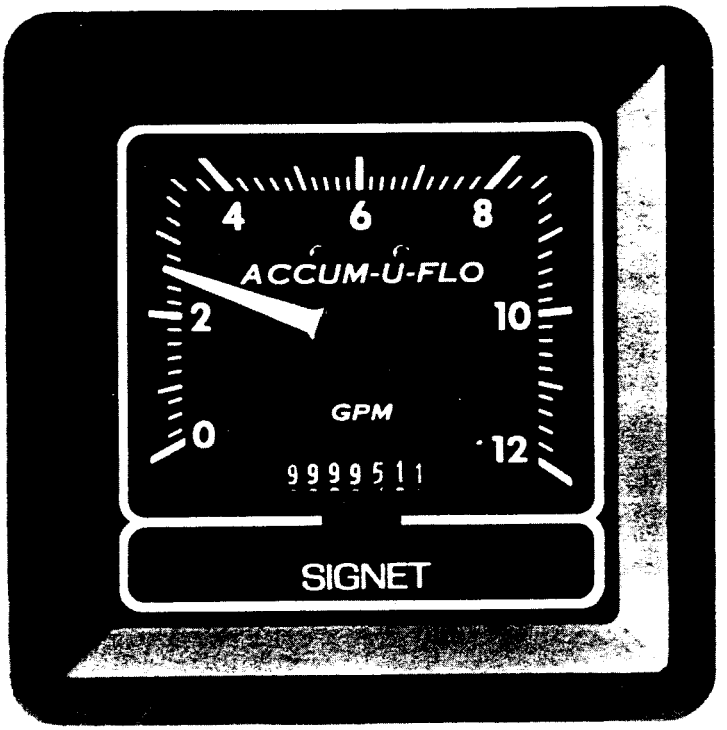


TABLE OF CONTENTS

1. INTRODUCTION

This manual contains description, specifications, and instructions for the installation and operation of your Signet MK 575/575R Accum-u-flo indicators. PLEASE READ ALL OF THIS INSTRUCTION MANUAL; it will answer most of your questions about installation and calibration of this indicator.

The MK 575 indicates flow rate and total flow of a liquid in a pipe by measuring the signal generated by a Signet Flosensor. This measurement is displayed on a large, graduated analog meter. An accumulator counter totalizes the volume of flow.

The MK 575 is compatible with all Signet Flosensor transducers. Using a compatible Flosensor, and other Signet instruments, systems can be assembled to measure, control, and/or integrate flow over a wide range of parameters.

The MK 575 contains a high-torque meter movement to ensure proper operation in high-vibration environments. The MK 575 requires no routine maintenance.

The MK 575 requires 12-volt dc at 315 milliamps. A 12-volt dc converter is included which allows you to power the indicator from 117 volts ac nominal.

1.1 DESCRIPTION

The MK 575 uses digital electronics to measure both total volume and rate of flow in a system. The indicator is offered in two versions to measure total volume. The MK 575 measures accumulated volume on a 7-digit non-resettable counter. The MK 575R performs this measurement on a 5-digit resettable counter. Reset the counter by pushing in the reset button on the front panel immediately below the counter display.

Volume and rate measurements are usually indicated in gallons or liters per minute, but the indicator and counter can be calibrated to measure virtually any volumetric unit from milliliters to acre-feet.

The analog meter of the MK 575 deflects 245 degrees full-scale with large numbers on a 5-½ inch dial for easier reading at a distance. The meter movement has ± ½% of full scale repeatability and is internally damped to reduce pulsation caused by flow fluctuations.

The MK 575 can be mounted in an instrument panel or on the optional mounting bracket (see 6.2 Optional Accessories). The Flosensor output connects to the terminal strip on the rear of the MK 575 case. The meter face is waterproof. However, if the unit is to be installed in a wet or dusty environment, it should be housed in a Signet MK 500.75 NEMA-rated enclosure. The MK 500.78 Conduit Mounting Kit (see 6.2 Optional Accessories) is a waterproof enclosure on the rear of the MK 575. It provides conduit adapters to permit housing all cabling in conduit.

NOTE:
THE STATEMENTS REFERRING TO THE MK 575 ALSO INCLUDE THE MK 575R.

1.2 SPECIFICATIONS

Input Signal Amplitude	0.4 volt peak-to-peak minimum
Input Frequency Range	5 to 200 Hz (5 to 500 Hz when used with MK 505)
Input Impedance	47 kilohms (10 kilohms when used with MK 505)
Rate Display Accuracy	± 1% of full scale
Rate Display Repeatability	± ½% of full scale
Volume Display Accuracy	± 2% of reading at calibrated flow rate, ± quantizing error (usually negligible)
Outputs:	
Pulse: TTL Compatible	source, 6.5 milliamps at 4.6 V sink 25 milliamps at 0.4 V
Frequency	synchronous with input
Pulsewidth	5 milliseconds nominal

(continued)

Counter: TTL Compatible	source, 5 milliamps sink, 5 milliamps
Frequency	synchronous with accumulator
Pulsewidth	100 milliseconds ± 20%
Power Requirements	12 Vdc, 315 milliamps. Not damaged by voltage as high as 25 Vdc. Contains reverse voltage protection.
Ambient Operating Temperature	0°C to 60°C (32°F to 140°F)
Weight	1.8 lbs. (0.82 kilograms)
Power Supply Converter:	
Input	117 Vac nominal at 0.19 amp max.
Output	12 Vdc at 1.2 amps

2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION

When unpacking your MK 575 package, be sure you have received everything (see Figure 1). Carefully check each item for any damage incurred during shipment. If damage has occurred, promptly notify your dealer and the shipping carrier.

The following items are included in your MK 575 package:

1. MK 575 Accum-u-flo indicator
2. M15129 Mounting Strap
3. P30075 Power Converter
4. Instruction Manual and Warranty Card

Please fill out and return the Warranty Card as soon as possible.

2.2 INDICATOR INSTALLATION

The MK 575 may be installed as far as 200 feet from the Flosensor. If the indicator location is beyond the standard 25-foot sensor cable length, an extension cable must be used. Additional distances, or systems incorporating several instruments, may require the use of a Signet MK 514 Signal Conditioner. The MK 575 may be used in combination with all Signet indicating and controlling instruments.

The MK 575 may be mounted in an instrument panel having a 5.1 inch square hole with sufficient clearance around it to accommodate the 5-½ inch front bezel of the indicator. There must be a minimum 4-¾ inch rear clearance.

Installation

1. Loosen the clamp ring (see two "A" screws in Figure 2).

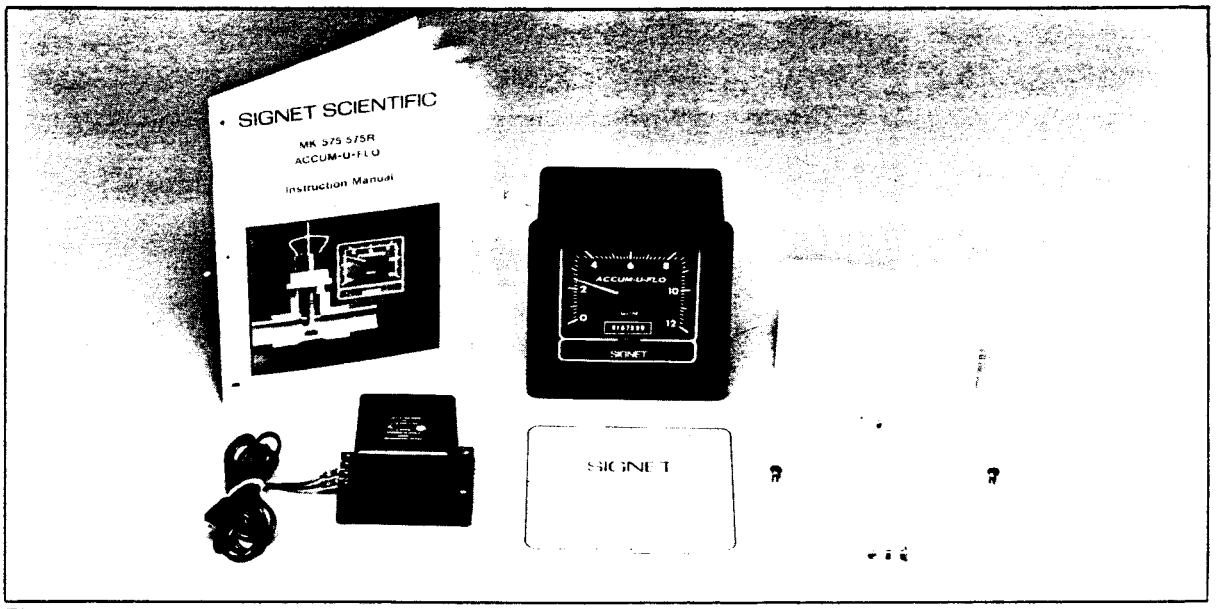


Figure 1.

2. Insert the rear of the indicator through the front of the prepared hole.

3. Slip the clamp ring over the rear of the indicator. With the front flange of the indicator held tightly against the front of the panel, position the clamp ring snugly against the rear of the panel.

4. Tighten the two "A" screws.

5. Seal the front flange firmly against the panel by tightening the two "B" clamping screws hand tight (see Figure 2). Do not overtighten these screws. Overtightening will cause the clamp ring to slip.

6. Remove the plastic safety shield from the rear terminal strip by pinching inward each pair of plastic locking latches. Then connect the Flosensor output cable to the appropriate XDCR (transducer) terminals on the rear of the indicator case (see Figures 3 and 4).

7. Connect a 12 Vdc source or the Signet Power Converter to the Vdc + and − terminals on the rear panel of the MK 575. When using the supplied Signet Power Converter, connect 117 Vac nominal to the input terminals of the converter. Then connect either adjacent + and − output terminal pair of the converter to the 12 Vdc + and − terminals respectively, on the rear panel of the MK 575. The extra pair of 12 Vdc output terminals on the converter is available to power another Signet indicator requiring the same dc source as the MK 575. Make any other desired connections on the terminal strip, such as PULSE OUT and/or CNT (counter) OUT* with circuit-low connected to SIG GND (signal ground). Replace the plastic safety shield on the terminal strip.

NOTE:
FOR FLOSENSOR INSTALLATION, REFER TO APPROPRIATE SIGNET INSTRUCTION MANUAL.

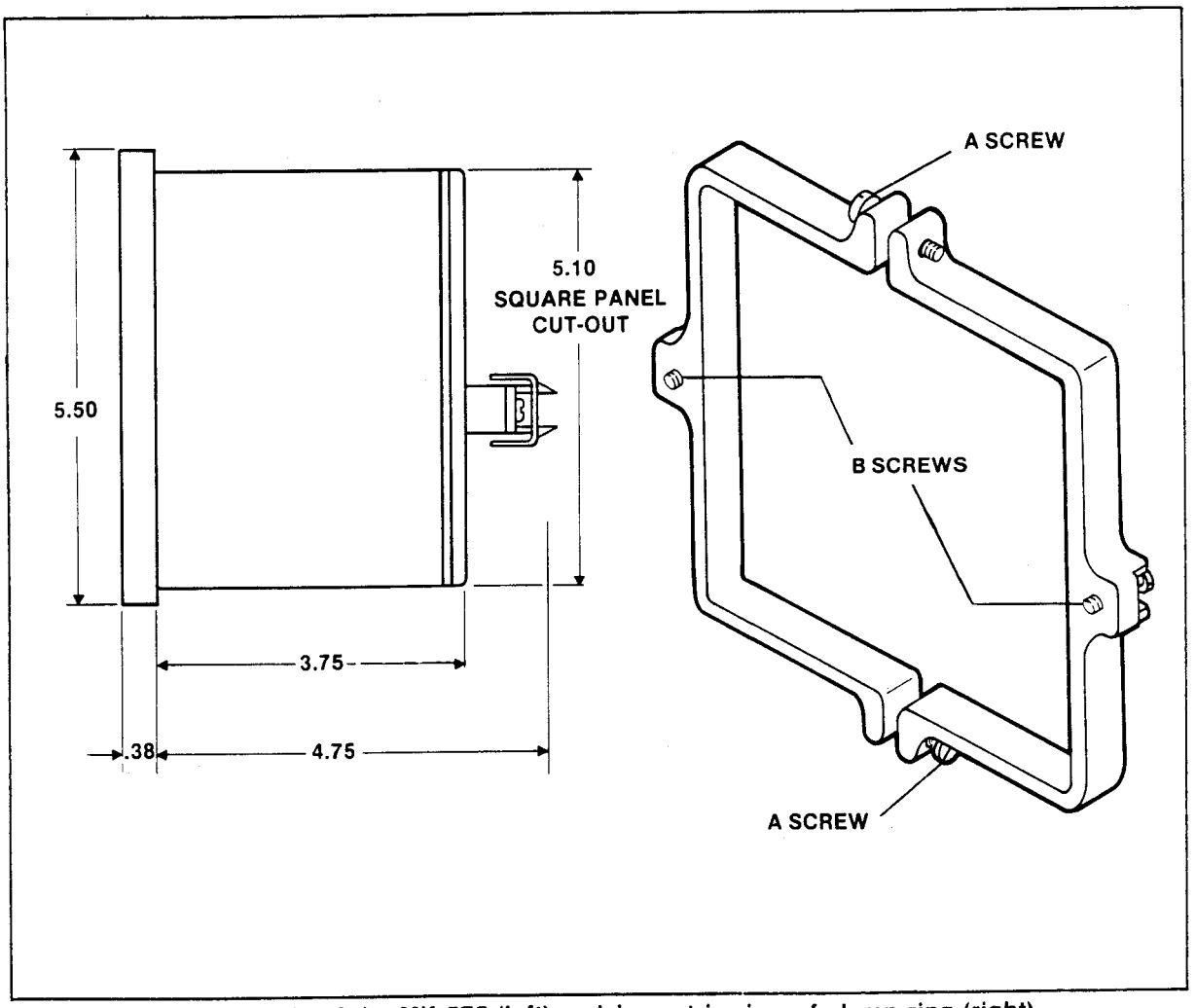


Figure 2. Detailed profile of the MK 575 (left) and isometric view of clamp ring (right).

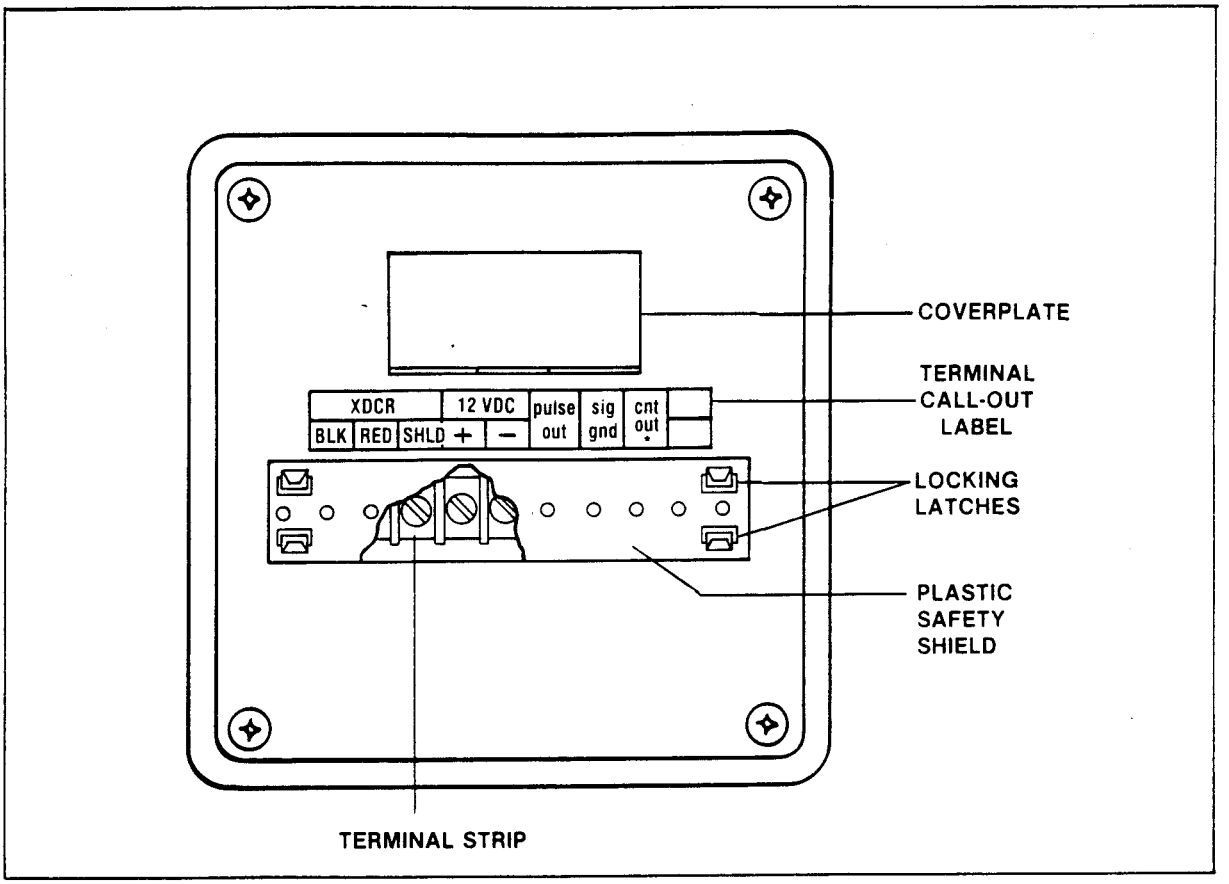


Figure 3. Rear view of MK 575 with coverplate in place over calibration and counter controls.

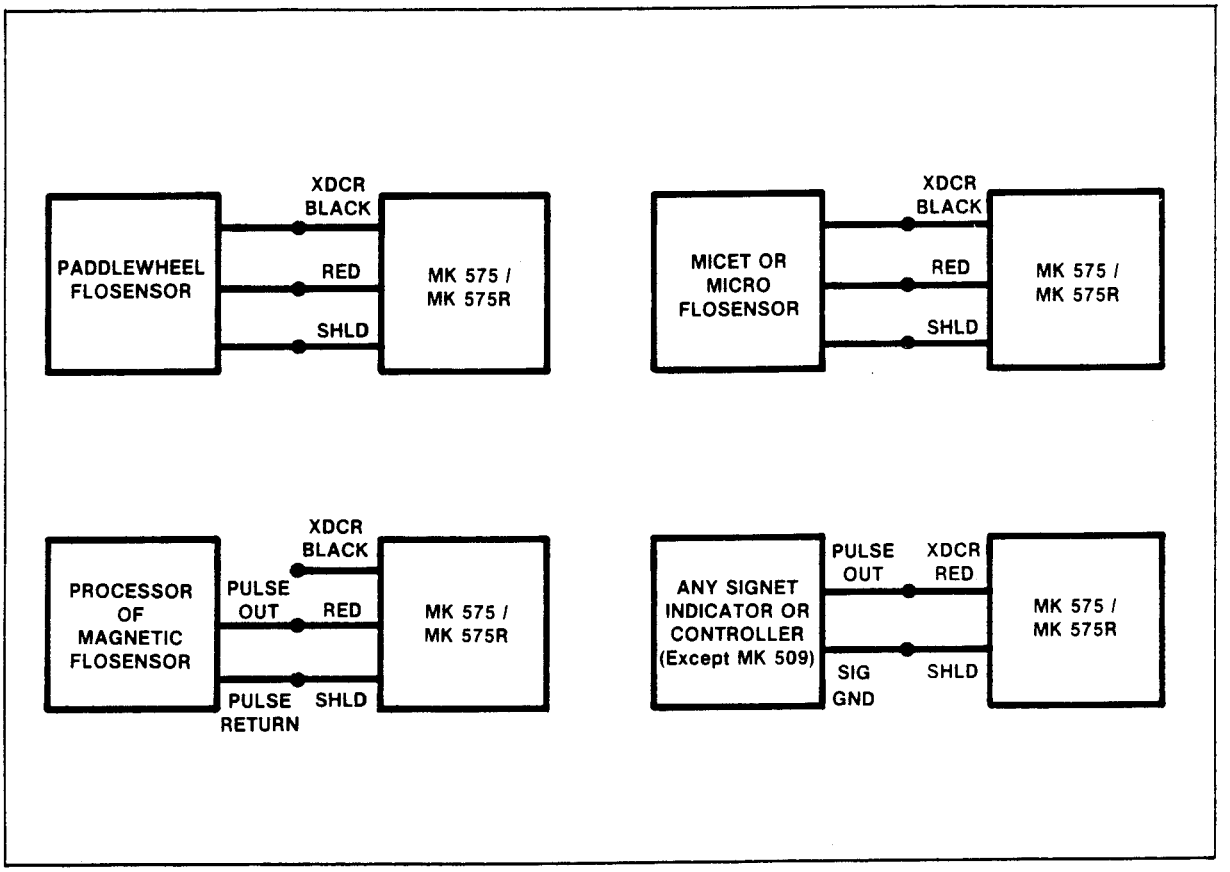


Figure 4. Various inputs to MK 575/575R Accum-u-flo. Verify all flosensor output connections by referring to the appropriate Signet instruction manual.

3.0 THEORY OF OPERATION

Basically, the MK 575 Accum-u-flo electronics convert the sinusoidal ac transducer signal from a Signet Flosensor into fixed-width positive pulses. The time between leading edges of two adjacent pulses is equal to one cycle of transducer output frequency. These pulses are converted into an analog voltage which drives the meter.

The single printed circuit (PC) board of the MK 575 contains the voltage regulator, the input-shaping and processing circuitry, the meter-drive circuitry, and the counter-drive circuitry. The + 12 Vdc power for the electronics is applied to the PC board voltage input. A diode is in series with the + 12 volt line to provide reverse-voltage protection. The unregulated + 12 Vdc is applied to a voltage regulator to provide a regulated + 5 Vdc to power the MK 575.

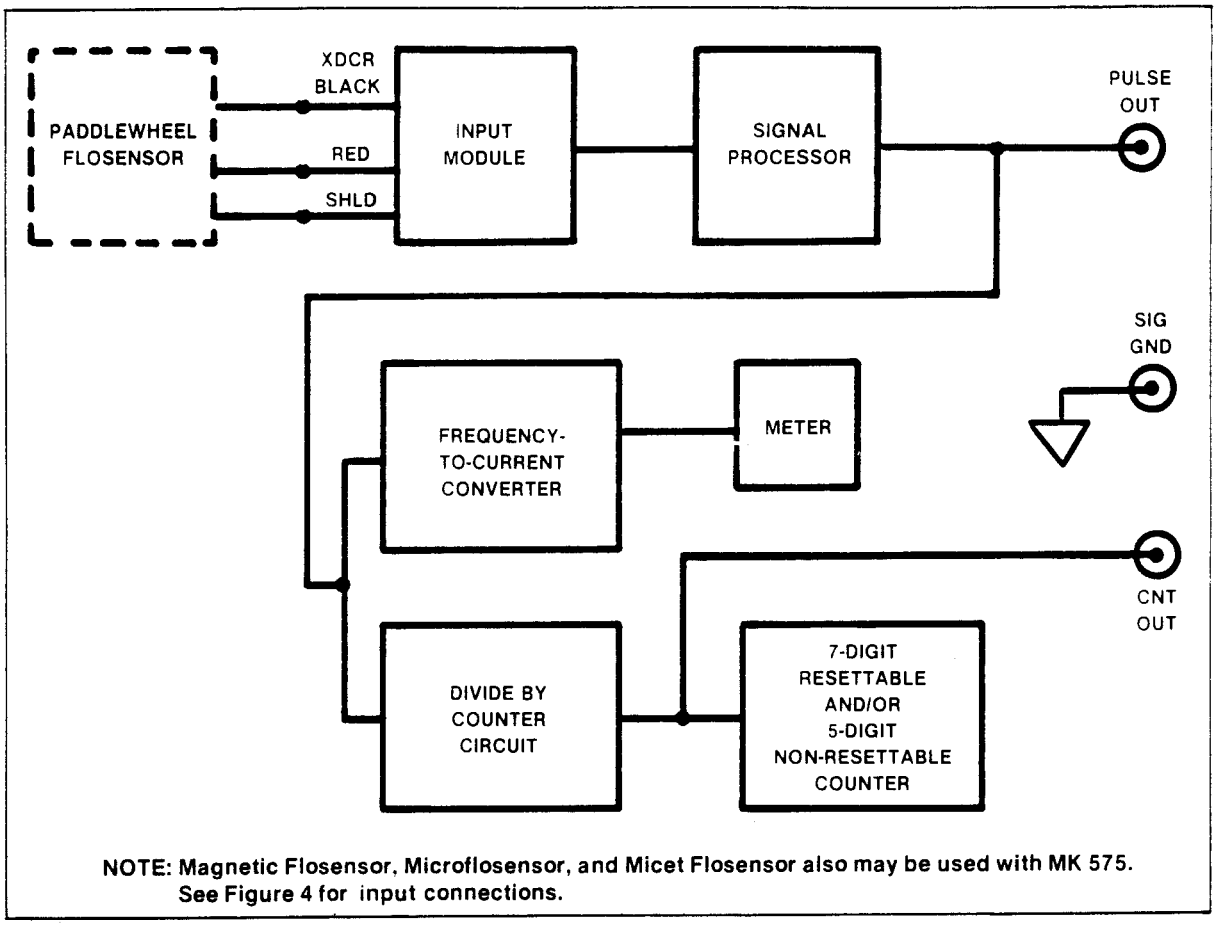
The input module of the MK 575 conditions the Flosensor signal. The processor circuitry then forms the conditioned input signal into square-wave-shaped, precision width, noise-free positive pulses. The pulses are also separately amplified and are available to drive external instrumentation, including other Signet indicators and controllers, at the PULSE OUT terminal on the MK 575's rear panel (see Figure 3). Internally, these pulses are inputed to a frequency-to-current converter. This circuitry employs a constant-current generator where the pulse waveforms are converted to a current in a closed-loop system by charging a capacitor, with this charge being directly proportional to the frequency. This current drives the Flometer's meter.

TABLE 1

	PADDLEWHEEL	MICET/MICROFLO	MAGNETIC
Transducer	MK 515 or MK 415	MK 505 or MK 508	MK 566
Module P/N	M0177	P30507	M0177
#1	SIG REF	+ 5V	N/A
#2	SIG HIGH	SIG	SIG HIGH
#3	GND	GND	GND
#4	+ 12V	+ 12V	+ 12V
#5	12V RETURN = POWER GROUND	12V RETURN = POWER GROUND	12V RETURN = POWER GROUND
#6	PULSE OUT	PULSE OUT	PULSE OUT
#7	SIG GND	SIG GND	SIG GND
#8	COUNTER OUT	COUNTER OUT	COUNTER OUT
#9	N/A	N/A	N/A

Reference the simplified block diagram of the indicator circuitry as shown in Figure 5. The Flosensor transducer output signal is applied to the input module of the MK 575. This interchangeable module is available in two configurations which allow the MK 575 to process signals from the various types of Signet Flosensors (Paddlewheel, Magnetic, Microflo, or Micet). The configuration required for your Flosensor is factory installed. Table 1 lists the sensor type with the required input module, and resulting assignments on the terminal strip.

The pulse signal is connected to a presettable divide-by N counter circuit. The counter divides the pulse frequency by a preset number. This number, N, is the number dialed into the rear-panel rotary decade switches, plus one (see Figure 6). For example, if 378 is dialed into the switches, the counter will divide by 379. The divider has a division range of 2 to 10000, corresponding to switch settings from 0001 to 9999. The counter also provides an output to drive an external counter, pump, or other equipment at the CNT OUT* terminal on the rear of the MK 575 (see Figure 3).



NOTE: Magnetic Flosensor, Microflosensor, and Micet Flosensor also may be used with MK 575. See Figure 4 for input connections.

Figure 5. Block diagram of MK 575/575R circuitry.

4.0 CALIBRATION

Your MK 575 Accum-u-flo indicator was factory calibrated to a water standard for your particular pipe fitting and Signet Flosensor type (indicated on the rear of the MK 575 case). If used with this pipe fitting, recalibration should not be necessary unless the viscosity of the fluid used differs substantially from water. This indicator must be used with the Signet Flosensor transducer type specified. Use of another transducer type may require a different input module or recalibration.

The flow measurement and accumulator sections of the MK 575 are independent of one another. Each section is calibrated separately.

4.1 FLOMETER CALIBRATION

Adjusting the MK 575 meter movement for different units of measurement or recalibration can be accomplished using the Signet MK 561 Flow Test Indicator (see 6.2 Optional Accessories). The complete procedure for using this Tester is supplied in its manual.

NOTE:
FOR COMPLETE CALIBRATION DATA AND PROCEDURES, REFER TO SIGNET'S CALIBRATION MANUAL. CONSULT THE FACTORY FOR DETAILS.

4.2 COUNTER RECALIBRATION

Recalibrating the counter circuitry can be accomplished in the field simply by resetting the decade rotary switches on the rear of the MK 575 case (see Figure 6) using the appropriate K factor (pulses/gallon or pulses/liter) from Table 2 in the following equation:

$(K \times I) - 1 =$ Setting of Switches

where I is the number of increments you want counted.

For example, if you want the counter to count in 10-liter increments, and your pipe size is 2-½"-80, the K pulses/liter value is 6.123. Therefore,

$(6.123 \times 10) - 1 = 60.23$

Rounding off the answer to the nearest integer gives 60. Thus switches would be set to 0060.

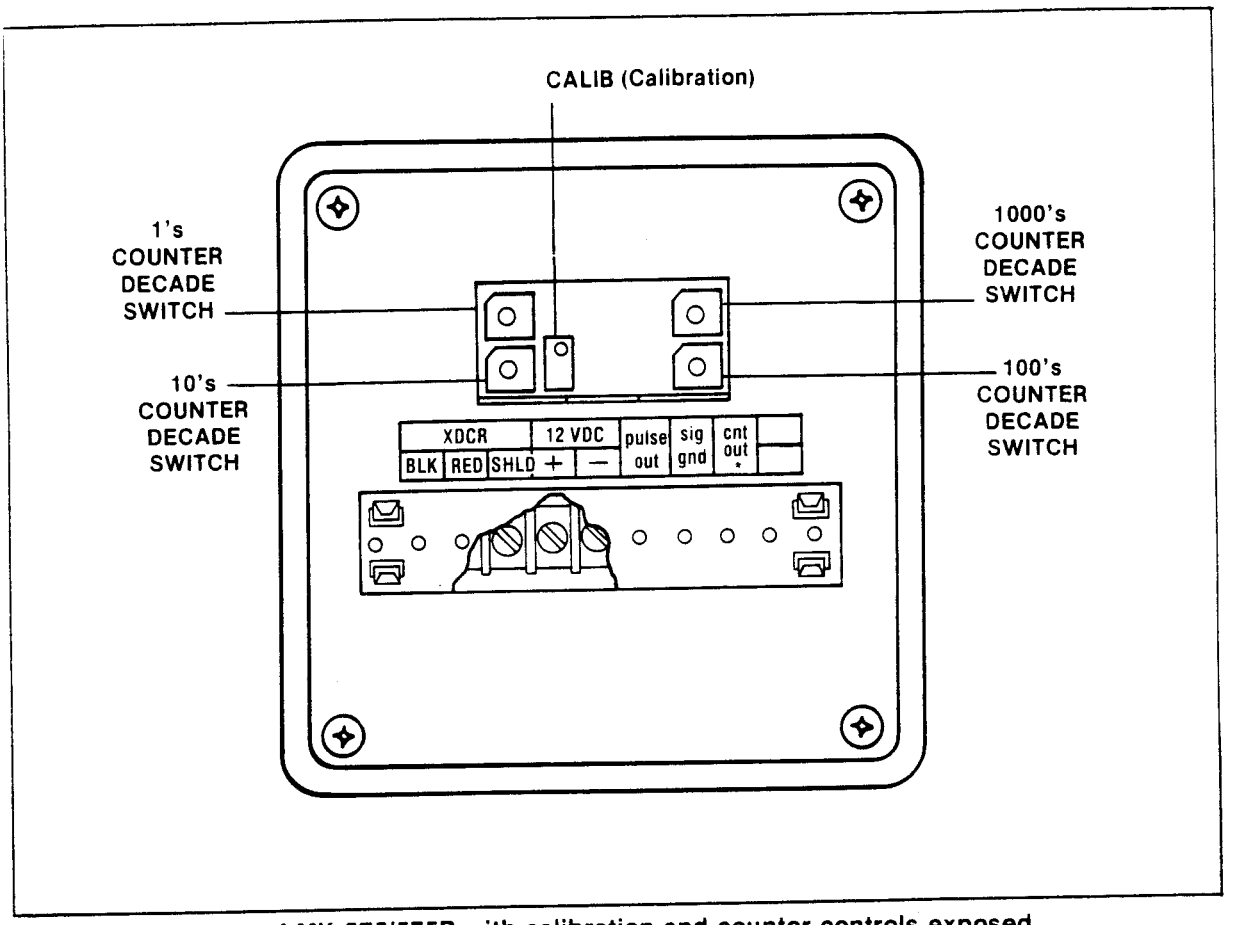


Figure 6. Rear view of MK 575/575R with calibration and counter controls exposed.

NOTE:
THE VALUES SHOWN IN TABLE 2 ARE DERIVED FROM SIGNET'S CALIBRATION CHART. THEY ARE NOT IDENTICAL TO THE CHART VALUES AND ARE NOT MEANT TO REPLACE THE CALIBRATION CHART.

If, because of some peculiarities in your piping system or the material flowing in that system, the MK 575 does not read correctly, you may have to adjust the calibration by some small percentage. This can be done using the following equation:

$$\frac{\text{Indicated Flow Volume}}{\text{Actual Flow Volume}} \times (\text{Setting of Switches} + 1) - 1 = \text{New Setting of Switches}$$

For example, with an actual flow of 100 gallons, the indicator shows 110 gallons. The switches are set at 271. Therefore,

$$\frac{110}{100} \times (271 + 1) - 1 = 298.2$$

Rounding off the answer to the nearest integer gives 298. Thus switches would be set to 298.

NOTE:
FOR COMPLETE CALIBRATiON DATA AND PROCEDURES REFER TO SIGNET'S CALIBRATION MANUAL.

Table 2

NOMINAL DIAMETER	PIPE SIZE/ SCHEDULE	ACTUAL I.D.	K* PULSES/ GALLONS	K* PULSES/ LITERS
½"	80	0.526"	451.2	119.2
¾"	80	0.722"	254.9	67.34
1"	80	0.935"	183.5	48.49
1-¼"	80	1.256"	88.27	23.32
1-½"	80	1.476"	59.93	15.83
2"	80	1.913"	33.53	8.861
2-½"	80	2.291"	23.17	6.123
3"	80	2.864"	14.62	3.865
4"	80	3.789"	8.171	2.159

*Illustrative values only.

5.0 MAINTENANCE AND TROUBLESHOOTING

Your MK 575 was designed to require no routine maintenance. After correct installation has been verified, malfunctions will generally be traceable to operating conditions at the flosensor transducer (for example, sediment or particulate matter clogging the free movement of the rotor of a Paddlewheel Flosensor), not within the transducer or indicator. Transducer-oriented problems are explained in detail in the appropriate Signet Flosensor instruction manual. Please refer to it.

Non-transducer problems may be traced to the power supply. Measure the dc voltage from the power source to be sure it is within specifications (see 1.2 Specifications).

Malfunctions isolated to the Flosensor or MK 575 can be checked only by qualified technicians working in a well-instrumented technical laboratory. Attempting repairs inside the Flosensor or MK 575 can void your limited warranty (see 6.3 Warranty).

6.0 APPENDICES

6.1 PARTS LIST

Case (MK 575) ..... MK 509.49
Case (MK 575R) ..... MK 575.49
Glass (MK 575) ..... MK 509.47
Glass (MK 575R) ..... MK 575.47
Meter M00108
Mounting Strap Kit M15129
Reset Button Kit (MK 575R) ... MK 75.95
Power Converter P30075

6.2 OPTIONAL ACCESSORIES

Mounting Bracket ..... MK 500.60
Conduit Mounting Kit ..... MK 500.78
Liquid Tight Kit: one ½" NPT Hub and two ¾" NPT hubs for waterproof cable connections to 500 Series Flometers with rear enclosures ..... MK 500.75
Flow Test Indicator ..... MK 561
Cable Adapter Kit: Flosensor-to-Tester and Tester-to-Flometer adapter cables for the MK 561 ..... MK 561.60
Cable Adapter Kit: Series 300 Sensor to MK 575, adapter cables ..... MK 500.61-1

6.3 WARRANTY

SIGNET SCIENTIFIC COMPANY LIMITED TWO-YEAR WARRANTY

Signet Scientific Company warrants its instruments to be free from defects in material and workmanship under normal use for a period of two years from date of purchase by the initial

owner, or three years from date of manufacture, whichever comes first, as described in the following paragraphs.

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7.0 MANUAL CHANGE INFORMATION

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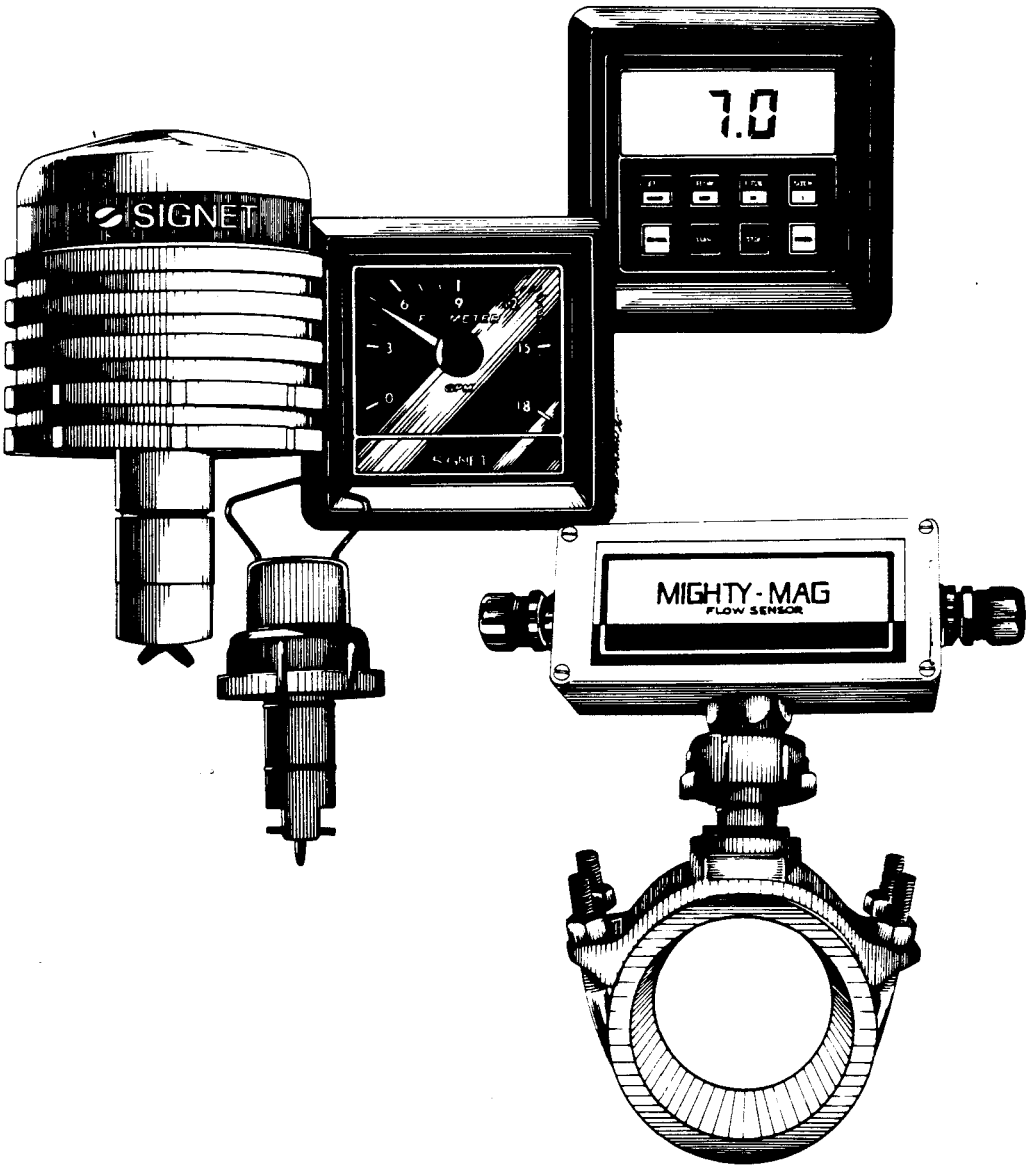
SIGNET SIGNAL CONDITIONER

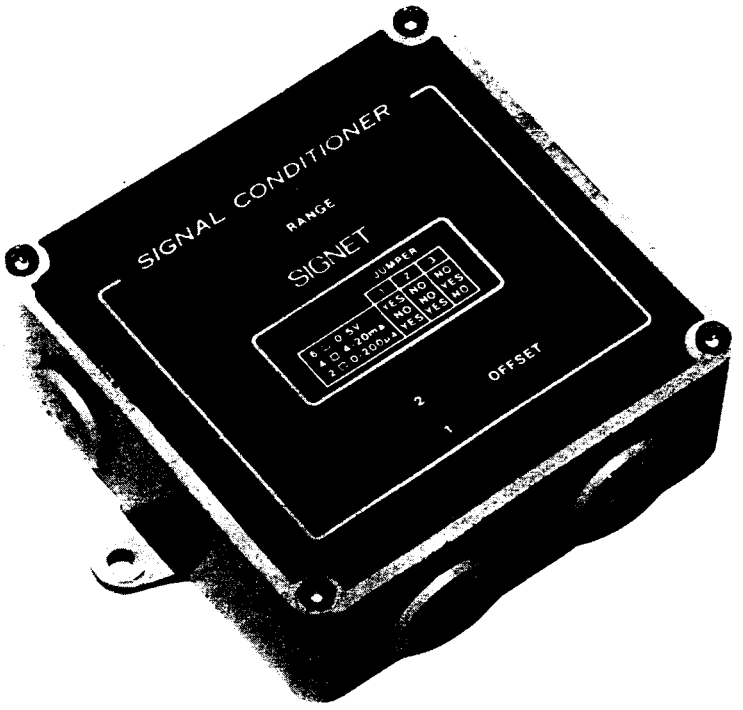
SIGNET SCIENTIFIC

MK 514
SIGNAL CONDITIONER

INSTRUCTION MANUAL



MK 514
SIGNAL CONDITIONER



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PRINTED IN U.S.A.

1.0 INTRODUCTION

This manual contains description, specifications, and instructions for the installation and operation of your Signet MK 514 Signal Conditioner. PLEASE READ ALL OF THIS INSTRUCTION MANUAL; it will answer most of your questions about use of the MK 514. If you require further assistance, contact your Signet dealer.

1.1 DESCRIPTION

The MK 514 is an instrument designed to convert the frequency output from a Signet Flosensor and provide the user with the choice of a current or analog voltage output. The user may choose 0 to 200 microamps, 4 to 20 milliamps, or 0 to 5 volts dc. The desired output of the MK 514 is user-selectable by adjusting the location of three externally-accessed jumpers. One of the three available outputs is factory-set as ordered.

The Signal Conditioner also provides a full-time digital pulse output whose frequency is identical to the output of the Flosensor. Your MK 514 with appropriate plug-in input module is compatible with, and connects directly to, the MK 515/MK 415, MK 505, MK 508, or MK 566 Flosensor. The Signal Conditioner may be installed in an existing Signet system without the need for recalibration.

The pulse output of the MK 514 provides noise-free amplification of a Signet Flosensor output signal in applications requiring a transmission distance in excess of 200 feet or where electrical noise interferes with normal signal transmission. The pulse output may be connected to any Signet indicator or controller (EXCEPT THE MK 509 FLOMETER). The 0 to 200 microamp output can be used for proportional control of process-control equipment. The 0 to 5 volt dc output or the pulse output can be used for datalogging or computer interfacing. Maximum total transmission distance is 1000 feet from the Flosensor.

The MK 514 is powered by an external + 12 volt dc source like the included Signet P30075A Power Converter which accepts 117 volts ac nominal.

The high-impact plastic case and top cover of the Signal Conditioner are completely waterproof. The case has three conduit adapter holes to permit housing all cabling in conduit.

1.2 SPECIFICATIONS

Input Signal Amplitude	0.4 volt peak-to-peak minimum
Input Frequency	200 Hertz maximum (500 Hertz maximum when used with MK 505 & MK 508)
Outputs:	
Pulse: TTL Compatible	source, 6.5 milliamps at 4.6 volts sink, 25 milliamps at 0.4 volt
Frequency	synchronous with input
Pulsewidth	5 milliseconds nominal
Current Range	0 to 200 microamps or 4 to 20 milliamps
Maximum-Load Loop Resistance	60 kilohms at 0 to 200 microamps 450 ohms at 4 to 20 milliamps
Voltage Range	0 to 5 volts dc
Minimum-Load Impedance	100 kilohms
Power Requirements	12 ± 3 volts dc at 80 milliamps
Ambient Operating Temperature	0°C to 60°C (32°F to 140°F)

(continued)

Power Converter:

Input	117 volts ac nominal, 60 Hz 220 volts ac nominal, 50 Hz
Output	12 to 16 volts dc at 1.2 amps

2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION

When unpacking your MK 514 package, be sure you have received everything (See Figure 1). Carefully check each item for any damage incurred during shipment. If damage has occurred, promptly notify your dealer and the shipping carrier.

The following items are included in your Signal Conditioner package:

1. MK 514 Signal Conditioner
2. P30075A Power Converter
3. Instruction Manual and Warranty Card

Please fill out and return the Warranty Card as soon as possible.

2.2 MOUNTING PROCEDURES

2.2.1 SIGNAL CONDITIONER

The MK 514 case may be secured in any convenient location by its two mounting ears using 1/4-inch hardware. Mounting ear centers are 5.600 inches.

2.2.2 POWER CONVERTER

The supplied Power Converter case may be secured in any convenient location by its four mounting holes using #6 hardware. Mounting hole centers are 2.562 inches and 3.062 inches rectangular.

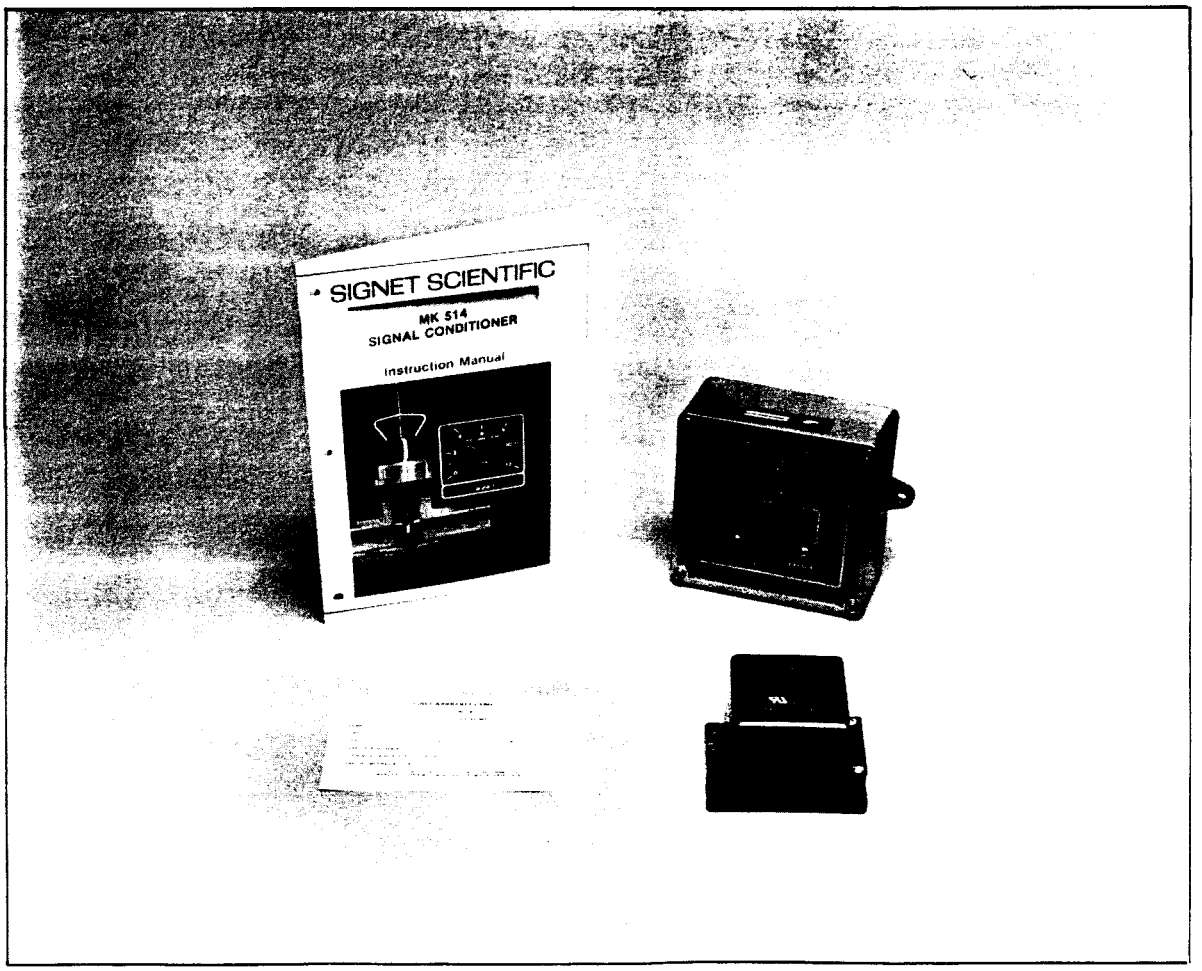


Figure 1. MK 514 package.

2.3 OUTPUT JUMPERS AND CONTROLS

The clear plastic top-cover of the MK 514 must be removed in order to adjust the position of the three output jumpers or to calibrate the Signal Conditioner. The jumpers are accessed through the face plate (see Figure 2). These jumpers are positioned on the component-side of the PC board.

(continued)

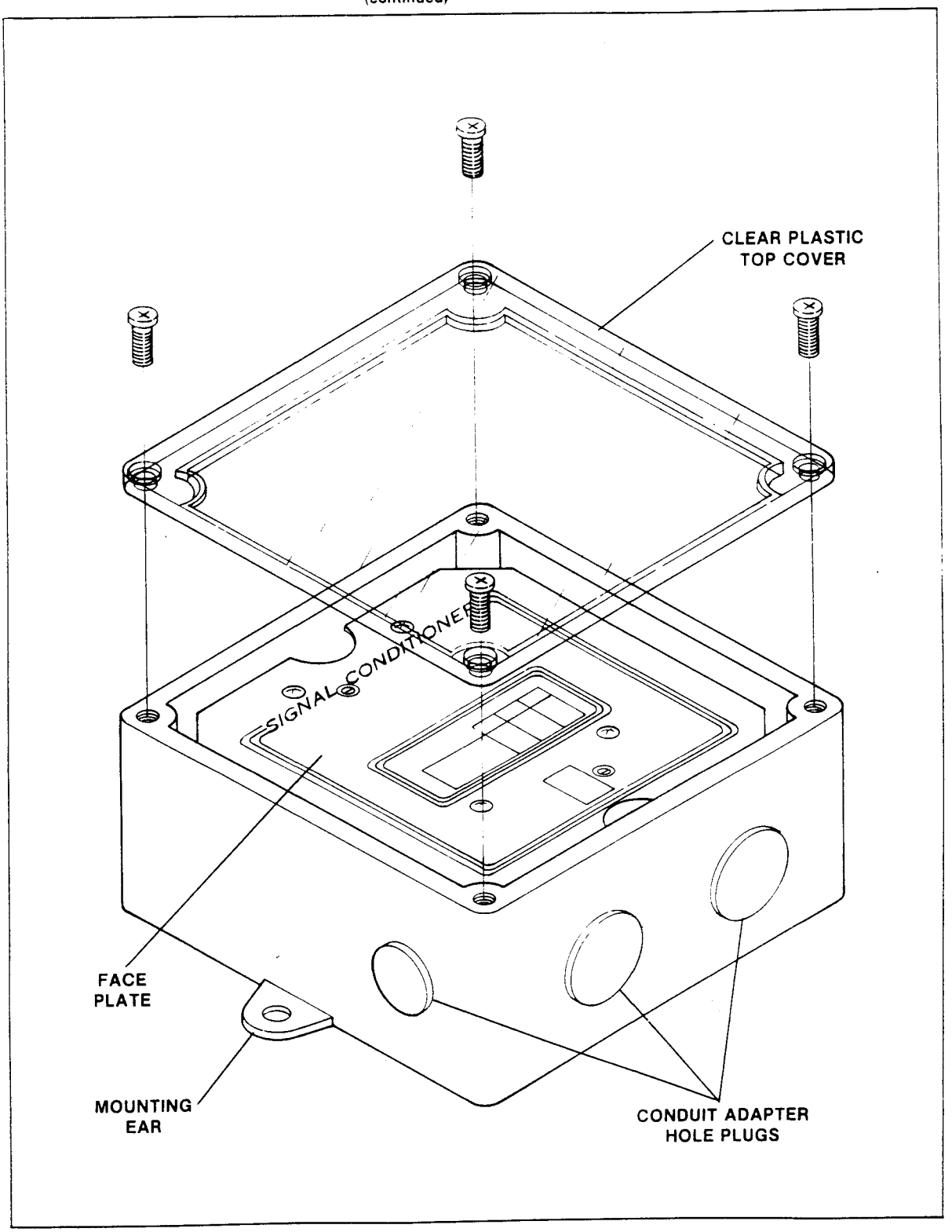


Figure 2. Top cover assembly and face plate of MK 514.

The face plate of the Signal Conditioner is numbered 1, 2, 3 (see Figure 3) to represent exactly where each jumper should be placed, or not placed, on the PC board according to Table 1.

The face plate is also factory-marked to indicate which output has been factory set. A white mark is placed inside the white square next to 0-5 V, 4-20 mA, or 0-200 mA as applicable (see Figure 3).

Two calibration controls are also accessed through the face plate. One is the RANGE adjustment potentiometer, the other the OFFSET adjustment potentiometer (see Figure 3).

To remove the top cover of the MK 514, remove the four Phillips-head screws holding it in place. Replace the top cover after installation or calibration is completed.

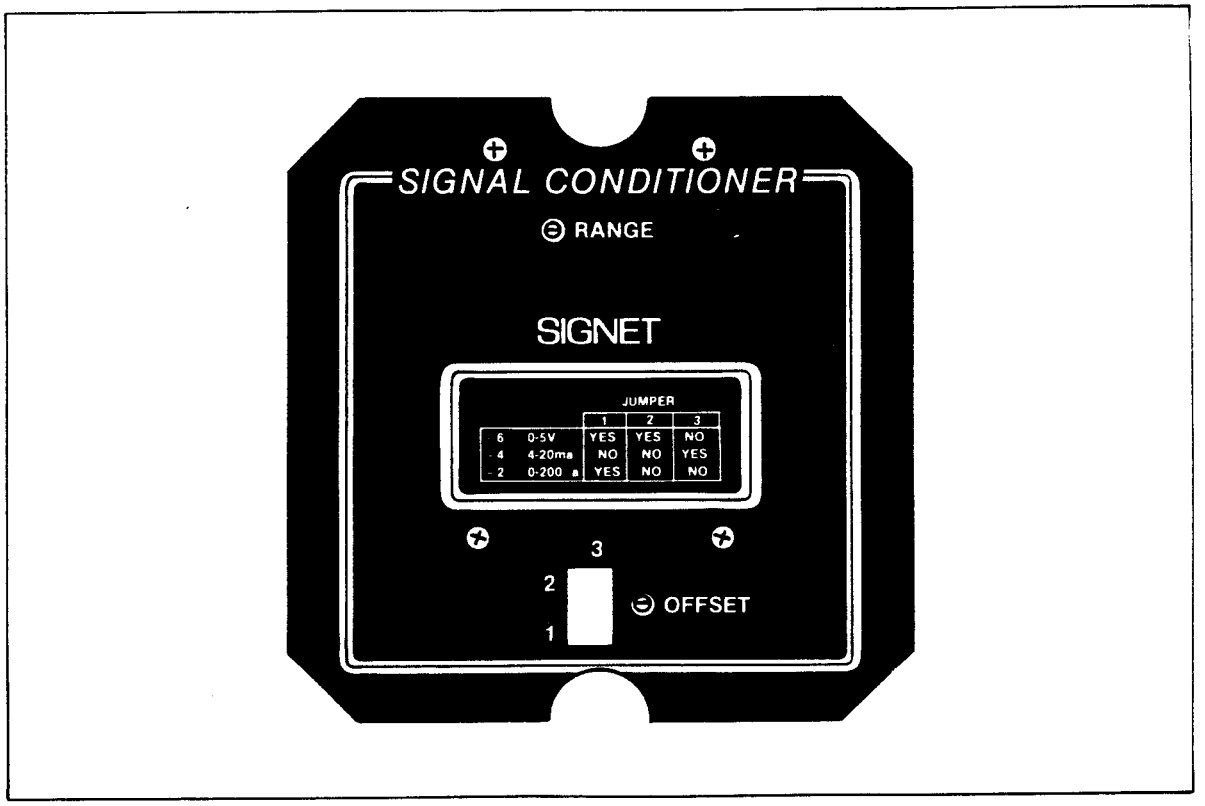


Figure 3. Details of face plate and controls access.

TABLE 1

Output	Jumpers Used 1	2	3
0-200 microamps	Yes	No	No
4-20 milliamps	No	No	Yes
0-5 volts	Yes	Yes	No

2.4 INPUT MODULE

The input module of the MK 514 conditions the output signal from a Flosensor. This plug-in module is available in two configurations, each designed for use with specific Flosensors: (1) module M0177 for the MK 515/MK 415 Paddlewheel and MK 566 Magnetic Flosensors, (2) module P30507 for the MK 505 Microflosensor and MK 508 Micet Flosensor (see 3.0 Theory of Operation for circuit details). The module configuration required for your Flosensor is factory-installed as ordered (see Figure 4). Additional modules may be ordered at any time. Using an input module different from that orginally installed will require recalibration of the MK 514.

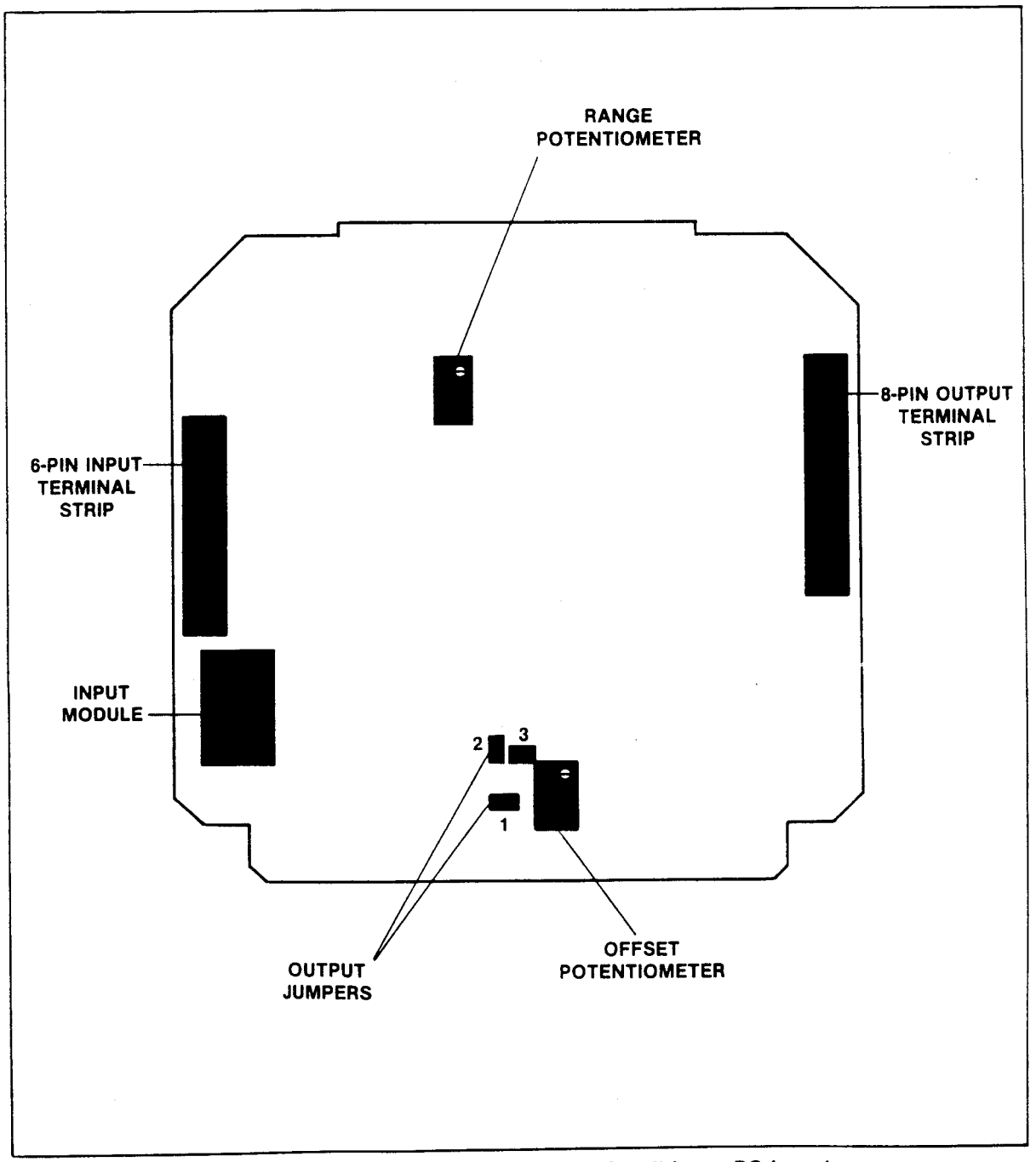


Figure 4. Abbreviated view of component-side of Signal Conditioner PC board.

2.5 TERMINAL STRIPS

The face plate and PC board of the MK 514 must be removed in order to access the 6-pin input and 8-pin output terminal strips located on the printed circuit (non-component) side of the PC board (see Figure 5). To remove these items, remove the four Phillips-head screws (accessed through the face plate) holding them in place (see Figure 3). Note the orientation of the face plate to the PC board.

The four standoffs attached to the face plate are permanent and should not be removed. Note that the output terminal strip is adjacent to the side-by-side conduit adapter holes in the case.

All connections must be made on the inward-side of each terminal strip (see Figure 5). Strip all wires 1/4-inch. Use tin braided wires, if possible, to prevent fraying. Then unloosen the clamping screw of each terminal pin to be used and insert the appropriate wire (top of unloosened screw head should not project beyond top surface of terminal strip). FULLY UNLOOSENED TERMINAL SCREWS ARE NOT CAPTIVE AND CAN BE REMOVED FROM TERMINAL STRIP; SCREWS ARE SMALL AND CAN BE MISPLACED.

2.6 INPUT TERMINAL CONNECTIONS

2.6.1 FROM FLOSENSOR

Reference Figures 5 and 6. Connect the black wire from a Paddlewheel Flosensor, Microflosensor, or Micet Flosensor to input terminal strip pin #1, the red wire to pin #2, and the shield to pin #3. For a Magnetic Flosensor, connect a twisted pair from the PULSE OUT and PULSE RETURN terminals of the Magnetic Processor to input terminal strip pin #2 and #3 respectively.

2.6.2 FROM POWER SOURCE

Connect the + and − of the external 12 volt dc source to input terminal strip pin #4 and #5 respectively (see Figure 5). If using the supplied Signet Power Converter, connect 117 volts ac nominal (60 Hz) to the Power Converter's input terminals. Then connect either adjacent + and − terminal pair of the Converter to MK 514 input terminal strip pin #4 and #5 respectively.

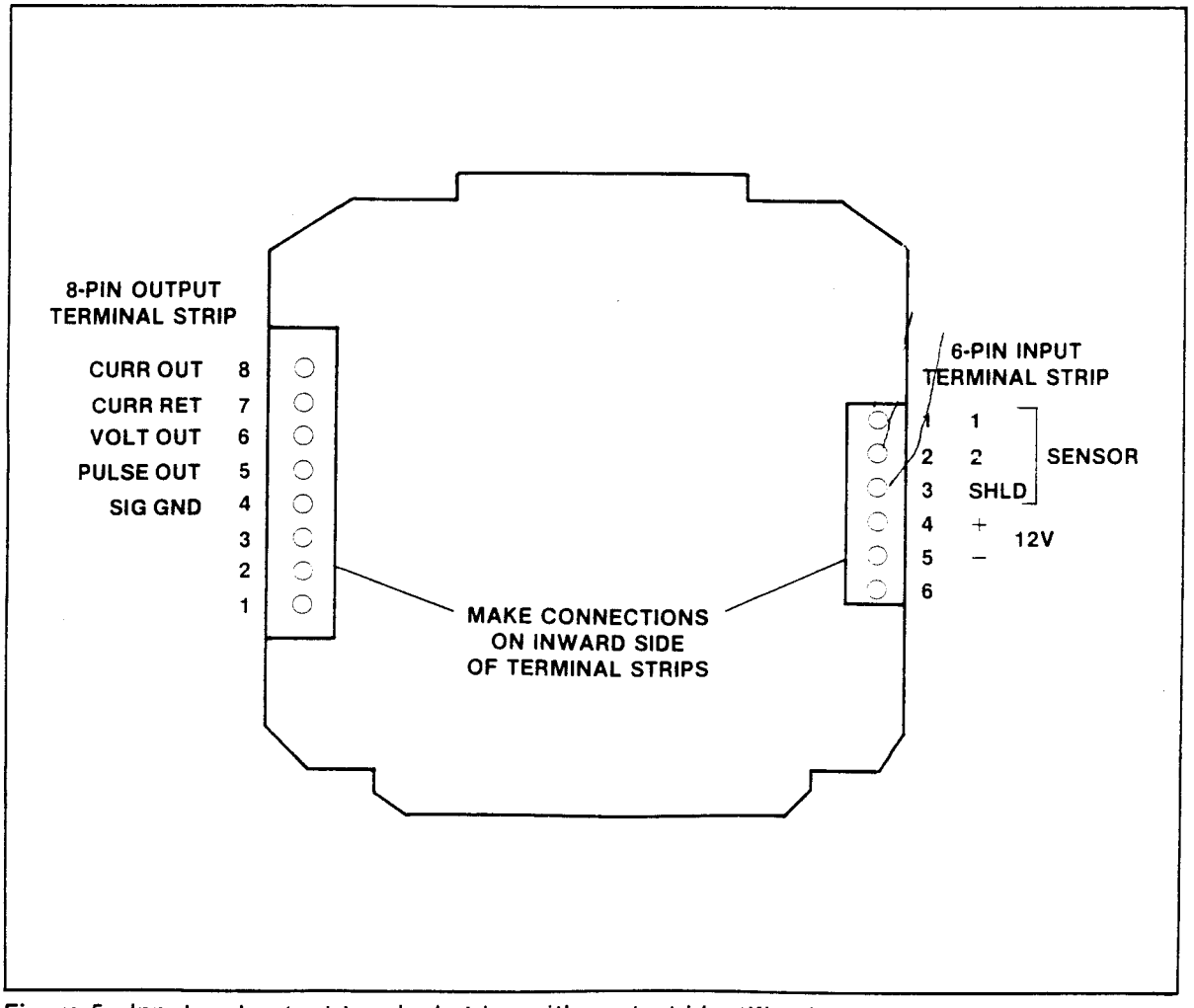


Figure 5. Input and output terminal strips with contact identification.

2.7 OUTPUT TERMINAL CONNECTIONS

2.7.1 PULSE OUT

Other Signet instruments may be driven by the pulse output of the MK 514 (EXCEPT THE MK 509 FLOMETER). PULSE OUT is available on output terminal strip pin #5 (see Figure 5). Pulse return, or low, is connected to output terminal strip pin #4.

2.7.2 CURRENT OUTPUTS

The MK 509 Flometer can be driven by the 0 to 200 microamp current output of the MK 514. The 4 to 20 milliamp output can drive process-control or other appropriate equipment including valves and recorders. For either output, CURRENT OUT is available on output terminal strip pin #8 (see Figure 5). CURRENT RETURN, or low, is connected to output terminal strip pin #7.

2.7.3 VOLTAGE OUTPUT

The 0 to 5 volt dc output of the MK 514 can drive chart recorders, dataloggers, computer interfaces, or other appropriate equipment. VOLTAGE OUT is available on output terminal strip pin #6 (see Figure 5). Voltage return, or low, is connected to output terminal strip pin #4.

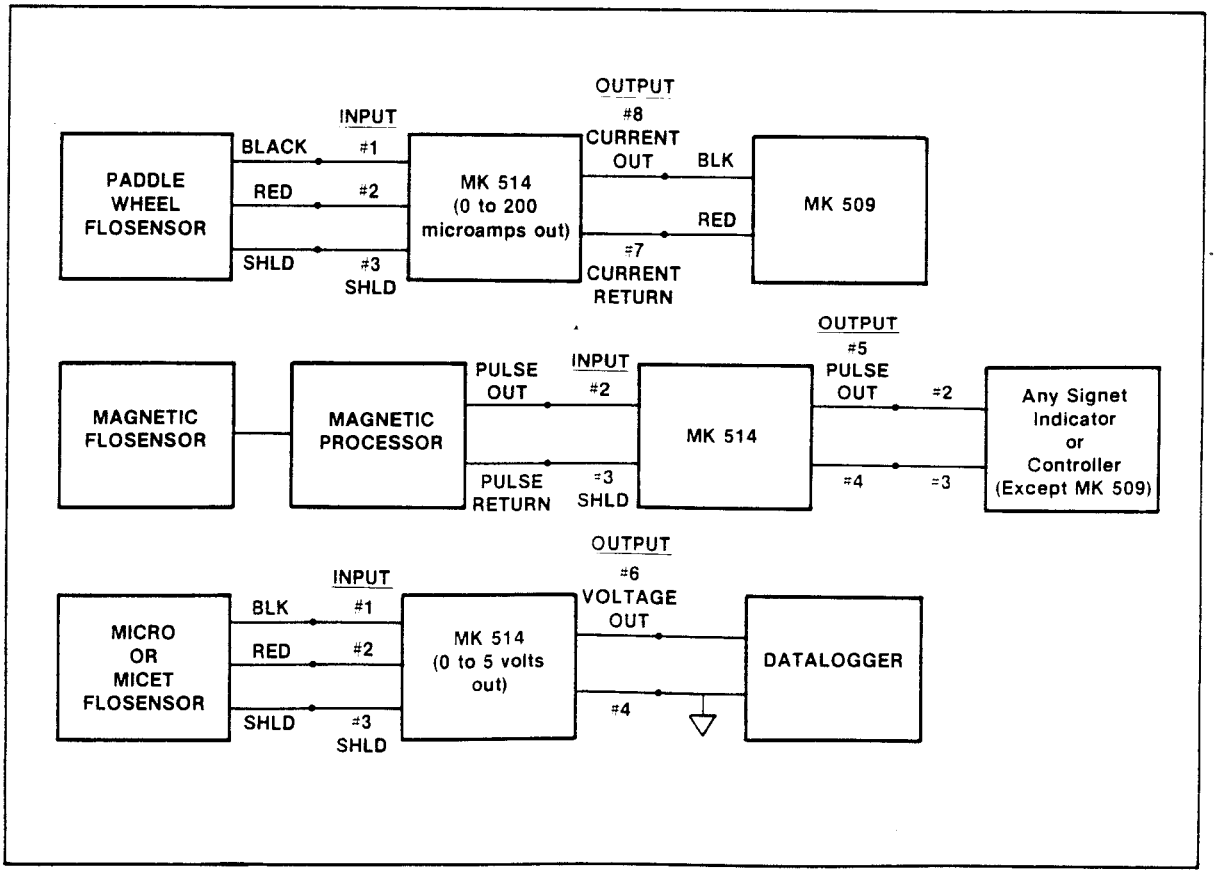


Figure 6. Various flosensor inputs to, and typical outputs from, an MK 514.

3.0 THEORY OF OPERATION

Basically, the MK 514 electronics convert the ac transducer signal from a Signet Flosensor into fixed-width positive pulses. The Signal Conditioner also converts this frequency to an analog signal for current or voltage outputs.

The single PC board of the MK 514 contains the voltage regulator, input-shaping and processing circuitry, and frequency-conversion circuitry. The +12 volts dc power for the electronics is applied to the PC board voltage input. A diode is in series with the +12 volt line to provide reverse voltage protection. The unregulated +12 volts dc is passed through a voltage regulator to provide a regulated +5 volts dc. Both the unregulated +12 volts and regulated +5 volts are used to power the MK 514.

Reference the simplified block diagram of the MK 514 circuitry as shown in Figure 7. The Flosensor output signal is applied to the plug-in input module of the MK 514. Two modules are available (see 2.4 Input Module).

The input module conditions the Flosensor signal. The processor circuitry then forms the conditioned input signal into square-wave shaped, precision width, noise-free positive pulses. These input pulses are available to drive external instrumentation, including other appropriate Signet indicators and controllers, at the PULSE OUT pin on the output terminal strip (see Figure 2.7.1 Pulse Out). Internally, these same pulses are inputed to a frequency-to-voltage converter. The frequency of the pulses turns a current generator on and off, and the generator charges a capacitor. After filtering, the resultant output drives the current.

4.0 CALIBRATION

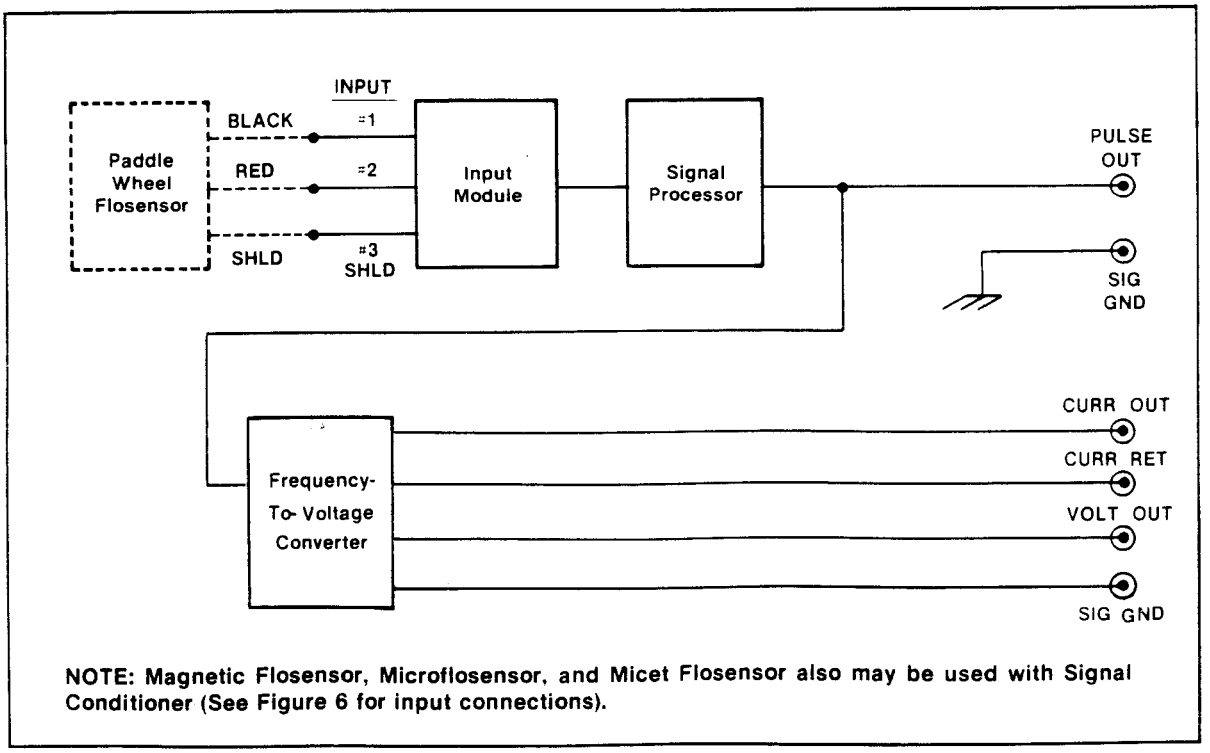
Your MK 514 Signal Conditioner is factory-calibrated for your specific application (i.e., Flosensor type, pipe size, units of measurement, maximum flow rate, fitting). Recalibration is not normally necessary unless some significant parameter of your application has changed.

The MK 514 can be calibrated but only for the output being used. The proper output jumper(s) must be in place (see 2.3 Output Jumpers and Controls).

The two calibration adjustments necessary are the RANGE and OFFSET potentiometers accessed through the face plate (see Figure 3).

A digital multimeter capable of reading the current and voltage output ranges of the MK 514 is necessary for OFFSET and RANGE adjustments. A standard sine-wave generator (function generator) is necessary for RANGE adjustments.

Contact your dealer or Signet for a copy of the Signet Calibration Chart in order to perform RANGE adjustments. This Chart provides frequency-to-flow rate and flow rate-to-frequency conversion data for gallon and liter flow rates for



NOTE: Magnetic Flosensor, Microflosensor, and Micet Flosensor also may be used with Signal Conditioner (See Figure 6 for input connections).

Figure 7. Simplified block diagram of the MK 514 circuitry.

Paddlewheel Flosensors and properly adjusted Magnetic Flosensors. Your Signal Conditioner may be calibrated for flow rates in terms other than gallons/minute or liters/minute (i.e., cubic feet/second, pounds/hour, fluid ounces/minute, acre-feet/day, etc.). Contact Signet for the appropriate conversion factor.

1. Remove the clear plastic top cover of the MK 514 by removing the four Phillips-head screws holding it in place.

2. Connect a digital multimeter to the output being used (i.e., 0-200 microamps, 4 to 20 milliamps, or 0 to 5 volts) (see 2.7.2 Current Outputs or 2.7.3. Voltage Output for connections).

3. With no input connected to the MK 514, adjust the OFFSET potentiometer (see Figure 3) until the low end of the output being used (i.e., 0 microamp, 4 milliamps, or 0 volt) is displayed on the digital multimeter.

4. Connect the sine-wave generator to the Flosensor input of the MK 514 (see 2.6.1 From Flosensor for connections).

5. Using the Signet Calibration Chart, calculate the correct frequency equivalent of the desired full-scale flow rate taking into consideration the pipe fitting, size, and schedule. For example, multiply Hz/GPM by the known GPM full-scale flow rate to get the frequency (Hz) equivalent.

6. Using the generator, apply the frequency (Hz) calculated in step 5 to the MK 514.

7. Adjust the RANGE potentiometer (see Figure 3) until the high end of the output being used (i.e., 200 microamps, 20 milliamps, or 5 volts) is displayed on the digital multimeter.

8. Repeat steps 3, 4, 6, and 7 to verify results.

5.0 MAINTENANCE AND TROUBLESHOOTING

Your Signal Conditioner was designed to require no routine maintenance. After correct installation has been verified, malfunctions will generally be traceable to operating conditions at the Flosensor (for example, sediment or particulate matter clogging the free movement of the rotor of a Paddlewheel Flosensor).

Non-Flosensor problems may be traced to the power supply. Measure the dc voltage from the power source to be sure it is within specifications (see 1.2 Specifications).

Malfunctions isolated to the Flosensor internally or the MK 514 can be checked and repaired only by qualified technicians. Attempting repairs can void your limited warranty (see 6.3 Warranty). If in doubt about the performance of a Signet instrument, return it to Signet or a designated service center (addresses furnished upon request).

6.0 APPENDICES

6.1 PARTS LIST

Top cover, clear plastic	P50007-2
Case Assembly Complete	MK 313.49
Power Converter	P30075A

6.2 OPTIONAL ACCESSORIES

Liquid Tight Kit: one ½" NPT Hub and two ¾" NPT hubs for waterproof cable connections to MK 514	MK 500.75

6.3 WARRANTY

SIGNET SCIENTIFIC COMPANY LIMITED TWO-YEAR WARRANTY

Signet Scientific Company warrants its instruments to be free from defects in material and workmanship under normal use for a period of two years from date of purchase by the initial owner, or three years from date of manufacture, whichever comes first, as described in the following paragraphs.

This warranty does not cover defects caused by abuse or electrical damage. Signet will not cover under warranty any instruments damaged during shipment to the factory less case or improperly packed. Repair attempts by anyone other than authorized service personnel will void the warranty. Proof of date of purchase will be required before warranty repairs can begin.

Parts which prove to be defective in the first year will be repaired or replaced free of charge including labor, shipped F.O.B. our factory or a designated service center (addresses furnished upon request).

Only non-moving parts, such as electrical components, which prove defective during the second year are warranted. Meter movements will not be covered. All units qualifying for warranty service after one year are subject to a maximum service charge of $15.00 for replacement of non-moving parts.

Items returned for warranty repairs must be shipped prepaid and insured. Warranty claims are processed on the condition that prompt notification of a defect is given to Signet within the warranty period. Signet shall have the sole right to determine whether in fact a warranty situation exists.

The Signet warranty does not cover travel time, mileage expenses, removal, reinstallation, or calibration.

Signet is continually making design changes and improvements that adapt to original circuit configurations. These will be incorporated as required in older units on a minimal-charge basis while under warranty.

CONSEQUENTIAL DAMAGES

Signet Scientific Company shall not be liable for special consequential damages of any nature with respect to any merchandise or service sold, rendered, or delivered.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

7.0 MANUAL CHANGE INFORMATION

Signet continually strives to keep up with the latest electronic and design developments by adding circuit, component, and design improvements to its instruments as soon as they are developed and tested. Sometimes, due to printing and shipping requirements, we cannot immediately get these changes into printed manuals. Therefore, your manual may contain new change information on the following pages. A single change may affect several sections. Be sure to make all changes within the appropriate sections of this manual.

SIGNET FLOW RECORDER

SIGNET
FLO RECORDER

MK 317

SIGNET SCIENTIFIC

3401 AEROJET AVENUE / EL MONTE, CALIFORNIA
P. O. BOX 5770, 91734

TABLE OF CONTENTS

GENERAL DESCRIPTION

The Signet Recorder is a stripchart recorder employing a permanent magnet, moving coil measuring system and inkless writing element. The inkless record is composed of a dot trace registered on pressure - sensitive chart paper.

The recorder consists of measuring element, electronics, drive motor and chart transport assembly. The combination of motor RPM and one of the interchangeable type gear train modules will produce a specific rate of chart travel. These gear-train modules can be exchanged easily in the field.

Many features are included with the MK 317 Recorder:

1. The methods of handling the recorded portion of the chart are possible with only a single adjustment needed to change from one method to the other.

2. A manual advance of the chart can be accomplished by depressing and rotating a thumbwheel on the outside of the case door.

3. Notations can be conveniently entered on the chart during recording sessions through a slide-down access window in the case door.

4. Accessories are supplied to allow the recorder to be panel mounted or use as a portable.

SHIPPING LIST

1 - MK 317 Recorder
2 - Rolls of Chartpaper (one is installed in the Recorder)
1 - Box of hardware
1 - Instruction Manual and Warranty Card

INSTALLATION INSTRUCTIONS

Examine all parts carefully for any damage which may have occurred after shipment from the factory. The MK 317 Recorder can be used as a portable instrument or mounted in a panel.

For portable operation use the four white rubber feet supplied with the Recorder. Cut the feet apart and remove the paper backing covering the adhesive surface. Place the feet at the four corners of the bottom of the Recorder.

For panel mounting, mount the bottom bracket to the Recorder case using two 8-32 screws (Fig.1). Mount the top bracket also using two 8-32 screws. Cut a mounting hole in the panel using the dimensions in Fig. 1, Drill 3/16 inch diameter holes to match the holes on the mounting bracket and mount the Recorder, using 8-32 screws and nuts.

Note: To avoid the possibility of adverse effects from strong magnetic fields, do not position the recorder in close proximity to bus bars or cables carrying large currants.

Care should be taken to mount the Recorder near a 115VAC 60 Hz power source since the power cord has a length of 6 feet. Also keep in mind the length of all other wiring, such as the signal cable, that has to be connected to the Recorder.

WIRING

The Recorder has two cables coming out the back. The cable with two 4 pin connectors is the signal cable. As shown in Fig. 2, plug the Flosenser into the female connector. The male connector may be connected to a Flometer or Accumulator. Fig. 3 shows a typical system employing Flosenser, Florecorder, Analog Flometer, and Accumulator.

The second cable is the power cord. It is plugged into a 115VAC 60 Hz source. When plugged in, the paper drive will operate and the stylis clapper bar should be heard.

OPERATION

Two basic methods of handling the recorded portion of the chart are possible. The REROLL method, proceed as follows:

(1) Flip chassis latch outward.

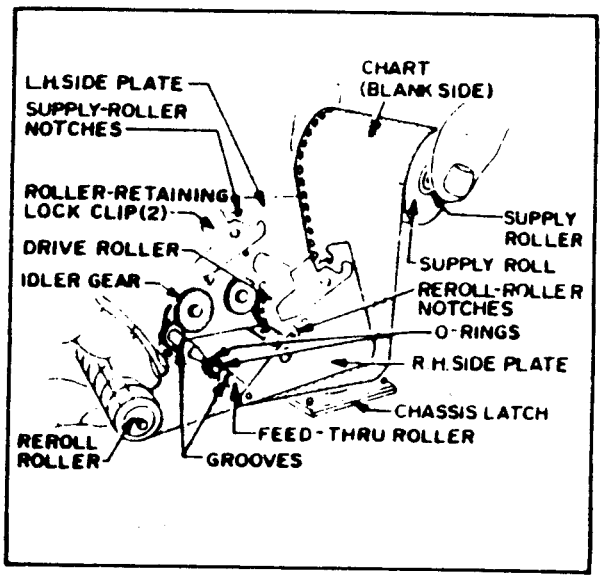
(2) Flip up roller-retaining lock clips to release rollers.

(3) Remove supply roller and insert it into perforated end of chart supply roll.

(4) Place cardboard sleeve (from accessory package) onto reroll roller.

(5) Tape end of chart paper to cardboard sleeve (perforations in chart must be at geared end of roller); roll chart a few turns onto roller, keeping it straight and taut.

(6) Hold reroll roller in left hand and supply roll in right hand so that blank side of paper is facing upward between rollers. Slip paper under right sideplate and maneuver chart perforations over sprockets on drive roller.



(7) Press supply-roll tension arm toward left sideplate, then seat supply roller and reroll roller in their respective notches and snap roller-retaining lock clips to locked position.

(8) Take up slack in chart by rotating idler gear downward towards you.

(9) Press down on right-hand sideplate and flip up chassis latch (press latch against sideplate until it snaps in place). Close door and rotate thumbwheel on outside of door to advance chart to desired position.

The FEED-THRU method routes the chart up through the top of the door so that it may be easily reviewed during recording activities or torn from the rest of the chart, as desired.

To load a new roll of chart paper for the FEED-THRU/TEAR-OFF method, proceed as follows:

(1) Flip chassis latch outward.

(2) Roll two O-Rings from center of feed-thru roller outward until they seat in grooves of roller.

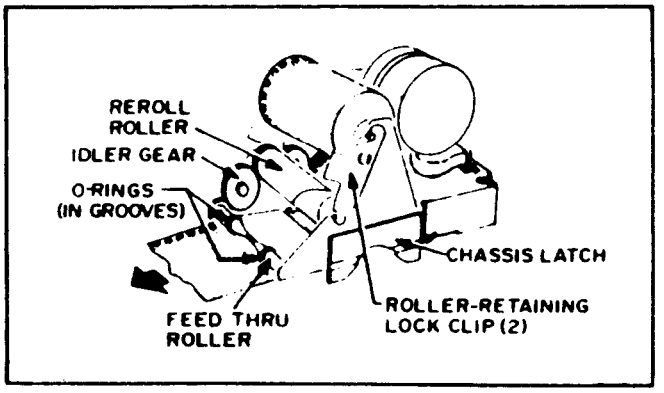
(3) Flip up roller-retaining lock clips to release empty supply roller; seat reroll roller in reroll-roller notches.

(4) Remove supply roller and insert it into perforated end of chart supply roll.

(5) Hold loose end of chart in left hand and supply roll in right hand so that blank side of paper is facing upward between left hand and roller. Slip chart paper under right-hand sideplate and carefully maneuver chart perforations over sprockets on drive roller.

(6) Press supply-roll tension arm toward left sideplate, then seat supply roller pins in notches of sideplates and snap roller-retaining lock clips back to locked position.

(7) Pull chart out from supply roll until extended behond top of door.



(8) Press down on right-hand sideplate and flip chassis latch up (press latch against sideplate until it snaps in place),

close door, reconnect power and rotate thumbwheel on outside of door to advance chart to desired position.

Connect the power cord to 115 VAC 60 Hz and the paper drive will operate. The clapper bar will also be heard tapping the stylus. With water or other liquid flowing past the Flosenser or someone spinning the Flosenser paddle wheel, the stylus should deviate from the zero or left hand position.

CALIBRATION

The Signet Florecorder has been factory calibrated for your specific requirements and should require no further calibration. Should you find calibration is required you may make the adjustments by:

1. Unplug the Flosensor from the Recorder.
2. Plug the power cable into a 115 VAC 60 Hz source.
3. Remove the "SIGNET RECORDER" name plate as shown in Fig. 4.
4. Check and adjust mechanical zero. When adjusting be sure the chart drive and clapper is operating.
5. Connect the Flosensor to the Recorder.
6. With a known flow rate traveling past the Flosensor, turn the calibration adjustment shown in Fig. 4 until the proper reading is shown on the chart. A small bladed screw driver with a 2" shaft will be required.
7. Replace the name plate.

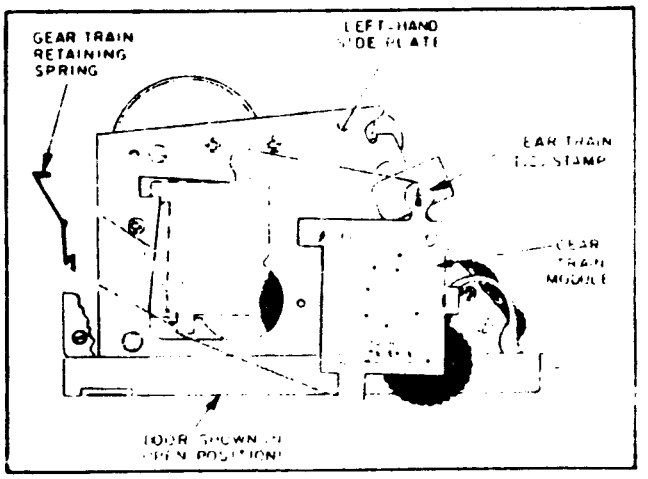
At times it may be desirable to change the chart paper speed. The gear-train module can be changed by a simple operation.

1. Select a gear-train from the chart that will give the desired chart speed.

Signet P/N	Inches/ Hour	Hours Roll	Days/ Roll
1190-0001	¼	3024	126.0
1190-0002	½	1512	63.00
1190-0003	1	756.0	31.50
1190-0004	2	378.0	15.62
1190-0005	3	252.0	10.50
1190-0006	4	189.0	7.87
1190-0007	6	126.0	5.25
1190-0008	10	75.0	3.15
1190-0009	12	63.0	2.62
1190-0010	15	50.4	2.10
1190-0011	30	25.2	1.05

2. Remove gear-train retaining spring from left-hand sideplate.

3. Gently move gear train in DIRECTION OF ARROW and lift assembly out from top. DO NOT FORCE or lift from bottom.



4. Install new gear train module by inserting bottom first; then slide in OPPOSITE DIRECTION OF ARROW.

5. Replace gear-train retaining spring to secure new gear-train.

6. Restore power, close instrument door, and check operation.

MAINTENANCE

Note: Prior to servicing or cleaning, always remove power. Do not disturb parts or wiring during cleaning.

The Flowrecorder, designed for long, trouble free operation, should require little attention in the field. Periodic intervals are recommended during which an inspection should be made for low chart supply, accumulation of dirt, loose hardware, damaged wiring, loose connection and worn parts.

Light dirt marks can be removed from the case finish with a damp, lint-free cloth or sponge. Heavier dirt smudges can be removed with any commercially-available liquid detergent, whereas grease stains should be removed by using a lint-free cloth dampened with naptha (use a clean portion of the cloth for each application to prevent spreading the stain). A mild soap or detergent may be used on the front windows and removable rollers. To clean the instrument internally, remove chart paper, removable rollers and gear-train module, then clean with a soft-bristled brush or low-vacuum system.

TROUBLE SHOOTING

SYMPTOM	POSSIBLE CAUSE	SERVICE HINT
Meter records right or left of zero with no signal applied	Meter zero out of adjustment.	Remove front nameplate. Adjust mechanical zero. (See"Calibration"

SYMPTOM	POSSIBLE CAUSE	SERVICE HINT
Meter can't be zeroed.	Stylus bent; cross arm bent.	Return instrument to factory.
Meter reads zero with signal applied.	Meter open. Connections to Recorder open; cable open. Faulty electronics.	Check meter (Do not use VOM). Check plug and terminal wiring.
Meter hangs above or below zero.	Dust in meter.	Return Recorder to factory.
Offset stylus visibly bent.	Meter has been overloaded.	Return Recorder to factory.
Recorder has continuous trace.	Stylus bent; rubs on chart paper.	Return to factory.
Reroll mode: Paper crinkles at view window.	Take-up spool not seated to engage drive gear.	Unlatch retaining clip; reseat take up spool in further notch.
Reroll: Paper doesn't drive through recorder.	Perforations not engaged in drive drum. Gear train doesn't engage drive drum.	Reload following loading instructions. Bend tabs on gear train slightly for end play; bend gear train spring for more tension.
Paper tears on drive drum.	Roll of chart paper is spiraled.	Reload taking care chart paper is perfectly aligned.

SYMPTOM	POSSIBLE CAUSE	SERVICE HINT
Tear-off: Paper doesn't drive through tear-off slot.	O-Rings not seated on take-up roller. Also riding in large center groove of drive roller.	Seat O-Rings as shown in loading instructions.
Chart advance thumbwheel is locked.	Tab that dis-engages gear train is bent.	Remove gear train and straighten tab.
"Reroll method-Sprocket holes tearing and not keeping proper time.	Feed thru drive O rings in drive grooves.	O-rings must be in center cutout for reroll operation.

PARTS LIST

Item No. (See Fig. 5)	Description	SSC P/N
1	Chart Paper-Scale (GPM)0-12,0-30, 0-120 0-180, 0-300 & -600	8390-0001
	Scale (GPM) 0-20, 0-40, 0-80, & 0-500	8390-0001
2	Motor & Gear	7100-0001
3	Power Cord	5540-0001
4	Cable Assy.	P31761
5	Electronics Board	P31742
6	Gear-See table in "Calibration" section	
7	Dial (specify scale)	P31750
8	Name Plate	M1761
9	Connector,4 Pin Female.	M0114-7
10	Connector,4 Pin Male.	M0114-2

LIMITED WARRANTY

Signet Scientific Company warrants the Mk 317 Florecorder for six months from date of purchase against defects in materials or workmanship. This is considered a limited warranty under the guidelines of the Federal Warranty Act. Parts which prove to be defective will be repaired or replaced free of charge (including labor) F.O.B. our factory, provided:

1) The warranty card has been filled within thirty days from date of purchase.

2) No repairs have been attempted by other than factory-authorized service centers.

3) Signet Scientific Company has been notified in writing upon discovery of the defect.

4) The original parts have been returned to Signet Scientific Company, transportation charges prepaid and insured against any damage which might occur during shipment.

5) Upon examination, Signet Scientific Company personnel are satisfied that the defect were not caused by abuse after delivery.

Consequential Damages: Signet Scientific Company shall not be liable for special consequential damages of any nature with respect to any merchandise or service sold, rendered, or delivered.

OTHER QUALITY SIGNET INSTRUMENTS

1. Analog Flometers
2. Digital D.A.D. Flometers
3. Dual Channel D.A.D. Flometers
4. Single Channel Recorders
5. Dual Channel Recorders
6. Flometer/Accumulator Combos
7. Accumulators
8. Batch Accumulators
9. Batch Controllers
10. Flomonitor Systems
11. Airmonitor Systems
12. Flo Alarms

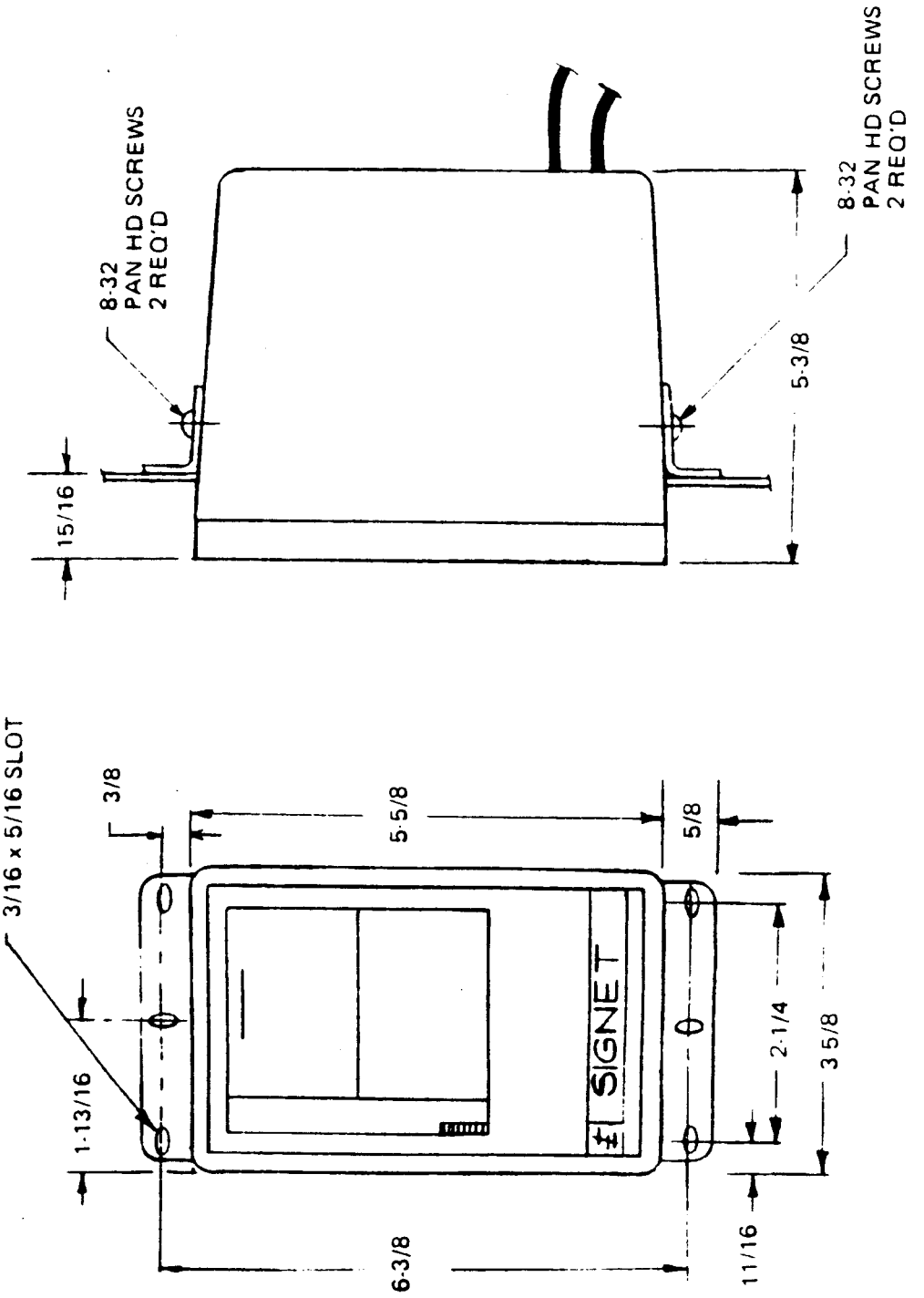

8-32
PAN HD SCREWS
2 REQ'D
8-32
PAN HD SCREWS
2 REQ'D
15/16
5-3/8
3/16 x 5/16 SLOT
3/8
5-5/8
5/8
1-13/16
SIGNET
2-1/4
3 5/8
6-3/8
11/16

FIG. 1

FIG. 1

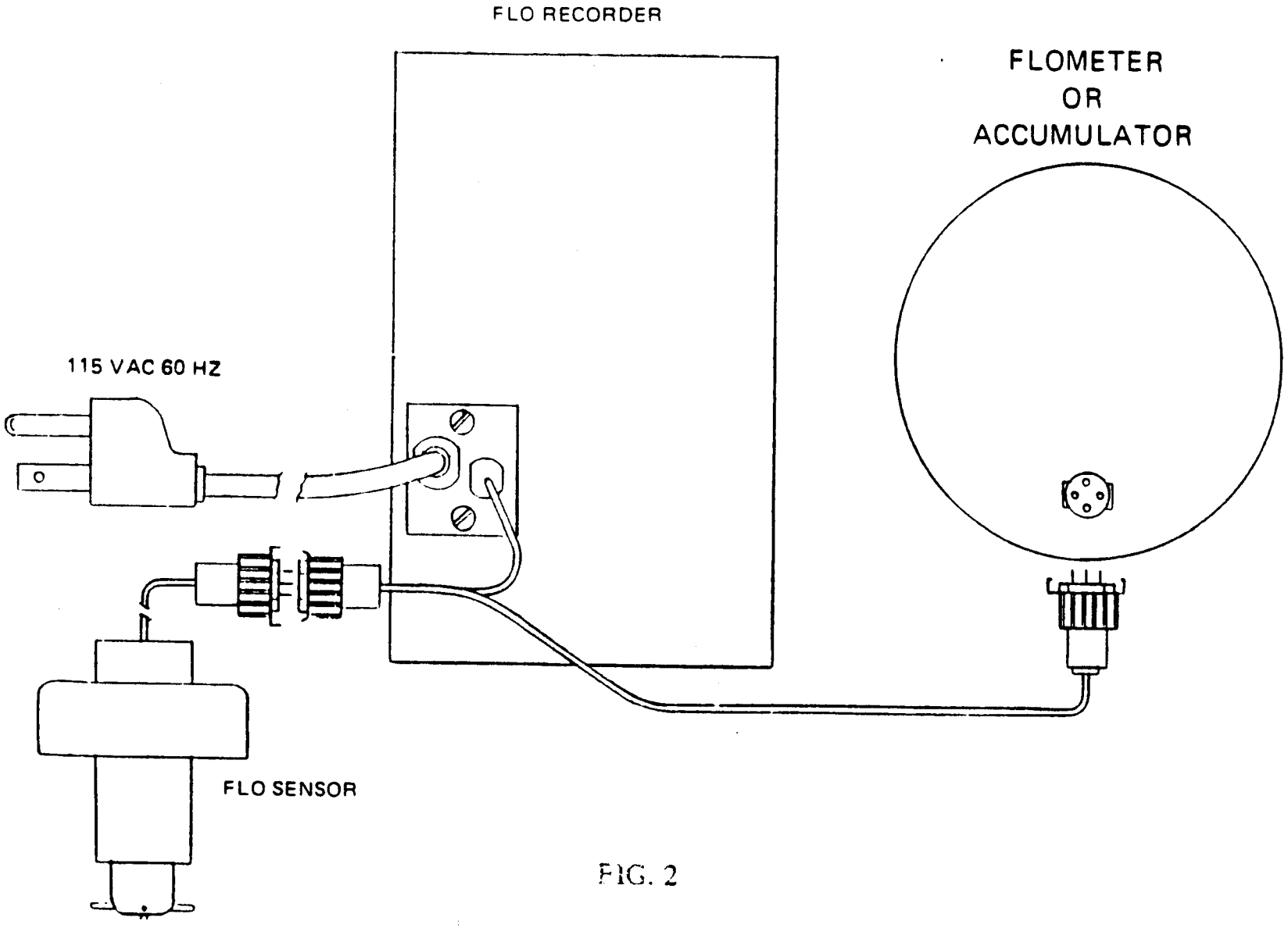

FLO RECORDER
FLOMETER
OR
ACCUMULATOR
115 VAC 60 HZ
FLO SENSOR

FIG. 2

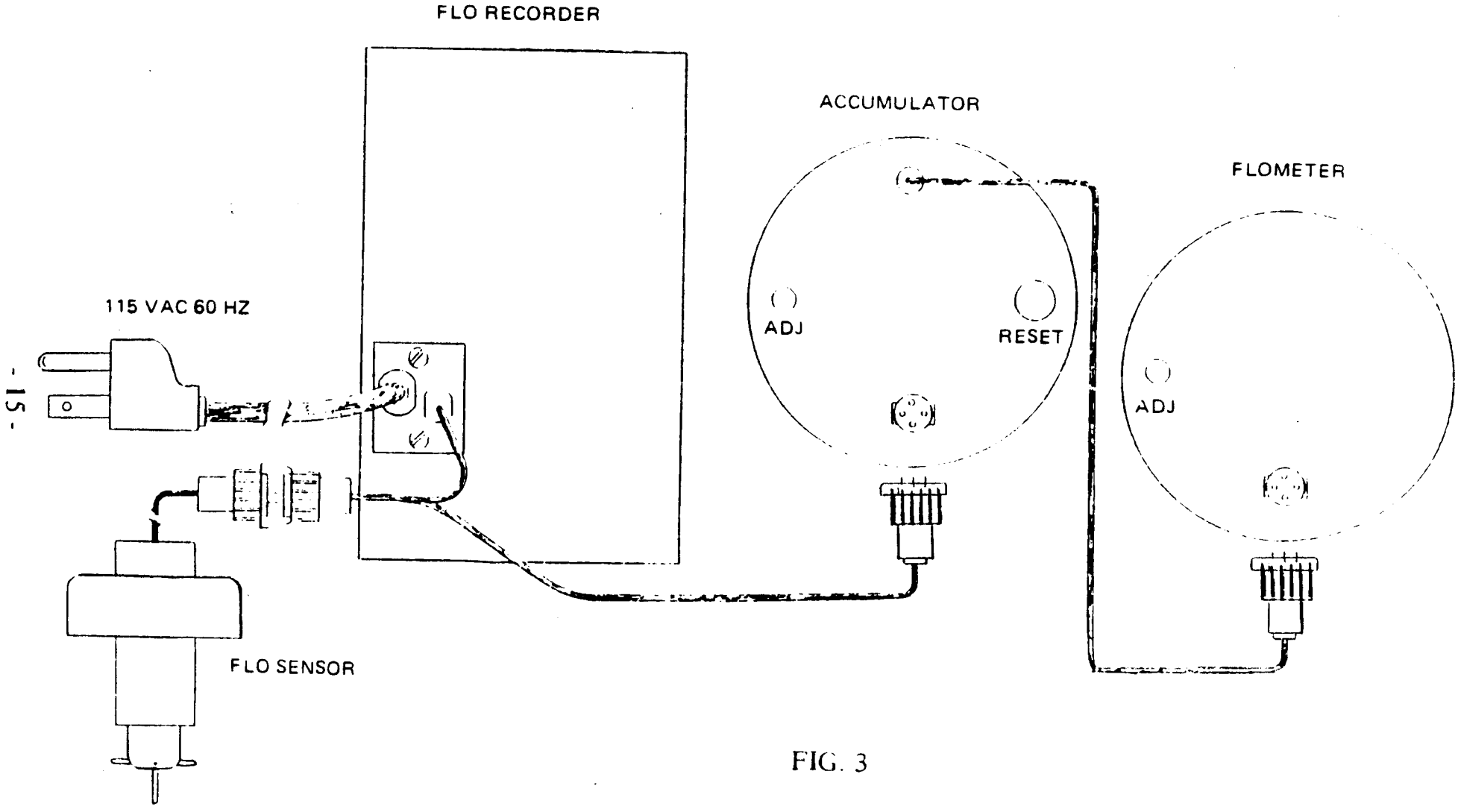

FLO RECORDER
ACCUMULATOR
FLOMETER
115 VAC 60 HZ
ADJ
RESET
ADJ
FLO SENSOR

FIG. 3

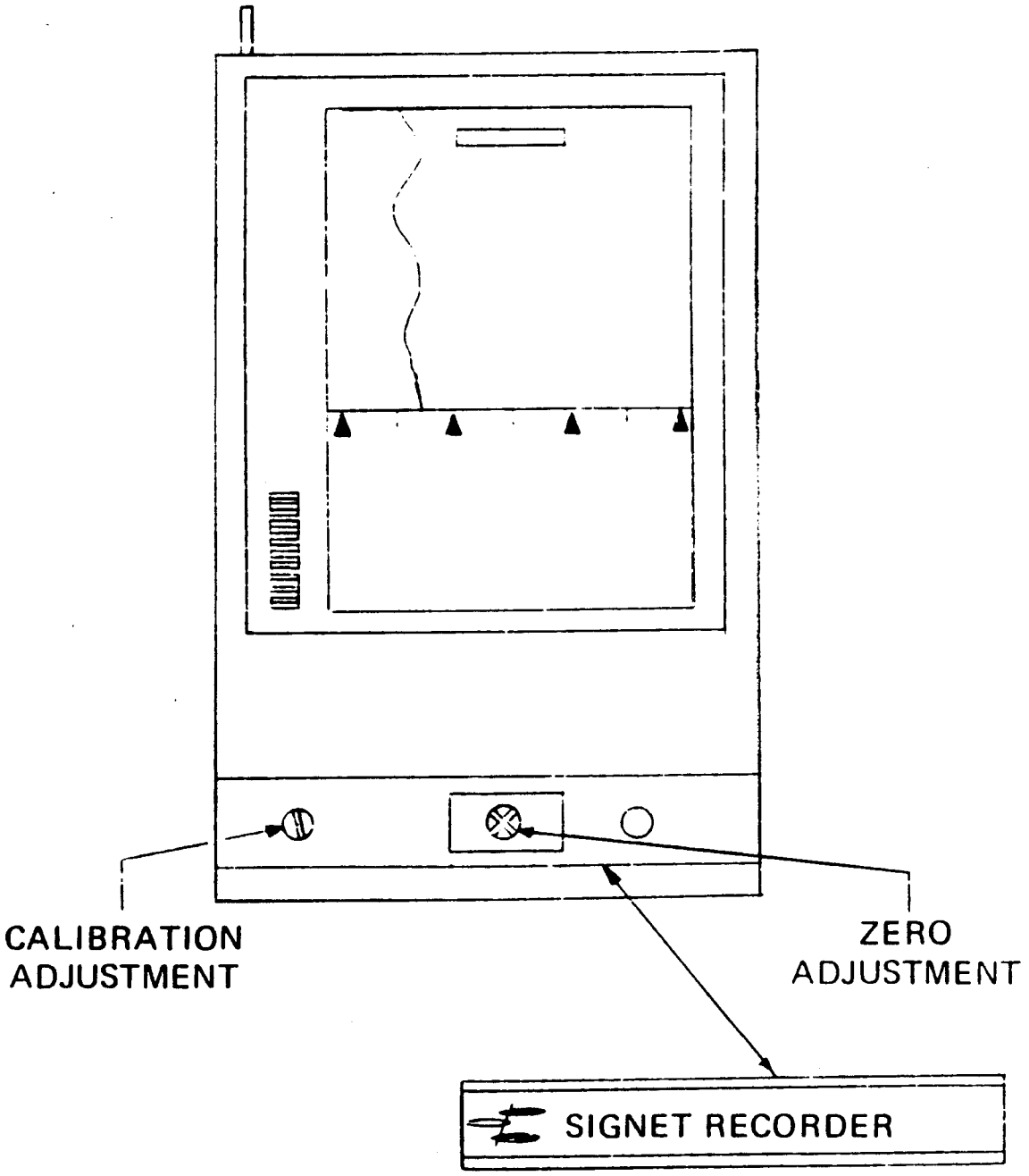


FIG. 4

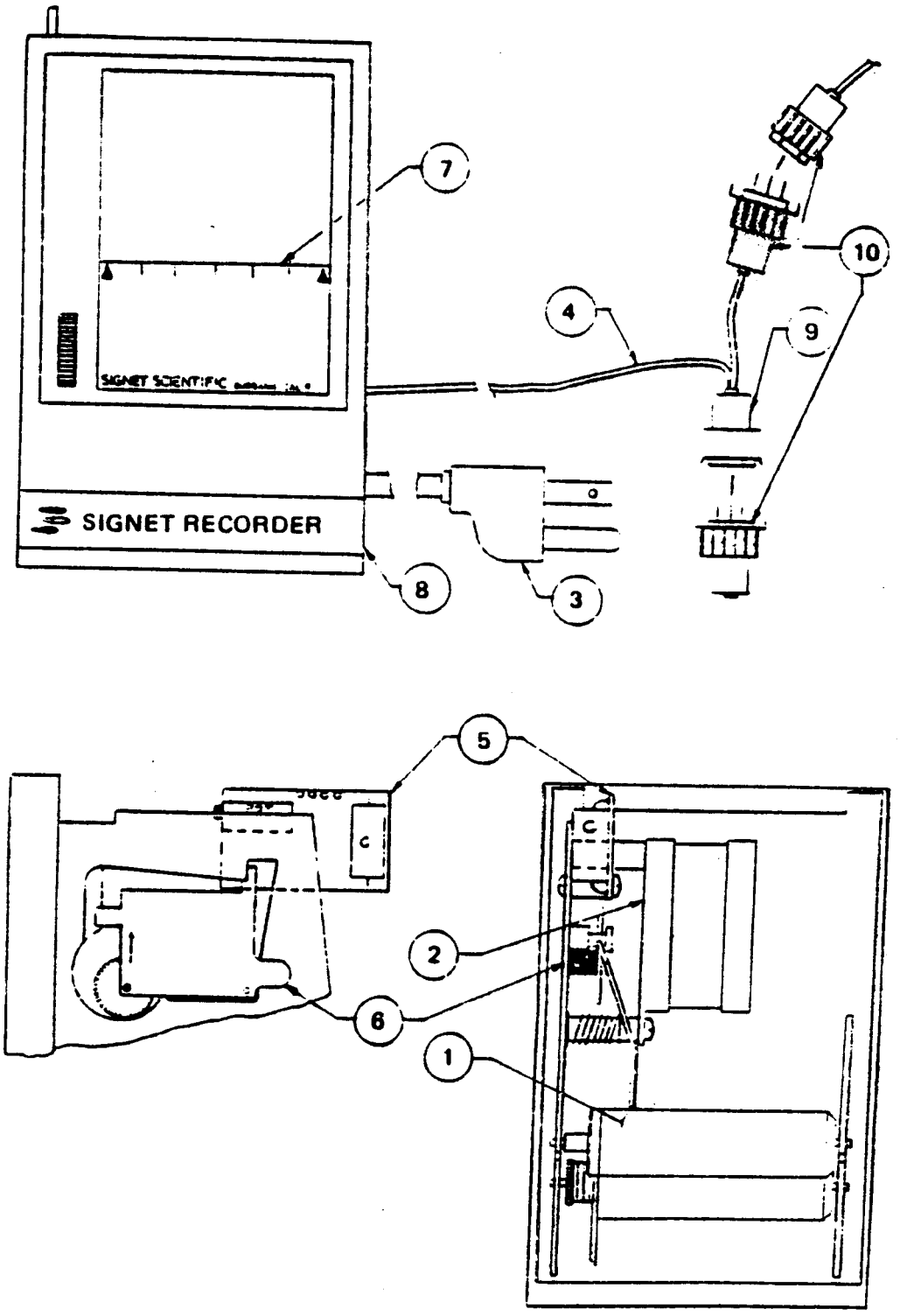


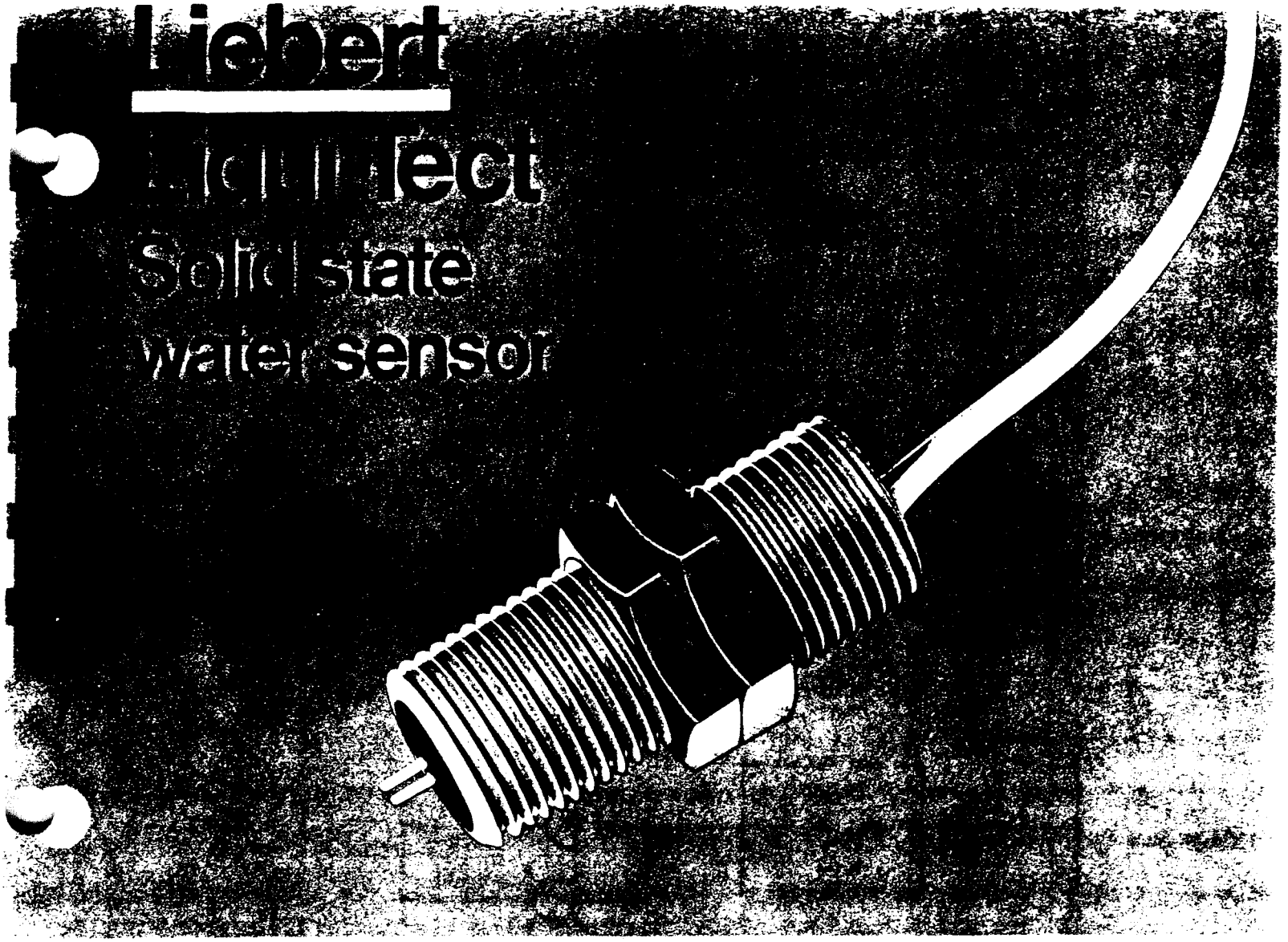
FIG. 5

LIQUI-TECT WATER SENSOR

Liebert

Liqui-Tect

Solid state water sensor



Senses the presence or absence of conductive liquids. Then does something about it.

Liqui-Tect provides an instantaneous response to the presence of moisture in "dry" areas. Or when water levels are too high.

When these hazards occur, Liqui-Tect's solid state switch instantly closes the circuit, relaying a signal to an alarm system such as the Liebert Liqui-Tector, or Mode-Alert system on the Deluxe System/2.

It's a response that can always be depended upon no matter what the application. Because, we've built in these features:

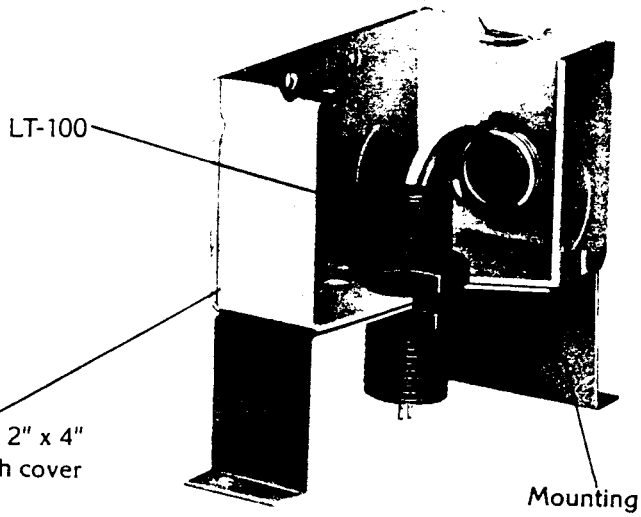
- Solid state circuitry for reliability.
- No moving parts. No wear.
- Compact micro-design. It can go just about anywhere.
- Hermetically sealed. Keeps out dust.
- Highest quality components for precision operation.
- No power supply invertors or relays required.
- Operation unaffected by dirt and vibration.

Under floor water sensing for computer rooms. Senses water in hidden pipe and wire chases. High or low level sensor in sumps and humidifiers.

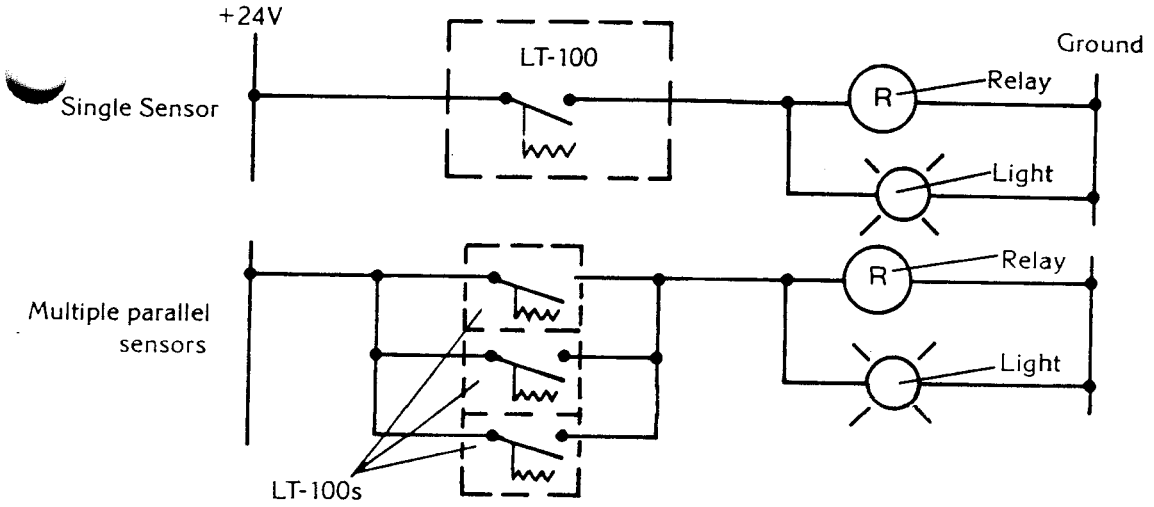
- 24 volt 50/60 Hz circuit applications up to 1 AMP load.
- Connections are 6" long leads – 18 Ga. stranded wire.
- Supplied in 2" x 4" Handi-Box with mounting bracket.
- Adjust height with two locking nuts.
- Hermetically sealed in PVC nipple.
- Can be mounted in any position.

Typical Mounting Method

Conduit Wiring



Typical Electrical Hookups



Typical Guide Specification for Liqui-Tect Sensor
Provide one solid state "Liqui-Tect" Water Sensor as manufactured by Liebert Corporation. Sensor shall close a solid state switch on presence of conductive liquid. The sensor shall be hermetically sealed in an all thread PVC nipple, complete with mounting nuts, to be located and installed under the raised floor by the installing contractor. The Sensor shall sound an audible alarm and illuminate the "Water Under Floor" light as an integral part of the PCR-2 Mode-Alert warning system or Liqui-Tector. The silencer switch in the solid state system shall de-energize the audible alarm, however, the light shall remain on until the absence of water is detected by the sensor.

SELECT LIEBERT. SELECT QUALITY.
Liebert Corporation
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Appendix B

APPENDIX B

GROUND WATER SAMPLING PROTOCOL

GROUND WATER SAMPLING PROTOCOL
FAIRCHILD CAMERA & INSTRUMENT CORPORATION

Protocol Intent

This Ground Water Sampling Protocol is prepared by Canonie Engineers, Inc. to provide a consistent and uniform procedure for obtaining samples of ground water from monitoring and production wells. It is intended for the protocol to reduce potential sources and magnitude of extraneous contamination to ground water samples. The protocol also provides a mechanism for obtaining field replicate, certified blind, and trip blank samples to be used in evaluating field and laboratory techniques.

This protocol is complimentary to various analytical methods of the U.S. Environmental Protection Agency as published in the Federal Register. Specific reference is made to paragraphs 1.1, 3.1, 3.2, 4.1, 7.2, 8.1, 8.2, and 8.3 of U.S. EPA Method 624 published on Monday, December 3, 1979.

This protocol does not provide for replicate or fortified samples required for in-house validation of accuracy or precision by the testing laboratory. Standard quality assurance practices should be followed by the laboratory and calculated values of accuracy and precision reported with the ground water analytical results.

Well Sampling Sequence

Where more than one well within a specific well field or site is to be sampled, the sampling sequence will begin with the well having the least suspected contamination. Successive samples will be obtained from wells of increasing suspected contamination.

If the relative degree of suspected contamination at each well cannot be reasonably assumed, sampling will proceed from the perimeter of the site towards the center of the site. The sampling sequence will be arranged such that wells are sampled in order of increasing proximity to the suspected source of contamination.

Equipment Cleaning

Sample bottles, bottle caps, and septums will be thoroughly washed with detergent, rinsed extensively with tap water, and then rinsed again with high purity deionized water. After washing and rinsing, sample bottles and components will be dried at a temperature of 105°C for a period of one hour. Sample bottles, bottle caps, and septums will be protected from all forms of solvent contact between the time of drying and actual usage at the sample site.

Prior to purging or sampling each well, all equipment surfaces which will be placed in the well or may come in contact with the ground water will be cleaned to prevent the introduction of spurious contaminants. Cleaning will be accomplished by flushing, washing, or wiping equipment components with electronic grade Methanol and then thoroughly rinsing the Methanol with fresh deionized water. Care will be exercised to assure that normally wetted interior surfaces of pumps, bailers, hoses, tubes, or other components are properly cleaned. A replicate sample of clean wash solvent will be obtained during each day's sampling from each container of solvent used. The solvent will be sampled in the manner described for ground water and included within the ground water sampling sequence. Health and safety requirements appropriate for the use of Methanol will be rigorously enforced.

In lieu of using Methanol, purging and sampling equipment can be cleaned with hot water and steam. Interior surfaces will be flushed with fresh deionized water heated to 60° C (140° F) or higher. The interior flushing water will fully traverse the same circuit of hoses, tubes, valves, or other equipment components as that followed by the well water during purge and sampling. The volume of hot water used for flushing interior surfaces will equal or exceed ten (10) times the physical volume of the equipment piece based on outside (exterior) dimensions, excluding attached hoses, cables, or wires. Replicate samples of the final interior flushing water

will be obtained from a random 20 percent (20%) or more of the wells sampled each day. Exterior surfaces will be cleaned with steam generated from fresh deionized water. Thorough steam cleaning will be performed immediately prior to initiation of the interior flushing procedures and again prior to insertion of the equipment piece into the well. As with all purging and sampling equipment, access to and use of the steam generator will be controlled to prevent extraneous contamination. Health and safety requirements appropriate for the use of heating elements, fuels, hot water, and steam will be initiated and rigorously observed.

Stainless steel wire, which can be properly cleaned after repeated usage, should be used for lowering and raising equipment in the wells. In the event that absorbent materials (ie: rope or cord) are placed in the wells, they will be stored in dust tight containers until usage and the used portion will be discarded after completion of sampling at each well. Similarly, disposable surgical-type gloves will be worn while sampling and discarded after each well sample is completed.

All equipment components and critical openings (ie: bailer slots, pump values, etc.) will be visually inspected to assure they are free of soil particles or other solid material which may become dislodged during purging or sampling operations.

Well Purging and Sampling

Immediately prior to purging each well, the depth from top of well casing to top of water surface will be determined to the nearest 0.1 foot and recorded as a portion of the well sample data. The top of well casing elevation will be determined to the nearest 0.1 foot by conventional survey methods.

Jetting methods will not be used for purging the monitor wells. The preferred method for purging and sampling of the monitoring wells is with a submersible type pump providing a uniform rate of discharge. Pumps causing aeration or agitation of the water are not to be used for sampling purposes. Teflon tubing will be used for intake/discharge lines as required for pump operation. The pump intake or suction end will be lowered to the well bottom and then raised one foot before starting the pump. In small diameter, low purging volume monitor wells, purging and sampling can be effected with a bailer constructed of stainless steel, glass, or teflon-coated materials.

Initially, monitoring wells will be purged by removing the minimum quantity of ground water (Vw) determined by one of the following equations:

$$Vw = 0.03\ d^2W \text{ cubic feet}$$
$$\text{or } Vw = 0.19\ d^2W \text{ gallons}$$

where; d is the well casing diameter in inches and W is the depth of water in the well casing measured in feet. Note that W must be calculated by subtracting the measured depth to water in the well from the total well casing length reported on the well installation details or boring log. Recognizing the variabilities of well size and depth, water depth, and aquifer characteristics, it is intended for pumping rates to be such that the specified purge volumes are removed in a time period not exceeding 90 minutes. If a well is evacuated during the purge, it will be allowed to recharge for a period not exceeding 24 hours before sampling. An evacuated well which has not recovered sufficiently to allow sampling after 24 hours of recharge time will be deleted from the sampling sequence.

Operating water supply or production wells with in-place pumps will be purged prior to sampling by allowing a full free flow of water from the sampling point for a time period of 30 minutes or for one-half of the

volume (Vw) calculated by the preceding formulas, whichever occurs first. Abandoned water supply or other relatively large diameter and deep wells used infrequently will be purged for 60 minutes or for the full calculated volume (Vw), whichever occurs first.

At each well to be sampled, purged waters will be monitored for temperature, pH, and conductivity as a function of time. This data will be accurately recorded such that the variation of parameters can be related to elapsed purging time. These relationships along with sample data from selected purge evaluation wells will be used to modify the purging volumes at each specific well.

Purging methods, volumes, times, and any other pertinent information will be recorded and reported by the sampling agency. In addition, the sampling agency will be responsible for providing appropriate equipment to transport purged waters to a central storage location for subsequent disposal by the owner.

Prior to initiating a well field sampling sequence, one or more specific wells will be selected for evaluating the purging effort. The selected well(s) will be sampled at the beginning and approximately midway through the purging volume previously described in addition to normal sampling at the completion of purging. Selection of the purge evaluation well(s) will be from those wells suspected of containing solvent concentrations higher than the statistical mean for the site. To the degree possible, different wells will be used for purge evaluation from one sampling period to the next. The number of purge evaluation wells will be 1 if 9 or fewer wells are to be sampled and 2 if 10 or more wells are to be sampled. The purge evaluation wells will be sampled in their normal order within the sampling sequence.

The ground water samples will be placed in glass bottles fitted with caps having Teflon-faced silicon seals. The sample bottles will be 40 ml or larger in size. Each sample bottle will be labeled with a randomly selected numerical or alphanumerical designation. Additional information to be shown on the bottle label will include:

- o Name and address of sampling agency
- o Sampling agency project identification code
- o General site name, identification, or location
- o Sampling date

No specific reference to the well, sample depth, aquifer, or other physical/chemical distinction will be shown on the bottle label. Similarly, only the above information will appear on any "chain-of-custody" form or other documentation transmitted to the testing laboratory. At the time of sampling, one copy of a sample log or manifest will be prepared by the person physically responsible for collecting the samples. This sample log will correlate the random sample bottle designation to a specific well location or other distinguishing feature (ie: dummy sample, replicate sample, purge evaluation sampling, etc.). The sample log will be held confidential by the sampling agency, Fairchild, Canonie, or other designated entity. The sample log will be used for preparing laboratory test assignments and for referencing analytical results to specific well locations. After all analytical results have been formally reported, the sampling agency or Canonie will prepare a summary report which will directly identify sample locations and results. This summary report will be distributed to Fairchild, Canonie, the sampling agency, and all participating laboratories for review and comment.

Immediately prior to obtaining each ground water sample, the sample bottles and caps will be thoroughly rinsed two or more times with the final well purge water. The water sample will totally fill the sample bottle in such a manner as to prevent air bubbles from passing through the sample and eliminating the entrapment of any air in the bottle. The sample bottles will be capped immediately after filling, inverted, and tapped to test for air bubbles. If any bubbles are observed, the sample will be discarded and a fresh sample obtained from the monitor well. Samples will be placed in an ice chest or similar container capable of maintaining a temperature between 5°C to 15°C (40°F to 60°F) for transporting to the laboratory. Unavoidable vacuum bubbles may form during storage as a result of sample contraction from cooling.

Three separate sample bottles of ground water will be collected at each monitor well as the sample set. Each bottle of the sample set will be identified by its own independent and random designation, as previously described, without reference to other bottles of the sample set.

In addition to the ground water sample set (3 bottles), ten percent (10%) or more of the sample bottles will contain a certified blind sample and a minimum of four percent (4%) of the sample bottles will contain organic-free water as trip blanks. Certified blind samples will be prepared using concentrations of organic solvents not uncharacteristic of actual ground water samples from the site. The 10% requirement for blind samples is not to be construed as "every tenth sample" or a rigorous "1 in 10 samples" but rather as randomly selected and spaced samples which will numerically equal 10% or more of the actual ground water samples. The 4% of organic-free trip blanks will be prepared prior to initiating the sampling sequence and included in the random distribution of sample bottle designations. However, at least two trip blanks will be included with each container used to transport samples. The blind samples and trip blank samples will be identified with the same random system used for the actual ground water samples and only the field prepared sample log will distinguish them from the actual ground water samples.

The minimum total number of sample bottles to be prepared (cleaned and labeled) prior to initiating the sampling sequence will be determined by multiplying the number of sampling points (wells) by 3.5 and then adding 8 to the product. Decimal fractions will be rounded up to the next highest whole unit. This procedure will result in 2 extra bottles for 1 sampling point (12 prepared versus 10 required), 1 extra bottle for 10 sampling points (43 prepared versus 42 required), and 9 extra bottles for 100 sampling points (358 prepared versus 349 required). The number of "extra" bottles is based on minimum sampling requirements and sampling personnel may use the extra bottles for additional replicate samples. Also, the sampling agency may prepare additional bottles at their own discretion. All prepared sample bottles will be accounted for on the sample log with those not used appropriately noted. Note that the required total number of sample bottles will increase by 20% if equipment cleaning is accomplished with the hot water and steam alternative.

Canonie Engineers

Field Sample Data

PROJECT No. _____

PAGE _____ OF _____

PROJECT NAME _____ SAMPLED BY _____

STATION No./LOCATION _____ DATE _____

SKETCH ON BACK YES ☐ NO ☐ PHOTOGRAPHS YES ☐ NO ☐ ROLL No./EXPOSURE No. _____

FIELD DATA

TIME _____ AIR TEMP °F _____ WEATHER _____

WELL DEPTH _____ WATER DEPTH _____ SAMPLE DEPTH _____ SAMPLE METHOD _____

VOL. PURGED _____ SAMPLE TEMP. _____ °C ☐ IN SITU ☐ IN BOTTLE SP. COND. _____ / _____ AT 25° C ☐ IN SITU ☐ IN BOTTLE

pH _____ ☐ IN SITU ☐ IN BOTTLE Eh _____ ☐ IN SITU ☐ IN BOTTLE DISSOLVED O_2 _____ ppm ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL (ppm) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED

REMARKS: _____

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 _____ pH 7 _____ pH 10 _____

SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____

PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____

FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____

PROJ NO	PROJECT NAME	NO. OF CONTAINERS	ANALYSIS	REMARKS
L P NO	SAMPLERS: (Signature)			
DATE	SAMPLE I.D.			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)

Remarks

Canonie Engineers 83 W. March Lane, Stockton, Ca. 95207

Nº 1104

White Sampler — Canary Return Copy To Shipper — Pink Lab Copy

CHAIN OF CUSTODY

Canonie Environmental

WAPPINGERS FALLS, NEW YORK

Water Levels

PROJECT No. 84-098
MEASURED BY _____
INSTRUMENT TYPE _____
INSTRUMENT No. _____
PAGE 1 of 1

WELL NUMBER	ELEVATION TOP OF PVC (FT., MSL)	DEPTH TO WATER	GROUND WATER ELEVATION (FT., MSL)	DATE/TIME	NOTES
W-9	236.1				
W-10	200.8				
W-11	230.4				
W-12	227.8				
W-13	229.1				
W-14	230.1				
W-15	230.8				
W-16	231.4				
W-17	230.8				
W-18	230.8				
W-19	232.0				
W-20	234.1				
W-21	211.0				
W-22	198.5				
W-23	229.0				
W-24	202.2				
W-25	197.4				
W-26	198.9				
W-27	199.9				
W-28	227.6				
W-29	227.6				
W-30	229.6				
W-31	228.6				
W-32	229.6				
W-33	229.6				
W-34	227.6				
W-35	229.6				

Canonie Environmental

Water Levels

PROJECT No. 84-098
MEASURED BY _____
INSTRUMENT TYPE _____
INSTRUMENT No. _____
PAGE 1 of 1

WAPPINGERS FALLS, NEW YORK
GROUND WATER TRENCHES

ST-1 THROUGH ST-8: LOWER TRENCH
ST-9 THROUGH ST-11: UPPER TRENCH

STATION NUMBER	ELEVATION TOP OF PVC (FT., MSL)	DEPTH TO WATER	GROUND WATER ELEVATION (FT., MSL)	DATE/TIME	NOTES
ST-1	204.5				
ST-2	205.6				
ST-3	207.9				
ST-4	199.7				
ST-5	203.7				
ST-6	206.6				
ST-7	207.1				
ST-8	212.2				
ST-9	230.2				
ST-10	228.1				
ST-11	228.5				

Appendix C

APPENDIX C

PACKING AND SHIPPING GUIDELINES

1. Hydrochloric acid solutions at concentrations 0.04 percent (w/w) or less;

2. Mercuric chloride in water solutions at concentrations less than or equal to 0.004 percent (w/w);

3. Nitric acid in water, concentrations less than or equal to 0.15 percent (w/w);

4. Sulfuric acid solutions, concentrations less than or equal to 0.035 percent (w/w);

5. Sodium hydroxide in water, concentrations less than or equal to 0.080 percent (w/w);

6. Phosphoric acid in water, concentrations yielding a pH range between 4 and 2.