



U.S. Environmental Protection Agency
Region III

**Saunders Supply Company Superfund Site
Chuckatuck, Virginia**

June 30, 2003

*Groundwater Extraction and
Treatment System Operations
and Maintenance Manual*



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June 30, 2003

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PROJECT: Contract No. 68-S7-3003
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Groundwater Extraction and Treatment System Operations and
Maintenance Manual, Saunders Supply Company Superfund Site,
Chuckatuck, VA
DCN: 3233-037-OM-MANL-01870

Dear Mr. Palestini:

CDM Federal Programs Corporation (CDM) is pleased to submit the enclosed Groundwater Extraction and Treatment System Operations and Maintenance Manual, Saunders Supply Company Superfund Site, Chuckatuck, VA.

This document is submitted in partial fulfillment of the reporting requirements for this assignment. If you have any questions or comments, please contact me at (703) 968-0900.

Sincerely,

Daniel G. Gilroy, P.E.
Project Manager
CDM Federal Programs Corporation

cc: J. Tralie, RAC III Project Officer (letter only)
J. Knapp, CDM RAC III Program Manager
Document Control

**Response Action Contract
for Remedial Planning and Oversight Activities at Sites
in EPA Region III**

U.S. EPA Contract No. 68-S7-3003

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Operations and Maintenance Manual
Saunders Supply Company Superfund Site
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1650 Arch Street
Philadelphia, Pennsylvania 19103

Prepared by:
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Chantilly, Virginia 20151

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Section 1

Introduction

CDM Federal Programs Corporation (CDM) has prepared this Operations and Maintenance (O&M) Manual for the groundwater extraction and treatment system at the Saunders Supply Company Superfund Site in Chuckatuck, Virginia under the U.S. Environmental Protection Agency (EPA) Region III Response Action Contract (RAC). As required by the Scope of Work (SOW) for this work assignment, this document is an updated version of the existing O&M Manual (Weston, 1998). A site location map is presented in Figure 1-1.

The purpose of this O&M Manual is to serve as a reference document on proper operation of the groundwater extraction and treatment system for use by system operators. It provides an understanding of the overall purpose of the system and the functioning of the treatment technologies installed, describes the procedures for operating the system, and provides maintenance schedules and procedures. In addition, a compilation of equipment manufacturers' detailed O&M procedures, trouble shooting guides, catalog cuts, and parts lists with catalog numbers is provided as appendices to the manual. This O&M Manual does not contain sufficient detail to allow an operator who is unfamiliar with the treatment system to operate it. All operators will be trained on the operating conditions of this extraction and treatment system prior to performing O&M tasks.

CDM has prepared a companion document entitled "Final Sampling and Analysis Plan, Saunders Supply Company Site" (CDM 2003), that provides details on the procedures for collecting monthly samples from the groundwater treatment system and quarterly samples from the monitoring and recovery wells, and addresses health and safety and quality assurance issues.

1.1 Site Background

The Saunders Supply Company Superfund Site is located in the town of Chuckatuck, Virginia, eight miles north of the City of Suffolk. The site encompasses 7.3 acres and comprises the Saunders Supply and Kelly Nursery properties. The property slopes towards a drainage ditch immediately north of the site and an intermittent unnamed stream west of the site. These surface water drainage pathways discharge to Godwin's Millpond, located approximately 600 feet north of the property. The site previously hosted a wood preserving facility that used two processes in its wood treating operations: (1) pentachlorophenol (PCP), and (2) copper, chromium, and arsenic (CCA). The site is currently used as a wholesale lumber yard. A year-round nursery that grows and retails various annual and perennial flowers and potted plants is located north of Saunders Supply and is where the monitoring and recovery wells are located. The Saunders Supply Company property was purchased by the current owners in 1946 and operated as a lumber and hardware retail store. Onsite chemical wood treatment began in 1964. PCP was used for wood treatment until Saunders Supply began phasing it out from 1974-1984. When in use, the PCP treatment solutions were periodically drained into a series of oil/water separators. The final oil/water separator in the series was an unlined pond. A crust-like residue that formed on the surface of the former pond was occasionally burned as a

training exercise for the local fire departments. The pond has since been filled in and covered over by the Saunders Supply Company.

Sludge removed during annual maintenance of the PCP treatment process was used on the roads and/or around the lumber storage areas to control dust and weeds from approximately 1966-1981. After 1981, PCP sludge was disposed offsite. Prior to 1984, treated wood was placed on pallets located directly on the ground in the southern portion of the property near the wood treating process area to dry. From 1984-1991, the wood was air-dried on a concrete drip pad that collected the excess chemicals. By 1984, CCA replaced PCP in the wood treating operations at the site. The facility ceased all wood treating operations in 1991.

The site was proposed for the National Priorities List in January 1987. A Remedial Investigation/Feasibility Study was performed from September 1988 until May 1991. Godwin's Millpond is part of the City of Suffolk's public water supply. During routine monitoring conducted at the site for the remedial design, EPA detected the presence of PCP and traces of metals in the downgradient groundwater. Since the groundwater discharges into Godwin's Millpond, EPA used its emergency removal authority to design and construct a system to prevent the impacted groundwater from reaching the pond. The groundwater extraction and treatment system began operating in April 1998 with four recovery wells that deliver groundwater to a treatment building for processing. The major treatment process equipment include a reaction tank, a blower, a holding tank, a filter system, activated carbon units, and an effluent tank.

CDM began operation of the groundwater extraction and treatment system on November 1, 2002. A total of 2.3 million gallons of groundwater have been treated by the system through May 2003.

1.2 Summary of Extraction and Treatment System

EPA completed construction of the groundwater extraction and treatment system in April 1998 to treat PCP and trace levels of metals, and has operated the system continuously since that time. The groundwater extraction and treatment system has four recovery wells that deliver groundwater to a treatment building for processing. The major treatment process equipment includes a reaction tank, blower, holding tank, filter system, activated carbon units, and an effluent tank. The piping and instrumentation diagram (P&ID) depicting the system that was prepared by Weston in the initial O&M Manual is provided in Figures 1-2 and 1-3. The major components of the groundwater extraction and treatment system include the following:

Process System:

- Four recovery wells with pumps (RW-1 through RW-4)
- Reaction Tank (T-1)
- Chemical Feed Tank (CF-1)
- Inline pH meter for chemical feed control
- Blower (B-1)

- Settling Tank (T-2)
- Air Compressor
- Sand Filters
- Sand Filter Feed Pump (P-1)
- Activated Carbon Units (1A, 2A, 1B, 2B), 55-gal drum each
- Effluent Tank (T-3)
- Effluent Pump (P-2)
- Sampling Ports
- Associated piping, fittings, and appurtenances
- Associated electrical and control devices and panels
- Discharge piping to the storm sewer located along Godwin Blvd

Non-Process System:

- Overhead Heater
- Sump Pump

1.3 Summary of Maintenance Activities

The maintenance activities performed by the operator consist of two phases. Phase 1 is the routine operation and maintenance tasks. Phase 2 includes any unscheduled maintenance or unforeseen modifications to the system.

1.3.1 Phase 1 - Routine Maintenance Requirements

Phase 1 maintenance activities include routine O&M of the groundwater extraction and treatment system. All equipment is regularly inspected and maintained following a maintenance schedule that has been generated to outline the maintenance requirements. This schedule, System Maintenance Schedule and Record, is provided in Appendix A.

Weekly checks are conducted and the Weekly System Monitoring Checklist provided in Appendix B is completed by the operator.

A comprehensive monthly site O&M inspection is performed on the first week of each month to verify the operation of all critical devices. During each inspection, the operator observes and records the operational condition of the system, changes cartridge filters (if necessary), lubricates moving parts in accordance with manufacturer's instructions, and notes any conditions of disrepair. The Critical Device Checklist provided in Appendix C is completed by the operator.

Cleaning and replacement of groundwater pump impellers to remove clogging is performed as necessary to maintain adequate pumping rates. The autodialer is monitored by the operator to determine if any shutdown events occur. All maintenance and repairs are performed in accordance with the manufacturer's recommendations so as not to void either the manufacturer's or the construction contractor's warranty.

The operator provides routine facility operation and maintenance, and in particular, completes the following tasks:

- Fill the soda ash feed tank and ensure that the tank does not become empty
- Periodic recalibration of the pH probe and metering system
- Replace light bulbs and/or fixtures
- Maintain cleanliness of interior surfaces
- Maintain the site first aid kit, and all building safety equipment, (e.g., eye wash station, fire extinguisher)
- Provide for maintenance of the telephone/autodialer
- Dispose of any solid waste generated during maintenance activities

The operator inspects all equipment for any visual sign of damage including cracks, leaks, etc., and lubricates all pumps and blowers as prescribed in the manufacturer's guidelines. All pumps and blowers are inspected as prescribed in the Appendix A maintenance schedule.

The operator visually inspects electrical equipment during each scheduled inspection. Equipment will be inspected for sources of leaks or unusual heat, noise, or odors, and areas surrounding electrical equipment are kept clean.

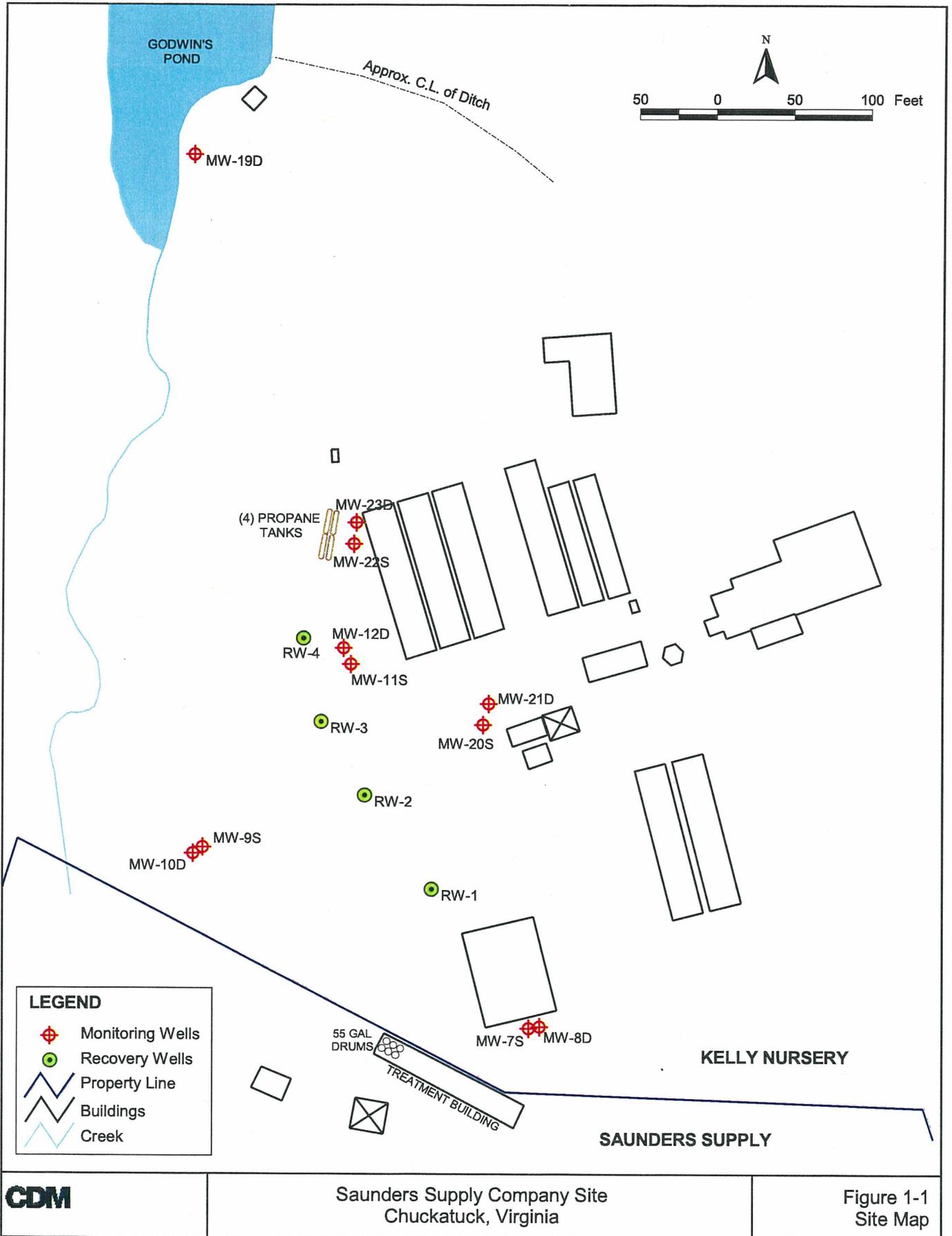
The operator changes out spent 55-gallon drum carbon filter units. This effort includes replacement of the spent carbon unit with a new carbon filter unit. The spent carbon is transported and disposed in accordance with all state and federal requirements. Spent carbon is transported by a pre-approved transporter and disposed of at a pre-approved disposal facility.

Current Material Safety Data Sheets (MSDSs) are maintained available onsite for all chemicals used or stored for operating the treatment system.

1.3.2 Phase 2 - Unscheduled Maintenance and Repairs

Actions necessary to maintain safe and proper system operation will be completed using sound O&M practices. Unscheduled maintenance and repairs will be approved by EPA prior to completion and will be logged on the Weekly System Monitoring Checklist. Unscheduled maintenance consists of performing non-routine, unscheduled maintenance or repairs to the system, such as blowers, motors, and other items that are outside routine maintenance for the treatment system.

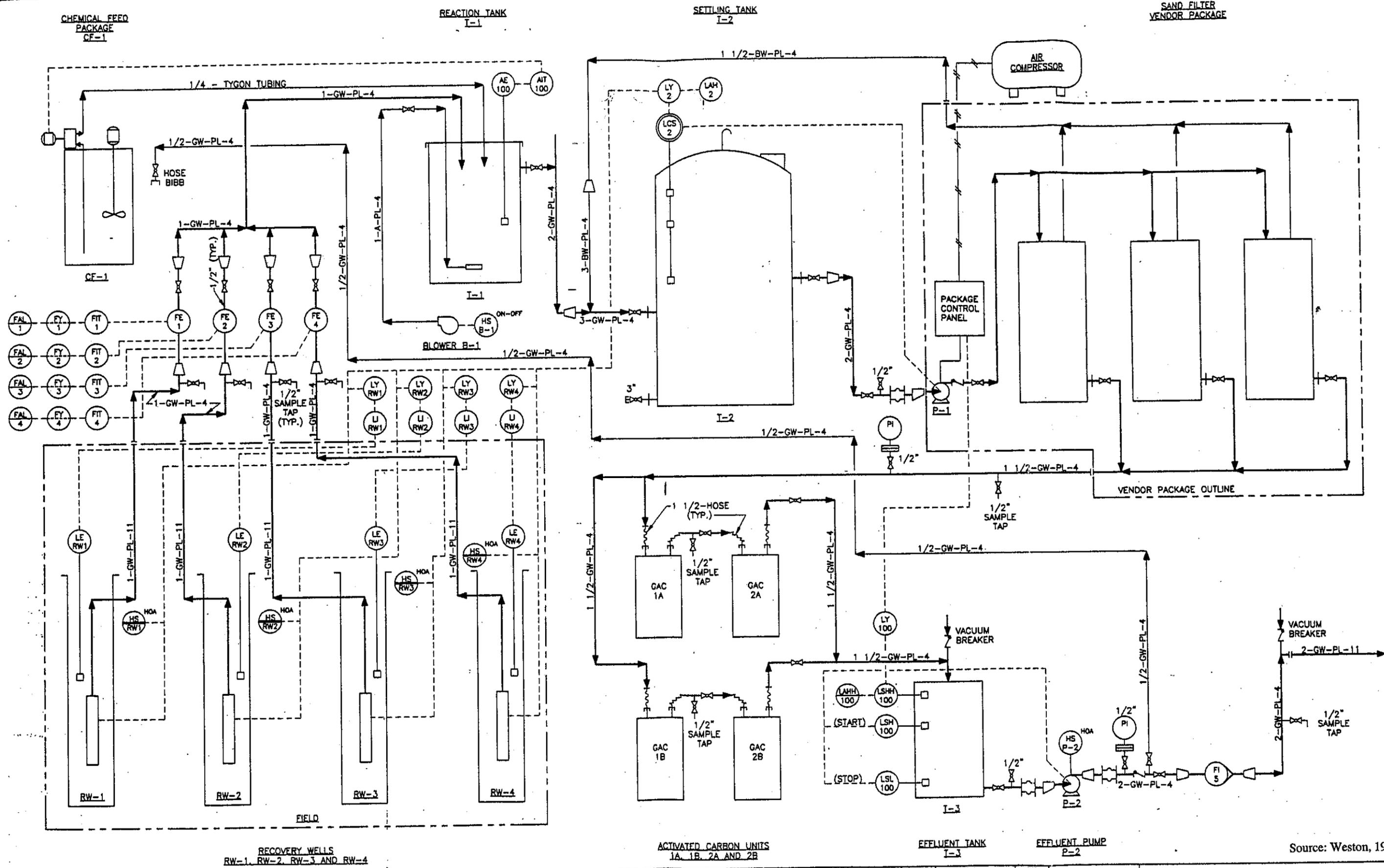
In the event of equipment failure, the operator is responsible for troubleshooting the treatment system to identify the cause of the failure. The operator will repair or replace any component of the system that fails. When it becomes necessary to provide replacement equipment, the operator will replace the failed piece of equipment with the same size and model that was originally provided, or equal. If equivalent replacement equipment is provided, the replacement equipment will be of equal or better quality than the original equipment that is to be replaced.



CDM

Saunders Supply Company Site
Chuckatuck, Virginia

Figure 1-1
Site Map



FILE NO. G:\ACUPROD\3347201\42011001
 PLOTTED
 PLOT. SC.

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

EPA - - - - - REAC
 SAUNDERS SUPPLY SITE
 NEWPORT NEWS, VIRGINIA

WESTON

WESTON CONSULTANTS
 1000 W. MARKET STREET, SUITE 200
 FORT MYERS, FLORIDA 33901

DESIGNED	DATE	CHECK APPROVALS	DATE
GAP/RDB	02/13/98		
REV. DES.	GAP/RDB	02/13/98	
PROJ. MGR.	CAL/SB	02/13/98	
APPROVED			
APPROVED			

Figure 1-2
 GROUNDWATER TREATMENT
 PIPING & INSTRUMENTATION
 DIAGRAM

DRWN	DATE	DRW. NO.	REV. NO.
DEC	2/11/98	101	
NO SCALE	03347142001		

Source: Weston, 1998

LINES		PIPING		PUMPS		IDENTIFICATION AND NUMBERING SYSTEM		INSTRUMENTS & ELECTRICAL DESIGNATIONS		INSTRUMENT TERMINOLOGY																																																																																																																																																												
	OPEN CHANNEL		FLEXIBLE CONNECTION		SUBMERSIBLE PUMP	8-1 BASIN/LAGOON C-1 CONVEYING EQUIPMENT F-1 FAN T-1 TANK/SUMP ME-1 MECHANICAL EQUIPMENT (GENERAL) MH-1 MANHOLE P-1 PUMP M-1 MIXER-AGITATOR	NOTE 2 INSTRUMENT-LOCALLY MOUNTED NOTE 1 XX INSTRUMENT-BOARD MOUNTED (LOCAL PANEL) LOCATION: NOTE 6 XX INSTRUMENT-BOARD MOUNTED (MAIN PANEL) INSTRUMENT-BACK OF MAIN PANEL INSTRUMENT-DUAL ELEMENT IN SINGLE CLOSURE EQUIPMENT MFR. SUPPLIED DEVICE BW COMPLEX INTERLOCK (BACKWASH) OR AND PURGE * A-AIR W-WATER TO FROM PI PRESSURE (VACUUM) GAUGE PI PRESSURE GAUGE W/SEAL ELECTRIC MOTOR OPERATING LIGHT * COLOR OR GD=GRAPHIC DISPLAY SHARED FUNCTION (DISTRIBUTED CONTROL) COMPUTER FUNCTION SIGNAL CONDITIONING (NOTE 7) EXISTING INSTRUMENT	<table border="1"> <thead> <tr> <th>UPPER CASE LETTER</th> <th>FIRST LETTER PROCESS VARIABLE</th> <th>MODIFIER (A) OR SECOND LETTER OR FUNCTION</th> <th>THIRD/FOURTH LETTER FUNCTION</th> </tr> </thead> <tbody> <tr><td>A</td><td>ANALYZER (NOTE 1)</td><td>ALARM</td><td>ALARM</td></tr> <tr><td>B</td><td>BURNER FLAME</td><td>-</td><td>-</td></tr> <tr><td>C</td><td>CONDUCTIVITY</td><td>CONTROL/CONTROLLER</td><td>CONTROLLER</td></tr> <tr><td>D</td><td>DENSITY</td><td>DIFFERENTIAL (Δ)</td><td>DISC</td></tr> <tr><td>E</td><td>ELECTRICAL (EMF)</td><td>ELEMENT</td><td>ELEMENT</td></tr> <tr><td>F</td><td>FLOW RATE</td><td>RATIO (FRACTION) (Δ)</td><td>-</td></tr> <tr><td>G</td><td>-</td><td>CLASS</td><td>CLASS</td></tr> <tr><td>H</td><td>HAND</td><td>HAND</td><td>HIGH</td></tr> <tr><td>I</td><td>CURRENT (ELECTRICAL)</td><td>INDICATING/INDICATOR</td><td>INDICATOR</td></tr> <tr><td>J</td><td>POWER</td><td>SCAN (Δ)</td><td>-</td></tr> <tr><td>K</td><td>TIME</td><td>-</td><td>-</td></tr> <tr><td>L</td><td>LEVEL</td><td>LIGHT (PILOT)</td><td>LOW</td></tr> <tr><td>M</td><td>MOISTURE (HUMIDITY)</td><td>-</td><td>-</td></tr> <tr><td>N</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>O</td><td>OPERATION</td><td>ORIFICE</td><td>-</td></tr> <tr><td>P</td><td>PRESSURE/VACUUM</td><td>PRESSURE</td><td>-</td></tr> <tr><td>Q</td><td>QUANTITY</td><td>TOTALIZER (Δ)</td><td>-</td></tr> <tr><td>R</td><td>RADIOACTIVITY</td><td>RECORDING/RECORDER</td><td>RECORDER</td></tr> <tr><td>S</td><td>SPEED/STOP</td><td>SWITCH (NOTE 5)</td><td>SWITCH</td></tr> <tr><td>T</td><td>TEMPERATURE</td><td>TRANSMITTER</td><td>TRANSMITTER</td></tr> <tr><td>U</td><td>MULTIFUNCTION</td><td>-</td><td>-</td></tr> <tr><td>V</td><td>VISCOSITY</td><td>VALVE/DAMPER/VALVE LOUVER</td><td>VALVE</td></tr> <tr><td>W</td><td>WEIGHT</td><td>WELL</td><td>-</td></tr> <tr><td>X</td><td>TORQUE</td><td>-</td><td>-</td></tr> <tr><td>Y</td><td>-</td><td>RELAY (NOTE 2.5)</td><td>RELAY</td></tr> <tr><td>Z</td><td>POSITION</td><td>DRIVE</td><td>-</td></tr> </tbody> </table> <p>NOTES: 1. THE FOLLOWING ABBREVIATIONS FOR ANALYSIS READING OR FUNCTION DESCRIPTIONS ARE TO BE PLACED OUTSIDE THE LOWER RIGHT QUADRANT OF THE BALLOON SYMBOL. <table border="1"> <thead> <tr> <th>ABBREVIATION</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td>CO</td><td>COMBUSTIBLES</td></tr> <tr><td>CL</td><td>CHLORINE</td></tr> <tr><td>DO</td><td>DISSOLVED OXYGEN</td></tr> <tr><td>ORP</td><td>OXIDATION REDUCTION POTENTIAL</td></tr> <tr><td>pH</td><td>ACID/ALKALINE</td></tr> <tr><td>TC</td><td>TOTAL CARBON</td></tr> <tr><td>TOC</td><td>TOTAL ORGANIC CARBON</td></tr> <tr><td>TU</td><td>TURBIDITY</td></tr> <tr><td>O₂</td><td>OXYGEN</td></tr> <tr><td>DO</td><td>DISSOLVED OXYGEN</td></tr> </tbody> </table> 2. 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FOR FURTHER INFORMATION REFER TO ISA STANDARDS. 5. THE FIRST ELEMENT IN A LOOP IS A SWITCH. SUBSEQUENT DEVICES ARE RELAYS. 6. LOCATION OF LOCAL PANEL IF MORE THAN ONE IS USED MGC MOTOR CONTROL CENTER PF PRESSURE FILTER GF GRAVITY FILTER VF VACUUM FILTER 7. USE MATHEMATICAL SYMBOLS AND/OR NOTES TO DEFINE FUNCTION.</p>	UPPER CASE LETTER	FIRST LETTER PROCESS VARIABLE	MODIFIER (A) OR SECOND LETTER OR FUNCTION	THIRD/FOURTH LETTER FUNCTION	A	ANALYZER (NOTE 1)	ALARM	ALARM	B	BURNER FLAME	-	-	C	CONDUCTIVITY	CONTROL/CONTROLLER	CONTROLLER	D	DENSITY	DIFFERENTIAL (Δ)	DISC	E	ELECTRICAL (EMF)	ELEMENT	ELEMENT	F	FLOW RATE	RATIO (FRACTION) (Δ)	-	G	-	CLASS	CLASS	H	HAND	HAND	HIGH	I	CURRENT (ELECTRICAL)	INDICATING/INDICATOR	INDICATOR	J	POWER	SCAN (Δ)	-	K	TIME	-	-	L	LEVEL	LIGHT (PILOT)	LOW	M	MOISTURE (HUMIDITY)	-	-	N	-	-	-	O	OPERATION	ORIFICE	-	P	PRESSURE/VACUUM	PRESSURE	-	Q	QUANTITY	TOTALIZER (Δ)	-	R	RADIOACTIVITY	RECORDING/RECORDER	RECORDER	S	SPEED/STOP	SWITCH (NOTE 5)	SWITCH	T	TEMPERATURE	TRANSMITTER	TRANSMITTER	U	MULTIFUNCTION	-	-	V	VISCOSITY	VALVE/DAMPER/VALVE LOUVER	VALVE	W	WEIGHT	WELL	-	X	TORQUE	-	-	Y	-	RELAY (NOTE 2.5)	RELAY	Z	POSITION	DRIVE	-	ABBREVIATION	DESCRIPTION	CO	COMBUSTIBLES	CL	CHLORINE	DO	DISSOLVED OXYGEN	ORP	OXIDATION REDUCTION POTENTIAL	pH	ACID/ALKALINE	TC	TOTAL CARBON	TOC	TOTAL ORGANIC CARBON	TU	TURBIDITY	O ₂	OXYGEN	DO	DISSOLVED OXYGEN	ABBREVIATION	DESCRIPTION	A	ANALOG	D	DIGITAL	E	VOLTAGE	H	HYDRAULIC	I	CURRENT (ELECTRICAL)	O	ELECTROMAGNETIC OR SONIC	P	PNEUMATIC	R	RESISTANCE (ELECTRICAL)	S	SUMMATOR	I-O	ON-OFF	HS	HIGH SELECTOR	LS	LOW SELECTOR	FG	FUNCTION GENERATOR
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Section 2

Treatment Objectives

The groundwater extraction and treatment system effluent piping discharges to a storm sewer/drainage ditch that flows along Route 10 and then turns to the east crossing under Route 10 and discharges into a drainage ditch. As a remedial action at a Superfund site, this discharge does not require a National Pollutant Discharge Elimination System (NPDES) permit. Instead, the maximum contaminant levels (MCLs) for the contaminants of concern are used as the treatment objectives for this discharge. The MCLs for these contaminants are as follows:

Parameter	MCL (ug/L)
Pentachlorophenol (PCP)	1.0
Cadmium	5.0
Chromium	100.0
Arsenic	10.0

Each of these analytes has historically been analyzed for in the effluent samples collected and the MCLs were not exceeded. CDM is currently performing effluent monitoring for only PCP on a monthly basis to verify that the main contaminant of concern is not exceeded in the effluent. Also, in January 2003, CDM collected an effluent sample for arsenic analysis. The arsenic result was less than 1 ug/l, which is below the MCL.

Section 3

Description, Operation, and Control of Groundwater Extraction and Treatment System

3.1 Groundwater Extraction

3.1.1 Description of System

The contaminated groundwater plume is located within the upper zone of sandy soil having a thickness of approximately 15 to 20 ft. Four extraction wells are installed along the axis of the plume. Their locations are shown in Figure 1-1. Each recovery well is 6 inches in diameter and consists of a 5-ft sump, 10 to 15-ft continuous wrap well screen, and riser casing, all constructed of Schedule 40 PVC. The top of each well is enclosed in a steel vault that is flush with the ground surface. A summary of recovery wells and monitoring wells is provided in Table 3-1.

Figures 1-2 and 1-3 provide the P&ID diagram from the 1998 O&M Manual (Weston 1998) that illustrates the extraction and treatment system. A 4-inch submersible pump is installed in each well and is connected to the discharge line with a pitless adapter. A transducer in each well senses the water level and operates the pump between selected control points. Individual discharge lines, and control and power conduits for each well are laid in a common trench to the treatment building. The level controllers and pump motor starters are mounted in the treatment building. At the selected high water levels the pumps will start and when drawdown reaches the low water levels the pumps stop, automatic operation is achieved when the selector switch on each pump starter is in automatic position. Other positions are off and manual on. A high water level in tank T-2 will override the level sensors in the wells and stop the well pumps. Based on an evaluation of the groundwater extraction system performance in achieving capture of the contaminant plume, a target drawdown for each well was established during system start-up in April 1998. Initially, the target drawdown was set at 5 ft for each well by adjusting the level controller to give the desired result. Also, within the building, each discharge line has a flow meter that indicates flow rate and records total flow, and a valve to throttle the flow to meet the flow rate settings. Table 3-2 presents a summary of the flow rates, water table drawdown, and pump elevation settings. Figures 3-1 through 3-4 provide operating details on each recovery well.

3.1.2 Standard Operating Procedures

The sequence to start up the groundwater extraction system is as follows:

1. At each discharge line entering the building, open the valves to allow flow to pass through the flow meters.
2. At the motor starter for each pump, move the disconnect lever to ON and turn the pump selector switch to AUTO. Flow should register through the flow meter. Adjust the valves to throttle the flow rate from each well to approximately 2.5 gallons per

- minute (gpm).
3. Adjust the flow control valves if necessary (will not normally require adjusting after a short-term shutdown.)
 4. Start the groundwater treatment system as described in Section 3.2.2.

Each pump will normally be left in AUTO mode and the level switches checked/adjusted periodically to maintain capture of the plume. The pumps will cycle on and off with the total flow from the four wells expected to average 3 gpm. To shut down the system each pump switch would be turned to OFF and the discharge line valves at the flow meters closed.

3.1.3 Common Operating Problems

The extraction system is a simple, straight-forward design with very reliable equipment so operating problems are expected to be very infrequent. Potential problems, however, may include:

1. A decrease in flow rate or total flow over time. Potential causes may be a significant drop in water, or the pump rate exceeds the well yield such that a low water level shuts the pump down until the well recovers. These issues can be evaluated by observations of the water level indicator.
2. A second cause of reduced flow could be clogging in the discharge line. This would be indicated by a reduced rate of flow with normal level readings and the flow control valves fully open.
3. A third cause of reduced flow could be a clog or malfunction of the pump. The manufacturer's O&M procedures will be consulted for diagnosing and correcting a pump problem.
4. Malfunctions of the level sensing or flow metering equipment will be diagnosed and corrected in accordance with the manufacturer's O&M manual.

The autodialer is monitored by the operator to determine if any shutdown events occur. The autodialer alerts the operator of any shutdown of the system due to high tank levels or low recovery well flow alarms. The following alarms record system shutdown:

1. Settling Tank Hi Level Alarm and System Shutdown
2. Effluent Tank Hi Level Alarm and System Shutdown
3. RW-1 Low Flow Alarm and System Shutdown
4. RW-2 Low Flow Alarm and System Shutdown
5. RW-3 Low Flow Alarm and System Shutdown
6. RW-4 Low Flow Alarm and System Shutdown

3.1.4 Extraction System Monitoring Plan

The extraction system monitoring plan details the procedures used to document ongoing hydraulic control and groundwater quality. To document that contaminated groundwater is being completely captured, it is necessary to show either that the horizontal hydraulic gradient

is toward the extraction wells from all directions or groundwater quality is being progressively improved from upgradient to downgradient along the plume. The hydraulic control of groundwater flow is documented by measuring water levels in selected monitoring wells and the pumping wells. The monitoring wells, which are used for water level measurements or groundwater sample locations, include MW-7S, MW-8S, MW-20S, MW-21D, MW-11S, MW-12D, MW-22S, MW-23D, MW-9S, MW-10D, and MW-19D. The pumping wells (RW-1, RW-2, RW-3 and RW-4) should show lower water elevations than the monitoring wells, indicative of flow toward the pumping wells from each direction. These measurements are collected quarterly as documented in the Sampling and Analysis Plan (CDM, 2003).

In addition, the following information will be collected and recorded:

1. Record the flow totalizer readings for each extraction well on a weekly basis. Calculate the total flow by subtracting the previous reading. The total of all 4 wells should nearly equal the quantity of treated water discharged, as recorded at the effluent flow meter. Review of these data will indicate a possible meter calibration problem, pump failure, or misadjusted pump level controls.
2. Collect groundwater level readings from the 15 wells on a quarterly basis using a water level indicator. These measurements are taken from the surveyed reference point on the well casing. Groundwater elevation is calculated by subtracting the depth-to-water reading from the top of well casing elevation. Measurements in the pumping wells should correspond with the drawdown interval established by the pump controllers.

Excessive drawdown in the extraction wells will result in extra water being treated unnecessarily; inadequate drawdown will result in the plume not being fully captured. Adjustments to the pump level controls may be required periodically with the aid of groundwater modeling due to seasonal rise and fall of the surrounding water table.

Quarterly sampling is performed at the 11 previously identified monitor wells (MW-7S, 8D, 9S, 10D, 11S, 12D, 19D, 20S, 21D, 22S, 22S) and the four recovery wells (RW-1, RW-2, RW-3, and RW-4). These samples are analyzed for PCP. The groundwater sampling objective is to document that the contaminant plume is being captured by the extraction wells. These wells will also be monitored until PCP is no longer detected. Groundwater samples are collected quarterly as documented in the Sampling and Analysis Plan (CDM, 2003).

3.2 Groundwater Treatment System

3.2.1 Description of Process/Equipment

The extraction system delivers groundwater to a reaction tank in the treatment building. This tank, designated T-1, provides for oxidation and precipitation of iron and other heavy metals. A chemical feeder meters soda ash (sodium carbonate) solution into the tank in response to a pH control signal to achieve the target pH set point of approximately 8.2. A blower, B-1, supplies air for mixing the tank and oxidizing iron. Tank T-1 has a gravity overflow line to

tank T-2 which serves as a settling and holding tank. T-2 has a capacity of 2,700 gallons with approximately 1,000 gallons available to store precipitated iron and other solids that settle. The upper portion of the tank provides a reservoir of clarified water that is pumped through the succeeding treatment units. Float switches are installed in tank T-2 such that at a depth of approximately 6-1/2 ft the high level float will start pump P-1. When the water drops to 4-1/2 ft the low level float will stop P-1. A high level float will activate an alarm and stop the well pumps.

Pump P-1 transfers the water from T-2 through the filter system and the activated carbon units and into effluent tank T-3. The filter system consists of three dual media filters operating in parallel. It is capable of operating at flow rates up to 16 gpm. The flow rate through the system is controlled by adjusting the ball valve on pump P-1 outlet while observing the inline flow meter. The system is set up to backwash automatically when the differential pressure across the filters reaches a preset level, approximately 10 psi. The three filters backwash in sequence for 10 min each using filtered water from two units to backwash the third. In the backwash mode the flow is reversed to expand the media and rinse the solids from the bed. Automation is accomplished with a series of automatic diaphragm valves that are pneumatically actuated. An adjustable limit stop on the drain valve for each filter controls the rate of backwash flow to 10 - 12 gpm. Dirty backwash water is returned to tank T-2 for reprocessing. For additional details on the filter system consult the instruction manual provided by the equipment manufacturer (Appendix J).

Four activated carbon units are arranged for two stage treatment in two parallel trains. This allows for efficient use of the carbon while protecting the effluent from PCP break through. Periodic monitoring between the stages will detect first stage breakthrough. When this occurs the first stage units will be removed, the second stage units moved to the first stage position, and fresh units installed in the second stage position. High pressure (6 psi) at the first stage inlet will also require that these two units be replaced.

Effluent from the carbon units will collect in tank T-3. High and low level switches will operate the effluent pump P-2. A high high level in T-3 will stop P-1 and give an alarm signal. A flow meter on the discharge totalizes the quantity of water treated and discharged.

3.2.2 Standard Operating Procedures

System startup requires a series of status checks, positioning of valves, and activating power switches as follows:

1. Check that a supply of soda ash solution is available in the chemical feed tank and the chemical feed pump power cord is plugged into the outlet.
2. Turn on blower B-1 at motor starter (disconnect lever and selector switch).
3. Adjust bleed-off and throttling valves on blower discharge to give gentle aeration in T-1.
4. Open all forward flow valves: T-1 effluent, T-2 influent and effluent, P-1 suction and discharge, each carbon unit effluent, P-2 suction and discharge.

5. Turn on air compressor.
6. Move disconnect level to ON position to activate filter unit.
7. While pump P-1 is operating adjust flow rate to 10 gpm with discharge valve.

Normal operation for the treatment system is to run continuously in AUTO mode. Pump P-1 will transfer water intermittently in AUTO mode based on the level in T-2 since the treatment rate exceeds the extraction system yield. No system changes will be made without EPA authorization.

Routine oversight is required weekly. The purpose of this oversight is to verify that all the equipment is operating normally, record meter readings, and replenish the soda ash solution. The pH system will also require periodic cleaning of the probe and calibration. Precipitated iron solids will accumulate in tank T-1. The depth of sludge accumulated in this tank must be checked periodically (once a month). When the depth approaches 3 ft (1 ft below effluent nozzle) the sludge will be removed.

Soda Ash Makeup

This chemical raises the pH of the groundwater to aid in precipitating iron and heavy metals. The required dosage to maintain the pH setpoint of 8.2 is approximately 35 mg/l. At an average groundwater treatment rate of 3 gpm this dosage will consume 1.26 lb per day of soda ash. Preparation of a 5% solution will provide a supply that will last approximately 2 weeks at the expected usage rate of 3 gpd. Soda ash solution is prepared as follows:

1. Plug in the solution mixer.
2. Fill the solution tank with treated effluent by connecting a hose to the tap provided (the treatment system must be operating and the effluent pump running).
3. Measure the required amount of soda ash in the calibrated container provided. The dense form has a bulk density about equal to water. A 5% solution will be obtained by mixing the following quantities:

Solution Quantity-gal	Soda Ash (lbs)
50	21.0
45	19.9
40	16.8
35	14.7
30	12.6

4. Add the chemical slowly to the solution tank and continue mixing until fully dissolved, at least 15 min.
5. Unplug mixer.

Operating experience may require increasing the solution strength to avoid running out between operator visits. Soda ash is soluble to approximately 12% at ambient groundwater temperature. The soda ash feed pump has a capacity of 14 gpd and is expected to operate at about 20% of this rate. The large knob in the center allows the stroke length of the pump to be selected/adjusted (while the pump is running). It should be set at 50% or more for this application. The smaller upper knob selects automatic external pulsing rate from the pH controller (normal mode) or a manually adjusted stroke frequency.

3.2.3 Shutdown

Short-term shutdown can be accomplished by turning off the filter system with the nearby disconnect switch (lever). This will allow the well pumps to continue to operate until tank T-2 reaches high high level, automatically stopping them. Otherwise the well pumps can be turned off at the individual motor starters. Shutdown for one day or longer will include turning off all operating equipment including all pumps, the blower and air compressor, and closing the valves at tanks T-2 and T-3 withdrawal points.

3.2.4 Common Operating Problems

Once stable operation has been achieved with proper pH control and chemical feed rate, few operating problems will occur. The most complex component of the treatment system is the sand filter unit. Problems are most likely to be associated with backwashing such as frequent backwash cycles due to the inadequate cleaning of the media on the previous cycle from inadequate flow or time, differential pressure set too high, backwash rate set too high causing loss of media, and too high a solids load due to inadequate pretreatment. The equipment supplier's manual gives a more detailed troubleshooting guide for the system and the proper settings for various components (Appendix J).

Precipitation and settling of the iron in tank T-2 requires proper pH control in tank T-1. Periodic calibration of the pH system is required to ensure correct pH readings. The frequency will be based on operating experience. Calibration requires removal of the probe assembly from the tank, cleaning the probe with water and tissue, and immersing it in buffer solution. The manufacturer's manual gives a detailed procedure for completing the calibration.

Mechanical failures may also occur. These are best resolved by consulting the manufacturer's manual that was provided with the particular equipment. Table 3-3 provides troubleshooting guidelines for the various pumps.

3.2.5 Treatment System Monitoring Plan

A monitoring plan for the treatment system will ensure that the treatment system is functioning properly to achieve the treatment objectives defined in Section 2. PCP is the principal

contaminant requiring removal. The carbon units are provided for this purpose. However, iron contained in the extracted groundwater will plug the carbon beds prematurely if not removed. The other treatment equipment is provided to remove iron and other heavy metals if present.

In order to assess the treatment system performance in removing PCP, samples are collected at the following points:

- The treatment system influent
- C1 sampling port between the two northern carbon units
- C2 sampling port between the two southern carbon units
- The effluent from the treatment system

This data will be used to compare effluent concentrations to established discharge limits, present removal efficiencies, and evaluate overall system performance. The main purpose of collecting the C1 and C2 sample ports samples will be to determine whether carbon breakthrough has occurred and the carbon units require change out.

The sampling program rationale and procedures, as well as the quality assurance project plan, are explained in further detail in the Sampling and Analysis Plan for OU1 Long Term Remedial Action, completed by CDM in June 2003.

Table 3-1
Construction Details for Recovery and Monitoring Wells
Saunders Supply Company Superfund Site

Well ID	Ground Elevation (ft MSL)	Elevation of Top of Casing (ft MSL)	Elevation of Top of Screened Interval (ft MSL)	Elevation of Bottom of Screened Interval (ft MSL)	Screen Length (ft)	Well Diameter (inches)
RW-1	--	--	--	--	15	6
RW-2	--	--	--	--	15	6
RW-3	--	--	--	--	10	6
RW-4	--	--	--	--	--	6
MW-7S	41.22	41.00	38.0	29.0	10	2
MW-8D	41.37	41.15	26.5	16.5	10	2
MW-9S	37.87	37.73	34.5	24.5	10	2
MW-10D	37.64	37.27	21.6	11.6	10	2
MW-11S	35.40	35.43	28.2	19.0	10	2
MW-12D	34.73	34.67	19.8	9.8	10	2
MW-19D	21.46	21.46	4.3	-4.3	10	2
MW-20S	--	--	--	--	10	2
MW-21D	--	--	--	--	10	2
MW-22S	--	--	--	--	10	2
MW-23D	--	--	--	--	10	2

Notes:

MSL = Mean sea level

"--" = Information not available

Sources:

Ecology & Environment, 1991.

OHM Remediation Services Corporation, 1989.

Table 3-2
Flow Rates and Pump Elevation Settings for Recovery Wells
Saunders Supply Company Superfund Site

Recovery Well	Flow Rate Setting (gpm)		Pump Intake Setting (ft BTOC)	Water Level Probe Setting (ft BTOC)	Water Level Operating Range for Pump (ft above probe)	Static Water Level Elevation ³ (ft above probe)
	Initial ¹	Current ²				
RW-1	1.5	2.5	21.73	22.75	5.3 to 7.3	13.6
RW-2	1.5	2.5	17.31	17.50	1.6 to 3.6	10.3
RW-3	1.5	2.5	16.44	18.29	3.8 to 5.8	13.2
RW-4	1.5	2.5	16.93	17.42	4.7 to 6.7	14.2

Recovery Well	Top of Screen (ft BTOC)	Well Depth (ft BTOC)
RW-1	4.35	23.80
RW-2	4.38	19.42
RW-3	4.00	18.68
RW-4	3.81	18.80

Notes:

¹Initial flow rate setting on April 1998.

²Current flow rate setting is adjusted to between 2.25 and 2.75 gpm after dropping below 1.5 gpm.

³Static water level elevation measured after pumps shut down 2 hours for RW-1 and RW-2 is an estimated value for equilibrated conditions, measurements for RW-3 and RW-4 after pumps shut down 3 days is equilibrated conditions.

gpm = gallons per minute

BTOC = Below top of casing.

Sources:

Weston, 1998.

Field measurements for water level and pump intake settings collected May 2003.

Table 3-3
Pump Troubleshooting Guidelines
Saunders Supply Company Superfund Site

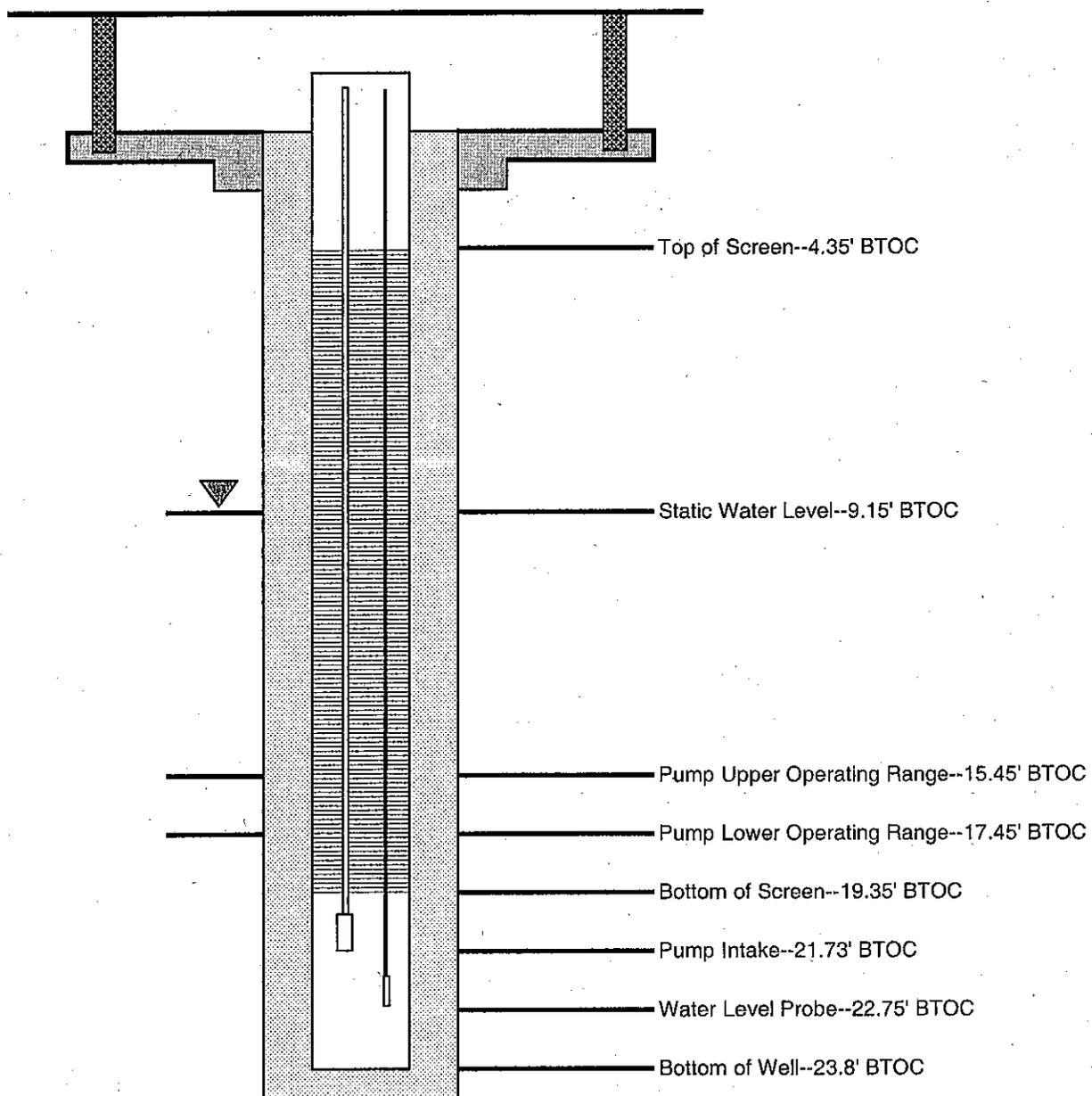
Problem	Solution
1. Pump will not start	a) Verify that switches and circuit breaker are on.
	b) Check the float switch for proper operation (if applicable).
	c) Check the impeller for any obstruction/damage.
	d) Turn the hand off automatic (HOA) switch to the OFF position and then to AUTO.
2. Repeated Tripping	a) Check for overcurrent draw.
	b) Check for any obstruction in the pump.
3. Pump will not shut off	a) Check the float switch for proper operation (if applicable).
	b) Check the HOA switch to ensure that it is on AUTO.
4. Low pump discharge	a) Check the suction and discharge valves and ensure that they are fully open or adjusted to the desired opening.
	b) Check the impeller for correct rotation.
	c) Check for air leaks in the suction line and rectify.
	d) Check for any obstruction in the pump/piping.

SAUNDERS SUPPLY COMPANY
SUPERFUND SITE
RECOVERY WELL DETAILS

CDM

FIGURE 3-1

RECOVERY WELL : RW-1



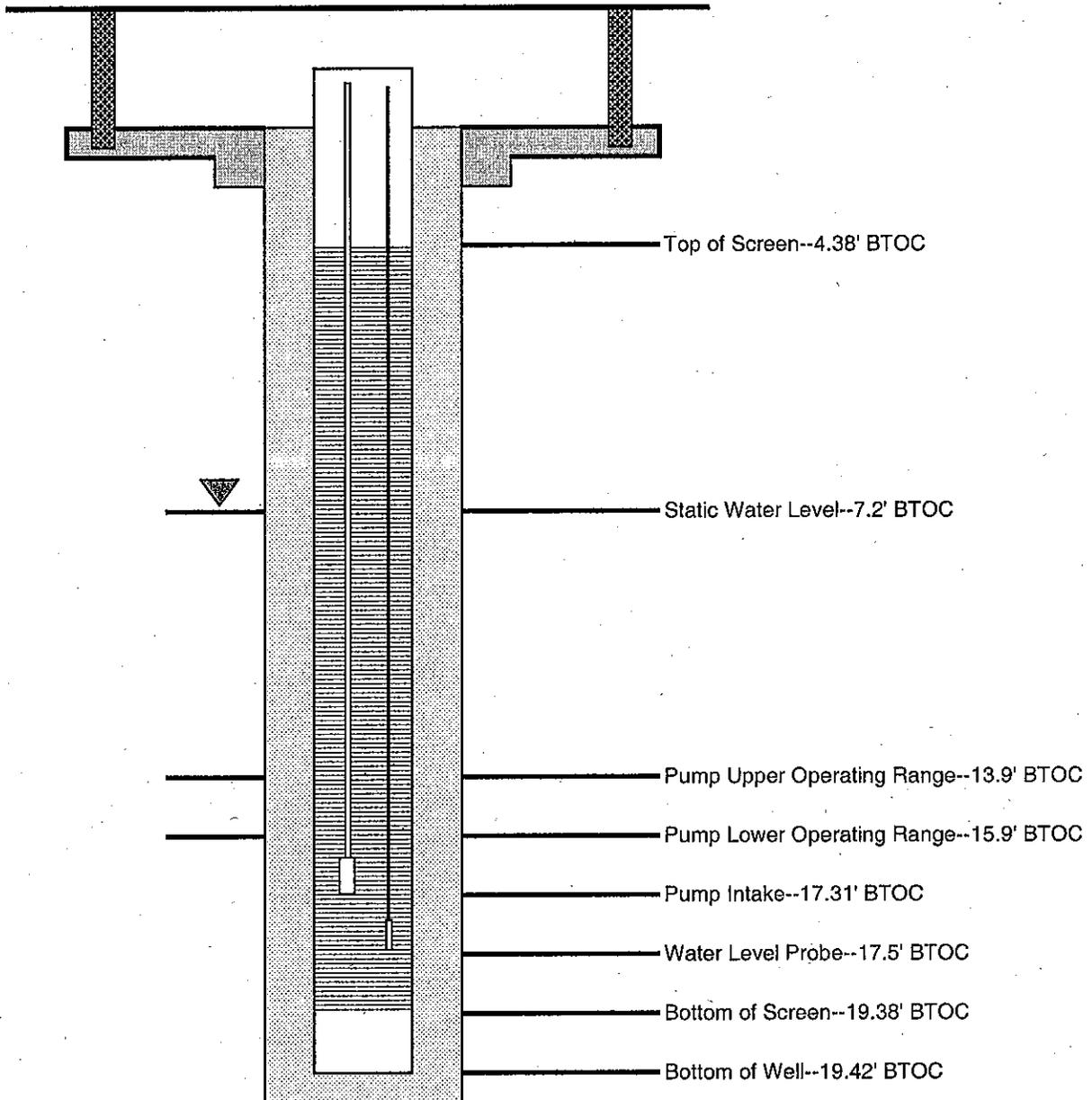
Not to Scale

SAUNDERS SUPPLY COMPANY
SUPERFUND SITE
RECOVERY WELL DETAILS

CDM

FIGURE 3-2

RECOVERY WELL : RW-2



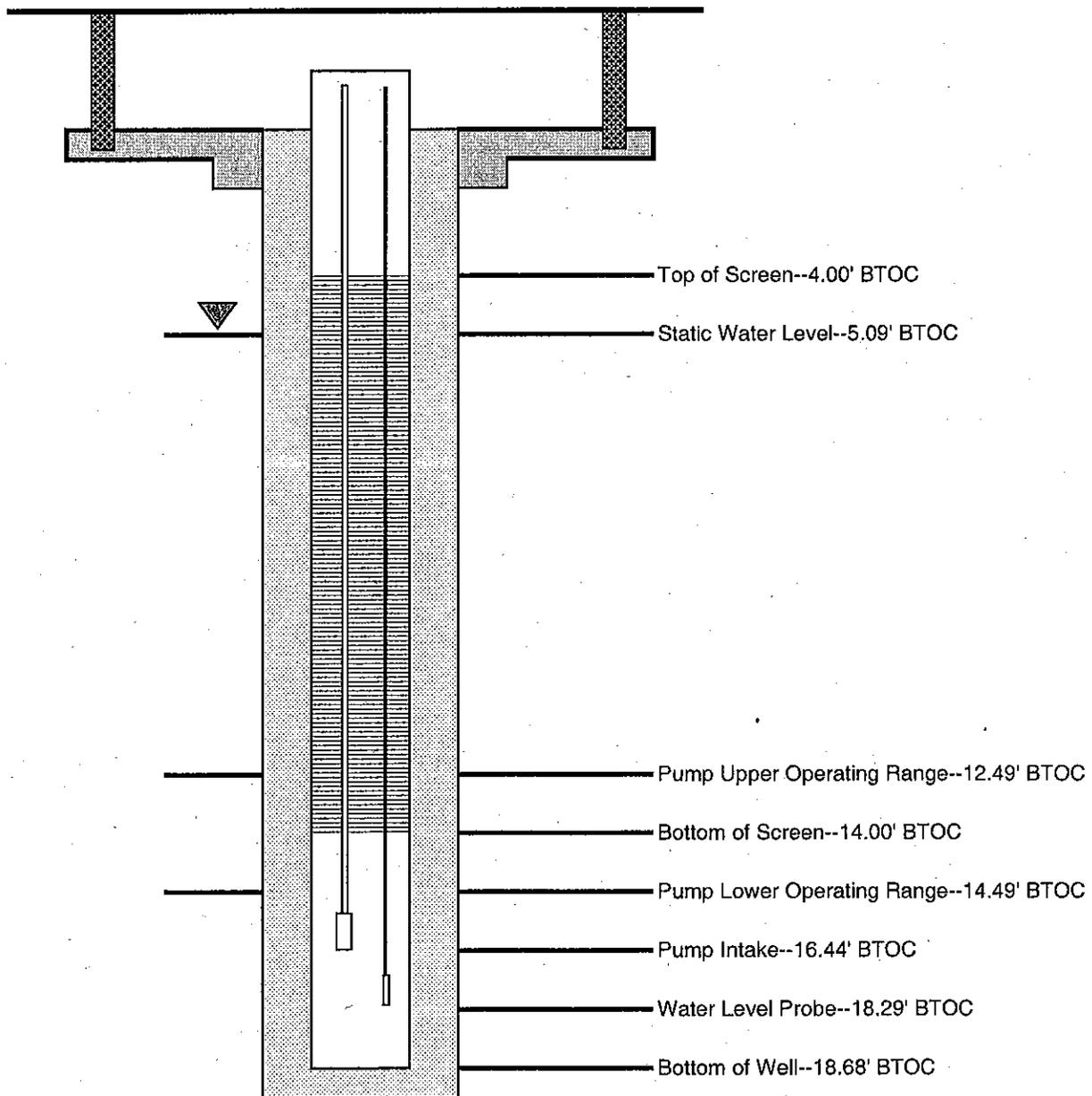
Not to Scale

SAUNDERS SUPPLY COMPANY
SUPERFUND SITE
RECOVERY WELL DETAILS

CDM

FIGURE 3-3

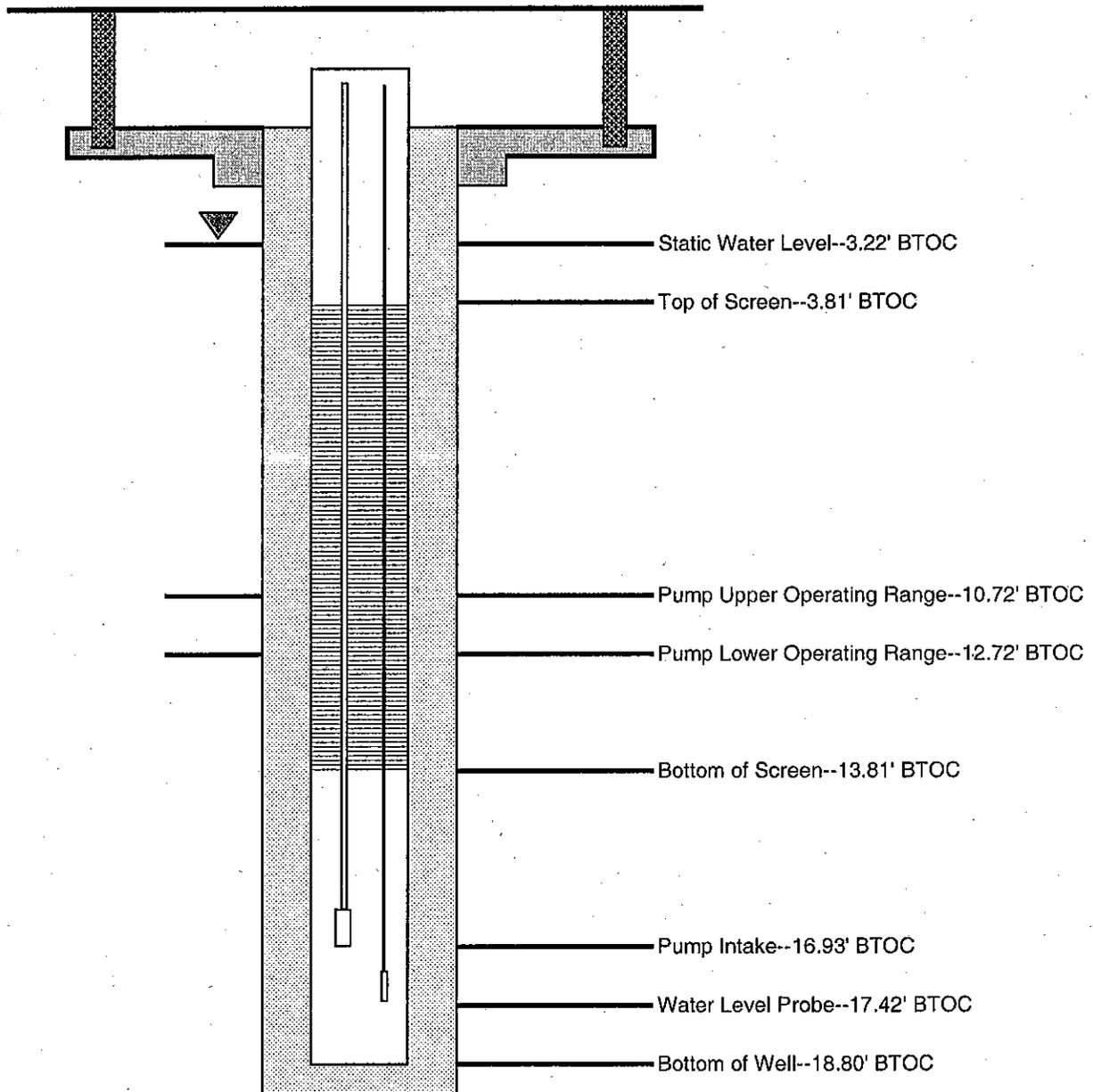
RECOVERY WELL : RW-3



Not to Scale

FIGURE 3-4

RECOVERY WELL : RW-4



Not to Scale

Note: RW-4 bottom of screen depth assumed based on RW-3, since original well construction diagram not available

Section 4

Maintenance Schedules and Procedures

4.1 General

Consistent oversight and maintenance are key to meeting the hydraulic control objectives and long-term service of the system. This section addresses the inspection and maintenance of the pumps, extraction wells, treatment units, and instrumentation. For detailed instructions on maintenance and repair, and the lubrication schedule for each equipment item, consult the vendor manuals provided.

Equipment maintenance can be broken down into two categories:

1. Preventative maintenance.
2. Corrective maintenance.

Preventative maintenance is maintenance conducted on a piece of equipment on a scheduled basis. This type of maintenance is desirable because it fits into the work schedule, enhances the life and performance of equipment, and avoids working under an emergency or shutdown condition. On the other hand, corrective maintenance is repair work that is required after the equipment breaks down. This condition generally requires more extensive work, and work that may often be required at inconvenient times.

A preventative maintenance program for all equipment includes certain considerations that ensure efficient performance of equipment. All equipment will be regularly inspected to determine its physical condition and accuracy of performance. Standby equipment, or any piece of equipment that is used at relative infrequent intervals, will be periodically operated to keep it in a state of operational readiness. All maintenance procedures will be performed using manufacturer's recommendations as a guide. Vendor manuals, plans, or blueprints, showing the dimensions of each unit as well as all pipes, valves, gates, pumps, etc., will be available for reference when performing maintenance. To ensure implementation of a good maintenance program, the operator will observe the following basic rules:

1. Practice good housekeeping, and keep a clean, neat, and orderly facility.
2. Be familiar with each piece of equipment, how it works, and what function it is to perform.
3. Establish a routine service and maintenance scheduled for each piece of equipment.
4. Keep manufacturers' catalogs, manuals, blueprints, etc., available and stored in an indexed file for ready reference. In addition, take care in handling this information because it will have to last throughout the life of the equipment.
5. Maintain O&M records on each piece of equipment, with emphasis on unusual incidents or faulty operating conditions.

6. Procure and maintain an adequate stock of tools required for performing maintenance.
7. Maintain a spare parts inventory for each piece of equipment. Consult manufacturers' recommendations for a listing of suggested spare parts.
8. Observe good safety procedures.

4.2 Well Pumps

The extraction well pumps are reliable and durable equipment, but malfunctions may occur. Potential pumping deficiency would be indicated by a decrease in the flow meter reading or the calculated rate from the flow totalizer readings. Clogging of the pump intake screen or internal passages is possible. A buildup on iron deposits is the likely cause of impaired performance.

Iron scaling may be primarily the result of iron bacteria or direct chemical deposition of iron hydroxides. Iron scale may accumulate rapidly and require regular maintenance.

If the pump has reduced capacity or the pump has failed completely, it will be necessary to pull the pump from the well for inspection and repair. Follow the manufacturer's troubleshooting and maintenance guidelines to diagnose and repair the problem. The pumps will be pulled from the wells every year for inspection even if no failure has occurred.

4.3 Extraction Well Fouling and Rehabilitation

The routine evaluation of pumping rates may indicate a reduced yield from the well due to fouling of the well screen or gravel surrounding the well. In this case the pump will produce at the desired rate but shut down periodically due to low water level. The well screen can be cleaned and the well rehabilitated by mechanical cleaning.

4.4 Inspection and Maintenance Procedures for the Groundwater Treatment System

Regular inspection and performance of preventative maintenance activities are required for the major equipment and their components in the groundwater treatment facility, including pumps, controls, blower, and piping and valves. Consistent achievement of maintenance

objectives requires an adequate supply of proper tools, a comprehensive and up-to-date records system, and proper training of all personnel involved in maintenance activities.

A preliminary maintenance schedule that lists preventative maintenance tasks is summarized the System Maintenance Schedule and Record in Appendix A. O&M manuals supplied by the equipment manufacturers will be consulted for specific details regarding inspection and maintenance procedures.

4.4.1 Importance of Records

Keeping adequate records of performance is an integral part of good treatment plant operation.

Logging clear and concise records ensures that the experiences will be of assistance in meeting future operation situations. Pertinent and complete records are a necessary aid to control procedures. Most importantly, records will be used as a basis for plant operation and for interpreting the results of groundwater treatment. Records also provide an excellent check on things done or to be done, especially with regard to maintenance problems. Equipment in treatment plants requires periodic service (i.e., weekly, monthly, or yearly). Adequate records note when service was last performed and when the time for service approaches; thus, a schedule can be maintained and nothing is overlooked or forgotten.

The significant details of operator experience also have an important historical value and form a running account of the operation of the plant. When accurately kept, records provide an essential basis for the design of future changes or expansions of the treatment facility. Records can also be used to aid in the design of treatment facilities for other locations where similar problems may be encountered. In the event of legal questions on connection with treatment or plant operations, accurate and complete records would be urgently required as evidence of what actually occurred.

4.4.2 Weekly System Monitoring Checklist

Proper operation and control of the groundwater remediation facility entails:

- Regular O&M.
- The maintenance of an operating log.

A weekly system monitoring checklist will be kept for tabulating pertinent operating data. The log will be kept in a bound record book or notebook and maintained at the site as a database reference. A Weekly System Monitoring Checklist is in Appendix B, and the Critical Device Checklist is provided in Appendix C. The information that will be recorded for the treatment system includes instantaneous and cumulative flow readings for each point of measurement and well water levels. The pressure gage readings at the sand filter, the carbon units, and the effluent line will be recorded. The chemical feed tank level will also be noted.

4.4.3 Laboratory Records

A record of laboratory data will be maintained. In addition, instrument calibration and maintenance records will be recorded.

4.4.4 Maintenance Records

Maintenance records will be kept on individual sheets for each piece of equipment. A record of regular periodic lubrication, inspections, cleaning, and replacement of worn parts, along with other data, will be kept on these sheets. The data indicating when the next regular servicing of the equipment is scheduled will also appear on the sheet where it can be easily seen. Each sheet will list the specific piece of equipment as well as instructions for lubricating, including the type of oil and the frequency of lubrication.

Section 5

References

Weston, 1998. Operation and Maintenance Manual for Groundwater Treatment System, Saunders Supply Site, Chuckatuck, Virginia, August.

CDM, 2003. Final Sampling and Analysis Plan for OU1 Long Term Remedial Action, Saunders Supply Company Superfund Site, Chuckatuck, Virginia, June 30.

Ecology and Environment, 1991. Remedial Investigation, Saunders Supply Company Site.

OHM Remediation Services Corporation, 1989. Well Boring Logs, Saunders Supply Site, June 3.

Appendix A
System Maintenance Schedule and Record

**SYSTEM MAINTENANCE SCHEDULE AND RECORD
SAUNDERS SUPPLY SUPERFUND SITE
CHUCKATUCK, VIRGINIA**

F	M	A	M	J	J	A	S	O	N	D	EQUIPMENT NAME	QTY	MANUFACTURER	MAINTENANCE	FREQUENCY
											WELL PUMPS	4	GRUNDFOS RED-FLO 4 3 WIRE, 480V, 3P	PULL, INSPECT PUMPS CLEAN PUMP SUCTION	QUARTERLY QUARTERLY
											LEVEL CONTROL	4	LEVEL PROBES	CHECK PROBE OPERATION, CLEAN CHECK OPERATION WITHIN LIMITS	QUARTERLY WEEKLY
											FLOW MEASUREMENT	4	ABB WATER METERS C-700	VISUAL CHECK OPERATION ADJUST FLOW RATE	WEEKLY AS REQUIRED
											CHEMICAL MIXER	1	NA	CHECK OPERATION	AS REQUIRED
											CHEMICAL FEED TANK (CF-1)	1	NA	CHECK PH, LEVEL MAINTAIN LIQUID LEVEL	WEEKLY AS REQUIRED
											CHEMICAL INJECTION CONTROL EQUIPMENT	1	GLI MODEL 872P EPOXY SENSOR MODEL 222 W/ INTEGRAL PREAMPLIFIER (6-WIRE CABLE) U-SONIC CLEANER #223	CHECK CALIBRATION CLEAN PROBE	MONTHLY MONTHLY
											BLOWER UNIT	1	NA	CLEAN FAN AND LUBRICATE BEARINGS CLEAN HOLES IN TRAY	QUARTERLY QUARTERLY
											BLENDING TANK (T-1)	1	NA	CHECK PH INSPECT TANK FOR SLUDGE CLEAN TANK OF SLUDGE BUILD-UP	WEEKLY QUARTERLY AS REQUIRED
											HOLDING TANK (T-2)	1	NA	FIELD TEST FOR IRON CLEAN TANK OF SLUDGE BUILD-UP	MONTHLY AS REQUIRED
											SAND FILTER TANKS	3	MONARCH WATER SYSTEM	OPERATE MANUAL BACKWASH RECORD PUMP PRESSURE/FLOW	QUARTERLY WEEKLY
											FLOWMETER	1	DWYER VFC SERIES VISI-FLOAT	VISUAL CHECK OPERATION CLEAN FLOW METER	WEEKLY AS REQUIRED
											AIR COMPRESSOR	1	NA	CLEAN AIR COMPRESSOR INLET FILTER CHECK PRESSURE REGULATION DRAIN AIR RECEIVER RECORD PRESSURE	MONTHLY MONTHLY WEEKLY WEEKLY
											ACTIVATED CARBON UNITS	4	NA	RECORD PRE-CARBON FILTER PRESSURE REPLACE CARBON	WEEKLY AS REQUIRED
											EFFLUENT TANK (T-3)	1	NA	INSPECT TANK FOR SCALE, BUILDUP CLEAN TANK OF BUILD-UP OR SCALE	MONTHLY AS REQUIRED
											EFFLUENT PUMP (P-2)	1	NA	LUBRICATE RECORD PRESSURE	MONTHLY WEEKLY
											FLOW TOTALIZER	1	NA	CHECK CALIBRATION CHECK FOR SMOOTH OPERATION RECORD FLOW, TOTAL VOLUME, RATE	ANNUALLY MONTHLY WEEKLY
											BUILDING THERMOSTAT AND HEATER	1	NA	SET THERMOSTAT OBSERVE CORRECT OPERATION	AS REQUIRED WEEKLY
											BUILDING VENT FAN	1	NA	OBSERVE CORRECT OPERATION	WEEKLY
											AUTO DIALER	1	SENSAPHONE	PROGRAM EMERGENCY NUMBERS VERIFY NUMBERS RUN AUTOTEST	AS REQUIRED MONTHLY MONTHLY
											TIMERS/RELAYS/SWITCHES/ LED INDICATORS	4 1 2 1 2	SIGNEY ROTOFLOAT ROTOFLOAT DREXELBROOK 504-100	RECOVERY WELL PUMP LOW FLOW SETTLING TANK T-2 HI HI ALARM SETTLING TANK T-2 PUMP CONTROL EFFLUENT TANK T-3 HI HI ALARM EFFLUENT TANK T-3 PUMP CONTROL	MONTHLY MONTHLY MONTHLY MONTHLY MONTHLY
											ELECTRICAL PIPING		MISC. NA	INSPECT GROUND, BREAKER POSITION INSPECT FOR LEAKS	MONTHLY MONTHLY
											FIRE EXTINGUISHER		NA	INSPECT	MONTHLY
											FIRST AID KIT		NA	INVENTORY	MONTHLY
											SIGNAGE		NA	INSPECT	MONTHLY
NA - INFORMATION NOT AVAILABLE IN O&M MANUAL															

Appendix B
Weekly System Monitoring Checklist

**Saunders Supply Superfund Site - Groundwater Treatment System
Weekly System Monitoring Checklist**

Time onsite: _____

Personnel Onsite: _____

Time offsite: _____

Note: For all readings, if equipment is not operating, turn the equipment on and take readings. Ensure conditions are safe to operate equipment (i.e. sufficient water supply exists for pump suction).

RECOVERY WELL			FLOW TRANSMITTER				AMETEK METER	
	TIME	PUMP RUNNING?	TOTAL FLOW TO DATE (gallons)	FLOW RATE (gpm)	FLOW RATE ADJUSTED	FINAL FLOW RATE	WELL WATER LEVEL	PROGRAMMED WATER LEVEL RANGE
RW-1		Y / N			Y / N ⁿ			7.3 to 5.3
RW-2		Y / N			Y / N			3.6 to 1.6
RW-3		Y / N			Y / N			5.8 to 3.8
RW-4		Y / N			Y / N			6.7 to 4.7

Yellow Lights: T-2 Hi-Hi OFF / ON Well Pump 1 OFF / ON Well Pump 3 OFF / ON
 (On Alarm Panel) T-3 Hi-Hi OFF / ON Well Pump 2 OFF / ON Well Pump 4 OFF / ON

Chemical Feed Tank CF-1: Full $\frac{3}{4}$ $\frac{1}{2}$ $\frac{1}{4}$ Empty Filled Tank? Y / N Feed Tank pH: _____
 Feed Tank pH: _____ (after filling)

Chemical Blending Tank T-1: Blower operating? Y / N pH Strips: _____
 pH Meter: _____

Sand Filter: In Operation? Y / N Pump Pressure (psi): _____ Flow (gpm): _____
 Air Receiver Pressure (psi): _____ Drain air receiver condensate: Y / N

Carbon Filters: Pre-carbon Filtration Pressure (psi): _____

Effluent Pump: In Operation? Y / N Pressure (psi): _____
 Flow meter (total gallons): _____ Timed flow rate (gpm): _____

Building: Heaters effective? Y / N / N.A. Vent fan operating? Y / N

Critical Device Check: Performed this visit? Y / N *Note any problems with critical devices below.*

NOTES:

Note: System start-up took place on 22 April 1998 @1306 hours. Flow transmitter total flow readings were set to zero and effluent meter reading read 2,197 gallons.

PM to Fax or E-mail to ACOE Attention Marc Gutterman - 441-7478. PM Review: _____

Appendix C
Critical Device Checklist

**CRITICAL DEVICE CHECKLIST
SAUNDERS SUPPLY, CHUCKATUCK, VIRGINIA**

Year: _____ Quarter: _____

Initial and Date When Inspected			
Month:	Month:	Month:	
			Inspector's Initials
			Date of Inspection
CRITICAL DEVICE			
Recovery Pumps			
			Well Pump Low Flow Alarm
			Pull and wash recovery well pumps, clean pump suction.
			Check level probes, clean.
Chemical Feed Package			
			Clean and Calibrate pH Probe
			Field test for iron
			Check Settling Tank HiHi Level alarm and pump control.
			Check Settling Tank level controls for Sand Filter Pump.
			Check Blending Tank, T-1 for sludge buildup.
			Clean blower fan, blower tray, and suction inlet.
			Measure and record sludge depth in Settling Tank, T-2
Sand Filter Package			
			Clean Air Compressor Inlet Filter
			Check Compressor Operation (on at 35 psi, off at 50 psi)
			Operate Manual Backwash, observe operation
Effluent Tank			
			Lubricate Pump
			Check Flow Meter for smooth operation
			Check Effluent Tank HiHi Level alarm and pump control.
			Check Effluent Tank level controls for Effluent Pump.
			Inspect Effluent Tank for scaling, build-up.
Signage			
			IMS identification at front door.
			Caution: Caustic Solution...
			Blending Tank Mixing Instructions
			Caution: More than one voltage source (Alarm Panel)
			Equipment Labels: Tanks, Piping, Motor Controller, C/B
Electrical			
			Ground connection for Circuit Breaker Panel
			Ground connection for Sand Filter Platform
			Circuit Breaker Panel
Misc.			
			Piping (Leaks, Supports)
			Pressure and Seal Fire Extinguisher
			Inspect First Aid Kit

**SYSTEM CRITICAL DEVICE CHECKLIST PROCEDURES
SAUNDERS SUPPLY GROUNDWATER TREATMENT PLANT
CHUCKATUCK, VA**

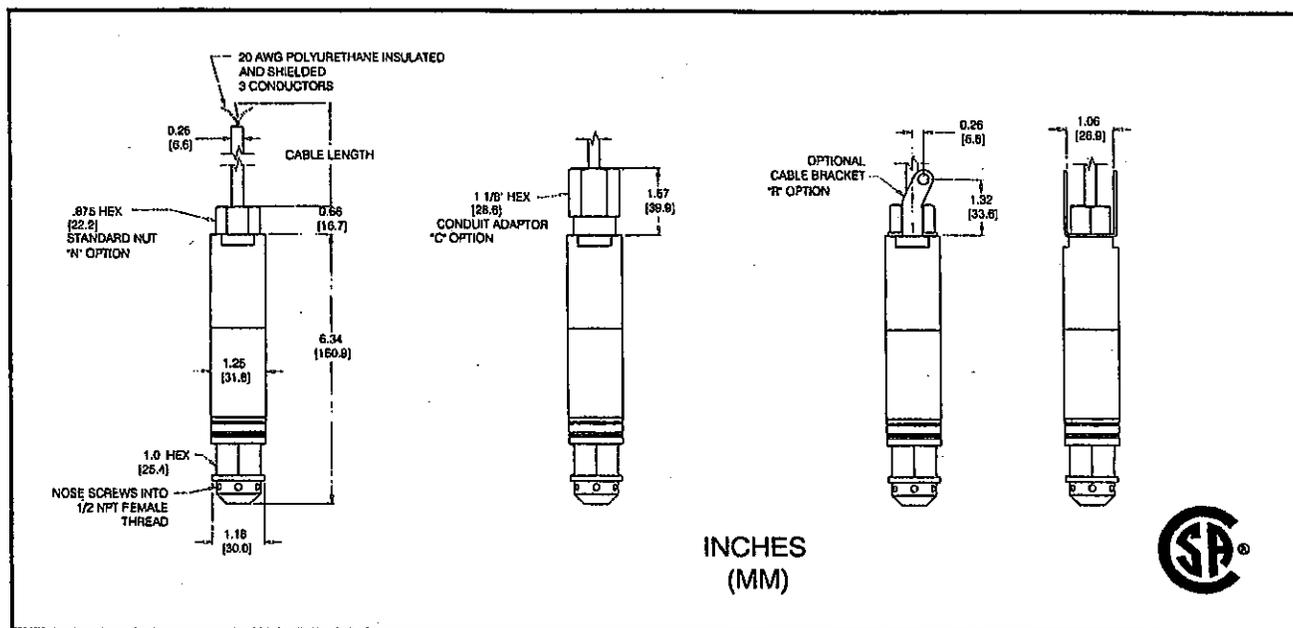
CRITICAL DEVICE	INSPECTION PROCEDURE
Recovery Pumps	<p>Write down flow for one of the recovery well pumps. Slowly close discharge valve, but do not close completely. Ensure low-flow alarm comes on. Reset valve to original flow within 1/10 gpm. Record which pump was tested.</p> <p>Pull Recovery Well Pump, inspect, wash, clean suction, reinstall, test operate.</p> <p>Inspect, clean level probe.</p>
Chemical Feed Package	<p>Clean pH probe with warm soapy water. Calibrate using procedure on p. 35, section 6.3 of Appendix G (Model 672P pH Analyzer).</p> <p>Sample each recovery well sample port, Influent Sample Port, Pre-carbon Sample Port. Test for iron with a field test kit.</p> <p>With a recovery well operating, lift top (red) float in settling tank using a reach rod stored on top of the tank. Ensure well pump stops. Ensure alarm comes on.</p> <p>With sand filter pump off, lift middle float in settling tank using a reach rod stored on top of the tank. Ensure sand filter pump starts. Ensure pump stops when level reaches bottom float (takes about 90 min.)</p> <p>Visually inspect Blending Tank, T-1, for sludge buildup.</p> <p>Clean blower fan, pull blower tray out of Blending Tank and clean holes, clean blower suction inlet</p> <p>Measure and record sludge depth in Settling Tank, T-2.</p> <p>Clean air compressor inlet filter.</p>
Sand Filter Package	<p>Open compressor receiver drain valve to bleed air, ensure compressor starts at 35 psi. Close valve, compressor stops at 50 psi.</p> <p>Operate Manual Backwash. This cycles backwash for 10 minutes through each filter (30 minutes total). Observe operation.</p> <p>Lubricate Pump.</p>
Effluent Tank	<p>With effluent pump operating, check that effluent flow meter "triangle" indicator is turning smoothly.</p> <p>With sand filter pump operating, pour water over top Verigap level sensor in effluent tank using a bucket of effluent water. Ensure sand filter pump stops. Ensure alarm comes on.</p> <p>With effluent pump off, pour a bucket of effluent water over middle Verigap level sensor in effluent tank. Ensure effluent pump starts. Ensure pump stops when tank level reaches bottom level sensor.</p> <p>Inspect Effluent Tank, T-3, for scaling, build-up.</p>
Signage	<p>Inspect warning and emergency notification signs for wear, legibility, accuracy, secure fastening.</p>
Electrical	<p>Visually check ground connections for Circuit Breaker Panel and Sand Filter Platform.</p> <p>Check all circuit breakers for proper condition and position.</p>
Misc.	<p>Visually inspect piping, hose connections, sample ports, and floor for leaks. Inspect pipe support brackets.</p> <p>Inspect pressure gauge and seal for fire extinguisher, record initial and date on the extinguisher tag.</p> <p>Inventory first aid kit.</p>

Appendix D
Recovery Well Level Control System

FIELD COPY
APX D

MODEL 575 SUBMERSIBLE PRESSURE TRANSMITTER

INSTRUCTIONS FOR INSTALLATION, SERVICE AND PARTS



SPECIFICATIONS

FUNCTIONAL SPECIFICATIONS

- Range Limits:** Reference Model Code
- Output:** 4-20 mA DC, limited to 30 mA DC
- Power Supply:** 12 to 40VDC with reverse polarity protection (limited to 28 volts for intrinsically safe use)
- Temperature Range:** **
- Ambient Operating:**
 - Silicone Fill -40° F to 180° F (-40° C to 82° C)
 - Mineral Fill 10° F to 140° F (-12° C to 60° C)
 - *CSA Intrinsically safe T3C, do not exceed 140° F (60° C)
- Storage:** -40° F to 180° F (-40° C to 82° C)
- Loop Resistance:** 1400 ohms max @ 40 volts

PERFORMANCE SPECIFICATIONS

- Zero Offset:** ±0.50% FS, Set at 77° F (25° C)
- Full Scale:** ±0.50% FS, Set at 77° F (25° C)
- Accuracy:** ±0.25% FS (BFSL) Includes linearity, hysteresis and repeatability (±0.50% FS 6 psi range only)
- Stability:** ±0.5% FS / six months
- Temperature Effect:** Compensated 23° F to 130° F (-5° C to 55° C) ±1% of Upper Range Limit for 77° F (25° C) temperature change within the compensated range.
- Power Supply Effect:** ±0.005% FS per Volt
- Proof Pressure:** 200% of Upper Range Limit
- Burst Pressure:** 3 times the Upper Range Limit

PHYSICAL SPECIFICATIONS

- Materials of Construction**
 - Cable Jacket:** Polyurethane
 - Diaphragm:** Type 316L Stainless Steel
 - Cover:** Type 316 Stainless Steel
 - Nut/Washer:** Type 316 Stainless Steel
 - Cable Grommet:** Viton
 - Cover "O" Ring:** Viton
 - Snub Nose:** Nylon 6/6, removable (1/2 inch NPT threads)
- Electrical Connection:** 20 AWG Shielded Cable
- Weight:** 1 pound (454 g).
- Media Compatibility:** Any media compatible with materials listed above

APPROVALS

Meets CSA requirements for intrinsically safe operation in hazardous locations as designated by Class I, Div 1, Groups A, B, C, & D and Class II, Groups E, F, & G. Temperature Code T3C. (When used with approved barrier.)

**If submerged in a liquid that has frozen solid, damage will result.

AMETEK
U.S. GAUGE, PMT PRODUCTS

MODEL 575 SUBMERSIBLE TRANSMITTER MODEL NUMBER CODE

575 SUBMERSIBLE PRESSURE TRANSMITTER

SENSING PORT

S = SNUBNOSE

INPUT/OUTPUT

B = 12-40 VDC / 4-20 mA

PRESSURE RANGE

0006 =	0-6 PSI/0-0.4 BAR (0-13.8 FT/0-4.2M WATER)
0015 =	0-15 PSI/0-1 BAR (0-34.6 F/0-10.5 M WATER)
0030 =	0-30 PSI/0-2 BAR(0-69.2 F/0-21.1 M WATER)
0060 =	0-60 PSI/0-4 BAR (0-138.4 FT/0-42.2 M WATER)
0100 =	0-100 PSI/0-7 BAR (0-230.7 FT/0-70.3 M WATER)
0150 =	0-150 PSI/0-10 BAR (0-346.0 FT/0-105.4 M WATER)
0200 =	0-200 PSI/0-14 BAR (0-461.3 FT/0-140.6 M WATER)
0300 =	0-300 PSI/0-20 BAR (0-692.0 FT/0-210.9 M WATER)

ELECTRICAL CONNECTION

N = STANDARD NUT/CABLE

R = CABLE SUPPORT WITH STANDARD NUT/CABLE

C = CONDUIT ADAPTER

MATERIAL	BASE	DIAPHRAGM
L =	316L SS	316L SS
H =	316L SS	HASTELLOY

FILL

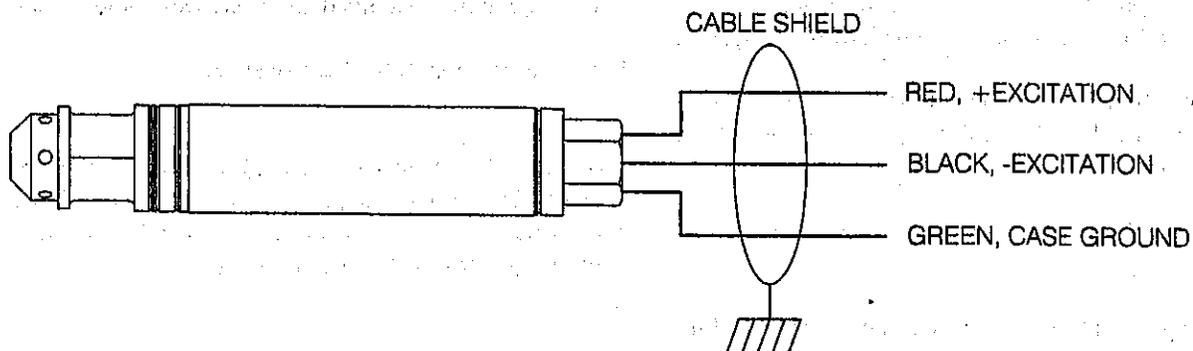
S = SILICONE

M = MINERAL

CABLE LENGTH (SPECIFY LENGTH IN FEET)

575 S B 0015 N L S (100 FT. CABLE) EXAMPLE

EXAMPLE: To specify Model 575 Snubnose submersible transmitter with 12-40 VDC input and 4-20mA output to measure 15 PSI having a standard nut with cable electrical connection, a 316L Stainless Steel diaphragm, silicone oil fill and 100 Ft. of cable, Order: 575-S-B-0015-N-L-S (100 Ft. of Cable)



MODEL 575 TRANSMITTER INSTALLATION

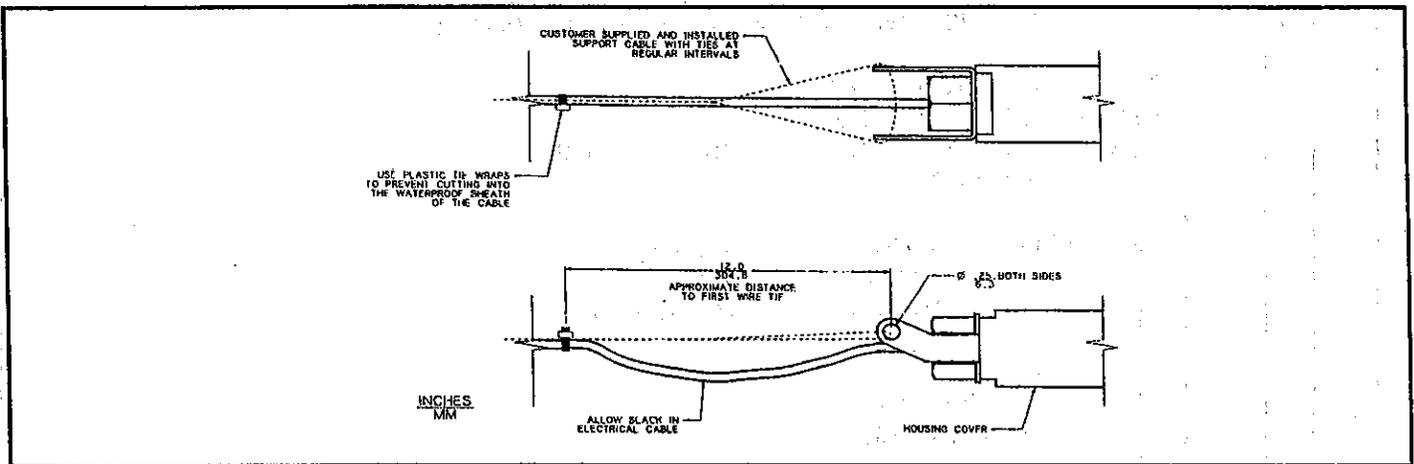
To install the Model 575 Transmitter, connect the surface end of the cable to the Ametek Model DMC Meter Controller or other power source and indicator. Suspend the transmitter into a well or tank supported only by its attached shielded electronic cable. Insure that the opening in the well or tank cover is large enough for possible future removal of the transmitter.

Additional support to the transmitter is available with an optional factory installed cable support. The optional cable support is recommended when using longer lengths of cable or when suspending the transmitter into agitated liquids. The cable support provides strain relief for the excess stress found under these circumstances. See diagram of Model 575 Transmitter with cable support using customer supplied and installed support cable.

Caution - The cable grommet and support are specially installed by factory-trained personnel to insure watertightness. Any adjustment or removal of these items may destroy the watertight feature thus exposing the transmitter to water seepage, an electrical short and transmitter failure. Any adjustment or removal of the cable grommet or cable support voids the warranty.

Caution - Waterproof cable should not be kinked or nicked, this would allow water into the electronics housing. Permanent damage will result. (Never cut or splice the waterproof cable). The surface end of the cable is used as the system's atmospheric reference, this end should not be sealed.

MODEL 575 WITH CABLE SUPPORT



SURGE OR LIGHTNING PROTECTION

Surge or lightning protectors are available as optional items and are **strongly recommended** for protection from secondary surges or lightning strikes. The units are easy to install, are maintenance-free and respond in less than one nanosecond. Install in accordance with the instructions:

1. Lightning protection devices should be placed as close to the instrument as possible and wired in accordance with National Electric Code in an approved watertight enclosure.
2. If the distance between the meter and transmitter, or the meter and recorder is less than 100 feet, only 1 protector per line may be used.
3. Use No. 10 AWG ground wire or better from protector to earth ground.
4. Provide a separate ground for each run of shielded cable or metal conduit.

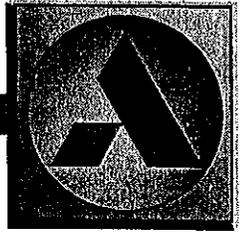
5. Keep the ground wire less than 1 foot long and tie to a suitable ground rod or metal frame ground. Surge capability is only as good as the grounding method. All ground connections must be installed.

6. Install all protectors in weathertight enclosures.

7. Run signal lines shielded and away from power lines.

8. Wire according to the Electrical Code.

Caution - This or any installation cannot protect against a direct lightning strike, or secondary strikes of sufficient magnitude. Ametek cannot accept liability for damage due to lightning or secondary surges.



LEVEL TRANSMITTERS

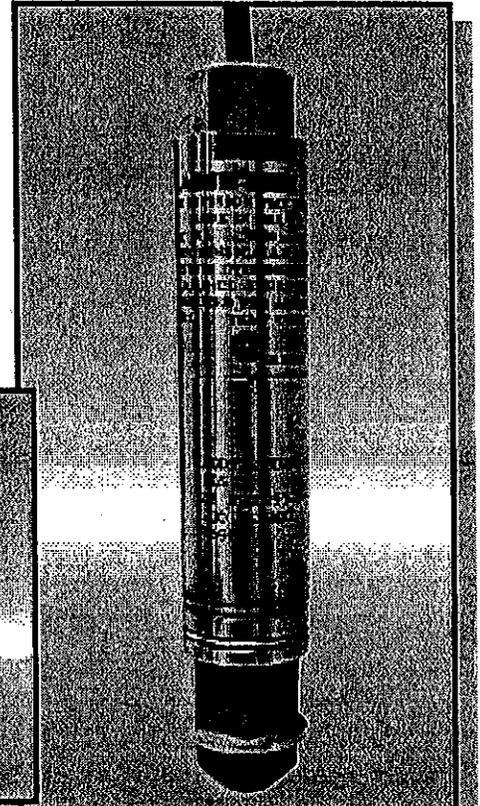
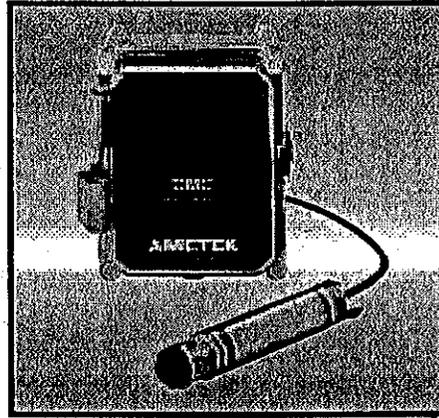
Model 575 Submersible Level Transmitter

FEATURES

- ◆ Solid state semiconductor sensor for accuracy and reliability
- ◆ Rugged 316 stainless steel housing with excellent environmental protection
- ◆ Easy to install and use
- ◆ Removable, nonclogging snub nose end protects sensing elements
- ◆ 2 wire 4-20 mA output
- ◆ Vented to the atmosphere through the surface end of the cable
- ◆ Reverse polarity and surge protected
- ◆ Lightning protectors available

APPLICATIONS

- ◆ Tanks
- ◆ Ponds
- ◆ Rivers
- ◆ Lakes
- ◆ Water wells
- ◆ Landfills
- ◆ Flood channels



MODEL 575 TRANSMITTER

DESCRIPTION

The Model 575 Submersible Level Transmitter is specially designed to provide the convenience of direct submergence in many type of liquid for quick, accurate and reliable level measurement. The simple design and rugged construction of this solid state instrument provide long lasting service with virtually no maintenance.

The Model 575 Transmitter indicates the level of liquid by continuously measuring hydrostatic pressure via its sensing element, an ion implanted silicon semiconductor chip with integral

Wheatstone Bridge circuit. Once the sensor measures the pressure, the data is transmitted by a 4 to 20 mA output signal. This design provides for excellent linearity and repeatability, low hysteresis and long term stability.

The Model 575 is easy to install, too. Simply lower the transmitter into a vessel or well. It's that easy. All the electronics are mounted in a submersible 316 stainless steel housing. A special cable support bracket is also available. This gives extra stability to the transmitter when used with longer

lengths of cable or when used in an agitated liquid.

The transmitter is available calibrated for any span needed, from 0 to 3 psi or 0 to 0.2 bar (0 to 7 feet or 0 to 2.1 meters of water) to 0 to 300 psi or 0 to 20 bar (0 to 690 feet or 0 to 211 meters of water).

To complete your liquid level measurement and control system, use the AMETEK Model DMC Digital Meter/Controller with the Model 575 Submersible Transmitter.

Model 575 Submersible Level Transmitter

SPECIFICATIONS

FEET OF WATER: 0/14, 0/35, 0/69, 0/138, 0/230, 0/345, 0/460, 0/690

METERS OF WATER: 0/4, 0/10, 0/21, 0/42, 0/70, 0/105, 0/140, 0/210

BAR: 0/0.4, 0/1, 0/2, 0/4, 0/7, 0/10, 0/14, 0/20

PSI: 0/6, 0/15, 0/30, 0/60, 0/100, 0/150, 0/200, 0/300

OUTPUT: 4-20 mA, 2 wire, current limited to 30 mA DC

POWER SUPPLY: 12 to 40 VDC with reverse polarity surge protection; Limit to 28 VDC for CSA I.S.

LOOP RESISTANCE: 1400 ohms maximum at 40 volts

TEMPERATURE RANGE:
Ambient Operating: CSA Intrinsically safe T3C

= 32° to 104° F (0° to 40° C)
Storage: -40° to 176° F (-40° to 80° C)

OVERRANGE EFFECT: ±0.15% full scale at 300% of maximum range

ACCURACY: ±0.25% full scale, BFSL (including linearity, hysteresis and repeatability); ±0.50% full scale (6 psi range only)

ZERO OFFSET: ±0.50% full scale set at 25° C

SPAN: ±0.50% full scale set at 25° C

TEMPERATURE EFFECTS:
Compensated: 32° to 122° F (0° to 50° C);
Maximum ±1% URL output change for ±25° C temperature change within compensated range when calibrated at 25° C

POWER SUPPLY EFFECT: ±0.005% full scale per volt

CONSTRUCTION:
Diaphragm: Type 316L stainless steel

Housing Type: 316 stainless steel
Nut/Washer Type: 316 stainless steel
Cable Grommet: Viton
Housing O Ring: Viton
Cable Jacket: Polyurethane
Snub Nose: Nylon 6/6, removable (1/2 inch NPT)

MEDIA COMPATIBILITY: Reference materials of construction

ELECTRICAL CONNECTION: Attached 20 gauge polyurethane shielded cable. Unspliced lengths available up to 5000 ft. (1662 m)

WEIGHT: 1.0 lb. (454 g)

APPROVALS: Meets CSA requirements for intrinsically safe operation in hazardous locations as designated by Class I, Div 1, Groups A, B, C & D and Class II, Groups E, F & G. Temperature Code T3C (when used with approved barrier)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ORDERING INFORMATION

MODEL NUMBER
575-S-B-0015-N-L-S (100 Ft. of Cable)

SENSING PORT

S = Snub nose

INPUT/OUTPUT

B = 12-28 VDC/4-20 mA

Consult factory for availability of different input/output options

RANGE

0006 = 0-6 psi/0-0.4 bar (0-14 ft./0-4.2 m water)

0015 = 0-15 psi/0-1 bar (0-35 ft./0-10.5 m water)

0030 = 0-30 psi/0-2 bar (0-69 ft./0-21.1 m water)

0060 = 0-60 psi/0-4 bar (0-138 ft./0-42.2 m water)

0100 = 0-100 psi/0-7 bar (0-230 ft./0-70.3 m water)

0150 = 0-150 psi/0-10 bar (0-345 ft./0-105.4 m water)

0200 = 0-200 psi/0-14 bar (0-460 ft./0-140.5 m water)

0300 = 0-300 psi/0-20 bar (0-690 ft./0-211.0 m water)

Calibrated ranges can be specified after the model code; the specific range should be between the upper and lower ranges in the category selected.

ELECTRICAL CONNECTION

N = Standard nut/cable

R = Cable support with standard nut/cable

C = Conduit adapter

DIAPHRAGM

L = 316L stainless steel

FILL

S = Silicone oil

Others = Consult factory for availability.

CABLE LENGTH

(Specify length in feet)

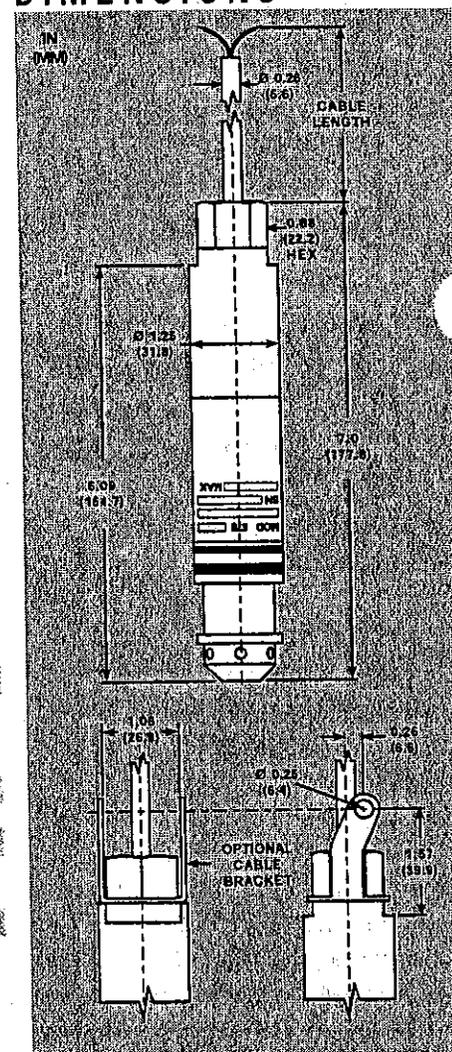
NOTE: For maximum reliability and long term performance, AMETEK recommends the use of a lightning protector with this level transmitter. For ordering information consult factory.

Example:

575-S-B-0015-N-L-S
(100 Ft. of Cable)

Model 575 snubnose submersible transmitter, 12-28 VDC input, 4-20 mA output, to measure 15 psi, standard nut, cable electrical connection, 316L stainless steel diaphragm, silicone fill, 100 ft. of cable

DIMENSIONS



AMETEK®

U.S. GAUGE • PMT PRODUCTS

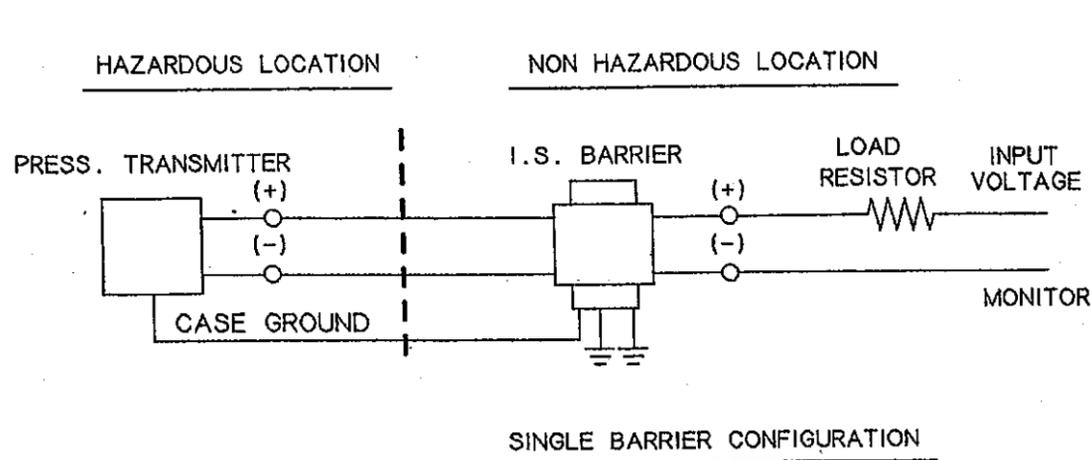
820 PENNSYLVANIA BLVD., FEASTERVILLE, PENNSYLVANIA 19053 U.S.A.
TEL: (215) 355-6900 • FAX: (215) 355-2937 • www.ametekusg.com

ISO 9001 REGISTERED MANUFACTURER

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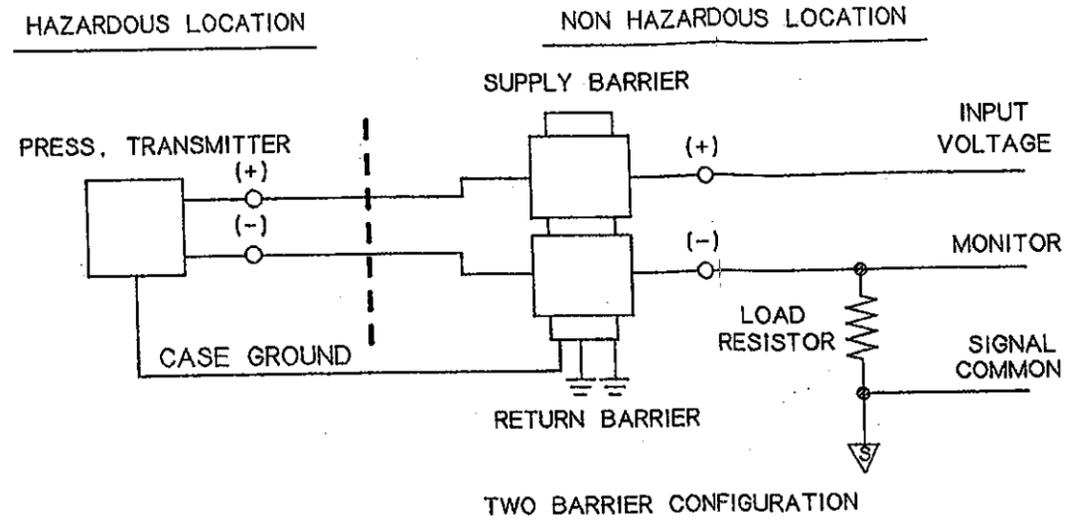
Printed in the U.S.A.
on recycled paper

BASIC INSTALLATION CIRCUIT DIAGRAM



SUGGESTED LIST OF CSA APPROVED BARRIERS:

MANUFACTURER	MODEL NO.	PUBLICATION NO.
STAHL	8901/31-280/100/70	8901603310
STAHL	8903/31-315/050/70	8903601310
HONEYWELL	38545-0000-0110-113-F585	S-385-22
MTL	728+	PS700-10
MTL	708	PS700-10



SUGGESTED LIST OF CSA APPROVED BARRIERS:

MANUFACTURER	MODEL NO.	PUBLICATION NO.
STAHL	8901/31-280/100/70 (SUPPLY)	8901603310
STAHL	8901/33-086/000/00 (RETURN)	8901603310
STAHL	8903/31-315/050/70 (SUPPLY)	8903601310
STAHL	8901/33-086/000/00 (RETURN)	8901603310
MTL	787 OR 787S (SUPPLY + RETURN)	PS700-10

NOTES :

- USE ANY CSA CERTIFIED SINGLE CHANNEL ZENER DIODE BARRIER, HAVING SAFETY PARAMETERS OF 28 V MAX/290 OHM MIN., FOR THE SINGLE BARRIER CONFIGURATION OR FOR THE SUPPLY BARRIER IN THE 2 BARRIER CONFIGURATION. FOR THE RETURN BARRIER, IN THE 2 BARRIER CONFIGURATION, USE ANY CSA CERTIFIED DIODE-RETURN BARRIER.
- TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS.
- INTRINSICALLY SAFE FOR HAZARDOUS LOCATIONS, CLASS I; GROUPS A, B, C, D, CLASS II; GROUPS E, F, G, AND CLASS III

PART NUMBER

REV.	DESCRIPTION	DATE
1	RELEASE	10/31/91

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LIMITS OF ACCEPTABLE WORKMANSHIP ARE DEFINED IN MS-645-A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON	SCALE	DATE	AMETEK PMT DIVISION	820 PENNSYLVANIA BLVD., FEASTERVILLE, PA. 19033
2 DEC. PL. ±.01	DRAWN BENNETT	10.4.91		
3 DEC. PL. ±.005	CHECKED MA	10-31-91	TITLE MODELS 841, 851, 88, 575 INTRINSICALLY SAFE SYSTEM CONTROL DRAWING (CSA)	
ANGLES ±1°	APPROVED WJA	11/31/91		
MATERIAL	SUPERSEDES		INCHES M.M.	
FINISH	USED ON			
	NEXT ASSY		DWG. NO. BK750483	
	PARTS LIST			
DO NOT SCALE DRAWING			SHEET OF	

SERVICE & ACCESSORIES

FACTORY SERVICE

Factory or field service is available by contacting the Customer Service Department. Supply the following information:

1. Instrument Model Number and Serial Number as shown on the Instrument Data Tag.
2. Description of the problem being experienced.
3. Description and location of the Installation.

For service: TEL: (215) 354-1848
FAX: (215) 354-1804

CAROL MC

PARTS - ORDERING

When ordering replacement parts, supply the following information:

1. Part description and part number.
2. Quantity of each item required.
3. Shipping instructions and address.

Mail, Telephone, or Fax Orders to:
AMETEK

820 Pennsylvania Blvd. Feasterville, PA 19053

TEL: (215) 355-6900
FAX: (215) 354-1801

ACCESSORIES

Part Number
LMA 912

Description

30 VDC SURGE/LIGHTNING PROTECTOR

Protects the excitation and signal lines between an Ametek Model DMC Meter Controller, or other power source and indicator, and the Model 575 4-20mA output transmitter.

WARRANTY POLICY

AMETEK ["Seller"] warrants for a period of one year from the date of shipment and that all products manufactured by the seller are free from defects of material and workmanship when used within the service, range, and purpose for which they were manufactured. Seller will, at its option, repair, replace, or refund the purchase price of parts found by Seller to be defective in material or workmanship provided that written notice of such defect requesting instructions for repair, replacement, or refund is received by Seller at the address below within the warranty period and provided that any instructions thereafter given by Seller are complied with.

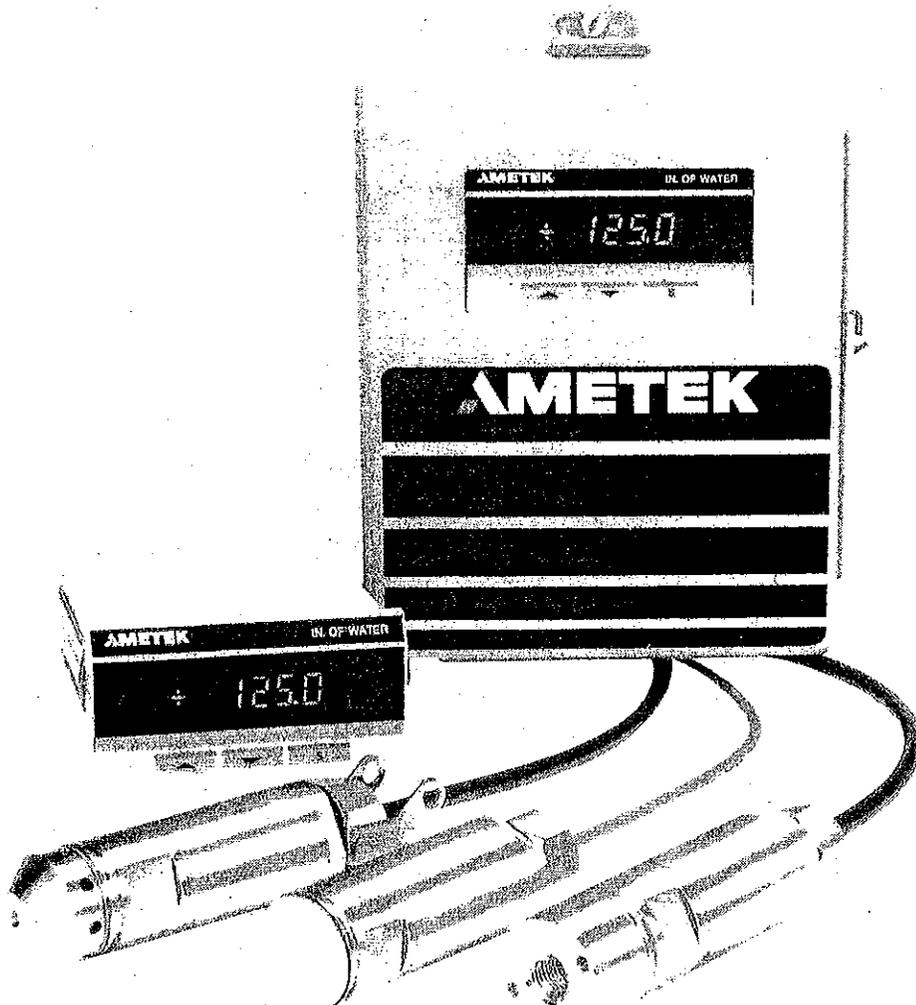
This warranty shall not apply (i) to the performance of any system of which Seller's products are a component part, (ii) to deterioration by corrosion or any cause of failure other than defect of material or workmanship, or (iii) to any of Seller's products or parts thereof which have been tampered with or altered or repaired by anyone except Seller or someone authorized by Seller, or subjected to misuse, neglect, abuse or improper use or misapplication such as breakage by negligence, accident, vandalism, the elements, shock, vibration, or exposure to any other service, range, or environment of greater severity than that for which the products were designed.

SELLER MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF FITNESS OR OF MERCHANTABILITY WITH RESPECT TO ITS PRODUCTS, OR ANY PART THEREOF, OTHER THAN AS EXPRESSLY SET FORTH ABOVE. NOR SHALL SELLER HAVE INCURRED ANY OTHER OBLIGATIONS OR LIABILITIES OR BE LIABLE FOR ANY ANTICIPATED OR LOST PROFITS, INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES, TIME CHARGES, OR ANY OTHER LOSSES INCURRED IN CONNECTION WITH THE PURCHASE, INSTALLATION, REPAIR, OR OPERATION OF ITS PRODUCTS (INCLUDING ANY PARTS REPAIRED OR REPLACED).

This warranty does not extend to anyone other than the original Buyer from Seller.

MODEL 572 METER/CONTROLLER FOR THE LEVEL SYSTEM

INSTRUCTIONS FOR INSTALLATION,
OPERATION, MAINTENANCE,
SERVICE AND PARTS



AMETEK
PMT DIVISION

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INTRODUCTION

The Model 572 Digital Meter Controller is used with an Ametek Model 57 Pressure Transducer or Transmitter or any 4-20mA or millivolt transducer or transmitter to provide digital indication of pressure or level.

Model 572A has two setpoints, each with an adjustable high and low setting and a common hysteresis adjustment. The display provides a visual indication when setpoints are exceeded. Each setpoint actuates a Form C relay (two relays). The relays provide on/off control of external control devices.

Model 572B is a Model 572A with 4 to 20 mA or 0 to 10 VDC analog output. The analog outputs are proportional to the pressure or level measurement and can be used for external indicating; recording, controlling; or computing devices which accept analog input.

Model 572C is a Model 572B with RS232 serial digital output which can be used for external indicating, printing, controlling, or computing devices which accept digital input.

SAFETY SUMMARY

This instrument is designed to prevent accidental shock to the operator when properly used. However, no design can ensure the safety of an instrument improperly installed or used negligently. Read this manual carefully and completely before operating the instrument. Failure to read this manual in its entirety could result in damage to the instrument or injury to the operator. Standard safety precautions must be used during installation and operation. Important messages located throughout this manual are as follows:

- WARNING** – Denotes a hazardous procedure or condition which, if ignored, could result in injury or death to the operator.
- CAUTION** – Denotes a hazardous procedure or condition which, if ignored, could result in damage or destruction to the instrument.
- IMPORTANT** – Denotes a procedure or condition which is essential to the correct operation of the instrument.
- NOTE** – Specifies supplementary and perhaps essential information in relation to a particular procedure or condition.

WARNING – Do not connect any wires to Terminal Boards No.'s P1 or P2 with the AC Power Input applied.

WARRANTY POLICY

AMETEK ["Seller"] warrants for a period of one year from date of shipment that all products manufactured by the Seller are free from defects of material and workmanship when used within the service, range, and purpose for which they were manufactured. Seller will, at its option, repair, replace, or refund the purchase price of parts found by Seller to be defective in material or workmanship provided that written notice of such defect requesting instructions for repair, replacement, or refund is received by Seller at the address below within one year after the date of shipment and provided that any instructions thereafter given by Seller are complied with.

This warranty shall not apply [i] to the performance of any system of which Seller's products are a component part, [ii] to deterioration by corrosion or any cause of failure other than defect of material or workmanship, or [iii] to any of Seller's products or parts thereof which have been tampered with or altered or repaired by anyone except Seller or someone authorized by Seller, or subjected to misuse, neglect, abuse or improper use or misapplication such as breakage by negligence, accident, vandalism, the elements, shock, vibration, or exposure to any other service, range, or environment of greater severity than that for which the products were designed.

SELLER MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF FITNESS OR OF MERCHANTABILITY WITH RESPECT TO ITS PRODUCTS, OR ANY PART THEREOF, OTHER THAN AS EXPRESSLY SET FORTH ABOVE. NOR SHALL SELLER HAVE INCURRED ANY OTHER OBLIGATIONS OR LIABILITIES OR BE LIABLE FOR ANY ANTICIPATED OR LOST PROFITS, INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES, TIME CHARGES, OR ANY OTHER LOSSES INCURRED IN CONNECTION WITH THE PURCHASE, INSTALLATION, REPAIR, OR OPERATION OF ITS PRODUCTS [INCLUDING ANY PARTS REPAIRED OR REPLACED].

This warranty does not extend to anyone other than the original Buyer from Seller.

AMETEK

PMT DIVISION

820 PENNSYLVANIA BLVD., FEASTERVILLE, PA 19053

SECTION I SPECIFICATIONS

COMMON SPECIFICATIONS FOR MODEL 572 A, B, & C METERS

- DISPLAY:** 7 Segment, 3 1/2 digit, Blue/Green vacuum fluorescent 0.5 in. high alphanumeric characters.
- CASE:** Noryl case "OFF WHITE" color per DMS 454C. 1/8 DIN cutout (1.78 in. x 3.63 in.). Splash proof NEMA 12 front panel with neoprene panel seal gasket. Weight 1.22 lb., max.
- TERMINATIONS:** Screw terminals, accept No. 14 AWG max.
- FRONT PANEL KEYS:** Membrane type.
- POWER:** 115VAC or 230VAC $\pm 10\%$, 50/60 Hz, 10VA. User selectable on terminal board.
- FULL SCALE INPUT RANGE:** 0 to 199.9 mVDC or 4 to 20 mADC, with precision resistor added.
- INDICATOR ACCURACY:** $\pm 0.05\% \pm 1/2$ least digit.
- *DIGITAL COUNTS:** Max Counts = 32 x mV input to Max of 1999.
- *DIGITAL OFFSET:** Display Counts + offset must not exceed 1999.
- *DECIMAL POINT:** Selectable.
- *MIN/MAX MEASUREMENT STORAGE:** Continuously updated since last reset by operator.
- *SET POINTS:** Two high and two low adjustable setpoints with front panel display when exceeded.
- *SET POINT HYSTERESIS:** Adjustable to 100% of display range, common to all setpoints.
- STROBE HOLD:** Suspends measurement and display from rear panel terminals.
- EXCITATION SOURCE:** Meter provides 18-24 VDC unregulated, or 10VDC regulated, to power external transducer, short circuit protected.
- REMOTE KEYPAD:** Keypad contacts available on rear panel terminals.
- DISPLAY RATE:** 2 updates per second.
- RESPONSE TIME:** 750mS typical for input step change.
- RELAY OUTPUTS:** Meters have two Form C, 5 amp relays actuated by the setpoints.
- RELAY CONTACT RATING:**
- | | |
|-------------------|---------------------------|
| Resistive: | 5A max. at 125VAC max. |
| | 0.6A max. at 110 VDC max. |
| | 5A max. at 30VDC max. |
| Inductive: | 0.1A max. at 50VDC |
- ISOLATION:** Relay has 1500V peak isolation from the signal input and 500V peak isolation from analog output and RS232 output.
- INPUT PROTECTION:** Floating protection to 300V min. 1 Meg Min. input impedance.
- NMR:** 60db typical at 50/60Hz.
- CMV:** ± 2500 v peak input to power line.
- CMR:** 80db at 50/60Hz input to power line.
- OPERATING TEMP:** 0 to 50° C.
- STORAGE TEMP:** - 40 to + 85° C.
- STORAGE HUMIDITY:** 20 to 80% non condensing.

Functions marked with an asterisk () are operator programmable from the front panel and stored in a nonvolatile memory. Alteration of programmed settings requires entry of a security code (28) for access.

SPECIFICATIONS FOR MODEL 572C (RS232 OUTPUT)

Model 572C provides serial ASCII, RS232C half duplex, or 20 mA current loop communications interface with 1500V peak isolation to signal input circuits and 300 or 1200 baud rate selection on rear connector.

- DATA FORMAT:** 1 start bit, 7 data bits, no parity, 2 stop bits.
- DISTANCE:** 20 mA = 4000 ft.
RS232C = 75 ft. max.

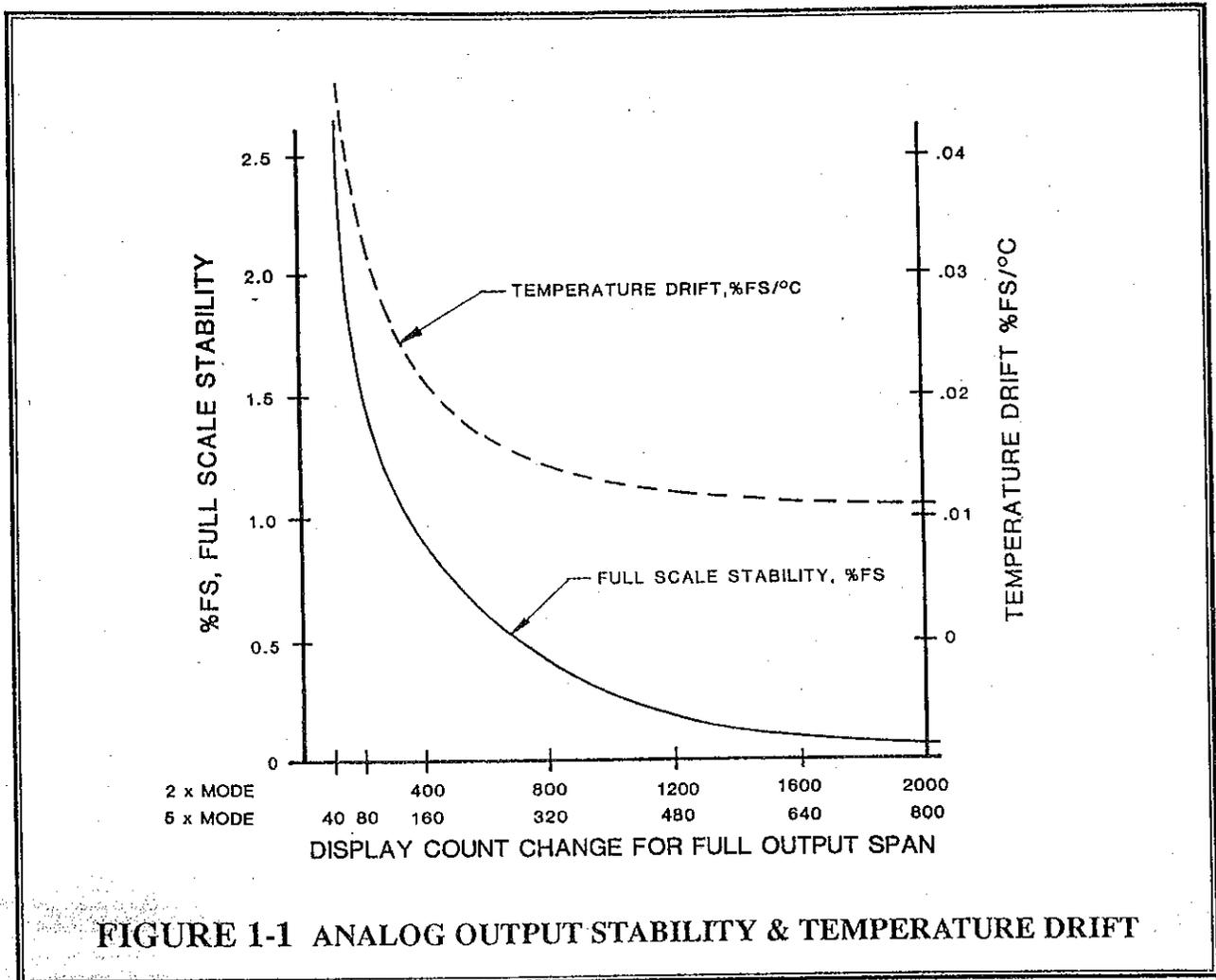


FIGURE 1-1 ANALOG OUTPUT STABILITY & TEMPERATURE DRIFT

SPECIFICATIONS FOR ANALOG OUTPUT (MODELS 572 B & C)

Models 572B & C provide 4 to 20mA or 0 to 10 VDC analog output with potentiometer adjustment of scale and offset.

DISPLAY COUNT CHANGE FOR FULL OUTPUT SPAN

- 1 x mode = full output. (See Note)
- 2 x mode = full output for 800 to 1999 counts.
- 5 x mode = full output for 80 to 799 counts.

Mode selection by connecting to appropriate terminals.

OUTPUT VOLTAGE: 10 VDC at 17mA (max)

OUTPUT CURRENT: 20 mA, 17V compliance (min.). Loop load resistance is 0 to 600 ohms max.

ANALOG OUTPUT STABILITY AND TEMPERATURE DRIFT: See Figure 1-1

Note: The 1 x mode is required if the display passes through zero, displaying both positive and negative numbers.

SECTION I SPECIFICATIONS

MODEL 572 MODEL NUMBER CODE

572 = MODEL 572 DIGITAL METER CONTROLLER

METER OUTPUT

- A = TWO RELAYS
- B = TWO RELAYS, ANALOG OUTPUT
- C = TWO RELAYS, ANALOG OUTPUT, RS232 OUTPUT

POWER

- 2 = 115 VAC 50/60 Hz
- 3 = 230 VAC 50/60 Hz

MOUNTING

- A = PANEL MOUNT
- B = WEATHER TIGHT HOUSING
- C = WALL MOUNT

OPTIONS (** AVAILABLE WITH MOUNTING OPTION B, WEATHER TIGHT HOUSING, ONLY)

- LC = CABLE STRAIN RELIEF **
- PB = PIPE MOUNTING BRACKET **
- AM = METAL TAG**
- VA = 18-24 VDC UNREGULATED SUPPLY / 4-20 mA INPUT

ANALOG OUTPUT CALIBRATION (572 B AND C ONLY)

- 1 = 4 TO 20 mA
- 2 = 0 TO 10 VDC
- 3 = NOT CALIBRATED

CALIBRATED RANGE

() IN PARENTHESIS WRITE INPUT SPAN AND UNITS OF MEASUREMENT FOR WHICH DISPLAY AND ANALOG OUTPUT IS TO BE CALIBRATED.

METER DISPLAY

- % = % CALIBRATION SPAN
- P = PSI
- FW = FEET OF WATER
- MW = METERS OF WATER
- IW = INCHES OF WATER
- FS = FEET OF LIQUID WITH SPECIFIC GRAVITY OF *
- MS = METERS OF LIQUID WITH SPECIFIC GRAVITY OF *
- IS = INCHES OF LIQUID WITH SPECIFIC GRAVITY OF *

TRANSDUCER

() IN PARENTHESIS WRITE MODEL NO. OF TRANSDUCER WHICH METER IS TO BE CALIBRATED WITH.

572 X X X X X () X ()

* FOR LIQUIDS WHOSE SPECIFIC GRAVITY IS NOT 1.00, SPECIFY ACTUAL SPECIFIC GRAVITY IN CALIBRATED RANGE PARENTHESIS.

EXAMPLE: 572B2BLCPB1 (0/30 FT SG 0.96) FS (57SN018A) IS A MODEL 572 DIGITAL METER CONTROLLER WITH 2 RELAYS AND ANALOG OUTPUT, 115 VAC 50/60 Hz., IN A WEATHER TIGHT HOUSING WITH CABLE STRAIN RELIEF AND PIPE MOUNTING BRACKETS, CALIBRATED 4 TO 20 mA FOR 0 TO 30 FT. OF A LIQUID WITH A SPECIFIC GRAVITY OF 0.96. METER LABEL WILL READ "FT SG 0.96". CALIBRATED WITH TRANSDUCER MODEL No. 57SN018A.

SPECIFICATION OF MODEL 57 TRANSDUCER RANGE CODE AND MODEL 572 METER DISPLAY FOR VARIOUS RANGES AND UNITS OF MEASUREMENT

Figure 1-2 illustrates the minimum and maximum pressure (or level) spans for which the meter and transducer system display can be calibrated. For example, a Model 57 Pressure Transducer with Range Code 019 (30 psi Nominal) can be calibrated with a Model 572 Meter to display any span between the minimum and maximum for each unit of measurement for Range Code 019. The system can also be calibrated to display 0 to 100% for any span between the minimum and maximum for Range Code 019. The 4 to 20 mA or 0 to 10 VDC analog output of Model 572B or C can also be calibrated for these spans.

FIGURE 1-2

MODEL 572 SYSTEM SPANS FOR WHICH DISPLAY & ANALOG OUTPUT CAN BE CALIBRATED

MODEL 57 TRANSDUCER		MINIMUM & MAXIMUM CALIBRATED SPANS FOR EACH MODEL 57 RANGE CODE FOR EACH UNIT OF MEASUREMENT.									
RANGE CODE	PRESS RANGE (psi)	(P) Psi		(IW) In. of Water		(FW) Ft. of Water		(MW) Mtr. of Water		(%) % Cal. Span	
		Min Span	Max Span	Min Span	Max. Span	Min Span	Max. Span	Min Span	Max Span	Min Span	Max Span
016	0 - 6	02.00	06.00	0080	0166	04.60	13.80	01.41	04.22	0100	100.0
018	0 - 15	05.00	15.00	0138	0415	011.5	034.6	03.50	10.50	0100	100.0
019	0 - 30	010.0	030.0	0276	0830	023.1	069.2	008.0	021.1	0100	100.0
005	0 - 60	020.0	060.0	0553	1660	046.0	138.0	014.0	042.2	100.0	100.0
006	0 - 100	033.3	100.0	0092	0277	0080	0231	023.4	070.3	100.0	100.0
008	0 - 200	066.6	199.9	NA	NA	0154	0461	046.6	140.0	100.0	100.0
009	0 - 300	0100	0300	NA	NA	0231	0692	0080	0211	100.0	100.0

NA = Not Available

NOTES:

- Maximum span is also maximum calibrated pressure.
- When calibrated to max. span, 4mA (or 0 VDC) will be at zero pressure and 20mA (or 10 VDC) will be at max pressure.
- When calibrated for less than max. span, 4mA (or 0 VDC) can be at zero pressure or more, 20mA (or 10 VDC) can be at max pressure or less as long as pressure change for 4 to 20mA (or 0 to 10 VDC) is not less than min. span.
- Display can be calibrated to 0 to 100% for any permissible calibrated span per Note 3.
- Max display counts = (calibrated span */ max span**) x max input mV *** x 32 but cannot exceed 1999.
- Display count change for analog output = display high - display low but should not be less than min. span counts or less than 80 counts, whichever is greater.

* Calibrated span is the span expressed in the units of measurement displayed.

** Max. span is the "Max.Span" as shown in Figure 1-2 for the unit of measurement displayed and the range of the Model 57 Transducer selected.

*** When using mV transducers or transmitters, the max. meter input is 50 mV for range codes 016, 018 and 019. Max meter input is 100 mV for all other ranges. When using 4-20 mA transducers or transmitters, the max. meter input is 100 mV for all ranges.

ORDERING EXAMPLES

WHEN CALIBRATED SPAN STARTS AT ZERO.

If the system is to be calibrated 0 to 20 ft. of water, look in the "Ft. of Water" column of Figure 1-2 to find that range Code 018 can be calibrated for a min. of 11.5 to a max. of 34.6 ft. of water.

A Model 57 with Range Code 018 should be ordered.

When ordering the Model 572 Meter enter "(20 ft. water)" in the "CALIBRATED RANGE" column.

If the display is to read 0 to 20 ft. water enter "FW" in the "METER DISPLAY LABEL" column and "FT WTR" will be printed on the label.

If the display is to read 0 to 100% enter "%" in the "METER DISPLAY LABEL" column and "% FS" will be printed on the label.

WHEN CALIBRATED SPAN STARTS ABOVE ZERO (SUPPRESSED ZERO).

If the system is to be calibrated 15 to 30 ft. of water, look in the "Ft. of Water" column of Figure 1-2 to find that range code 018 has a max. pressure (34.6) greater than 30 ft. of water and min. span of 11.5 which is less than calibrated span of 15 (30 - 15 ft. water).

A Model 57 with Range Code 018 should be ordered.

When ordering the Model 572 Meter enter "(15 to 30 ft. water)" in the "CALIBRATED RANGE" column.

If the display is to read 15 to 30 ft. of water enter "FW" in the "METER DISPLAY LABEL" column and "FT WTR" will be printed on the label.

If the display is to read 0 to 100%, enter "%" in the "METER DISPLAY LABEL" column and "%FS" will be printed on the label.

LEVEL MEASUREMENTS FOR LIQUIDS WHOSE SPECIFIC GRAVITY IS NOT 1.00

When the transducer is to measure level of a liquid whose specific gravity is not 1.00, multiply the height of the liquid by its specific gravity to convert the range to the equivalent height of water.

Use this height of water and Figure 1-2 to determine the Model 57 transducer range code.

In the Model 572 Model Code write in the calibrated level range followed by the specific gravity of the liquid in the "CALIBRATED RANGE" column.

Write FS, MS, CS, or % in the "METER DISPLAY LABEL" column.

If, for example, the system is to measure 0 to 40 ft. of oil with a specific gravity of 0.96, the equivalent ft. of water is $0.96 \times 40 = 38.4$ ft. of water.

Use Figure 1-2 to find Model 57 range code 019 (23.1 to 69.2 ft. water) should be ordered.

When ordering the Model 572 Meter enter "(40 FT SG 0.96)" in the "CALIBRATED RANGE" column.

If the display is to read 0 to 40 write "FS" in the "METER DISPLAY LABEL" column and the meter label will read "FT SG 0.96".

If the display is to read 0 to 100% enter "%" in the "METER DISPLAY LABEL" column and "%FS" will be printed on the label.

UNPACKING AND INSPECTION

The Model 572 is usually factory calibrated with a specific Ametek Model 57 Pressure Transducer.

The Transducer Model Number and Serial Number are identified on the meter nameplate in the section labelled "Meter calibrated for use with Transducer".

The meter should be used with the transducer with which it was calibrated.

Refer to the Model 57 Pressure Transducer instructions before putting the transducer into service.

Unpack the Model 572 meter from the shipping container and inspect for physical damage.

If the meter is in a weather tight housing, (Mod 572XXB) open the door and inspect for damage.

OPERATIONAL CHECKOUT

Before installing the Model 57 pressure transducer, make sure the system is operating with a bench check.

Connect a 4-20 mA transducer to the meter, in accordance with Figure 2-7. For a mV Transducer refer to Figure 2-8.

Refer to Figure 2-4 for 115 VAC operation, and Figure 2-5 for 230 VAC operation. Apply power and allow a twenty minute warmup.

With no pressure applied to the transducer, the meter display should be zero (or close to zero).

When pressure is applied to the transducer, the display should increase in a positive direction and return to the original zero reading when pressure is removed.

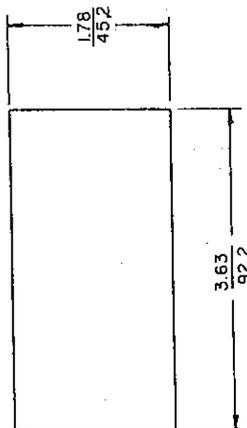
Model 57SP and 57SN submersible transducers can be pressurized by lowering the transducer into water.

Observe that the reading increases as the transducer is lowered into the water and returns to zero when removed from the water.

If the meter is used in a system requiring Analog or RS 232 output, refer to page 4-8 for checkout.

If adjustments are required, they can be made later at installation.

CAUTION – Do not simulate an increase in pressure by applying mechanical force to the sensing diaphragm of the transducer. Excessive force will result in damage or destruction to the transducer.



PANEL CUTOUT
 .188 MAX. PANEL THICKNESS
 4.8

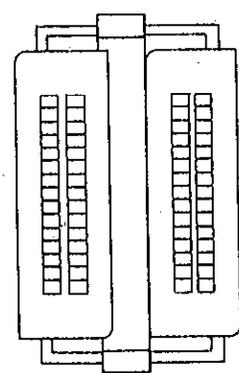
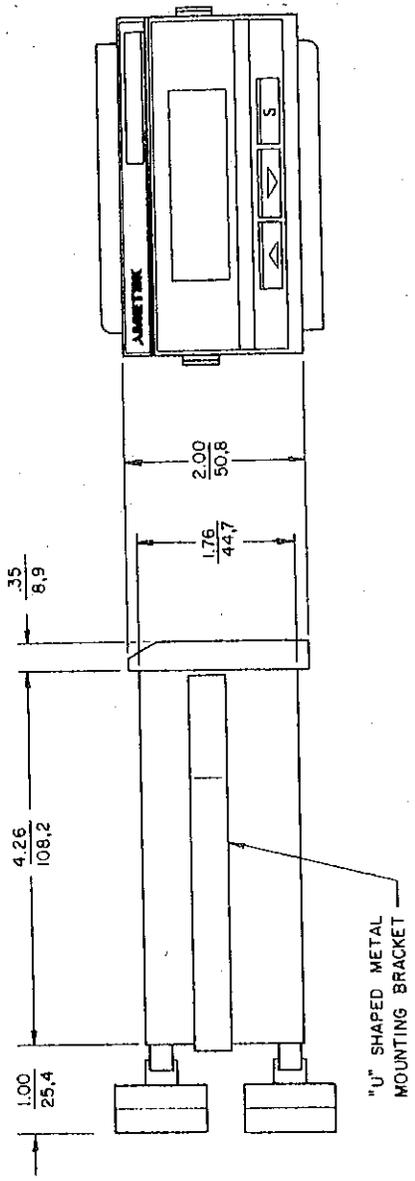
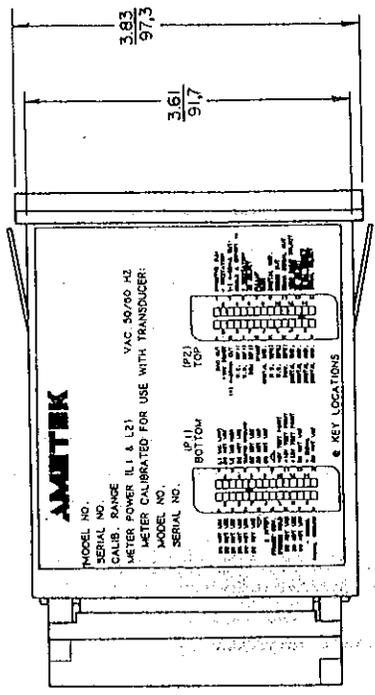


FIGURE 2-1 PANEL MOUNT

Refer to Model 57 Instruction Book for Installation of the Transducer.

SIGNAL NOISE ISOLATION

The meter should not be mounted close to high current switching relays or in an enclosure containing such relays.

Low voltage wiring (transducer signal wires and analog output wires) should be separated from high voltage wiring (115, 230, & 440 VAC) or should be shielded.

LIGHTNING AND SECONDARY SURGE PROTECTION

Surge/Lightning protection units are available and are strongly recommended to help protect the Model 572 Level Measurement System from unexpected lightning and secondary surges in an area where inductive surges can not be avoided.

These LP units are easy to install, are maintenance-free and respond in less than one nanosecond. When placed at the meter and at the transducer, they defend against powerful surges on both the signal and power lines. If a surge should occur, the LP unit will clamp the circuit, preventing excessive voltage from damaging the sensitive equipment. This saves replacement and down-time costs. A full range of models is available to meet protection requirements. Refer to Figures 2-10 and 2-11 for installation requirements.

PANEL MOUNT

Cut out panel as shown in outline drawing Figure 2-1.

Remove P1 and P2 connectors, remove mounting bracket, install meter through panel cutout and replace mounting bracket.

Tighten mounting bracket screws to secure meter against panel.

Replace P1 and P2 connectors.

WEATHER TIGHT HOUSING

The weather tight housing, Figure 2-2, can be mounted on a flat surface by using the four .31 inch diameter mounting holes.

When the pipe mounting brackets (PB option) are ordered, two "U" bolts are supplied to mount the housing to a vertical two inch pipe using the four .34 inch diameter "U" bolt mounting holes.

When the cable strain relief (LC Option) is ordered, two weather tight cable connectors are provided for connecting the Model 57 cable through the one half inch NPT conduit fitting. One connector grommet has a large hole for .250 to .312 inch diameter cable, the other has a small hole for .125 to .187 inch diameter cable.

The meter can be removed from the housing to make electrical connections to the meter terminal boards by:

1. Loosen the four meter plate mounting screws.
3. Remove the meter and plate assembly by lifting the plate off through the bayonet holes.
3. Connect wires to terminal boards on back of the meter.
4. Reinstall the meter and plate assembly and tighten the mounting screws.

WIRING TO TERMINAL BOARD No. P1

Terminal Board No. P1 is the bottom terminal board shown in Figure 2-1.

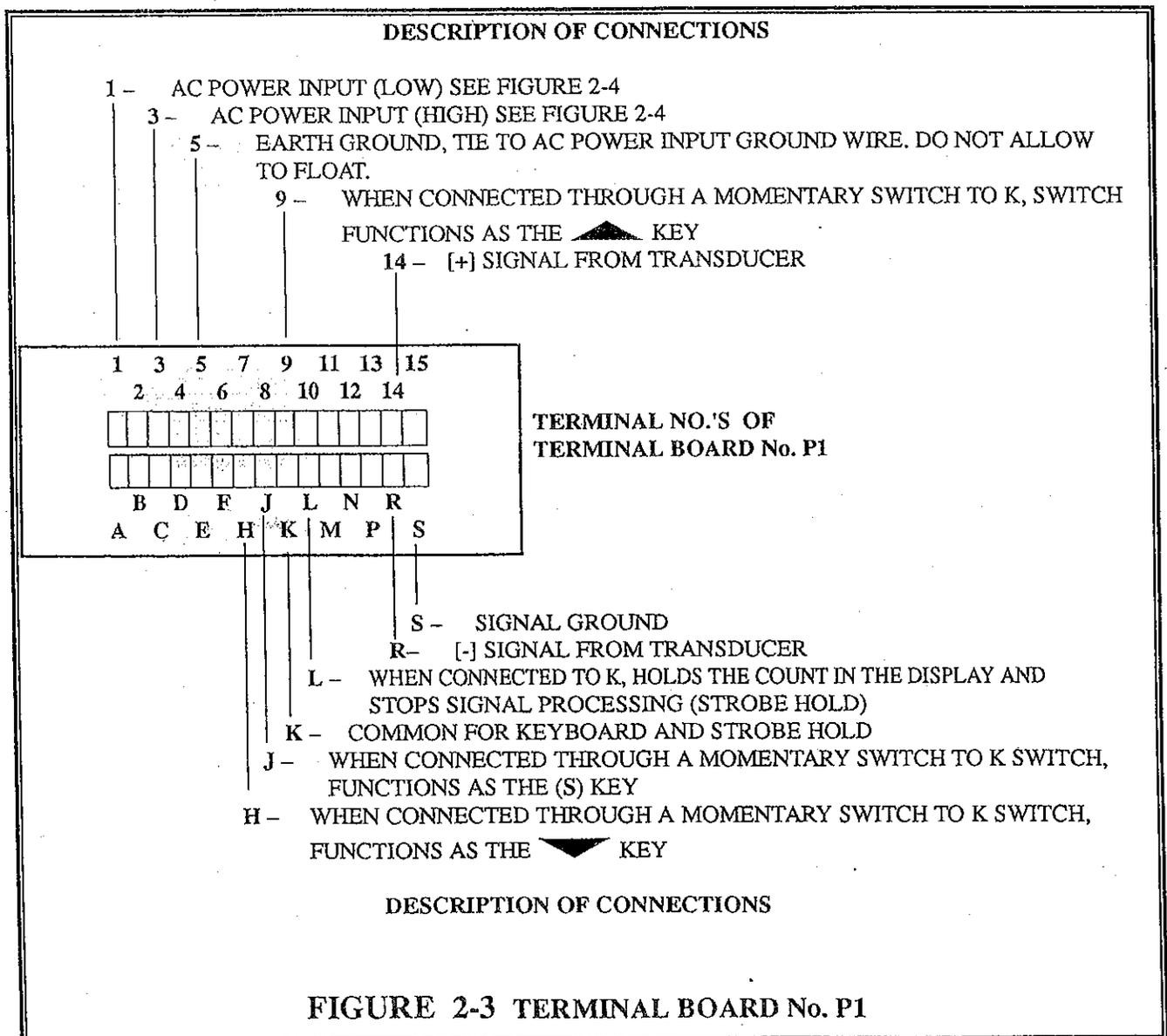
Loosen the two mounting screws and remove Terminal Board No. P1 from the circuit board.

WARNING - Do not connect any wires to Terminal Board No. P1 with the AC Power Input applied.

STROBE/HOLD

When strobe/hold is connected, all analog processing stops and the display freezes.

To obtain strobe/hold with external switch, wire a switch between terminal L and terminal K, on Terminal Board No. P1.



POWER

WARNING – Do not connect any wires to Terminal Boards P1 or P2 with the AC Power Input applied or power to any other wire(s) being connected.

Jumpers were installed at the factory on Terminal Board No. P1 for the voltage specified on the nameplate.

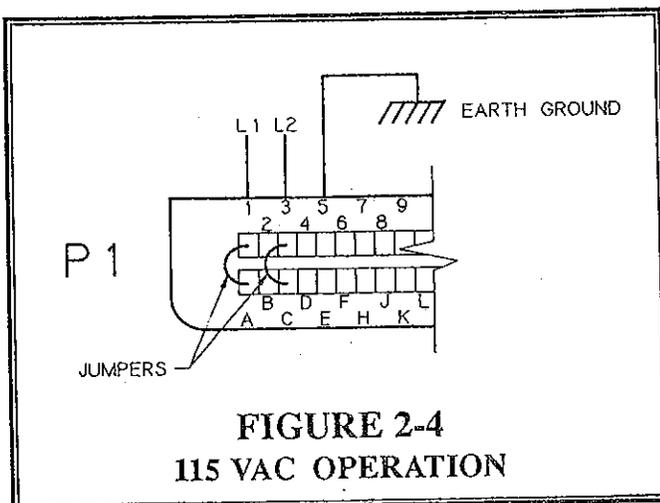
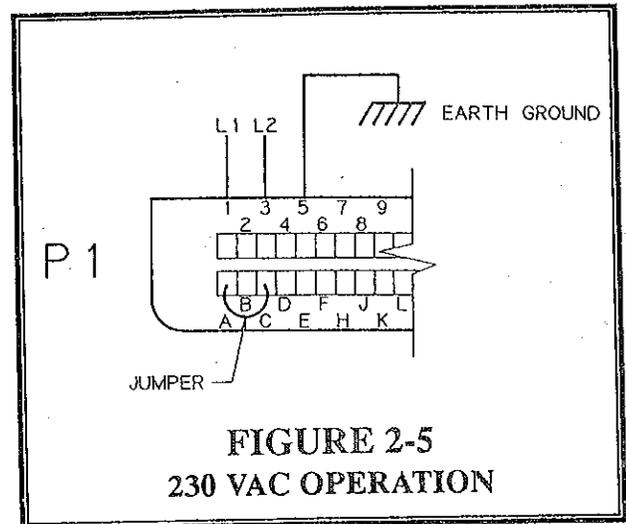
If it is necessary to change to another voltage, remove the factory installed jumper(s), reconnect the jumper(s) for the new voltage and mark the new voltage on the nameplate.

For 115VAC 50/60Hz power input: Install Jumpers between terminals A and 1 and between C and 3. See Figure 2-4.

NOTE – When connecting AC Power Input, jumpers must be in place.

For 230VAC 50/60Hz power input: Install a Jumper between terminals A and C. See Figure 2-5.

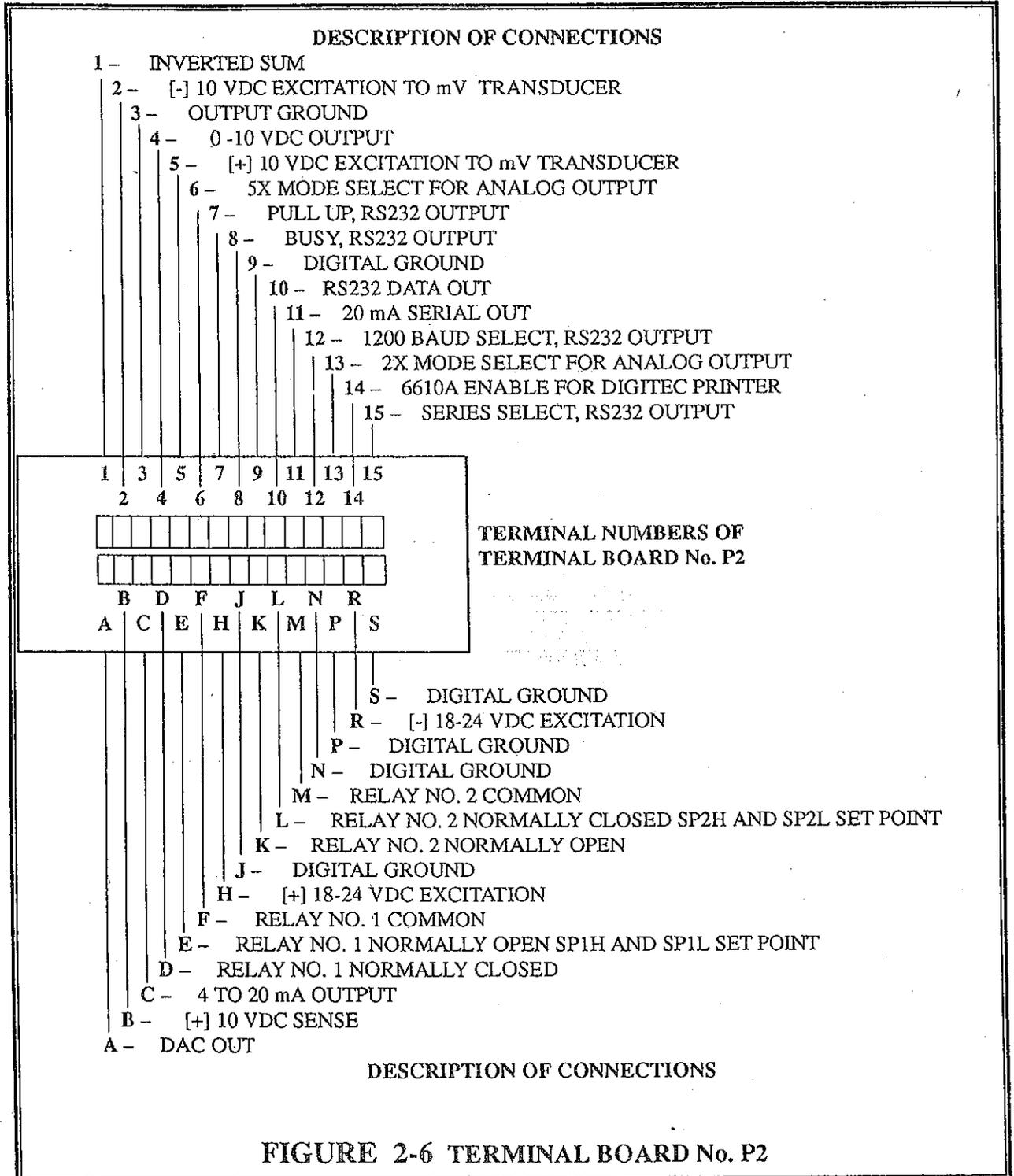
Earth ground must be connected to AC power input grounding wire.



WIRING TO TERMINAL BOARD No. P2

Terminal Board No. P2 is the top terminal board shown in Figure 2-2. Loosen the two

mounting screws and remove Terminal Board No. P2 from the circuit board.



SET POINT RELAYS

Refer to Figure 2-6 (Electrical Connections to P2 terminals) for connections D, E, F, K, L, M to relay contacts.

Refer to "Section 1, Specifications" for relay contact ratings.

To obtain maximum contact life, relay contacts should have arc suppression on the P2 terminal board because no internal arc suppression is provided. Use 0.047 microfarad 500V ceramic disc in series with a 10 ohm, 1/2 watt resistor.

Most applications require an additional customer supplied relay which is energized by the meter relay contacts and switches the load. See typical installation Figure 4-3.

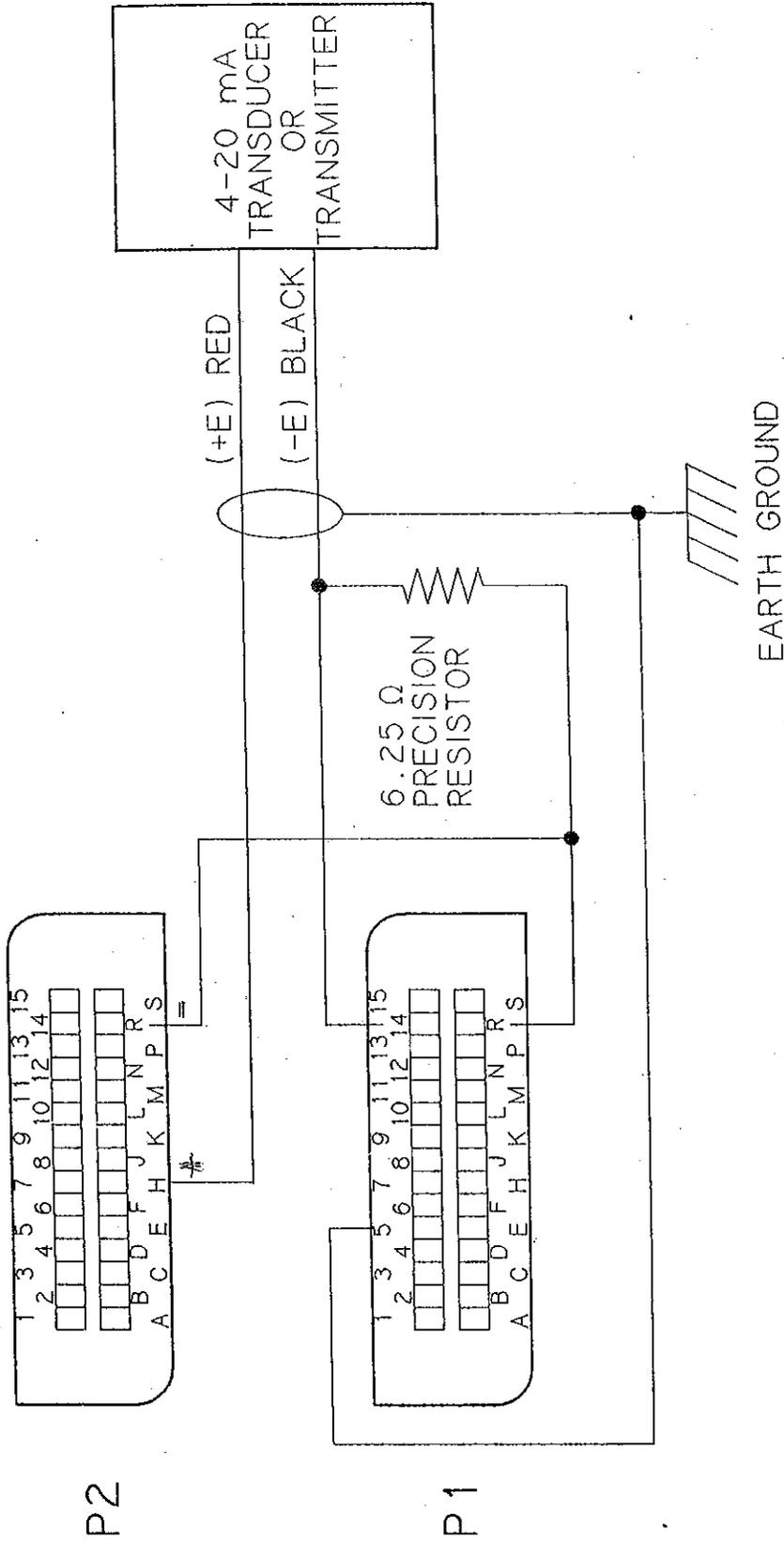


FIGURE 2-7 4-20 mA OUTPUT TRANSMITTER OR TRANSDUCER
(SHOWN WITHOUT SURGE PROTECTION)

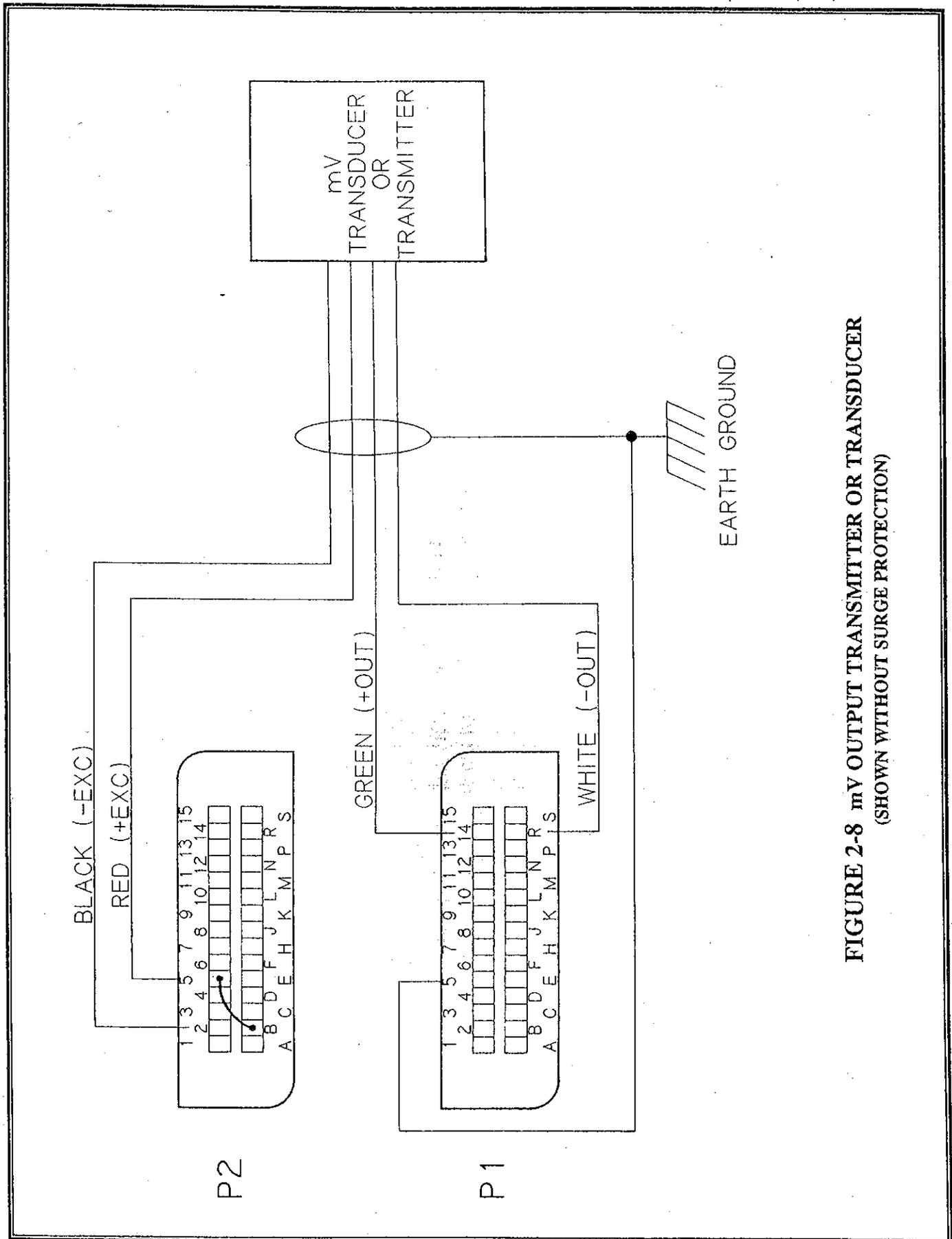
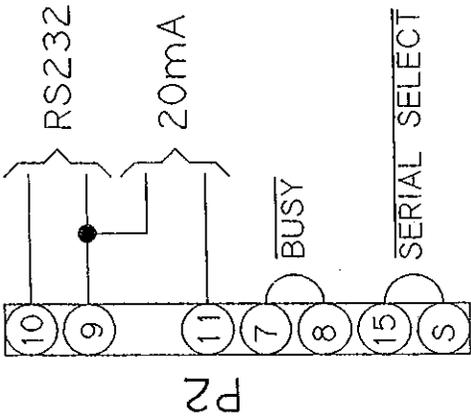
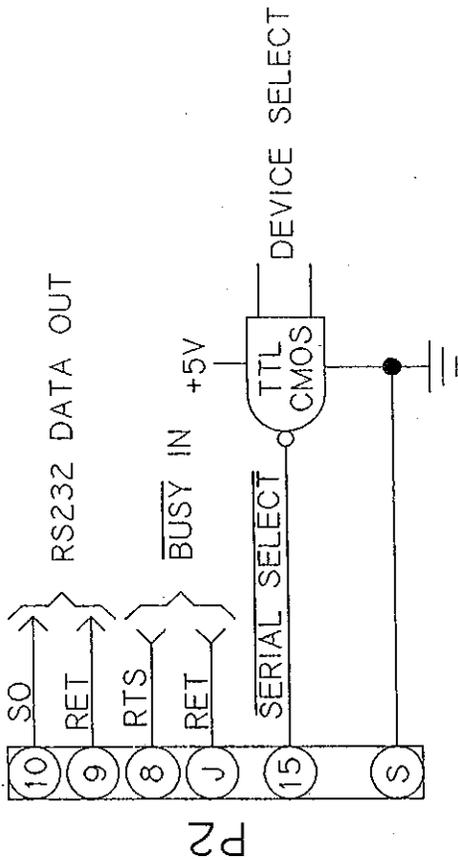


FIGURE 2-8 mV OUTPUT TRANSMITTER OR TRANSDUCER
 (SHOWN WITHOUT SURGE PROTECTION)

RS232 FULL IMPLEMENTATION

NO HANDSHAKE CONNECTION



20mA FULL IMPLEMENTATION

"6610A ENABLE" MODE

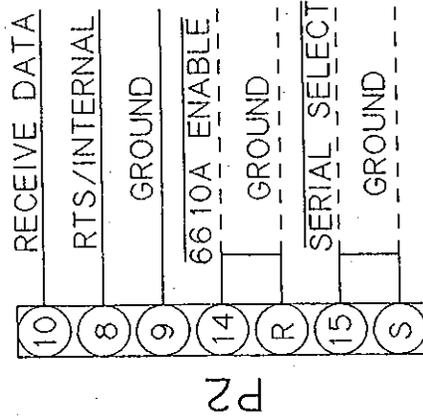
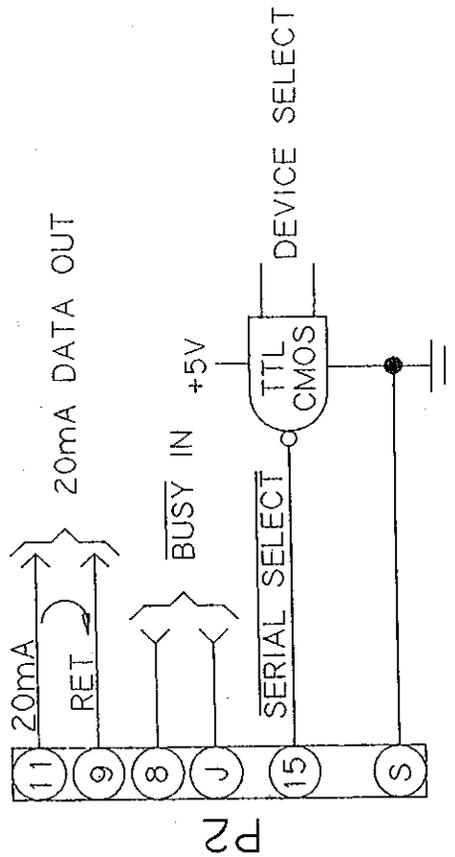


FIGURE 2-9

**MODEL 572 C CONNECTIONS
RS232 AND 20 mA SERIAL
OUTPUT**

1. Baud Rate:
For 1200 Baud, connect Terminal 12 to N
on Terminal Board No. P2.

For 300 Baud leave both terminals open.

2. Serial Select:
Connect to terminals 15 and S on
Terminal Board No P2.

For continuous transmission jumper ter-
minal 15 to S.

3. Busy:
Connect to Terminals J and 8 on Terminal
Board No. P2. If busy is not used jumper
terminal 8 to 7.

4. 6610A Enable:
Connect Terminals 3, 4, and 7 of Digital
6610AK printer to terminals 10, 8, and 9
respectively of Terminal Board No. P2.

Jumper terminal R to 14 and jumper S to
15 on Terminal Board No. P2.

SURGE PROTECTION

Surge protectors are available as an optional item and are strongly recommended to protect from secondary surges and lightning on outdoor installations. Install in accordance with applicable Figure 2-10 or 2-11 and the following instructions:

1. Lightning protection devices should be placed as close to the instrument as possible and wired in accordance with National Electric Code in an approved watertight enclosure.
2. If the distance between the meter and transducer, or the meter and recorder is less than 100 ft., only 1 protector per line may be used.
3. Use No. 10 AWG ground wire or better from protector.
4. Provide a separate ground for each run of shielded cable or metal conduit.
5. Keep ground wire less than 1 foot long and tie to a suitable ground rod or metal frame ground. Surge capability is only as good as the grounding method. All ground connections must be installed.
6. Install all protectors in weathertight enclosures.
7. Run signal lines shielded and away from power lines.
8. Mount the fused switch panel as close to meter as possible. Wire according to the Electrical Code.
9. Lead lines for 110 VAC and 220 VAC protectors should be cut as short as practical.

CAUTION: This or any installation cannot protect against a direct lightning strike, or secondary strikes of sufficient magnitude. Ametek cannot accept liability for damage due to lightning or secondary surges.

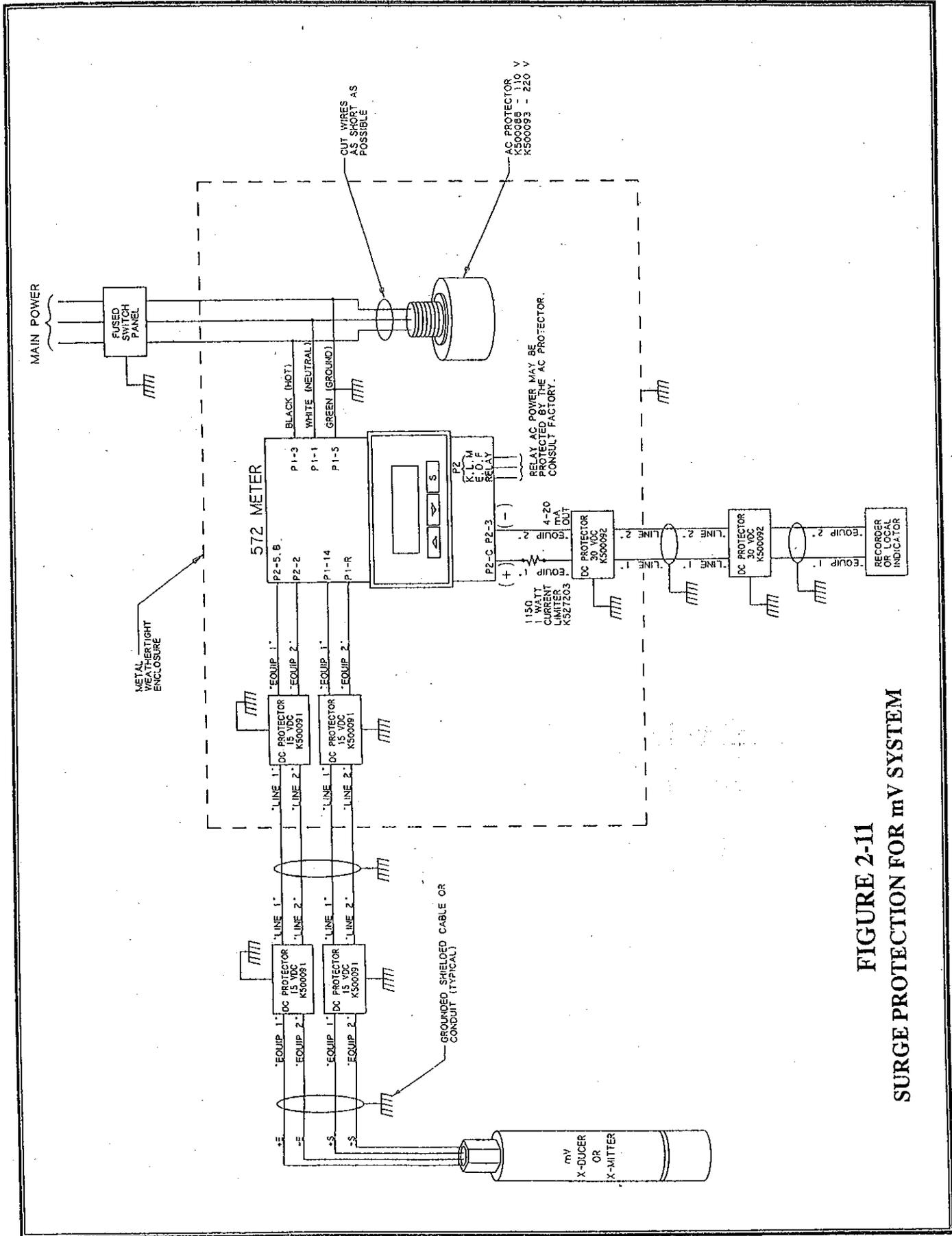


FIGURE 2-11
SURGE PROTECTION FOR mV SYSTEM

NORMAL OPERATION

When the meter is in the run (normal) mode, it displays the present reading.

If any setpoint is exceeded, the meter goes into an alarm condition. See Figure 3-1.

STORED MEMORY

Meters have a stored memory in addition to a temporary memory. The stored memory is maintained even when power to the meter is off.

Temporary memory is used during the setup mode to hold selected values until they are transferred to stored memory after exiting the setup mode.

It is not necessary to reprogram the meter each time it is turned on; however, Min/Max must be reset whenever the meter is turned on. See "Min/Max Feature" following for procedure.

MIN/MAX FEATURE

This feature remembers the highest and lowest readings since the values were last cleared.

Press  to display the highest reading or  to display the lowest reading.

IMPORTANT – Min/Max must be reset whenever the meter is turned on.

To reset Min, press and hold  press (S), release (S), then release .

The positive full scale value will flash on the display followed by the present reading.

To reset Max, press and hold  press (S), release (S), then release .

The negative full scale value will flash on the display followed by the present reading.

ALARM CONDITION

When input crosses a setpoint (SP), the meter goes into an alarm condition.

For a **Lo** alarm the relay is energized below the setpoint.

For a **Hi** alarm the relay is energized above the alarm.

During an alarm condition, the display alternates between an alarm message (Hi or Lo) and the present reading and the corresponding output relay is energized.

An example of the setpoints with hysteresis is illustrated in Figure 3-1.

Alarm messages which appear during an alarm condition and corresponding relay actuations are shown by Figure 3-1.

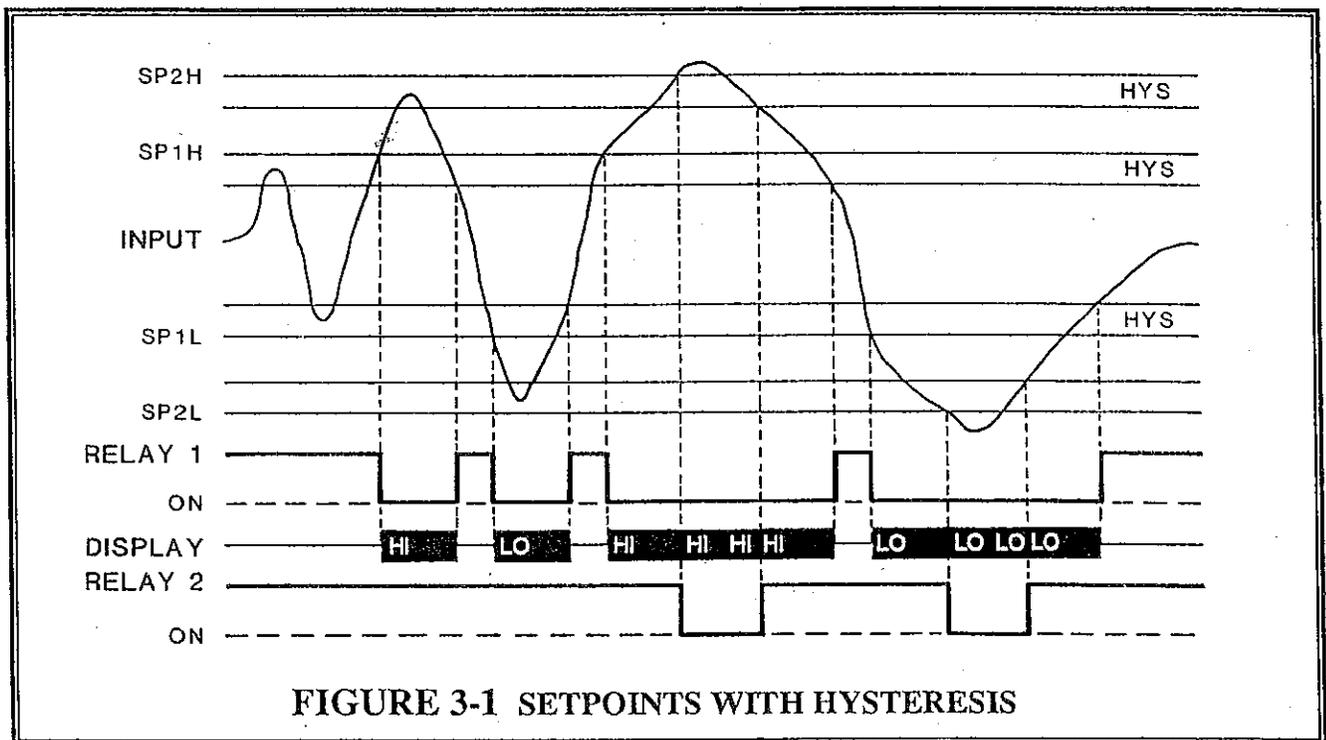


FIGURE 3-1 SETPOINTS WITH HYSTERESIS

ALARM MESSAGES ON THE METER DISPLAY

[ALARM MESSAGE]	DESCRIPTION
[Hi]SPIH exceeded. Display flashes present reading.
[Lo]SPIL exceeded. Display flashes present reading.
[Hi]SP2H exceeded. Display flashes present reading.
[Lo]SP2L exceeded. Display flashes present reading.
[Hi Hi]SPIH & SP2H exceeded. Display flashes present reading.
[Lo Lo]SPIL & SP2L exceeded. Display flashes present reading.
[Hi Lo]SPIH & SP2L exceeded. Display flashes present reading.
[Lo Hi]SPIL & SP2H exceeded. Display flashes present reading.

SETUP MODE

Use the setup mode to select setpoint values, hysteresis, offset and scale values, as well as setting the decimal point (dP) position.

During setup, values are entered into the meter's temporary memory until the Run Mode is entered at the end of the Setup cycle. At that time, temporary memory is transferred to stored memory.

IMPORTANT – Prior to changing any settings in stored memory, scroll through the setup prompts with the (S) key and record all existing values. If trouble is encountered, the original settings can be reentered.

To change any setting in stored memory:

1. Press (S). The display says [SETUP] followed by [0].
2. Enter the access code (28) using  to raise the displayed value to [30]. then press  twice to get to [28].
3. Press (S). The display will say [INPUT], followed by the input reading.
4. Press (S) until you come to the function you want to change.
5. After changing a setup entry, continue to press (S) until the [run] prompt is displayed.
6. The new value is entered into stored memory when the display goes blank.

IMPORTANT – During setup, the meter allows only two minutes between keystrokes to enter or change a parameter. If two minutes lapse without a keystroke, the meter automatically returns to the Run Mode and erases any temporary memory without changing stored memory.

KEY FUNCTIONS

The keys on the front panel are used to step through the Setup Program.

The Setup Program is used to program setpoints and select values such as scale, offset, and hysteresis.

There are three keys on the front panel:

(S) – Used to enter Setup Mode, to Scroll through setup prompts, or to enter a Selection or value into temporary memory.

 – Used to increase a displayed value. Press and hold this key to rapidly increase the displayed value.

 – Used to decrease a displayed value. Press and hold this key to rapidly decrease the displayed value.

SETUP PROMPTS

The following setup prompts appear in the display during the setup mode:

[SETUP] – This prompt tells you to enter the lockout code (28), to enter the setup mode.

[InPuT] – This prompt is followed by the actual input reading, disregarding scale, offset, and decimal point location.

[SP 1H] – This prompt, which is followed by the present setting, tells you to select the high limit value of setpoint 1 (SP1H).

[SP 1L] – This prompt, which is followed by the present setting, tells you to select the low limit value of setpoint 1 (SP1L).

[SP 2H] – This prompt, which is followed by the present setting, tells you to select the high limit value of setpoint 2 (SP2H).

[SP 2L] – This prompt, which is followed by the present setting, tells you to select the low limit value of setpoint 2 (SP2L).

[*HYS*] – This prompt, which is followed by the present setting, tells you to select the hysteresis (deadband) value. This is a number to be added to a low limit value or subtracted from a high limit value before an alarm condition is cancelled, and is common to both setpoints.

[*OFFSE*] – This prompt, which is followed by the present setting, tells you to select the display offset value. A 4-20 mA input signal requires offset if the displayed low is to be any number other than 4. For example, the meter must be "Offset" to display an input low of zero [0] with a 4-20 mA input signal.

[*SCALE*] – This prompt, which is followed by the present value tells you to select the display scale value. "Scale" often referred to as scale factor, span, gain factor or gain is the multiplier within the meter which multiplies the input signal to provide a display which is direct reading in the engineering units of measure; i.e., Feet of Water, P.S.I, etc.

[*dP*] – This prompt tells you to select the decimal point position.

[*run*] – This prompt tells you that the setup mode is complete. Any values selected in the setup mode are transferred to stored memory when the meter returns to the run mode.

SAMPLE SETUP PROGRAM

Setup sequence is as follows:

1. Press (S). The display says [*SETUP*] followed by [0].

2. Enter the access code (28) using  to raise the displayed value to [30] then press  twice to get to [28].
3. Press (S). The display will say [*INPUT*], followed by the input reading.
4. Press (S). The display will say [*SP 1H*] followed by its present setting, enter the high limit of Setpoint 1 (SPIH) by raising or lowering the displayed value and pressing (S).
5. With [*SP 1L*] displayed, followed by its present value, enter the low limit of Setpoint 1 by raising or lowering the displayed value and pressing (S).

Repeat these steps to set SP2H and SP2L.

Never set SP1L higher than SPIH or SP2L higher than SP2H.

6. When [*HYS*] is displayed, followed by its present value, enter the hysteresis (deadband) by raising or lowering the displayed value and pressing (S).
7. When [*OFFSE*] is displayed, followed by its present value, enter the offset value by raising or lowering the displayed value and pressing (S).
8. When [*SCALE*] is displayed, followed by its present value, enter scale value by raising or lowering the displayed value and pressing (S).
9. When [*dP*] is displayed, position the blinking decimal point using the  or  switches and pressing (S). If you want to stay in the setup mode, continue to press (S) when [*run*] is displayed.
10. The display will say [*run*] and, if you are not still holding (S), the display will go blank (at which time the values and setpoints are entered into stored memory).

FIELD ADJUSTMENTS

Normally, the meter and transducer are sold as a system, and factory calibrated to give digital display in the engineering units specified, for the pressure input specified.

Scale, Offset and Analog Output Adjustments are usually not required when the meter is used with the transducer with which it was calibrated at the factory. Field adjustment of alarm setpoints and hysteresis will be required.

If a new transducer or meter is installed in the field or the installation requires a change of calibrated range, refer to the procedure for "Adjustment of Alarm Setpoints and Hysteresis" which follows.

ADJUSTMENT OF ALARM SETPOINTS AND HYSTERESIS

1. Press (S). The display reads [SETUP] followed by [0].
2. Enter access code (28) using ▲ to raise displayed value to 30 then press ▼ twice to lower to 28.
3. Press (S) until [SP1H] is displayed followed by its present setting. Raise or lower the displayed value to the desired high limit of setpoint 1 (SP1H) and press (S).
4. When [SP1H] is displayed followed by its present setting, raise or lower the displayed value to the desired low limit of setpoint 1 (SP1L) and press (S).
5. Set SP2H and SP2L in a similar manner.
6. When [HYS] is displayed, followed by its present value, raise or lower the displayed value to the desired hysteresis (deadband) and press (S).

NOTE – In the setup mode the hysteresis and the setpoints are displayed without decimals. Example: 1.0 feet hysteresis is displayed as [10].

7. Press (S) until display reads [run], release (S), the display will go blank and the setpoint and hysteresis values will be entered in to stored memory.

EXAMPLE OF FIELD ADJUSTMENT OF ALARM SETPOINTS

A transducer and meter system factory calibrated so a pressure of 0 to 20 feet of water causes a display of 000.0 to 020.0 feet of water and an analog output of 4 to 20mA.

The installation requires "turn on" of a pump when water level reaches 15 feet and "turn off" of a pump when level reaches 10 feet.

Also an indicator light is to "turn on" when level is below 2 feet. The level is to be recorded.

The wiring for this example is shown in Figure 4-1.

Adjusting Alarm Setpoints

Desired Setpoints are as follows:

SP IH = 15 ft. of water = 0150 to turn pump on.

SP IL = -199 ft. of water = -1999. Set off scale so pump never turns on at a low water level.

SP 2H = 199 ft. of water = 1999. Set off scale so indicator light never comes on at a high water level.

SP 2L = 2 ft. of water = 0020 so indicator light comes on at 2 ft. of water.

HYS = 15-10 = 5 ft. of water = 0050 so pump turns off when level drops to 10 ft.

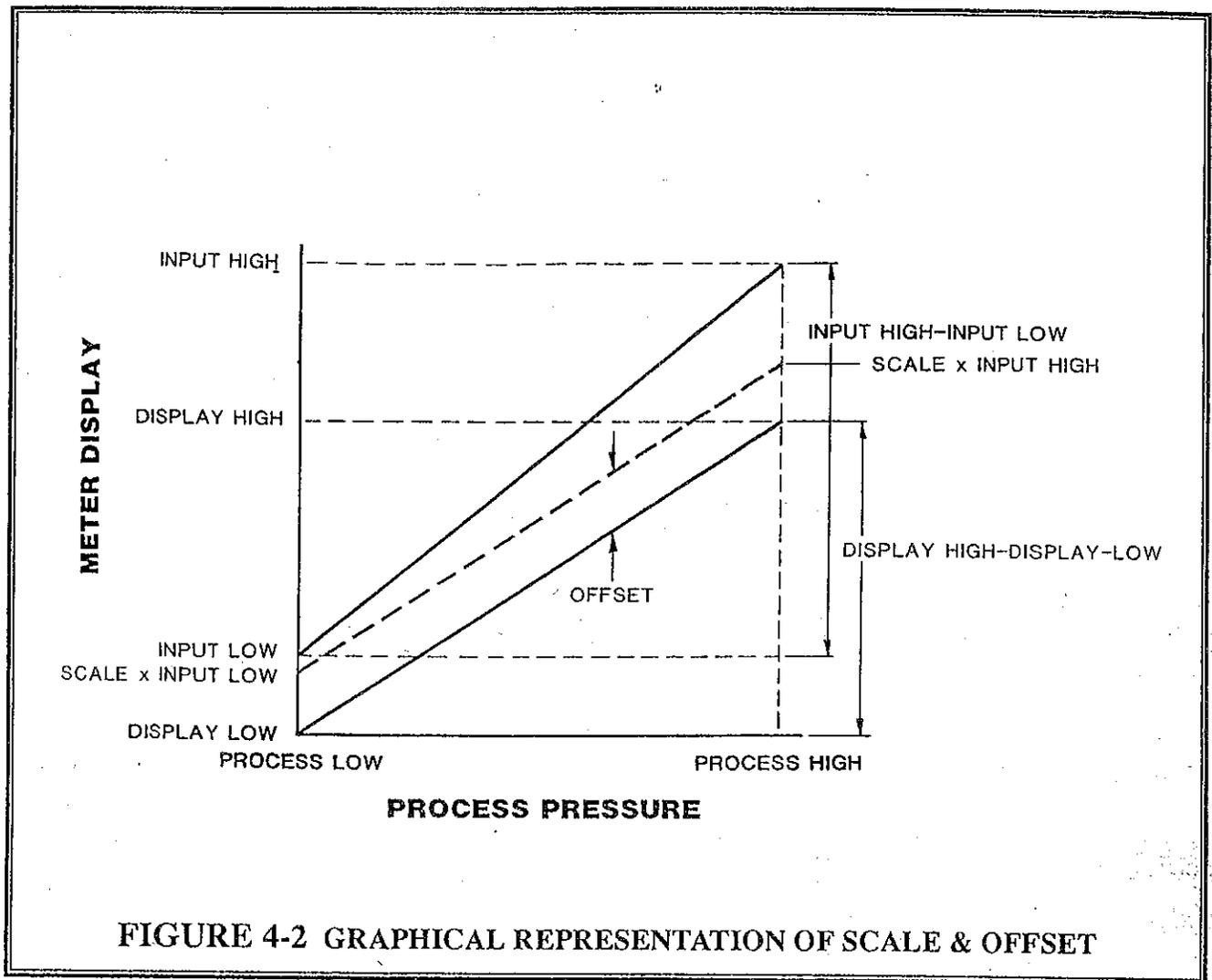
Note that this hysteresis also applies to SP2L so the indicator light will go out at $2 + 5 = 7$ ft. of water.

To enter these settings in meter:

1. Press (S), Enter 28, press (S) until [SP IH] is displayed.
2. Raise or lower displayed value to [0150].
3. Press (S) and change displayed value of "SP IL" to [-1999].
4. Press (S) and change displayed value of "SP 2H" to [1999].
5. Press (S) and change displayed value of "SP 2L" to [0020].
6. Press (S) and change displayed value of "HYS" to [0050].
7. Press (S) until [run] is displayed, release (S) and values enter stored memory.

Notes:

1. Figure 4-1 illustrates a typical system with alarm setpoints. All wiring voltages, grounding, etc. to customer supplied components to be as required and to local codes.
2. Jumper from B to 5 on terminal board No. P2 is installed at factory and is normally used with millivolt transducers or transmitters.
3. Jumpers from A to 1 and C to 3 are factory installed for 115V 50/60 Hz power.
4. Jumper from P to 6 on terminal board No. P2 is factory installed, when factory calibrated for 4 to 20 mA output.



DEFINITION OF TERMS

Process Low	Low end of calibrated span (Pressure applied to transducer).
Process High	High end of calibrated span (Pressure applied to transducer).
Input Low	Meter display when process low is applied.
Input High	Meter display when process high is applied.
Display Low	Desired display when process low is applied.
Display high	Desired display when process high is applied.
Scale	$(\text{Display High} - \text{Display Low}) / (\text{Input high} - \text{Input Low})$.
Offset	$\text{Display Low} - (\text{Scale} \times \text{Input Low})$.

SECTION IV SYSTEM CALIBRATION

APPLYING CALIBRATION PRESSURES

Some suggested methods of applying pressure for calibration are as follows:

Zero Pressure:

1. Test transducer before installing in tank, vessel, or well with no pressure applied.
2. Submersible transducers can be raised above the liquid level.
3. Transducers mounted on the outside of a tank should have a shutoff and vent valve between the tank and transducer so transducer can be vented to atmosphere.

To Apply a Known Pressure:

1. Use AMETEK ModCal Calibrator.
2. Use air or water deadweight tester.
3. Use compressed air with a pressure regulator and test gauge or digital indicator.
4. Raise or lower liquid level in tank to desired levels.
5. Submersible transducers can be lowered a known distance below liquid surface.

NOTE: Methods 4 and 5 automatically compensate for specific gravity of liquid.

See Section I, "Selecting Range Code and Meter Display", for calibration rules and chart of minimum and maximum calibrated spans for each Model 57 Range Code for each unit of measurement.

Determine the desired minimum and maximum pressure input (process low and process high) and the corresponding minimum and maximum display (display low and display high) following instructions in Section I.

CALIBRATION OF SCALE AND OFFSET

With the meter and transducer installed in accordance with Section II "Installation", Review Section III "Meter Operation".

Apply power to the meter and allow a twenty minute warm up.

1. Press (S), display reads [SETUP], enter access code (28).
2. Press (S), [INPUT] will be displayed.
3. Apply "process low" pressure to the transducer. Record the actual meter reading as the "input low" value. Record the desired meter reading as the "display low".
4. Apply "process high" pressure to transducer. Record the actual meter reading as the "input high" value. Record the desired meter reading as the "display high".
5. Calculate "Scale factor".

IMPORTANT – When reading [INPUT] Low and High, no decimals will be shown. The meter will display 100 mV as 1000, and is used as displayed in the scale factor calculations. When inserting "Display High" and "Display Low" use all the digits ignoring the decimal. Example: "Display High" in the formula for 166.0 is 1660, not 166.

$$\text{Scale Factor} = \frac{(\text{Display High} - \text{Display Low})}{(\text{Input High} - \text{Input Low})}$$

SECTION IV --- SYSTEM CALIBRATION

6. Calculate "Offset" (ignore decimal points)

Offset = Display Low - (Scale Factor x
Input Low) or

Offset = Displayed Reading - Desired
Reading

7. Press (S) until [OFFSE] is displayed followed by its present value. Enter the Offset value calculated above by raising or lowering the displayed value.
8. Press (S) [SCALE] will be displayed followed by its present value. Enter the SCALE FACTOR value calculated above. Note that max. scale factor is 3.2000.
9. Press (S), [dP] will be displayed and the decimal point will blink. Position the decimal point using the ▲ or ▼ switches.

10 Press (S), [run] will be displayed. If you want to stay in setup mode, continue holding (S). If you release (S), the display will go blank and the values will be entered into stored memory.

11. Apply process low and process high to the transducer. If display values are not correct repeat steps 1 thru 10 and reapply process low and process high to transducer until display values are correct.

NOTE: If more than 2 minutes elapse between (S) keystrokes, the meter automatically returns to run mode and all setup entries are lost. You must return to Step 1 and re-enter setup mode to resume setup and re-enter any previously entered values.

CALIBRATION EXAMPLES

FOR DIRECT READING IN
ENGINEERING UNITS.

If, for example, a 15 psi transducer (range code 018) is to be used with a Model 572 meter to display 0 to 20 ft. of water.

Process Low = 0 ft. water.
Process high = 20 ft. water.

Per Figure 1-2, Note 5. The Max. Display Counts is equal to the Calibrated Span divided by the Max. Span times the Max. Output mV times 32 but can not exceed 1999.

$$\text{Max display counts} = \frac{20.0}{34.6} \times 50 \times 32 = 925$$

The max display counts equal to or less than 925 is 200.

Display Low = 000.0
Display high = 020.0

1. With the system installed in accordance with "Section II, Installation", follow the sample set-up program on page 3-4 until [INPUT] is displayed.
2. Apply 0 ft. of water to the transducer and meter reads [0008] (input low).
3. Apply 20 ft. of water to the transducer and meter reads [0300] (input high).

$$\begin{aligned} 4. \text{ Scale Factor} &= \frac{(\text{Display High} - \text{Display Low})}{(\text{Input High} - \text{Input Low})} \\ &= \frac{(200 - 0)}{(300 - 8)} = 0.6849 \end{aligned}$$

5. Offset = Display Low - (Scale Factor x Input Low)
= 0000 - (0.6849 x 8)
= -5.48 = -5 (rounded off)
6. Press (S) until [OFFSET] is displayed and raise or lower value to -5.
7. Press (S), [SCALE] will be displayed and raise or lower displayed value to [0.6849].
8. Press (S), [dP] will be displayed, position decimal point with  and  switches so, display reads [8888.8].
9. Press (S), [run] will be displayed, release (S) and display will go blank and enter values in memory.

FOR READING IN PERCENT OF
MAXIMUM INPUT.

If, for example, the transducer and meter system is to be calibrated to display 0 to 100% for a pressure input of 0 to 20 ft. of water.

Process low = 0 ft. water
Process High = 20 ft. water per Figure 1-2, Note 5.

$$\text{Max Display Counts} = \frac{20}{34.6} \times 50 \times 32 = 925$$

The max display counts equal to or less than 925 is 100.

Display Low = 0000
Display High = 0100

1. With the system installed in accordance with "Section II, Installation", follow the sample set-up program on page 3-4 until [INPUT] is displayed.

SECTION IV

SYSTEM CALIBRATION

2. Apply 0 ft. of water to transducer and meter reads [0008] (input low).
3. Apply 20 ft. of water to transducer and meter reads [0300] (input high).
4. Scale Factor = $\frac{(\text{Display High} - \text{Display Low})}{(\text{Input High} - \text{Input Low})}$
 $= \frac{(100 - 0)}{(300 - 8)} = 0.3425$
5. Offset = Display Low - (Scale Factor x Input Low)
 $= 0000 - (0.3425 \times 8)$
 $= -2.74 = -3$ (rounded off)
6. Press (S) until [OFFSE] is displayed and raise or lower displayed value to [-3].
7. Press (S), [SCALE] will be displayed, and raise or lower displayed value to [0.3425].
8. Press (S), [dP] will be displayed, position decimal point to [88888.].
9. Press (S), [run] will be displayed, release (S) and display will go blank and enter values in memory.

FOR DIRECT READING IN ENGINEERING UNITS WHEN SP.GR. IS NOT 1.00

If, for example, the transducer and meter system is to be calibrated to display 0 to 20 ft. of a liquid with a specific gravity of 0.80, multiply ft. of liquid by 0.80 to obtain equivalent ft. of water.

Process Low = 0 ft. liquid x 0.80 = 0 ft. water.

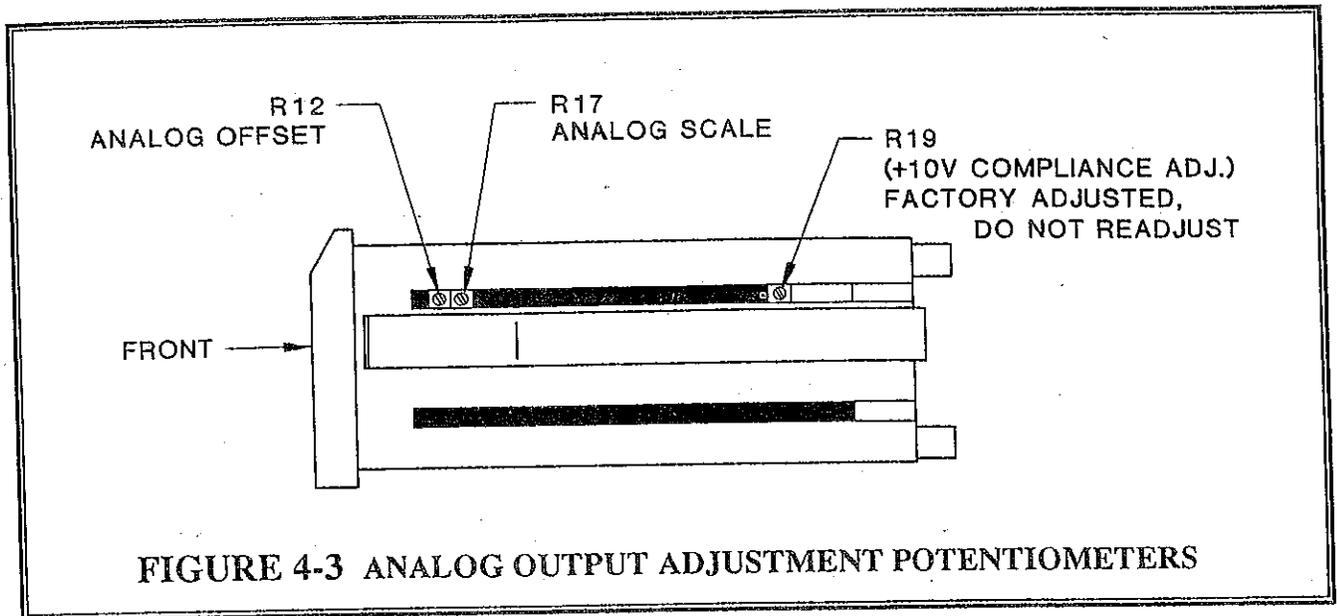
Per Figure 1-2, Note 5. The Max. Display Counts is equal to the Calibrated Span divided by the Max. Span times the Max. Output mV times 32 but can not exceed 1999.

$$\text{Max Display Counts} = \frac{20 \times .80}{34.6} \times 50 \times 32 = 740$$

Max Display Counts equal to or less than 740 is 200.

Display Low = 000.0
 Display High = 020.0

1. With the system installed in accordance with "Section II, Installation", follow the sample set-up program on page 3-4 until [INPUT] is displayed.
2. Apply process low (0 ft. of liquid) or (0 ft. of water) to transducer and meter reads [0008] (input low).
3. Apply process high (20 ft. of liquid) or (20 x 0.80 = 16 ft. water) to transducer and meter reads [242] (input high).
4. Scale Factor = $\frac{(\text{Display High} - \text{Display Low})}{(\text{Input High} - \text{Input Low})}$
 $= \frac{(200 - 0)}{(242 - 8)} = 0.8547$
5. Offset = Display Low - (Scale Factor x Input Low)
 $= 0000 - (0.8547 \times 8)$
 $= -6.837 = -7$ (rounded off)
6. Press (S) until [OFFSE] is displayed and raise or lower displayed value to [-7].
7. Press (S), [SCALE] will be displayed and raise or lower displayed value to [0.8547].
8. Press (S), [dP] will be displayed. Position decimal point to [8888.8].
9. Press (S), [run] will be displayed, release (S) and display will go blank and store values in memory.



CALIBRATION OF ANALOG OUTPUT (MOD 572 B & C)

Analog output is derived from the digital display, therefore the digital display "Scale Factor" and "Offset" must be adjusted using the keypad before the analog "Scale Factor" and "Offset" are adjusted using R12 and R17 potentiometers.

For example, if the meter is to be calibrated so a process pressure of 2 to 10 psi creates a meter display of 0 to 100% and an analog output of 4 to 20mA.

First, adjust display scale and offset so display reads 0 to 100% for 2 to 10 psi process applied to transducer "Calibration of Display, Span and Offset," page 4-1, then adjust analog output to 4 to 20mA when display reads 0 to 100%.

If transducer output drifts and digital display "Offset" must be readjusted to obtain 0% for 2 psi process applied to transducer, the analog output does not require adjustment; it will be 4mA for 0% display.

4 TO 20MA OUTPUT

1. With the meter calibrated per "Calibration of Display, Span and Offset", see Section 1, page 1-4 for calibration rules and chart of minimum and maximum spans for which 4 to 20mA output can be calibrated.
2. Calculate maximum display counts per Figure 1-2, note 5, and select desired display counts not exceeding maximum.

If display count change for 4 to 20mA is 1999 to 800 counts, jumper terminal P to 13 on terminal board No. P2 (this is called the X2 mode).

If display count change is 80 to 800 counts, jumper terminal P to 6 on terminal board No. P2 (this is called the X5 mode).

If the display is negative or bipolar, leave out the jumper (this is called the X1 mode).

SECTION IV **SYSTEM CALIBRATION**

WARNING – Do not install any jumpers with the AC Power Input applied.

3. Connect an ammeter to terminals C and 3 of Terminal Board No. P2. Ensure there are no other connections to these terminals.
4. To the transducer, apply a pressure which causes the lowest planned display reading and adjust R12 (offset) (Figure 4-3) until the current on the ammeter is zero or slightly negative.
5. With the display remaining at its lowest count, slowly rock the offset trimpot back and forth until the ammeter shows a small positive output current near zero (approx. 10 to 100 μ A).
6. To the transducer, apply a pressure which causes the highest planned display reading and adjust R17 (scale) (Figure 4-3) for 16mA on the ammeter.
7. With the display remaining at its highest count, adjust R12 (offset) until the current reaches 20mA.
8. To the transducer, apply a pressure which causes the lowest planned display reading and check the pedestal (offset) current to verify it is 4 mA. If it is not, repeat steps 5, 6, 7, and 8 until it is.

0 TO 10 VDC OUTPUT

1. With the meter calibrated per "Calibration of Display, Span and Offset", See Section 1, page 1-4 for calibration rules and chart of minimum and maximum spans for which 0 to 10 VAC output can be calibrated.

2. Calculate maximum display counts per Figure 1-2, note 5, and select desired display counts not exceeding maximum.

If display count change for 0 to 10 VAC is 1999 to 800 counts, jumper terminal P to 13 on terminal board No. P2 (this is called the X2 mode).

If display count change is 80 to 800 counts, jumper terminal P to 6 on P2 terminal board (this is called the X5 mode).

If display is negative or bipolar, leave out the jumper (this is called the X1 mode).

WARNING – Do not install any jumpers with the AC Power Input applied.

3. Connect +R load to terminal 4 and -R load to terminal 3 of terminal board No. P2.
4. Connect a voltmeter between terminals 3 and 4 of terminal board No. P2.
5. To the transducer, apply a pressure which causes the lowest planned display reading and adjust R12 (offset) (Figure 4-3) until the voltage at terminal 4, terminal board No. 2, goes to zero or slightly negative.
6. To the transducer, apply a pressure which causes the highest planned display reading and adjust R17 (scale) (Figure 4-3) for 10 VDC between terminals 3 and 4 of terminal board No. P2.
7. To the transducer, apply a pressure which causes the lowest planned display reading and check that the voltage between P2 terminals 3 and 4 is zero or slightly negative.

TROUBLE SHOOTING INSTALLATION

Check all wiring at terminal boards on rear of meter for correct connections, broken wires, loose or corroded connections or short circuits.

Check for proper power voltage and jumper locations.

TROUBLESHOOTING CHART

PROBLEM	COMMON CAUSE	CHECK
No Display	No power to meter	Voltage across Terminals 1 & 3 of Terminal Board No. P1
	Incorrect Power to Meter	
	Damaged Meter	Return to Factory
Incorrect Display	Transducer Connections	See Figures 2-7 & 2-8
	Incorrect Low Displayed	"Calibration of Scale and Offset", page 4-5
	Incorrect Span Adjust	
	Incorrect Transducer Output	Refer to transducer manual
	Damaged Meter	Return to Factory
Incorrect Set Pt.	Incorrect Set Pt. Adjust	Adjustment of Alarm Setpoints and Hysteresis, page 4-3
Relay Output	Incorrect Connections	Refer to Figure 2-6, page 2-7
Inoperative	Contacts shorted or open due to electrical overload	Return to Factory
Relay Chatter	Electrical Pickup	"Signal Noise Isolation", page 2-3
4-20 Analog Output does not track display. (nonlinear)	Wrong jumper location on Terminal Board No. P2 for the max display counts.	See "4 to 20 mA Output" para. 2, page 4-9 for proper jumper location.

SECTION VI

SERVICE & PARTS

FACTORY SERVICE

Factory or field service is available by contacting the Customer Service Department. Supply the following information:

1. Instrument Model Number and Serial Number as shown on the Instrument Data Tag.
2. Description of the problem being experienced.
3. Description and location of the Installation.

For service:

TELEPHONE: (215) 355-6900

FAX: (215) 355-7143

PARTS - ORDERING

When ordering replacement parts, supply the following information:

1. Instrument Model Number and Serial Number as shown on the Instrument Data Tag.
2. Part description and part number.
3. Quantity of each item required.
4. Shipping instructions and address.

Mail, Telephone, or Fax Orders to:

AMETEK

PMT DIVISION
820 Pennsylvania, Blvd., Feasterville, PA 19053

TELEPHONE: (215) 355-6900

FAX: (215) 355-7143

ITEM	QUAN.	PART NO.	DESCRIPTION
1	2	K880000	"U" BOLT MOUNT, WEATHER TIGHT HOUSING
2	1	K554085	STRAIN RELIEF, (.250 TO .312 IN. DIA. CABLE)
3	1	K554086	STRAIN RELIEF, (.125 TO .187 IN. DIA. CABLE)
4	AR	K500088	SURGE PROTECTOR, 110 VAC
5	AR	K500091	SURGE PROTECTOR, 15 VDC
6	AR	K500092	SURGE PROTECTOR, 30 VDC
7	AR	K500093	SURGE PROTECTOR, 220VAC
8	AR	K527203	CURRENT LIMITER RESISTOR, 115 OHM, 1 WATT
9	1	K574462	MAIN BOARD
10	1	K574463	OPTION BOARD, 2 RELAYS WITH ANALOG OUTPUT
11	1	K574464	OPTION BOARD, 2 RELAYS
12	1	K555150	TERMINAL NO. P1
13	1	K555151	TERMINAL NO. P2
14	1	K070941	DISPLAY BEZEL
15	2	K503018	FUSE, 1/16A / 250 VDC

AMETEK

PMT DIVISION

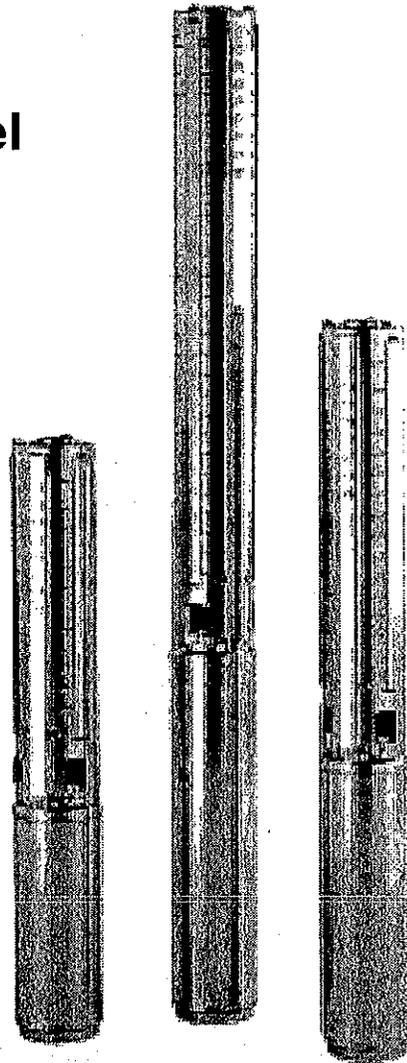
820 PENNSYLVANIA BLVD., FEASTERVILLE, PA 19053

Appendix E
Recovery Well Pump Information

SP4"

Installation and Operating Instructions

4-Inch Stainless Steel Submersible Pumps



DRINKING WATER SYSTEM COMPONENTS
ANSI/NSF 61 - 1999
65 GM

Please leave these instructions with the pump for future reference.

GRUNDFOS®



Leaders in Pump Technology



SAFETY WARNING



Electrical Work

WARNING: Reduced risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor (at least the size of the circuit supplying the pump) to the grounding screw provided within the wiring compartment.

Pre-Installation Checklist

1. Well Preparation

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

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

2. Make Sure You Have The Right Pump

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

3. Pumped Fluid Requirements

CAUTION: Submersible well pumps are designed for pumping clear, cold water; free of air or gases. Decreased pump performance and life expectancy can occur if the water is not cold, clear or contains air or gasses. Water temperature should not exceed 102°F.

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawdown level of the well. The bottom of the motor should never be installed lower than the top of the screen or within five feet of the well bottom.

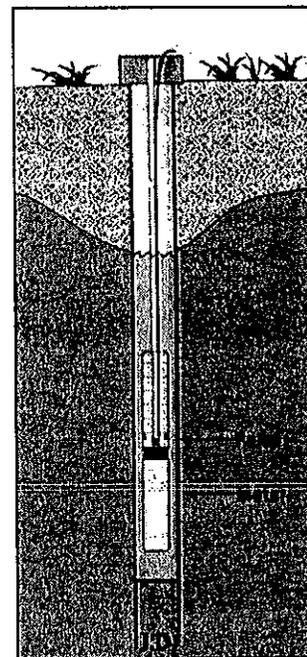
Ensure that the requirement for minimum flow past the motor is met, as shown in the table below:

Minimum Water Flow Requirements for Submersible Pump Motors

MINIMUM DIAMETER	CASING OR SLEEVE I.D. IN INCHES	MIN. GPM FLOW PASSING THE MOTOR
4-inch	4	1.2
	5	7
	6	13
	7	21
	8	30

NOTES:

- For Franklin Motors Only: A flow inducer or sleeve must be used if the water enters the well above the motor or if there is insufficient water flow past the motor.
- For Franklin Motors Only: The minimum water velocity over 4" motors is 0.25 feet per second.
- Grundfos 4" submersible motors do not require a minimum flow or flow sleeve.



Pre-Installation Checklist

4. Splicing the Motor Cable

If the splice is carefully made, it will be as efficient as any other portion of the cable, and will be completely watertight. There are a number of cable splicing kits available today – epoxy filled, rubber-sealed and so on. Many perform well if the manufacturer's directions are followed carefully. If one of these kits is not used, we recommend the following method for splicing the motor cable.

Examine the motor cable and drop cable carefully for damage. Cut the motor leads off in a staggered manner. Cut the ends of the drop cable so that the ends match up with the motor leads. Be sure to match the colors. Strip back and trim off one-half inch of insulation from each lead, making sure to scrape the wire bare to obtain a good connection. Be careful not to damage the copper conductor when stripping off the insulation. Insert a properly sized Sta-kon-type connector on each pair of leads, again making sure that colors are matched. Using Sta-kon crimping pliers, indent the lugs. Be sure to squeeze down hard on the pliers, particularly when using large cable. Form a piece of electrical insulation putty tightly around each Sta-Kon. The putty should overlap on the insulation of the wire. Use a good quality tape such as **#33 Scotch Waterproof** or **Plymouth Rubber Company Slipknot Grey**. Wrap each wire and joint tightly for a distance of about 2-1/2 inches on each side of the joint. Make a minimum of four passes over each joint and overlap each pass approximately one inch to assure a completely watertight seal.

Installation Procedures

1. Attach the Pump to the Pipe

A back-up wrench should be used when riser pipe is attached to the pump. The pump should only be gripped by the flats on the top of the discharge chamber. Under no circumstances grip the body of the pump, cable guard or motor. When tightened down, the threaded end of the first section of the riser pipe or the nipple must not come in contact with the check valve retainer in the discharge chamber of the pump. After the first section of the riser pipe has been attached to the pump, the lifting cable or elevator should be clamped to the pipe. Do not clamp the pump. When raising the pump and riser section, be careful not to place bending stress on the pump by picking it up by the pump-end only. It is recommended that plastic-type riser pipe be used only with the smaller domestic submersibles. The manufacturer or representative should be contacted to ensure the pipe type and physical characteristics are suitable for this use. Use the correct joint compound recommended by the specific pipe manufacturer. Besides making sure that points are fastened, we recommend the use of a torque arrestor when using plastic pipe.

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

Installation Procedures

2. Lower the Pump Into the Well

Make sure the electrical cables are not cut or damaged in any way when the pump is being lowered in the well. Do not use the power cables to support the weight of the pump.

To protect against surface water entering the well and contaminating the water source, the well should be finished off above grade utilizing a locally approved well seal or pitless adaptor unit. We recommend that steel riser pipes always be used with the larger submersibles. A pipe thread compound should be used on all joints. Make sure that the joints are adequately tightened in order to resist the tendency of the motor to loosen the joints when stopping and starting.

The drop cable should be secured to the riser pipe at approximately every 10 ft/3 m to prevent sagging, looping and possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above each joint.

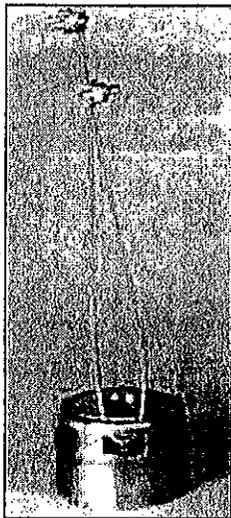


Figure 1

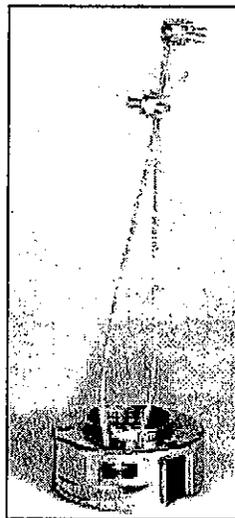


Figure 2

IMPORTANT: Plastic pipe tends to stretch under load. This stretching must be taken into account when securing the cable to the riser pipe. Leave three to four inches of slack between clips or taped points. This tendency for plastic pipe to stretch will also affect the calculation of the pump setting depth. As a general rule, you can estimate that plastic pipe will stretch to approximately 2% of its length. When plastic riser pipe is used, it is recommended that a safety cable be attached to the pump to lower and raise it. The discharge chamber of GRUNDFOS 4-inch submersibles is designed to accommodate this cable. (See Figures 1 & 2.)

Check Valves: A check valve should always be installed at the surface of the well and one at a maximum of 25 feet above static water level. In addition, for installations deeper than 200 feet, check valves should be installed at no more than 200 foot intervals.

Installation Procedures

3. Electrical Connections

WARNING: Reduced risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor (at least the size of the circuit supplying the pump) to the grounding screw provided within the wiring compartment.

Verification of the electrical supply should be made to ensure the voltage, phase and frequency match that of the motor. Motor electrical data can be found on page 6. If voltage variations are larger than $\pm 10\%$, do not operate the pump. Single-phase motor control boxes should be connected as shown on the wiring diagram mounted on the inside cover of the control box supplied with the motor. The type of wire used between the pump control boxes should be approved for submersible pump application. The conductor insulation should be type RW, RUW, TW or equivalent.

A high-voltage surge arrestor should be used to protect the motor against lightning and switching surges. Lightning voltage surges in power lines are caused when lightning strikes somewhere in the area. Switching surges are caused by the opening and closing of switches on the main high-voltage distribution power lines.

The correct voltage-rated surge arrestor should be installed on the supply (line) side of the control box or starter (See Figure 3a & 3b). The arrestor must be grounded in accordance with the National Electric Code and local governing regulations.

PUMPS SHOULD NEVER BE STARTED UNLESS THE PUMP IS TOTALLY SUBMERGED. SEVERE DAMAGE MAY BE CAUSED TO THE PUMP AND MOTOR IF THEY ARE RUN DRY.

The control box shall be permanently grounded in accordance with the National Electric Code and local governing codes or regulations. The ground wire should be a bare stranded copper conductor at least the same size as the drop cable wire size. Ground wire should be as short a distance as possible and securely fastened to a true grounding point. True grounding points are considered to be: a grounding rod driven into the water strata; steel well casing submerged into the water lower than the pump setting level; and steel discharge pipes without insulating couplings. If plastic discharge pipe and well casing are used, a properly sized bare copper wire should be connected to a stud on the motor and run to the control panel. Do not ground to a gas supply line. Connect the grounding wire to the ground point first, then to the terminal in the control box.

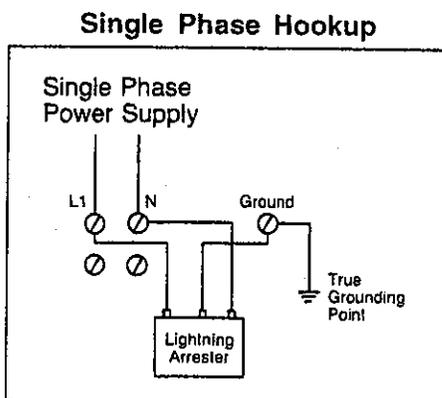


Figure 3a

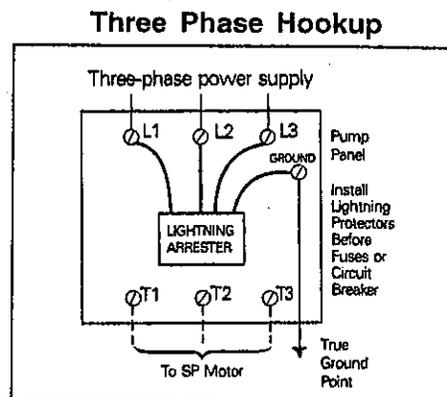


Figure 3b

Installation Procedures

Single-Phase 2-Wire Wiring Diagram for Submersible Motors

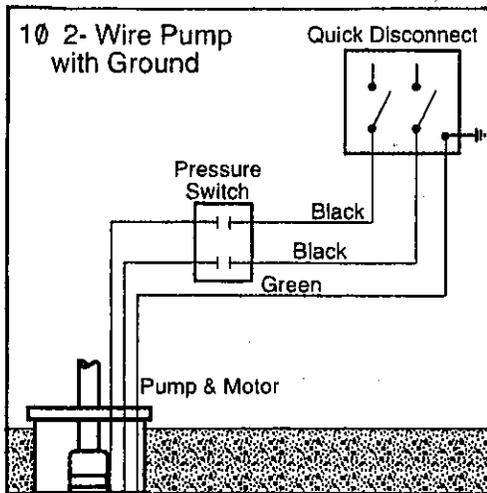


Figure 4

Three-Phase Wiring Diagram for Submersible Motors

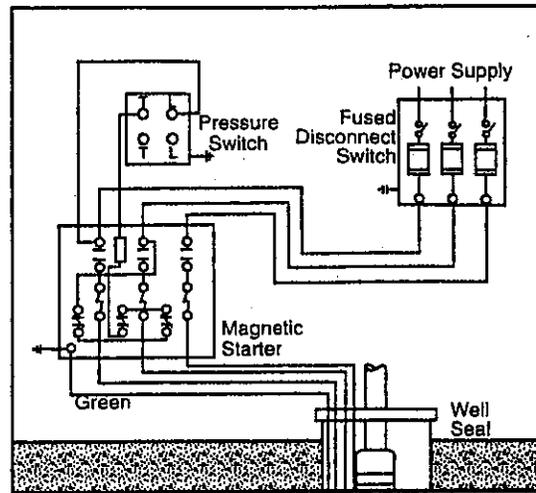


Figure 5

Single-Phase 3-Wire Control Box for Submersible Motors

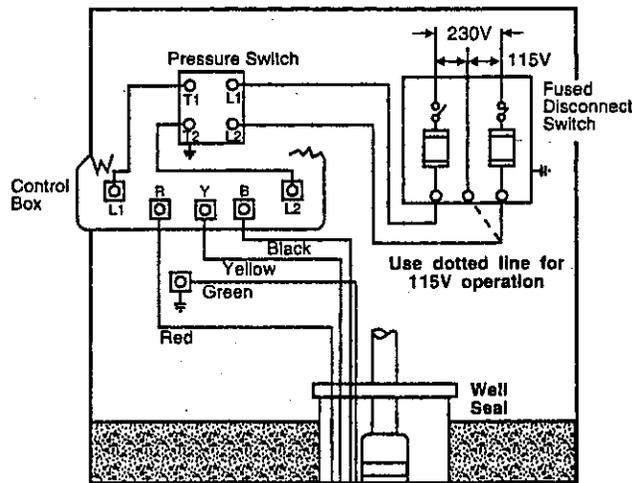


Figure 6

4. Starting the Pump for the First Time

- Attach a temporary horizontal length of pipe to the riser pipe.
- Install a gate valve and another short length of pipe to the temporary pipe.
- Adjust the gate valve one-third of the way open.
- Verify that the electrical connections are in accordance with the wiring diagram.
- After proper rotation has been checked, start the pump and let it operate until the water runs clear of sand, silt and other impurities.
- Slowly open the valve in small increments as the water clears until the valve is all the way open. The pump should not be stopped until the water runs clear.
- If the water is clean and clear when the pump is first started, the valve should still be opened until it is all the way open.

Motor Information

GRUNDFOS MOTORS Submersible Pump Motors -Electrical Data 60Hz

HP	Ph	Volt	S.F.	Circ. Brkr or Fuses		Amperage		Full Load		Max. Thrust (lbs)	Line-to-Line Resistance (Ohms)		KVA Code **	3-Ph. Overload Protection	
				Std.	Delay	Start	Max.	Eff. (%)	Pwr Fact.		Blk-Yel	Red-Yel		Starter Size	Furnes Amb. Comp
4-Inch, Single Phase, 2-Wire Motors (control box not required)															
1/3	1	230	1.75	15	5	25.7	4.6	59	77	900	6.8-8.2		S	-	-
1/2	1	115	1.60	30	15	55.0	12.0	62	76	900	1.1-1.3		R	-	-
1/2	1	230	1.60	15	7	34.5	6.0	62	76	900	5.2-6.3		R	-	-
3/4	1	230	1.50	20	9	40.5	8.4	62	75	900	3.2-3.8		N	-	-
1	1	230	1.40	25	12	48.4	9.8	63	82	900	2.5-3.1		M	-	-
1-1/2	1	230	1.30	35	15	62.0	13.1	64	85	900	1.9-2.3		L	-	-

4-Inch, Single Phase, 3-Wire Motors

1/3	1	115	1.75	25	10	29.0	9.0	59	77	900	1.55-1.9	2.4-3	M	-	-
1/3	1	230	1.75	15	5	14.0	4.6	59	77	900	6.8-8.3	17.3-21.1	L	-	-
1/2	1	115	1.60	30	15	42.5	12.0	61	76	900	0.9-1.1	1.9-2.35	L	-	-
1/2	1	230	1.60	15	7	21.5	6.0	62	76	900	4.7-5.7	15.8-19.6	L	-	-
3/4	1	230	1.50	20	9	31.4	8.4	62	75	900	3.2-3.9	14-17.2	L	-	-
1	1	230	1.40	25	12	37.0	9.8	63	82	900	2.6-3.1	10.3-12.5	K	-	-
1-1/2	1	230	1.30	35	15	45.9	11.6	69	89	900	1.9-2.3	7.8-9.6	H	-	-
2	1	230	1.25	30	15	57.0	13.2	72	86	1500	1.5-1.8	3.4-4.1	G	-	-
3	1	230	1.15	45	20	77.0	17.0	74	93	1500	1.2-1.4	2.45-3	F	-	-
5	1	230	1.15	70	30	110	27.5	77	92	1500	0.65-0.85	2.1-2.6	F	-	-

4-Inch, Three Phase, 3-Wire Motors

1-1/2	3	230	1.30	15	8	40.3	7.3	75	72	750	3.9		K	0	K41
		460	1.30	10	4	20.1	3.7	75	72	750	15.9		K	0	K32
		575	1.30	10	4	16.1	2.9	75	72	750	25.2		K	0	K28
2	3	230	1.25	20	10	48	8.7	76	75	750	3.0		J	0	K50
		460	1.25	10	5	24	4.4	76	75	750	12.1		J	0	K34
		575	1.25	10	4	19.2	3.5	76	75	750	18.8		J	0	K31
3	3	230	1.15	30	15	56	12.2	77	75	1000	2.2		H	0	K54
		460	1.15	15	7	28	6.1	77	75	1000	9.0		H	0	K37
		575	1.15	15	6	22	4.8	77	75	1000	13.0		H	0	K36
5	3	230	1.15	40	25	108	19.8	80	82	1000	1.2		H	1	K61
		460	1.15	20	12	54	9.9	80	82	1000	5.0		H	0	K50
		575	1.15	15	9	54	7.9	80	82	1000	7.3		H	0	K43
7-1/2	3	230	1.15	60	30	130	25.0	81	82	1000	0.84		H	1	K67
		460	1.15	35	15	67	13.2	81	82	1000	3.24		J	1	K56
		575	1.15	30	15	67	10.6	81	82	1000	5.2		J	1	K53
10	3	460	1.15	50	25	90	18.0	81	80	1500	1.16		H	1	K61
		575	1.15	40	20	72	14.4	81	80	1500	1.84		H	1	K58

*All Grundfos 4" motors have a ground (green wire)

The Franklin 1 PH, 3 wire motors listed below require the use of the following Franklin Control Box:

RATING		FRANKLIN MOTOR MODEL NO.		CONTROL BOX.	
HP	VOLT	THE MODEL MAY HAVE ADDITIONAL DIGITS		THE MODEL MAY HAVE ADDITIONAL DIGITS	
1/3	115	214502		28010249	
1/3	230	214503		28010349	
1/2	115	214504		28010449	
1/2	230	214505		28010549	
3/4	230	214507		28010749	
1	230	214508		28010849	
1.5	230	224300		2823008	
2	230	224301		2823018	
3	230	224302		2823028	
5	230	224303		2821138	
				2821139	

(Refer to the Franklin Submersible Motors Application Maintenance Manual)

Motor Information

Maximum Cable Length Motor Service to Entrance (Length in feet)

Single-Phase 60 Hz

MOTOR RATING		COPPER WIRE SIZE								
VOLTS	HP	14	12	10	8	6	4	2	0	00
115	1/3	130	210	340	540	840	1300	1960	2910	
	1/2	100	160	250	390	620	960	1460	2160	
230	1/3	550	880	1390	2190	3400	5250	7960		
	1/2	400	650	1020	1610	2510	3880	5880		
	3/4	300	480	760	1200	1870	2890	4370	6470	
	1	250	400	630	990	1540	2380	3610	5360	6520
	1-1/2	190	310	480	770	1200	1870	2850	4280	5240
	2	150	250	390	620	970	1530	2360	3620	4480
	3	120	190	300	470	750	1190	1850	2890	3610
5			180	280	450	710	1110	1740	2170	

Three-Phase 60 Hz

VOLTS	HP	14	12	10	8	6	4	2
208	1-1/2	310	500	790	1260			
	2	240	390	610	970	1520		
	3	180	290	470	740	1160	1810	
		5170	280	4690	1080			1660
230	1-1/2	360	580	920	1450			
	2	280	450	700	1110	1740		
	3	210	340	540	860	1340	2080	
		5	200	320	510	800	1240	1900
460	1-1/2	1700						
	2	1300	2070					
	3	1000	1600	2520				
		5	590	950	1500	2360		
575	1-1/2	2620						
	2	2030						
	3	1580	2530					
		5	920	1480	2330			

FOOTNOTES:

1. If aluminum conductor is used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of same size.
2. The portion of the total cable which is between the service entrance and a 3Ø motor starter should not exceed 25% of the total maximum length to ensure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

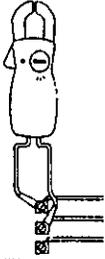


DRINKING WATER SYSTEM COMPONENTS
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Pump Model & Stages	Temp °C	Temp °F	Water Contact Volume in Liters for Highest Number of Stages	Contact Volume in Gallons for Highest Number of Stages	Minimum Submergence in Feet for Highest Number of Stages 4" Well ID
5S					
9-26	30	86	26	7	11
31-48	30	86	37	10	15
7S					
8-26	30	86	26	7	11
10S					
6-27	30	86	27	8	11
34-48	30	86	37	10	15
58	30	86	45	12	18
16S					
5-24	30	86	25	7	10
38	30	86	30	8	12
56-75	30	86	58	16	24
25S					
3-26	30	86	26	7	11
39	30	86	26	7	11
52	30	86	40	11	17
40S					
3-44	30	86	268	71	109
50-66	30	86	401	106	162
60S					
4-18	30	86	35	9	14
75S					
3-16	30	86	31	8	13

Troubleshooting

SUPPLY VOLTAGE



How to Measure

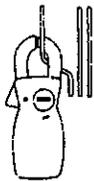
By means of a voltmeter, which has been set to the proper scale, measure the voltage at the control box or starter. On single-phase units, measure between line and neutral.

What it Means

When the motor is under load, the voltage should be within $\pm 10\%$ of the nameplate voltage. Larger voltage variation may cause winding damage. Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

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

CURRENT MEASUREMENT



How to Measure

By use of an ammeter, set on the proper scale, measure the current on each power lead at the control box. See page 6, for motor amp draw information.

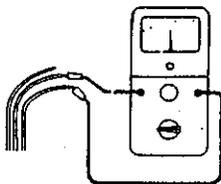
Current should be measured when the pump is operating at a constant discharge pressure with the motor fully loaded.

What it Means

If the amp draw exceeds the listed service factor amps (SFA), check for the following:

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

WINDING RESISTANCE



How to Measure

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

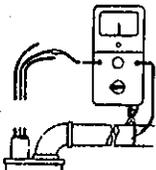
Zero-adjust the meter and measure the resistance between leads. Record the values. Motor resistance values can be found on page 6.

What it Means

If all the ohm values are normal, and the cable colors correct, the windings are not damaged. If any one ohm value is less than normal, the motor may be shorted. If any one ohm value is greater than normal, there is a poor cable connection or joint. The windings or cable may also be open.

If some of the ohm values are greater than normal and some less, the drop cable leads are mixed. To verify lead colors, see resistance values on page 6.

INSULATION RESISTANCE



How to Measure

Turn off power and disconnect the drop cable leads in the control box. Using an ohm or mega ohmmeter, set the scale selector to Rx 100K and zero-adjust the meter. Measure the resistance between the lead and ground (discharge pipe or well casing, if steel).

What it Means

For ohm values, refer to table below. Motors of all Hp, voltage, phase and cycle duties have the same value of insulation resistance.

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

Troubleshooting

Pump Won't Start

POSSIBLE CAUSE	CHECK THIS BY...	CORRECT THIS BY...
No power at the motor	Check for voltage at the control box or panel.	If there is no voltage at the control panel, check the feeder panel for tripped circuits and reset those circuits.
Fuses are blown or the circuit breakers have tripped	Turn off the power and remove the fuses. Check for continuity with an ohmmeter.	Replace the blown fuses or reset the circuit breaker. If the new fuses blow or the circuit breaker trips, the electrical installation, motor, and wires must be checked for defects.
<i>(3-phase motors only)</i> Motor starter overloads are burned or have tripped	Check for voltage on the line and load side of the starter. Check the amp draw and make sure the heater is sized correctly.	Replace any burned heaters or reset. Inspect the starter for other damage. If the heater trips again, check the supply voltage. Ensure that heaters are sized correctly and the trip setting is appropriately adjusted.
<i>(3-phase motors only)</i> Starter does not energize	Energize the control circuit and check for voltage at the holding coil.	If there is no voltage, check the control circuit fuses. If there is voltage, check the holding coil for weak connections. Ensure that the holding coil is designed to operate with the available control voltage. Replace the coil if defects are found.
Defective controls	Check all safety and pressure switches for defects. Inspect the contacts in control devices.	Replace worn or defective parts or controls.
Motor or cable is defective	Turn off the power and disconnect the motor leads from the control box. Measure the lead-to-lead resistance with an ohmmeter (set to R x 1). Measure the lead-to-ground values with an ohmmeter (set to R x 100K).	If an open or grounded winding is found, remove the motor from the well and recheck the measurements with the lead separated from the motor. Repair or replace the motor or cable.
<i>(1-phase motors only)</i> Defective capacitor	Turn off the power and discharge the capacitor by shorting the leads together. Check it with an analog ohmmeter (set to R x 100k).	When the meter is connected to the capacitor, the needle should jump toward 0 (zero) ohms and slowly drift back to infinity (∞). Replace capacitor if it is defective.
Defective pressure switch or the tubing to it is plugged	Watch the pressure gauges as the pressure switch operates. Remove the tubing and blow through it.	Replace as necessary.
The pump is mechanically bound or stuck	Turn off the power and manually rotate the pump shaft. Also check the motor shaft rotation, the shaft height, and the motor's amp draw (to see if it indicates a locked rotor).	If the pump shaft doesn't rotate, remove the pump and examine it. If necessary, dismantle it and check the impellers and seal for obstruction. Check for motor corrosion.

Pump Does Not Produce Enough Flow (GPM)

POSSIBLE CAUSE	CHECK THIS BY...	CORRECT THIS BY...
<i>(3-phase motors only)</i> Shaft is turning in the wrong direction	Check to make sure the electrical connections in the control panel are correct.	Correct the wiring. For single phase motors, check the wiring diagram on the motor. For three phase motors, simply switch any two power leads.
Pump is operating at the wrong speed (too slow)	Check for low voltage and phase imbalance.	Replace defective parts or contact power company, as applicable.
Check valve is stuck (or installed backwards)	Remove the check valve.	Re-install or replace.
Parts or fittings in the pump are worn -- or -- Impellers or Inlet Strainer is clogged	Install a pressure gauge near the discharge port, start the pump, and gradually close the discharge valve. Read the pressure at shutoff. (Do not allow the pump to operate for an extended period at shutoff.)	Convert the PSI you read on the gauge to Feet of Head by: $\text{PSI} \times 2.31 \text{ ft/PSI} = \frac{\quad}{\text{Specific Gravity}} \text{ ft.}$ Add to this number the number of feet (vertically) from the gauge down to the water's pumping level. Refer to the pump curve for the model you are working with to determine the shutoff head you should expect for that model. If that head is close to the figure you came up with (above), the pump is probably OK. If not, remove the pump and inspect impellers, chambers, etc.
The water level in the well may be too low to supply the flow desired -- or -- Collapsed well	Check the drawdown in the well while the pump is operating.	If the pumping water level (including drawdown) is not AT LEAST 3 FEET above the pump's inlet strainer, either: 1. Lower the pump further down the well. 2. Throttle back the discharge valve to decrease the flow, thereby reducing drawdown.
Broken shaft or coupling	Pull pump and inspect.	Replace as necessary.
There are leaks in the fittings or piping	Pull the pump out of the well.	The suction pipe, valves, and fittings must be made tight. Repair any leaks and retighten all loose fittings.

Troubleshooting

Fuses Blow or Heaters Trip

POSSIBLE CAUSE	CHECK THIS BY...	CORRECT THIS BY...
Improper voltage	Check the voltage at the control box or panel.	If the voltage varies by more than 10% (+ or -), contact the power company.
	If the incoming voltage is OK, check the wire size and the distance between the pump motor and the pump control panel.	Rewire with correct gauge. Undersized wire and a great distance between the control panel and the pump motor increases resistance and decreases the voltage by the time it reaches the pump motor.
The starter overloads are set too low	Cycle the pump and measure the amperage.	Increase the heater size or adjust the trip setting. Do not, however, exceed the recommended rating.
<i>(3-phase motors only)</i> The three-phase current is imbalanced	Check the current draw on each lead to the motor.	The current draw on each lead must be within 5% of each other (+ or -). If they are not, check the wiring.
The wiring or connections are faulty	Check to make sure the wiring is correct and there are no loose terminals.	Tighten any loose terminals and replace any damaged wire.
<i>(1-phase motors only)</i> Capacitor is defective	Turn off the power and discharge the capacitor. Check the capacitor with an ohmmeter (set at R x 100k). See page 15 for instructions.	When the meter is connected to the capacitor, the needle should jump toward 0 (zero) ohms and then slowly drift back to infinity (∞). Replace capacitor if it is defective.
Fuse, heater, or starter are the wrong size	Check the fuses and heaters against the motor manufacturer's specification charts.	Replace as necessary.
The control box location is too hot	Touch the box with your bare hand during the hottest part of the day – you should be able to keep your hand on it without burning.	Shade, ventilate, or move the control box so its environment does not exceed 120°F.
<i>(1-phase motors only)</i> Wrong control box	Check requirements for the motor against the control box specifications.	Replace as necessary.
Defective pressure switch	Watch gauges as pressure switch operates.	Replace as necessary.
The motor is shorted or grounded.	Turn off the power and disconnect the wiring. Measure the lead-to-lead resistance with an ohmmeter (set to R x 1). Measure the lead-to-ground values with an ohmmeter (set to R x 100K) or a megohmmeter. Compare these measurements to the rated values for your motor.	If you find an open or grounded winding, remove the motor and recheck the leads. If OK, check the leads for continuity and for bad splice.
Poor motor cooling	Find the internal diameter of the well casing (or sleeve, if used). For proper cooling, the flow of water must not be less than the GPM shown across the bottom scale on page ____.	Throttle up the pump flow (GPM) so proper cooling is possible. – or – Pull the pump out of the well and add a sleeve with a smaller internal diameter.

Pump Cycles Too Often

POSSIBLE CAUSE	CHECK THIS BY...	CORRECT THIS BY...
The pressure switch is defective or is not properly adjusted	Check the pressure setting on the switch. Check the voltage across closed contacts.	Readjust the pressure switch or replace it if defective.
The tank is too small	Check the tank size and amount of air in the tank. The tank volume should be approximately 10 gallons for each Gallon-Per-Minute of pump capacity. At the pump cut-in pressure, the tank should be about 2/3 filled with air.	Replace the tank with one that is the correct size.
There is insufficient air charging of the tank or piping is leaking	Pump air into the tank or diaphragm chamber. Check the diaphragm for leaks. Check the tank and piping for leaks with soapy water. Check the air-to-water ratio in the tank.	Repair as necessary.
Plugged snifter valve or bleed orifice (causing pressure tank to be waterlogged)	Examine them for dirt or erosion.	Repair or replace as necessary.
Leak in the pressure tank or piping	Apply soapy water to pipes and tank, then watch for bubbles, indicating leaks.	Repair or replace as necessary.
The level control is defective or is not properly set	Check the setting and operation of the level control.	Readjust the level control setting (according to the manufacturer's instructions) or replace it if defective.
Pump is oversized for the application. It is outpumping the yield of the well and pumping itself dry.	Check the yield of the well (determined by the well-test) against the pump's performance curve.	Reduce the flow by throttling back the valve. – or – Change the pump.

Notes

LIMITED WARRANTY

Products manufactured by GRUNDFOS are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS printed installation and operating instructions.

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The telephone number of our service and repair facilities central directory, from which you can obtain the locations of our service and repair facilities is, 1-800-333-1366.

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L-SP-TL-048	Rev. 02/01
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Model 5S

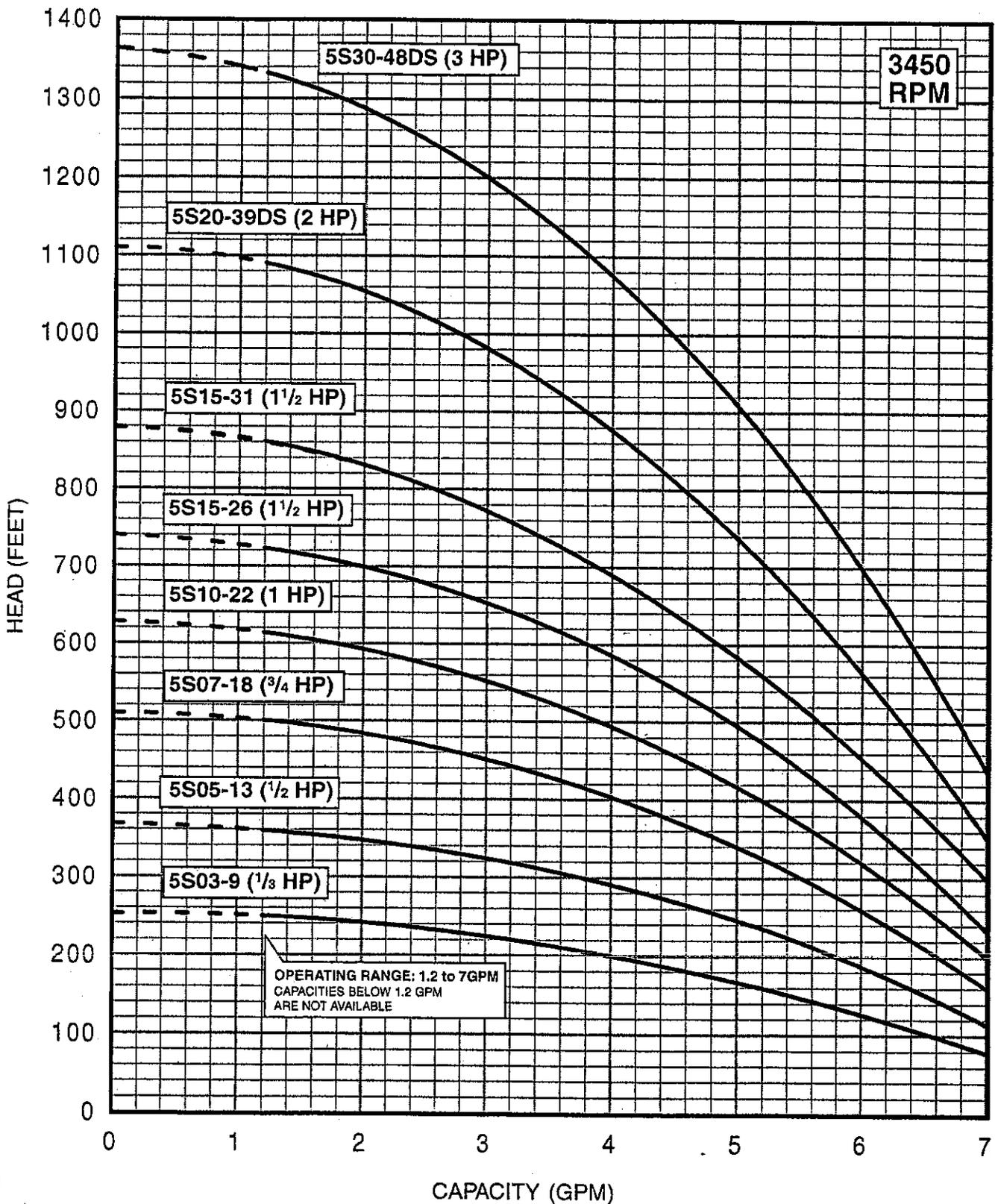
5 GPM

Performance Curves

FLOW RANGE: 1.2 - 7 GPM

OUTLET SIZE: 1" NPT

NOMINAL DIA. 4"



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 3450 RPM.

Performance conforms to ISO 2548 Annex B
@ 2 ft. min. submergence.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
5S03-9	A	1/3	4"	1" NPT	22.3	8.8	13.5	3.8	3.9	27
5S05-13	A	1/2	4"	1" NPT	26.4	9.5	16.9	3.8	3.9	31
5S07-18	A	3/4	4"	1" NPT	31.7	10.7	21.0	3.8	3.9	34
5S10-22	A	1	4"	1" NPT	36.1	11.8	24.3	3.8	3.9	42
5S15-26	A	1 1/2	4"	1" NPT	41.2	13.6	27.6	3.8	3.9	46
5S15-31	A	1 1/2	4"	1" NPT	47.1	13.6	33.5	3.8	3.9	58
5S20-39DS	A	2	4"	1" NPT	55.2	15.1	40.1	3.8	3.9	65
5S30-48DS	A	3	4"	1" NPT	70.0	20.6	49.3	3.8	3.9	90

NOTES: All models suitable for use in 4" wells.
Weights include pump end with motor in lbs.

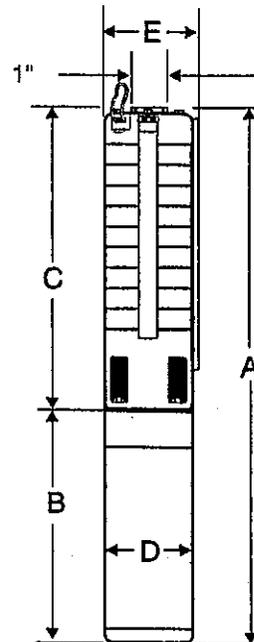


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (9-26 Stgs.)	CYLINDRICAL SHAFT (31-48 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel
Motor	304 Stainless Steel	304 Stainless Steel
Motor Interconnector	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	316 Stainless Steel
Coupling	329/420/431 Stainless Steel	329/420/431 Stainless Steel
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR/304 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel

NOTES: Specifications subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechst Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.

GRUNDFOS



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LSP-TL-1004 6/96
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5S Easy Selection Chart

5 GPM

FLOW RANGE

(1.2 TO 7 GPM)

PUMP OUTLET
1" NPT

SELECTION CHARTS

(Ratings are in GALLONS PER HOUR-GPH)

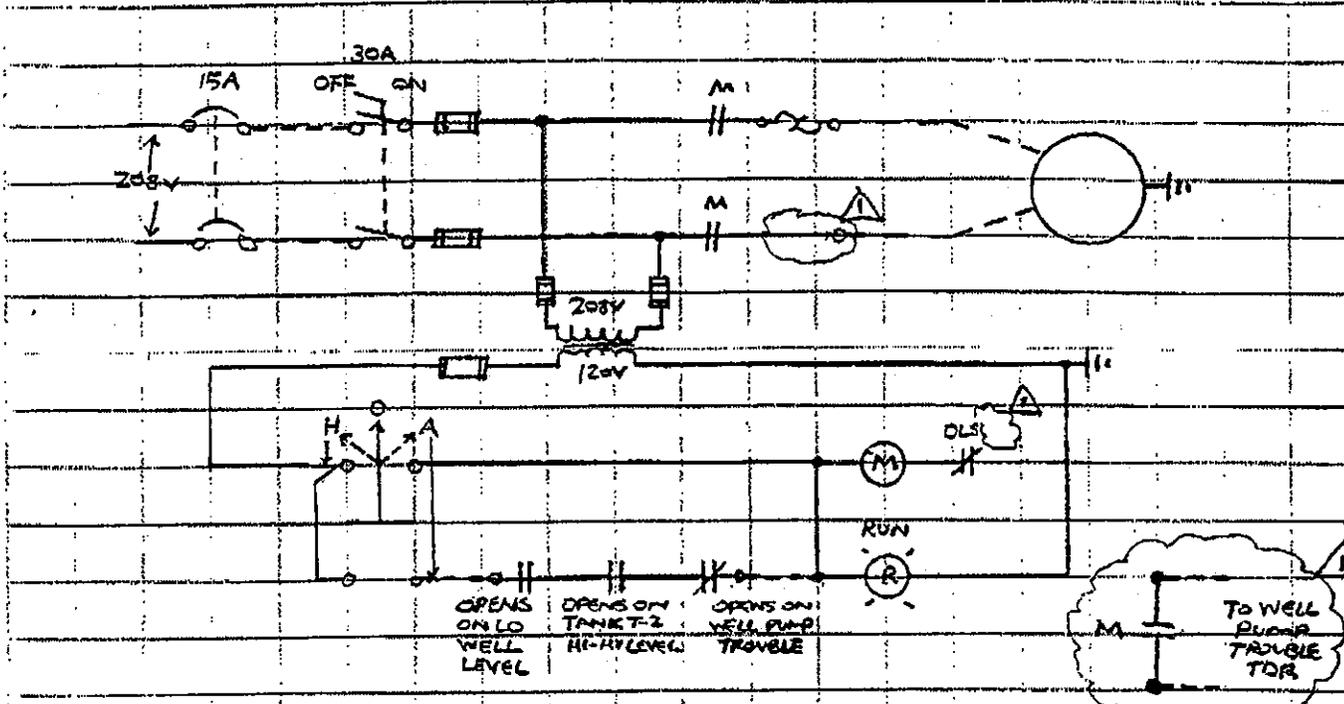
DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100		
5S03-9	1/3	0				428	401	374	347	320	288	256	191	127															
		20		420	393	366	339	312	277	242	169	96																	
		30		389	362	335	306	276	225	174	87																		
		40	400	358	330	303	265	228	143																				
		50	369	327	296	265	206	150	75																				
		60	337	294	253	211	114																						
SHUT-OFF PSI:			102	94	85	76	68	59	50	42	33	24	16	7															
5S05-13	1/2	0						423	405	386	367	349	330	311	289	267	233	137											
		20			437	418	399	380	362	343	324	305	282	259	222	185	117												
		30		434	415	396	377	359	340	322	301	281	251	222	170	117													
		40	431	412	393	375	356	338	318	299	275	250	210	170	94														
		50	409	390	372	353	335	316	295	273	242	210	153	95															
		60	388	369	350	332	312	293	267	241	197	153	76																
SHUT-OFF PSI:			152	143	134	126	117	108	100	91	82	74	65	56	48	39	30	13											
5S07-18	3/4	0								427	413	400	386	373	360	346	333	305	254	163									
		20						423	409	396	382	369	355	342	329	315	300	267	193										
		30					421	407	394	380	367	353	340	327	313	299	282	242	149										
		40			432	419	405	392	378	365	351	338	325	311	296	281	261	212	92										
		50	430	417	403	390	376	363	349	336	323	308	294	277	259	235	173												
		60	428	415	401	388	374	361	347	334	320	307	291	275	255	234	203	123											
SHUT-OFF PSI:			213	204	195	187	178	169	161	152	143	135	126	117	109	100	91	74	48	22									
5S10-22	1	0										426	415	404	393	382	371	349	316	279	228	103							
		20								423	412	401	390	379	368	357	346	324	289	241	167								
		30							421	410	399	388	377	366	355	344	334	311	273	216	126								
		40						420	409	398	387	376	365	354	343	332	321	297	255	186	75								
		50			429	418	407	396	385	374	363	352	341	330	319	307	282	233	149										
		60		427	416	405	394	383	372	361	350	340	329	317	306	293	265	207	103										
SHUT-OFF PSI:				245	237	228	219	211	202	194	185	176	168	159	150	142	124	98	72	46	12								
5S15-26	1 1/2	0											427	418	408	399	381	353	325	296	245	126							
		20										424	415	406	396	387	378	359	332	303	269	202							
		30								423	414	404	395	386	376	367	349	321	290	253	175								
		40							422	412	403	394	384	375	366	357	338	310	277	335	142								
		50						420	411	401	392	383	374	364	355	346	327	298	262	214	102								
		60						419	409	400	391	381	372	363	354	345	335	317	286	245	188								
SHUT-OFF PSI:							269	260	252	243	234	226	217	208	200	191	174	148	122	96	61	18							
5S15-31	1 1/2	0														425	417	401	378	355	331	309	246	158					
		20											423	415	407	399	383	360	337	313	277	212	94						
		30											421	413	406	398	390	374	351	328	303	265	191	53					
		40											420	413	405	397	389	381	365	342	318	293	252	166					
		50								427	419	411	403	395	388	380	372	357	333	309	283	237	138						
		60								426	418	410	402	395	387	379	371	363	348	324	300	271	219	104					
SHUT-OFF PSI:								320	311	303	294	285	277	268	259	251	233	207	181	155	121	77	34						

See 5S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.



CLIENT/SUBJECT REAC SAUNDERS SUPPLY
 TASK DESCRIPTION MOTOR SCHEMATICS
 PREPARED BY SKIP BOUZ DEPT _____
 MATH CHECK BY _____ DEPT _____
 METHOD REV. BY _____ DEPT _____

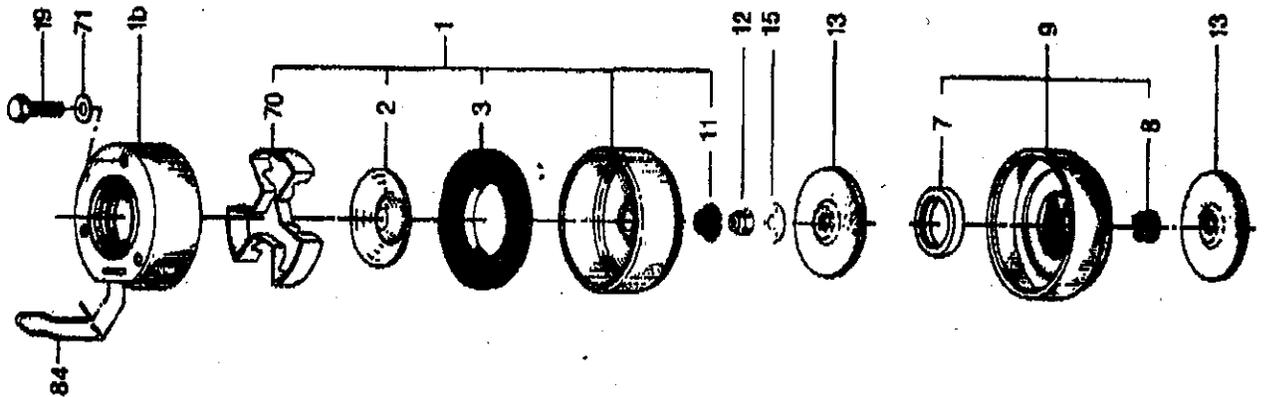


TYPICAL WELL PUMP SCHEMATIC

	LO WELL LEVEL	TANK T-2 HI-LEVEL	WELL PUMP TROUBLE
WP-1	CR-3	CR-1	CR-10 [△]
WP-2	CR-4	CR-1	CR-11
WP-3	CR-5	CR-2	CR-12
WP-4	CR-6	CR-2	CR-13

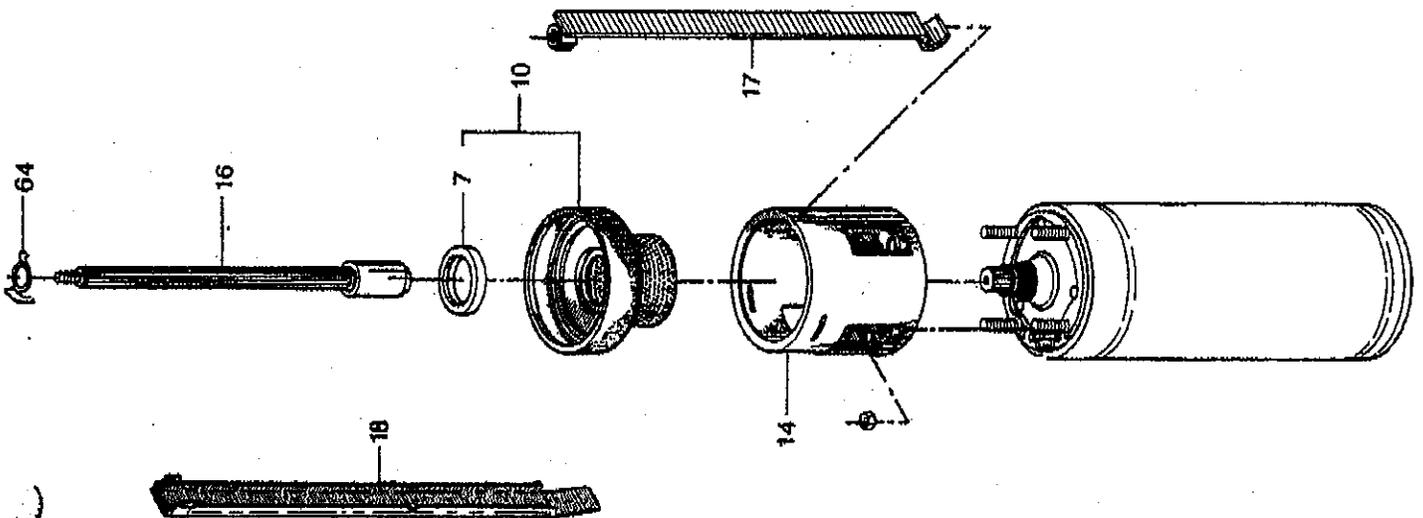
Kit Parts List

5S SPLINE SHAFT



POS.	DESCRIPTION	QTY.	PART #	KIT
1b	INLET/DISCHARGE KIT	1	085027	INLET/DISCHARGE KIT FOR ANY NUMBER OF STAGE PUMPS Part No. 08001Z
1	DISCHARGE PIECE 1'	1	085053	
14	INT. CHAM. W/SAND BEARING	1	085020	
10	4" INLET	1	085029	
84	LOWER INT. W/SCREEN SAFETY HOOK	1	080055	
8	BEARING KIT	SEE KIT	080011	BEARING KIT UP TO 9 STAGES Pn. 08003Z (Higher stages order multiple kits)
7	INT. BEARING	SEE KIT	095040	
11	SEAL RINGS SAND BEARING	1	080050	
13	IMPELLER KIT	SEE KIT	085023	IMPELLER KIT UP TO 9 STAGES Pn. 08009Z 10 TO 18 STAGES Pn. 08010Z 19 TO 26 STAGES Pn. 08011Z
19	5s IMPELLER	1	UB 9000	
71	NUT KIT	3	ID 3943	
71	BOLT FOR STRAP WASHER	4	410026	
9	CHAMBER KIT	SEE KIT	095051	CHAMBER KIT UP TO 9 STAGES Pn. 08014Z 10 TO 18 STAGES Pn. 08015Z 19 TO 27 STAGES Pn. 08016Z
10	INT. CHAMBERS	1	UB 5000	
19	NUT KIT	1	085029	
71	LOWER INT. W/SCREEN	3	ID 3943	
71	BOLT FOR STRAP WASHER	4	410026	
17	STRAP KIT	3	089209	STRAP KIT Part No. 08050Z
19	STRAP 5S03-9	3	ID 3943	
71	BOLT FOR STRAP WASHER	3	410026	
18	CABLE GUARD 5S03-9	1	089509	
17	STRAP KIT	3	089213	STRAP KIT Part No. 08050Z
19	STRAP 5S05-13	3	ID 3943	
71	BOLT FOR STRAP WASHER	3	410026	
18	CABLE GUARD 5S05-13	1	089513	
17	STRAP KIT	3	089218	STRAP KIT Part No. 08050Z
19	STRAP 5S07-18	3	ID 3943	
71	BOLT FOR STRAP WASHER	3	410026	
18	CABLE GUARD 5S07-18	1	089518	

17	STRAP KIT STRAP 5S10-22	3	089222	STRAP KIT Part No. 08065Z
19	BOLT FOR STRAP	3	ID3943	
71	WASHER	3	410026	
18	CABLE GUARD 5S10-22	1	089522	
17	STRAP KIT STRAP 5S15-26	3	089226	STRAP KIT Part No. 08067Z
19	BOLT FOR STRAP $\frac{5}{16}$ DIA (24)	3	ID3943	
71	WASHER	3	410026	
18	CABLE GUARD 5S15-26	1	089526	
16	SHAFT KIT SHAFT 5S03-9	1	086209	SHAFT KIT Part No. 08026Z
64	PRIMING PLATE	1	080051	
12	SAND NUT	1	080101	
15	UPTHRUST PLATE	1	080100	
16	SHAFT KIT SHAFT 5S05-13	1	086213	SHAFT KIT Part No. 08030Z
64	PRIMING PLATE	1	080051	
12	SAND NUT	1	080101	
15	UPTHRUST PLATE	1	080100	
16	SHAFT KIT SHAFT 5S07-18	1	086218	SHAFT KIT Part No. 08032Z
64	PRIMING PLATE	1	080051	
12	SAND NUT	1	080101	
15	UPTHRUST PLATE	1	080100	
16	SHAFT KIT SHAFT 5S10-22	1	086222	SHAFT KIT Part No. 08035Z
64	PRIMING PLATE	1	080051	
12	SAND NUT	1	080101	
15	UPTHRUST PLATE	1	080100	
16	SHAFT KIT SHAFT 5S15-26	1	086226	SHAFT KIT Part No. 08036Z
64	PRIMING PLATE	1	080051	
12	SAND NUT	1	080101	
15	UPTHRUST PLATE	1	080100	



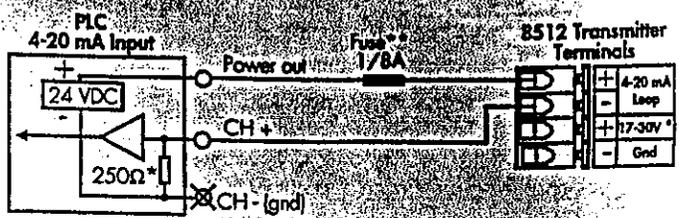
Appendix F
Recovery Well Flow Element Information

CAUTION!
Remove power to unit before wiring input and output connections.

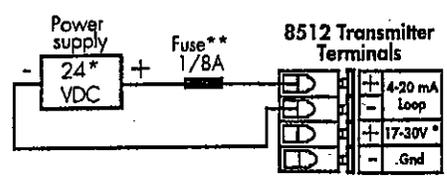
1. Loop/System Power Connections

1.1 2-Wire operation (for +GF+ SIGNET 515, 525, 2517, 3-8510-XX, 2536/3-8512-XX flow sensors).

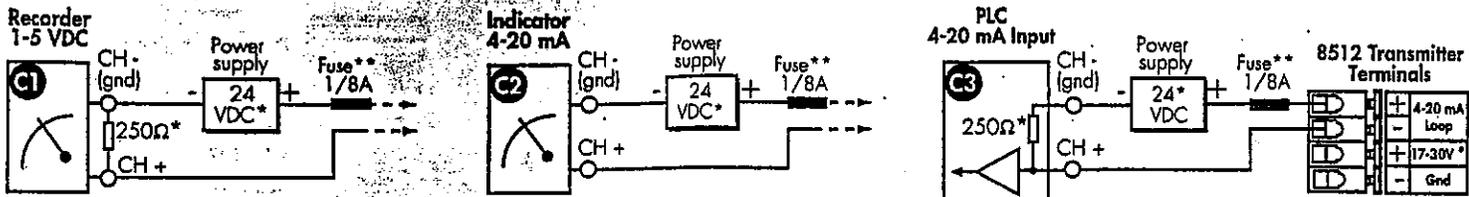
A. Ground referenced PLC with internal transmitter power supply



B. Power connection for display use only



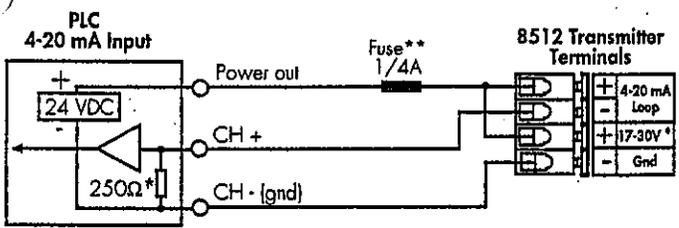
C. 1 to 5 VDC recorder (C1), 4 to 20 mA indicator (C2), or ground referenced PLC (C3) connections without internal transmitter power supply



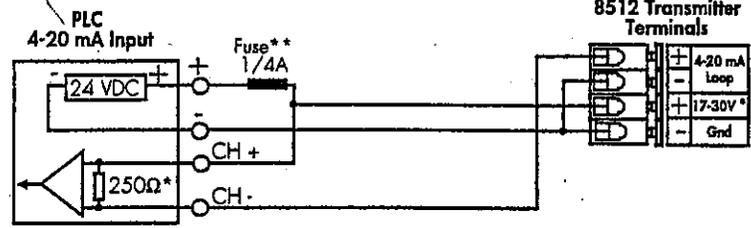
*Refer to maximum loop impedance specification for minimum operating voltage requirements (section 10).
** 1/8A fuse recommended (customer supplied)

1.2 3-Wire operation (for +GF+ SIGNET 2000, 2507, 2530, 2535, 2540 flow sensors). This wiring is required for powered flow sensors that consume more than 1.5 mA DC current.

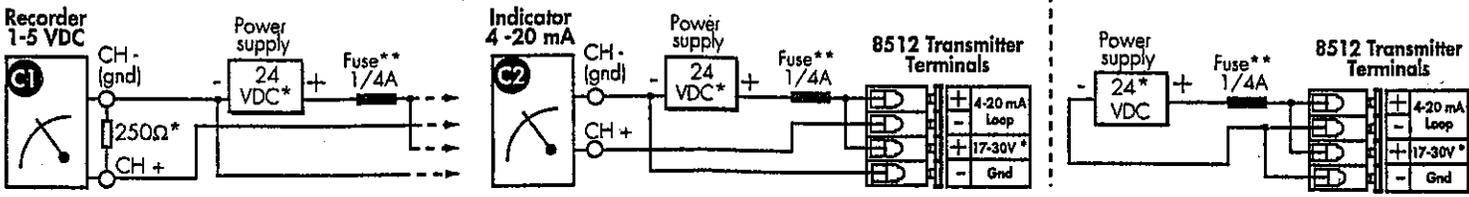
A. Ground referenced PLC with internal transmitter power supply



B. Differential input PLC with internal transmitter power supply



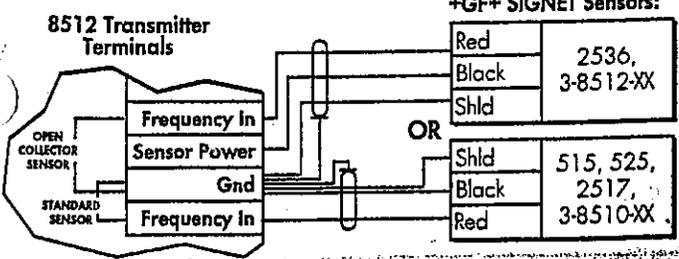
C. 1 to 5 VDC recorder (C1) and 4 to 20 mA indicator (C2) connections without internal transmitter power supply



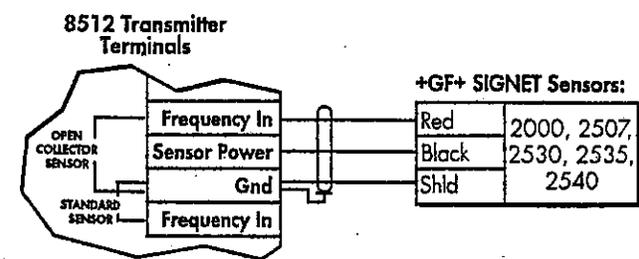
*Refer to maximum loop impedance specification for minimum operating voltage requirements (section 10).
** 1/4 A fuse recommended (customer supplied).

2. Compatible Sensor Connections

2.1 2-Wire Operation (sec. 1.1)



2.2 3-Wire Operation (sec. 1.2)



10. Specifications

General Data

Compatible Sensors: All current +GF+ SIGNET flow sensors
 Display Accuracy: Flow, ±0.1% of reading
 Totalizers, ±0.03% of reading

Enclosure:
 • Material: NEMA 4X/IP65
 • Gasket: Glass-filled polypropylene
 • Gasket: Silicone rubber (captive)
 • Screws: 8-32, self-tapping (captive)

Display:
 • Type: 8-digit alphanumeric dot matrix
 • Update rate: Flow=1s, Totalizers=100 mS
 • Contrast: Variable
 • Ranges: Flow, 0.01 to 9999.
 Resettable/permanent totalizers, 0 to 99999999
 Loop current, 3.90 to 21.00 mA

Environmental

Operating temperature: -15 to 70 °C (5 to 158 °F)
 Storage temperature: -15 to 80 °C (5 to 176 °F)
 Relative humidity: 0 to 95%, non-condensing

Quality Standards

• CE
 • Manufactured under ISO 9001

Electrical Data

Frequency range: 0.5 Hz to 500 Hz
 Loop/system power: 17 to 30 VDC
 Sensor power: (2-wire mode) 5 VDC @ 1.5 mA max.
 (3-wire mode) 5 VDC @ 20 mA max.

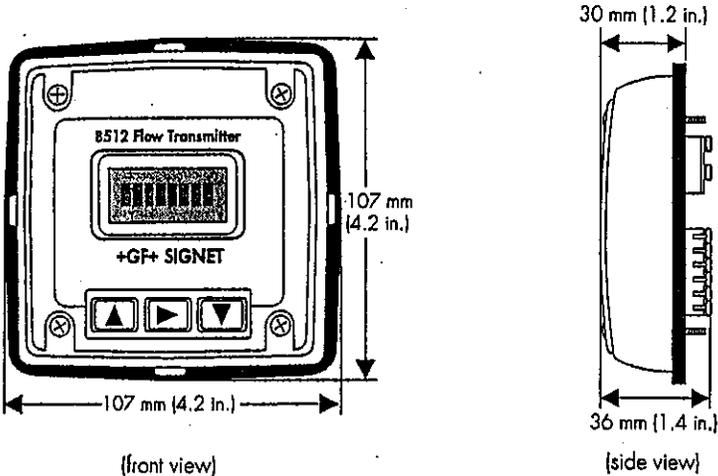
Electrical Data

Loop:
 • Impedance: 1 Ω max. @ 17 VDC,
 300 Ω max. @ 24 VDC,
 600 Ω max. @ 30 VDC

• Accuracy: ±0.050 mA
 • Resolution: 5 μA
 • Update rate: 100 ms

Outputs:
 • Current: 4 to 20 mA (adjustable & reversible)
 • Pulse output: Sensor frequency, optically isolated open-collector transistor, max. current sink 10 mA @ 30 VDC

Dimensions:



11. Troubleshooting

Display Message	Cause	Solution
OVER ^gpm	1) Input frequency too high 2) Display overrange 3) Display timebase too large	1) Reduce input frequency. 2) Move display decimal to right in OPTIONS menu. 3) Change display timebase (H,M,S,D) to smaller value (e.g. LPH to LPM).
K=0 error	K-Factor cannot be zero	Change K-Factor to a non-zero value.
2s - Check ↳ Setup - 2s	Memory corrupted	Press to restore normal operation. Settings will revert to factory default. Recalibration is required.

+GF+ SIGNET

Sales Offices:

USA George Fischer, Inc., 2882 Dow Avenue, Tuslin, CA 92780/USA, Tel. (714) 731-8800, Fax (714) 731-6201
Switzerland Georg Fischer Rohrleitungssysteme AG, P.O. Box 671, CH-8201 Schaffhausen/Switzerland, Tel. 052/631 1111, Fax 052/631 2830
Singapore George Fischer Pte. Ltd., 15 Kaki Bukit Road 2, KB Warehouse Complex, Singapore 1441, Tel. 65/747 0611, Fax 65/747 0577
Japan Kubota George Fischer, 2-47 Shikitsuhgashi, 1-Chome, Naniwa-Ku, Osaka, 556-91 Japan, Tel. 816/648 2545, Fax 816/648 2565
China Georg Fischer Ltd., Rm 1503, Business Residence Bldg. of Asia Plaza, 2-3 Bldg. No. 5th Qu Anzhenxili, Chaoyang Qu, Beijing 100029, P.R. China, Tel. 86/10 6443 0577, Fax 86/10 6443 0578
Australia George Fischer Pty. Ltd., Suite 3, 41 Stamford Road, Oakleigh, Victoria 3166, Australia, Tel. 61/3 9568 0966, Fax 61/3 9568 0988

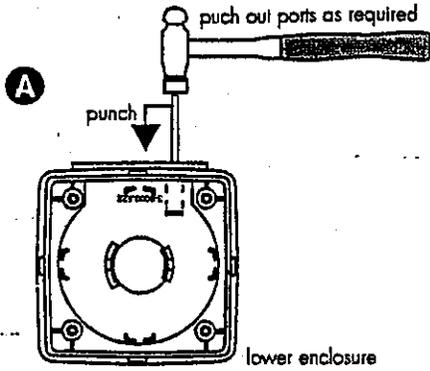
Signet Scientific Company, 3401 Aerojet Avenue, El Monte, CA 91731-2882 U.S.A., Tel. (626) 571-2770, Fax (626) 573-2057

SIGNET Compak Transmitter Mounting Instructions 8010, 8010-D Kits

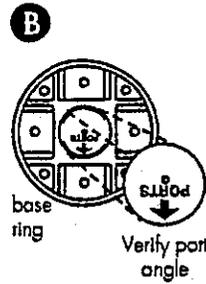
ENGLISH

3-8010.090-1/(E-8/96), English

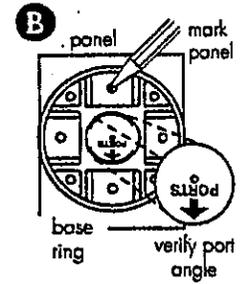
1 Pipe/Surface Mount Instructions



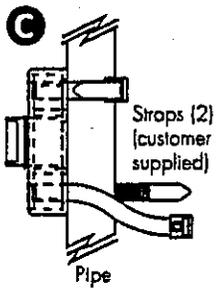
Pipe mount



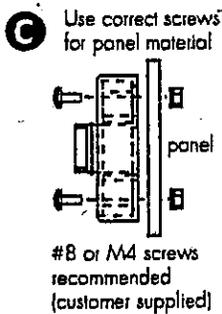
Surface mount



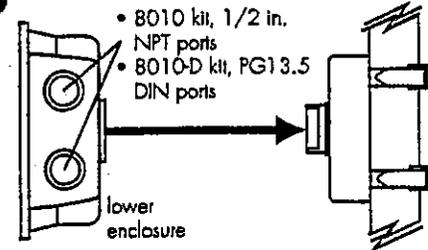
Pipe mount



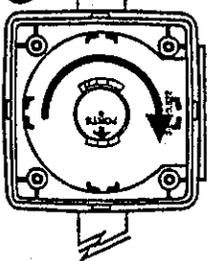
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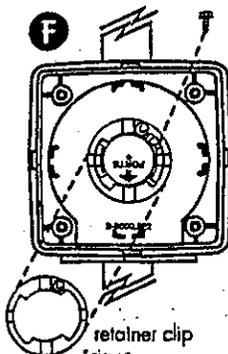
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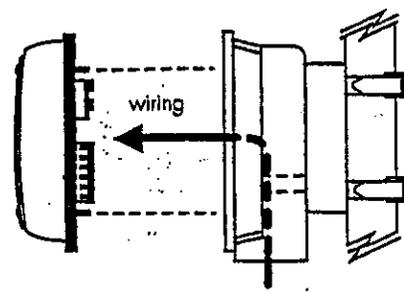
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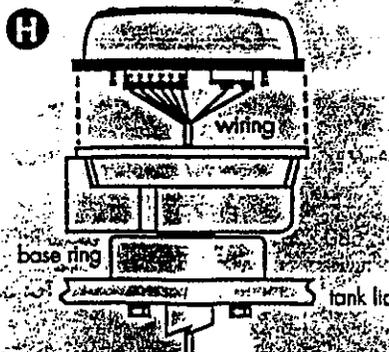
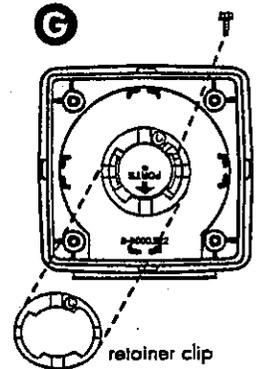
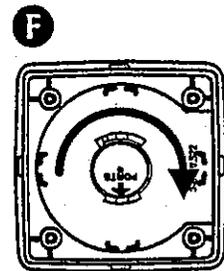
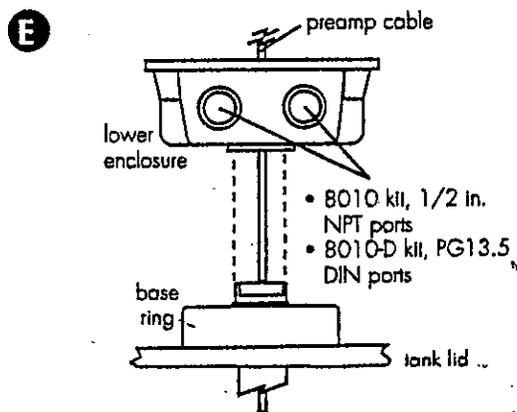
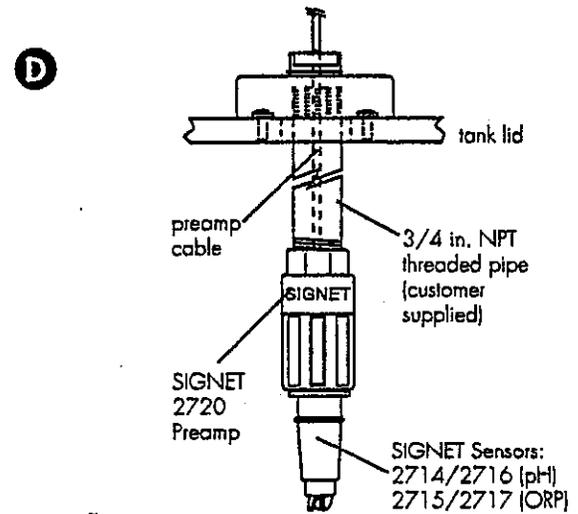
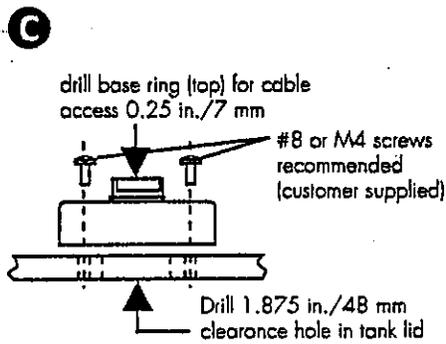
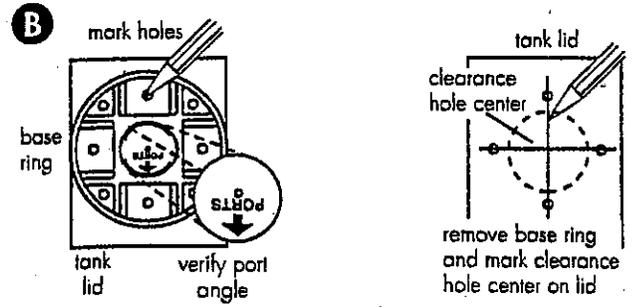
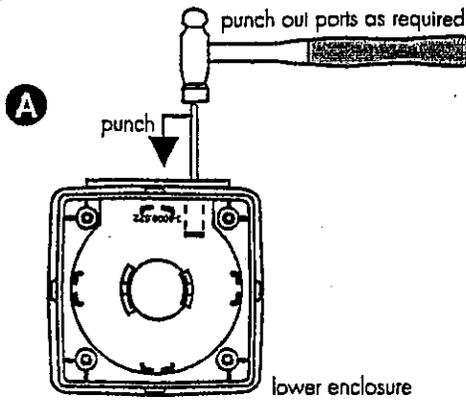
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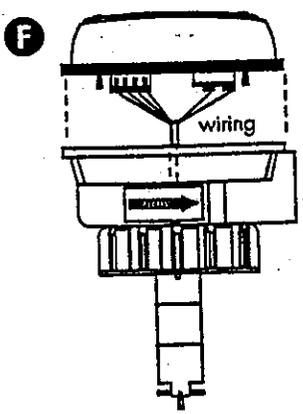
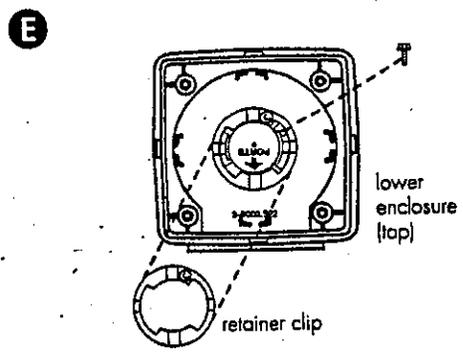
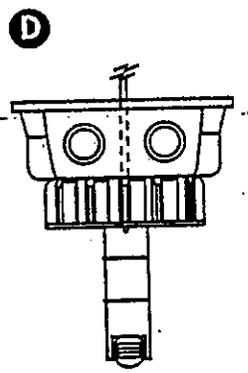
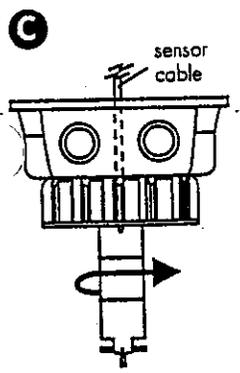
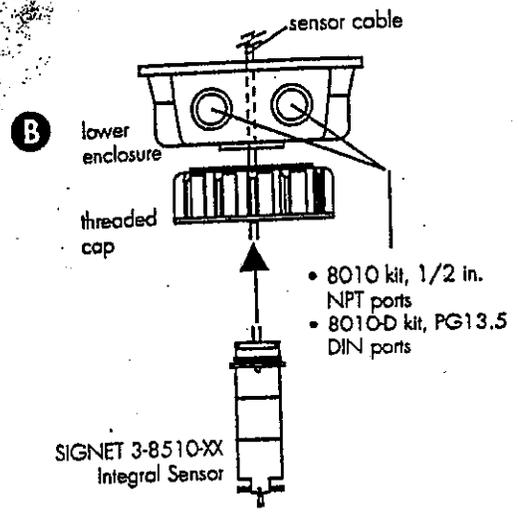
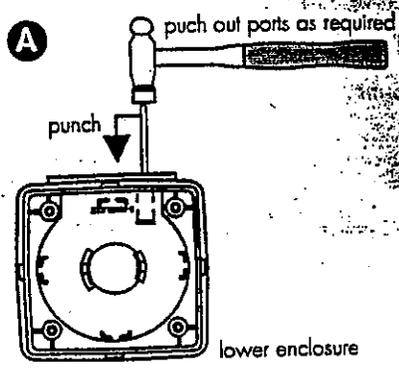
G



2 Tank Lid Mounting



Integral Sensor Mounting



G Refer to sensor manual for installation requirements and instructions

Specifications

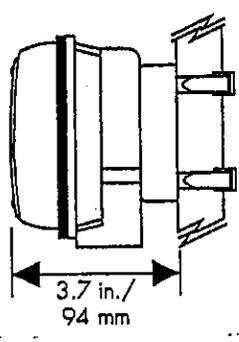
8010/8010-D Universal Mounting Kits:

Order no.	Conduit ports	Code
8010 kit:	1/2 in. NPT	198 864 502
8010-D kit:	PG13.5/DIN	198 864 503

Ma.) Glass filled Polypropylene (PP)

Base ring hole pattern: 2.60 in./66 mm bolt circle
2.25 in./57 mm bolt circle

Mounting dimensions:
8010/8010-D Kits



8011/8011-D Integral Sensor Mounting Kits:

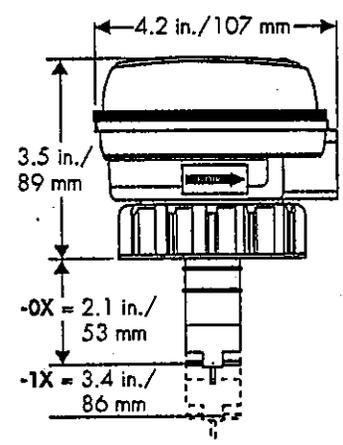
Order no.	Conduit ports	Code
8011 kit:	1/2 in. NPT	198 864 500
8011-D kit:	PG13.5/DIN	198 864 501

Material: Glass filled polypropylene (PP)

Compatible sensors:

Order no.	Material	Pipe range	Code
3-8510-PO	PP	0.5 - 4 in.	198 864 504
3-8510-P1	PP	5 - 8 in.	198 864 505
3-8510-VO	PVDF	0.5 - 4 in.	198 864 506

Mounting dimensions:
8011/8011-D Kits



Warranty

This product includes a limited warranty. Consult your Signet distributor for specific warranty conditions.

SIGNET

Signet Scientific Company, 3401 Aerojet Avenue, El Monte, CA 91731-2882/U.S.A., Phone (818) 571-2770, Fax (818) 573-2057

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- C** Georg Fischer Rohrleitungssysteme AG, CH-8201 Schaffhausen/Schweiz, Tel. 053/81 11 11, Telex 89 70 70 64 gf ch, Fax 053/25 91 30
- SIN** George Fischer Pte Ltd., 15 Kaki Bukit Road 2, KB Warehouse Complex, Singapore 1441, Tel: 65/747 0611, Fax: 65/747 0577

GEORGE FISCHER +GF+ Piping Systems
3-8010.090-1/(E8/96), English

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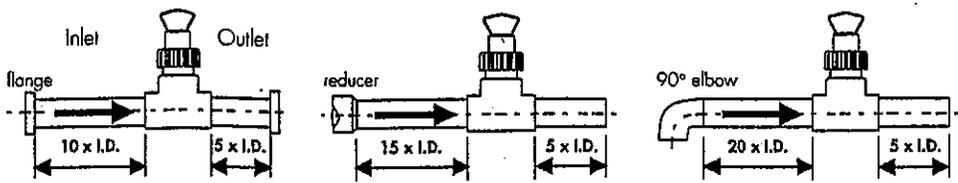


SAFETY INSTRUCTIONS

1. Do not remove from pressurized lines.
2. Do not exceed maximum temperature/pressure specifications.
3. Do not install/service without following installation instructions (see sensor manual).
4. Wear safety goggles and faceshield during installation/service.
5. Do not alter product construction.
6. Failure to follow safety instructions could result in severe personal injury!

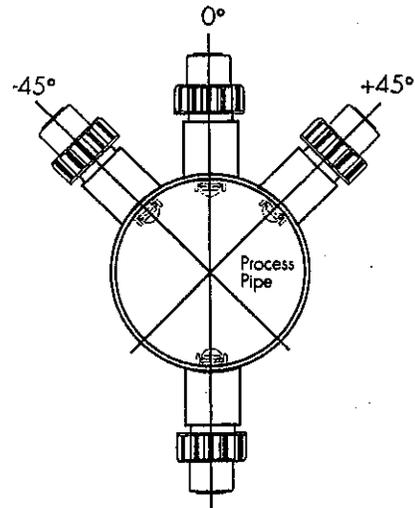
1. Location of Fitting

Recommended sensor upstream/downstream mounting requirements.

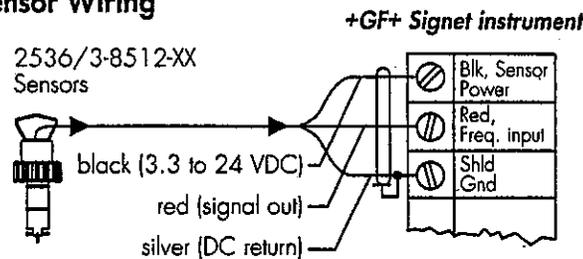


2. Sensor Mounting Position

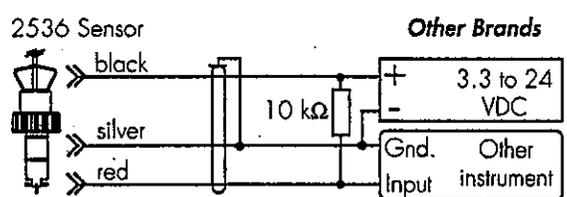
- Horizontal pipe runs: Mount sensor in the upright (0°) position for best overall performance. Mount at a maximum of 45° when air bubbles are present. Do not mount on the bottom of the pipe when sediments are present.
- Vertical pipe runs: Sensor must be mounted in lines with UPWARD flow only.



3. Sensor Wiring



- Use 2-conductor shielded cable for cable extensions up to 300 m (1000 ft).
- Cable shield must be maintained through cable splice.
- +GF+ Signet Inteltek-Pro, use 2535 input card setting
- Refer to you instrument manual for specific wiring details.



- Pull-up resistor required (10 kΩ recommended).
- Use 2-conductor shielded cable for cable extensions up to 300 m (1000 ft).
- Cable shield must be maintained through cable splice.

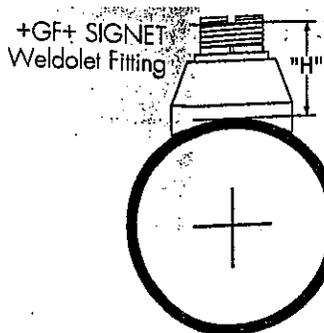
4. +GF+ SIGNET Fittings

Type	Description
<p>Plastic tees</p>	<ul style="list-style-type: none"> • 0.5 to 4 in. versions • PVC or CPVC • Mounts via glue-on fittings
<p>PVC glue-on saddles (O-ring not required)</p>	<ul style="list-style-type: none"> • 2 to 4 in., cut 1-7/16 in. hole in pipe • 6 to 8 in., cut 2-1/4 in. hole in pipe • Align wedge arrows with saddle arrows during assembly. • Pipes over 8 in., use iron saddle
<p>Iron strap-on saddles</p>	<ul style="list-style-type: none"> • 2 to 4 in., cut 1-7/16 in. hole in pipe • Over 4 in., cut 2-1/4 in. hole in pipe • Special order over 12 in.
<p>Carbon steel weld-on weldolets</p>	<ul style="list-style-type: none"> • 2 to 4 in., cut 1-7/16 in. hole in pipe • Over 4 in., cut 2-1/4 in. hole in pipe • Remove insert before welding • Installed by certified welder only • Special order over 12 in.
<p>Carbon steel threaded tees</p>	<ul style="list-style-type: none"> • 0.5 to 2 in. versions • Mounts on threaded pipe ends

Type	Description
	<p>Metric plastic saddle</p> <ul style="list-style-type: none"> • For pipes DN 65 to 200 mm • Requires a 30 mm diam. hole in the pipe • Wedge and saddle arrows must match
	<p>Metric wafer fitting</p> <ul style="list-style-type: none"> • For pipes DN 65 to 200 mm • Follow the recommended installation guidelines
	<p>Metric union fitting</p> <ul style="list-style-type: none"> • For pipes from DN 15 to 50 mm • Follow the recommended installation guidelines

5. H-Dimensions

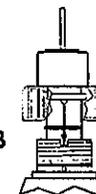
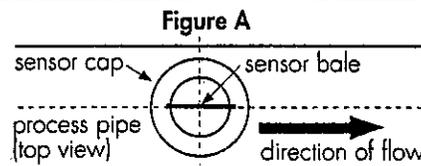
The plastic sensor insert in the Weldolet fitting **MUST** be removed during the welding process. When reinstalled, it is important that the insert be threaded to the proper height ("H" dimension).



Weldolet			"H" dimension		
part number	inches	mm	part number	inches	mm
CS4W020	2.38	60.45	CS4W240	4.16	105.66
CS4W025	2.33	59.18	CS4W360	4.10	104.14
CS4W030	2.32	58.92			
CS4W040	2.30	58.42	CR4W020	2.38	60.45
CS4W050	3.09	78.48	CR4W025	2.33	59.18
CS4W060	2.96	75.18	CR4W030	2.32	58.92
CS4W080	2.73	69.34	CR4W040	2.30	58.42
CS4W100	5.48	139.19	CR4W050	3.09	78.48
CS4W120	5.25	133.35	CR4W060	2.96	75.18
CS4W140	5.10	129.54	CS4W080	2.73	69.34
CS4W160	4.85	123.19	CS4W100	5.48	139.19
CS4W180	4.60	116.84	CS4W120	5.25	133.35
CS4W200	4.38	111.25			

6. Standard Sensor Installation

1. Lubricate the sensor O-rings with a silicone lubricant (e.g. GE silicone compound #G632 or equivalent). Do not use any petroleum based lubricant that will attack the O-rings.
2. Using an alternating/twisting motion, lower the sensor into the fitting, making sure the installation arrows on the black cap are pointing in the direction of flow, **see Figure A.**
3. Engage one thread of the sensor cap then turn the sensor until the alignment tab is seated in the fitting notch. **Hand tighten the sensor cap. DO NOT** use any tools on the sensor cap or the cap threads and/or fitting flange threads will be damaged, **see Figure B.**



7. K-Factors

The **K-Factor** is the number of pulses the sensor will generate for each engineering unit of fluid which passes. They are listed in U.S. gallons and in liters. For example, in a 1 inch PVC pipe, the paddlewheel generates 352.435 pulses per gallon of fluid passing the rotor. K-Factors are listed for pipes up to 12 inch. For pipes over 12 inch, consult your +GF+ Signet distributor.

PIPE SIZE	+GF+ SIGNET FITTING TYPE	---K-FACTOR---	
		U.S. GAL	LITERS
SCH 80 PVC TEES FOR SCH 80 PVC PIPE			
1/2 IN.	PV8T005	991.706	262.010
3/4 IN.	PV8T007	545.142	144.027
1 IN.	PV8T010	352.435	93.114
1 1/4 IN.	PV8T012	177.184	46.812
1 1/2 IN.	PV8T015	117.852	31.137
2 IN.	PV8T020	66.739	17.633
2 1/2 IN.	PV8T025	42.994	11.359
3 IN.	PV8T030	26.652	7.041
4 IN.	PV8T040	15.006	3.964
SCH 80 CPVC TEES FOR SCH 80 CPVC PIPE			
1/2 IN.	CPV8T005	991.706	262.010
3/4 IN.	CPV8T007	545.142	144.027
1 IN.	CPV8T010	352.435	93.114
1 1/4 IN.	CPV8T012	177.184	46.812
1 1/2 IN.	CPV8T015	117.852	31.137
SCH 80 PVC SADDLES ON SCH 80 PVC PIPE			
2 IN.	PV8S020	66.739	17.633
2 1/2 IN.	PV8S025	42.994	11.359
3 IN.	PV8S030	26.652	7.041
4 IN.	PV8S040	15.006	3.964
6 IN.	PV8S060	8.325	2.199
8 IN.	PV8S080	5.016	1.325
SCH 80 PVC SADDLE ON SCH 40 PVC PIPE			
2 IN.	PV8S020	54.700	14.452
2 1/2 IN.	PV8S025	37.159	9.817
3 IN.	PV8S030	23.697	6.261
4 IN.	PV8S040	13.456	3.555
6 IN.	PV8S060	7.459	1.971
8 IN.	PV8S080	4.529	1.197
CARBON STEEL TEES ON SCH 40 PIPE			
1/2 IN.	CS4T005	756.000	199.736
3/4 IN.	CS4T007	438.690	115.902
1 IN.	CS4T010	286.784	75.768
1 1/4 IN.	CS4T012	121.218	32.026
1 1/2 IN.	CS4T015	91.139	24.079
2 IN.	CS4T020	54.468	14.391
STAINLESS STEEL TEES ON SCH 40 PIPE			
1/2 IN.	CR4T005	734.200	193.976
3/4 IN.	CR4T007	412.100	108.877
1 IN.	CR4T010	252.700	66.764
1 1/4 IN.	CR4T012	128.120	33.849
1 1/2 IN.	CR4T015	77.320	20.428
2 IN.	CR4T020	45.780	12.095
GALVANIZED IRON TEES ON SCH 40 PIPE			
1 IN.	IR4T010	213.009	56.277
1 1/4 IN.	IR4T012	127.746	33.751
1 1/2 IN.	IR4T015	94.401	24.941
2 IN.	IR4T020	59.420	15.699
CARBON STEEL WELDOLETS ON SCH 40 PIPE			
2 1/2 IN.	CS4W025	37.600	9.934
3 IN.	CS4W030	24.340	6.431
4 IN.	CS4W040	13.920	3.678
5 IN.	CS4W050	10.860	2.869
6 IN.	CS4W060	7.520	1.987
8 IN.	CS4W080	4.340	1.147
10 IN.	CS4W100	2.760	0.729
12 IN.	CS4W120	1.940	0.513
STAINLESS STEEL WELDOLETS ON SCH 40 PIPE			
2 1/2 IN.	CR4W025	37.600	9.934
3 IN.	CR4W030	24.340	6.431
4 IN.	CR4W040	13.920	3.678
5 IN.	CR4W050	10.860	2.869
6 IN.	CR4W060	7.520	1.987
8 IN.	CR4W080	4.340	1.147
10 IN.	CR4W100	2.760	0.729
12 IN.	CR4W120	1.940	0.513
SCH 80 IRON SADDLES ON SCH 80 PIPE			
2 IN.	IR8S020	64.720	17.099
2 1/2 IN.	IR8S025	42.480	11.223
3 IN.	IR8S030	26.420	6.980
4 IN.	IR8S040	14.700	3.884
5 IN.	IR8S050	12.180	3.218
6 IN.	IR8S060	8.440	2.230
8 IN.	IR8S080	4.900	1.295
10 IN.	IR8S100	3.060	0.808
12 IN.	IR8S120	2.160	0.571
SCH 80 IRON SADDLE ON SCH 40 PIPE			
2 IN.	IR8S020	53.640	14.172
2 1/2 IN.	IR8S025	37.600	9.934
3 IN.	IR8S030	23.220	6.135
4 IN.	IR8S040	13.260	3.503
5 IN.	IR8S050	11.040	2.917
6 IN.	IR8S060	7.240	1.913
8 IN.	IR8S080	4.400	1.162
10 IN.	IR8S100	2.800	0.740
12 IN.	IR8S120	1.980	0.523
COPPER/BRONZE BRAZOLETS ON SCH 40 PIPE			
2 1/2 IN.	BR4B025	37.600	9.934
3 IN.	BR4B030	24.340	6.431
4 IN.	BR4B040	13.920	3.678
5 IN.	BR4B050	10.860	2.869
6 IN.	BR4B060	7.520	1.987
8 IN.	BR4B080	4.340	1.147
10 IN.	BR4B100	2.760	0.729
12 IN.	BR4B120	1.940	0.513
BRONZE TEES ON SCH 40 PIPE			
1 IN.	BR4T010	213.009	56.277
1 1/4 IN.	BR4T012	127.746	33.751
1 1/2 IN.	BR4T015	94.401	24.941
2 IN.	BR4T020	59.420	15.699
COPPER PIPE W/COPPER INSTALLATION FITTINGS			
1/2 IN. SK K	CUKT005	917.844	242.495
1/2 IN. SK L		858.217	226.742
3/4 IN. SK K	CUKT007	428.270	113.149
3/4 IN. SK L		385.737	101.912
1 IN. SK K	CUKT010	256.430	67.749
1 IN. SK L		241.639	63.841
1 1/4 IN. SK K	CUKT012	176.437	46.615
1 1/4 IN. SK L		170.902	45.152
1 1/2 IN. SK K	CUKT015	115.690	30.565
1 1/2 IN. SK L		112.030	29.598
2 IN. SK K	CUKT020	63.385	16.746
2 IN. SK L		61.735	16.310

Conversion Formulas:

1 U.S. gallon = 0.003785 cubic meters
 0.000003069 Acre feet
 8.3454 pounds of water

K-Factors DIN Pipes

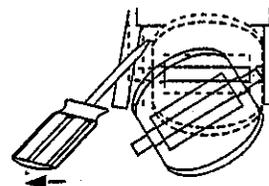
PIPE SIZE	+GF+ SIGNET FITTING TYPE	---K-FACTOR---		CODE	PIPE SIZE	+GF+ SIGNET FITTING TYPE	---K-FACTOR---		CODE
		U.S. GAL	LITER				U.S. GAL	LITER	
POLYPROPYLENE FITTINGS (DIN/ISO AND BS AND ANSI)					PVC FITTINGS (DIN/ISO) - EUROPE ONLY				
DN 15	PPMTO05	952.870	251.749	198.150.522	DN 15	PVMT005	972.366	256.900	198.150.480
DN 20	PPMTO07	563.100	148.771	198.150.523	DN 20	PVMT007	485.691	128.320	198.150.481
DN 25	PPMTO10	291.604	77.042	198.150.524	DN 25	PVMT010	297.274	78.540	198.150.482
DN 32	PPMTO12	169.222	44.709	198.150.525	DN 32	PVMT012	170.249	44.980	198.150.483
DN 40	PPMTO15	103.897	27.450	198.150.526	DN 40	PVMT015	103.709	27.400	198.150.484
DN 50	PPMTO20	60.789	16.060	198.150.527	DN 50	PVMT020	59.500	15.720	198.150.485
DN 65	PPMTO25	41.498	10.964	198.150.560	DN 65	PVMT025	34.973	9.240	198.150.538
DN 80	PPMTO30	26.786	7.077	198.150.561	DN 80	PVMT030	24.981	6.600	198.150.539
DN 100	PPMTO40	17.415	4.601	198.150.562	DN 100	PVMT040	16.275	4.300	198.150.540
DN 125	PPMTO50	10.168	2.686	198.150.563	DN 150	PVMT060	8.176	2.160	198.150.543
DN 150	PPMTO60	7.312	1.932	198.150.564	DN 200	PVMT080	4.088	1.080	198.150.545
DN 200	PPMTO80	3.995	1.055	198.150.565					
PVDF FITTINGS (DIN/ISO AND BS AND ANSI)									
DN 15	SFAMTO05	827.257	218.562	198.150.529					
DN 20	SFAMTO07	489.869	129.424	198.150.530					
DN 25	SFAMTO10	283.554	74.915	198.150.531					
DN 32	SFAMTO12	158.588	41.899	198.150.532					
DN 40	SFAMTO15	86.980	22.980	198.150.533					
DN 50	SFAMTO20	50.385	13.312	198.150.534					
DN 65	SFAMTO25	36.133	9.546	198.150.571					
DN 80	SFAMTO30	24.715	6.530	198.150.572					
DN 100	SFAMTO40	16.120	4.259	198.150.573					
DN 125	SFAMTO50	8.862	2.341	198.150.574					
DN 150	SFAMTO60	6.454	1.705	198.150.575					
DN 200	SFAMTO80	4.072	1.076	198.150.576					

8. Order Information

Standard 2536 low Flow Sensors						+GF+ SIGNET 3-8512-XX Integral Sensor Accessories					
All O-rings are Viton®											
Order No.	Housing	Rotor Pin	Rotor	Pipe Size	Code	Order No.	Description				Code
3-2536-P0	Polypro.	Titanium	PVDF (black)	0.5 to 4.0 in.	198 840 143	3-8011	Integral sensor mounting kit with 1/2 in. NPT ports				198 864 500
3-2536-P1	Polypro.	Titanium	PVDF (black)	5.0 to 8.0 in.	198 840 144	3-8011-D	Integral sensor mounting kit with PG13.5/DIN ports				198 864 501
3-2536-P2	Polypro.	Titanium	PVDF (black)	10 to 36 in.	198 840 145						
3-2536-V0	PVDF (natural)	Hastelloy C	PVDF (natural)	0.5 to 4.0 in.	198 840 146						
3-2536-V1	PVDF (natural)	Hastelloy C	PVDF (natural)	5.0 to 8.0 in.	198 840 147						
3-2536-T0	PVDF (natural)	PVDF (natural)	PVDF (natural)	0.5 to 4.0 in.	198 840 149						
Accessories						+GF+ SIGNET 3-8512-XX Integral Sensors					
All O-rings are Viton®											
Order No.	Material	Code	Rotor Pin	Material	Code	Order No.	Housing	Rotor Pin	Rotor	Pipe Size	Code
3-2536.320	PVDF (black)	198 820 052	M1546-1	Titanium	198 801 182	3-8512-P0	Polypro.	Titanium	PVDF (black)	0.5 to 4.0 in.	198 864 513
3-2536.321	PVDF (natural)	198 820 054	M1546-2	Hastelloy C	198 801 183	3-8512-P1	Polypro.	Titanium	PVDF (black)	5.0 to 8.0 in.	198 864 514
	+ Shaft		M1546-3	Tantalum	198 820 014	3-8512-V0	PVDF (natural)	Hastelloy C	PVDF (natural)	0.5 to 4.0 in.	198 864 516
			M1546-4	316 SS	198 820 015	3-8512-T0	PVDF (natural)	PVDF (natural)	PVDF (natural)	0.5 to 4.0 in.	198 864 518
			P51545	Ceramic	198 820 016						
			3-2536.321	PVDF (natural)	198 820 054						
				+ Rotor							
Order No.	Material	Code	Order No.	Description	Code						
1220-0021	Viton® (std.)	198 801 186	P31542-2	Sensor cap, PP	198 840 232						
1224-0021	EPR	198 820 006	P31536	Plug, PP	198 840 201						
1228-0021	Kalrez	198 820 007	P31536-2	Plug, PVDF with std. cap	198 840 202						

9. Rotor Replacement Procedure

- To remove the rotor, insert a small screwdriver between the rotor and the ear of the sensor.
- Twist the screwdriver blade to flex the ear outward enough to remove one end of the rotor and pin. **DO NOT** flex the ear any more than necessary! If it breaks, the sensor cannot be repaired.
- Install the new rotor by inserting one ear into the hole, then flex the opposite ear back enough to slip rotor into place.



10. Specifications

General Data

Flow rate range: 0.1 to 6 m/s (0.3 to 20 ft/s)
 Linearity: $\pm 1\%$ of full range
 Repeatability: $\pm 0.5\%$ of full range

Pipe range:

- 2536 Sensor: 15 to 900 mm (0.5 to 36 in.)
- 3-8512-XX Sensor: 15 to 200 mm (0.5 to 8 in.)

Cable length (2536): 7.6 m (25 ft), can splice up to 300 m (1000 ft)

Cable type: 2-conductor twisted-pair with shield (Belden 8451)

Materials

Sensor assembly: Various thermoplastics available. Refer to section 8 for details.

Electrical

Supply voltage: 3.3 to 24 VDC regulated
 Supply current: < 1.5 mA @ 3.3 - 6 VDC,
 < 20 mA @ 6 - 24 VDC

Output type: Open collector transistor, sinking
 Output current: 10 mA max.

Quality Standards

- CE
- Manufactured under ISO 9001

Fluid Conditions

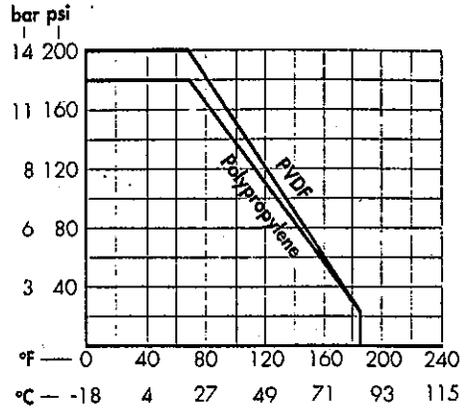
Pressure/Temperature Ratings

Polypropylene Body:

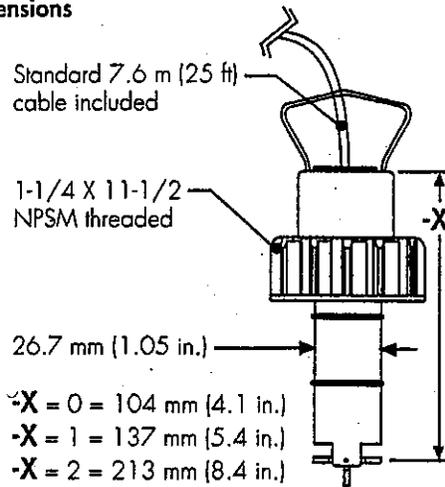
- 12.5 bar (180 psi) max. @ 20 °C (68 °F)
- 1.7 bar (25 psi) max. @ 85 °C (185 °F)

PVDF Body:

- 14 bar (200 psi) max @ 20 °C (68 °F)
- 1.7 bar (25 psi) max @ 85 °C (185 °F)



2536 Dimensions



The last digit (X) in the sensor's part number represents the sensor's overall length

+GF+ SIGNET

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SIN George Fischer Pte Ltd., 15 Kaki Bukit Road 2, KB Warehouse Complex, Singapore 1441, Tel: 65/747 0611, Fax: 65/747 0577

GEORGE FISCHER +GF+ Piping Systems
 3-2536.090-1/(A-8/96), English

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Appendix G
Reaction Tank Information

W-130/230 Series pH & ORP Transmitter/Monitor Instruction Manual

The W-130/230 Series pH & ORP Transmitter/Monitor is a microprocessor-based instrument designed for accurate and reliable measurement of pH and ORP in a wide range of aqueous solutions. It features a built-in microprocessor for automatic temperature compensation (ATC) and a high-resolution display for easy reading of the measured value. The instrument is designed for long-term stability and accuracy, making it suitable for laboratory and industrial applications. It is available in two models: W-130 (pH only) and W-230 (pH and ORP).

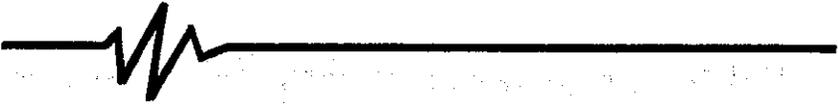
The W-130/230 Series is designed to be user-friendly and easy to operate. It features a simple menu structure and a clear display. The instrument is also equipped with a variety of features, including a built-in calibration routine, a data memory function, and a power-saving mode. The W-130/230 Series is a reliable and accurate instrument for pH and ORP measurement.

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1.0 INTRODUCTION



The W-130/230 series microprocessor based transmitters are used to monitor and transmit data in pH/ORP applications such as effluent monitoring, signal conditioning for PC's or PLC's and simple on/off control in water treatment, waste water treatment and other industrial uses. They are available in wall mount (W-130 series) and panel mount (W-230 series) enclosures.

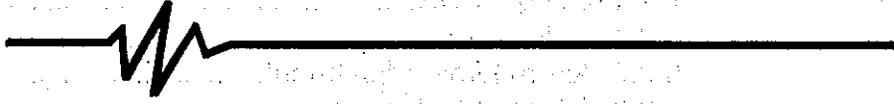
Depending on the model ordered, the unit is powered by 24 VDC or AC line voltage and contains two relays for alarm purposes or for on/off control functions.

Check the model number/serial number label on the unit for the proper voltage *before* connecting power to the unit!!

The unit is compatible with any electrode that generates a millivolt signal, and may be used with Pt 1000 automatic temperature compensation (ATC) elements. If no ATC probe is detected at power-up, the controller will automatically go into manual compensation mode.

An isolated 4-20 milliampere output is optional; it is powered internally. The pH/ORP span between 4-20 mA may be any value, and the mA signal may be adjusted from the front panel.

2.0 PACKING LIST



Notify your carrier immediately if there are any signs of damage to the transmitter or its parts. Contact your distributor if any parts are missing. The W-130/230 series transmitter shipping carton should contain the following items:

W-130/230 series pH/ORP transmitter/monitor
Instruction Manual
Mounting clips (W-230 panel mount models only)

3.0 INSTALLATION



The W-130/230 series units are designed to be mounted within 20 feet of the electrode. The W-130 series models are supplied with wall mountable enclosures, while the W-230 models are in panel mount enclosures.

3.1 Wall Mount

The W-130 series models are ideally mounted with the display at eye level, on a vibration-free surface, in a location where it will not be splashed while the enclosure cover is off.

Take off the front cover and mount the unit to the wall using #6 screws which are inserted into the holes at the four corners of the enclosure. See fig 1 for mounting template. *DO NOT* use any of the blind holes on the back of the enclosure for mounting!

(The screws may penetrate the enclosure and damage the internal electronics.) Route the wires through the provided cable glands. Install the wiring, carefully observing the polarity of all DC connections (see fig. 2). Replace the front panel of the unit and tighten the cable glands around the wiring just installed. Connect the pH or ORP electrode to the BNC connector.

3.2 Panel Mount

Mount the unit in the panel cutout and secure with the provided mounting clips. Install the wiring, carefully observing the wiring diagram and the polarity of all DC connections (see fig. 3). Note that the terminal strips on the rear of the panel mount unit unplug, to enable wiring of the unit. Connect the pH or ORP electrode to the BNC connector.

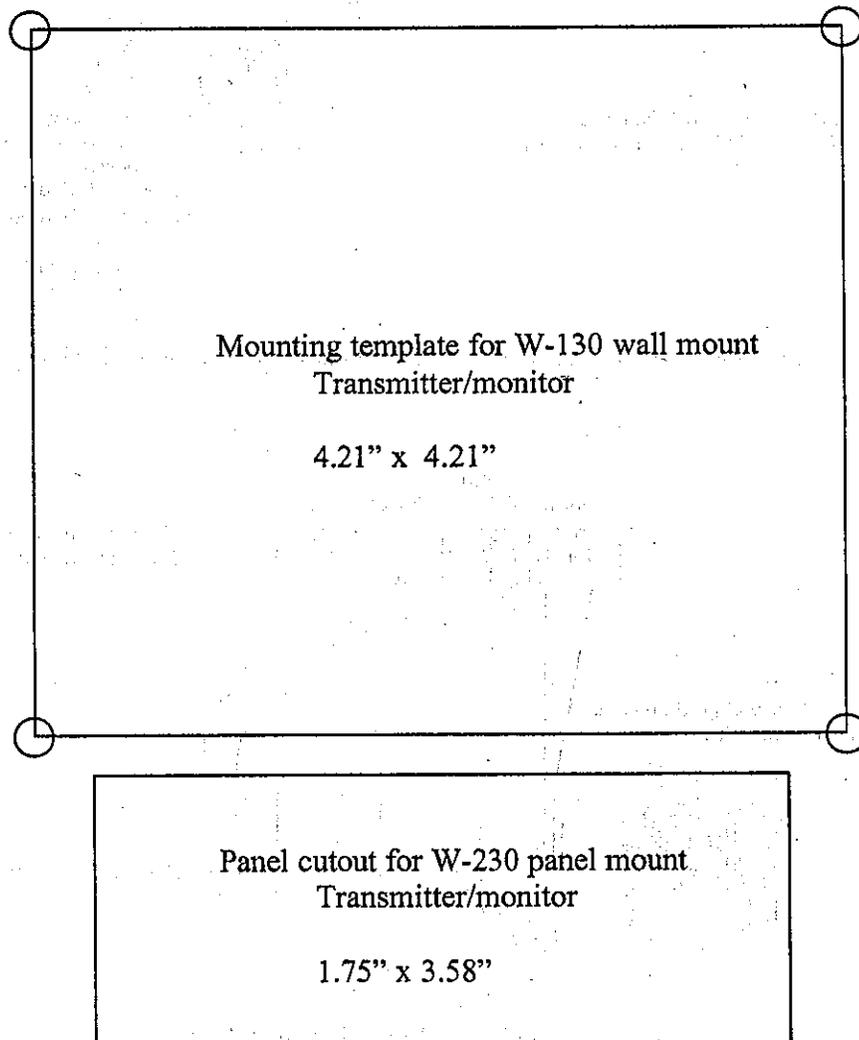


Figure 1 Mounting Templates

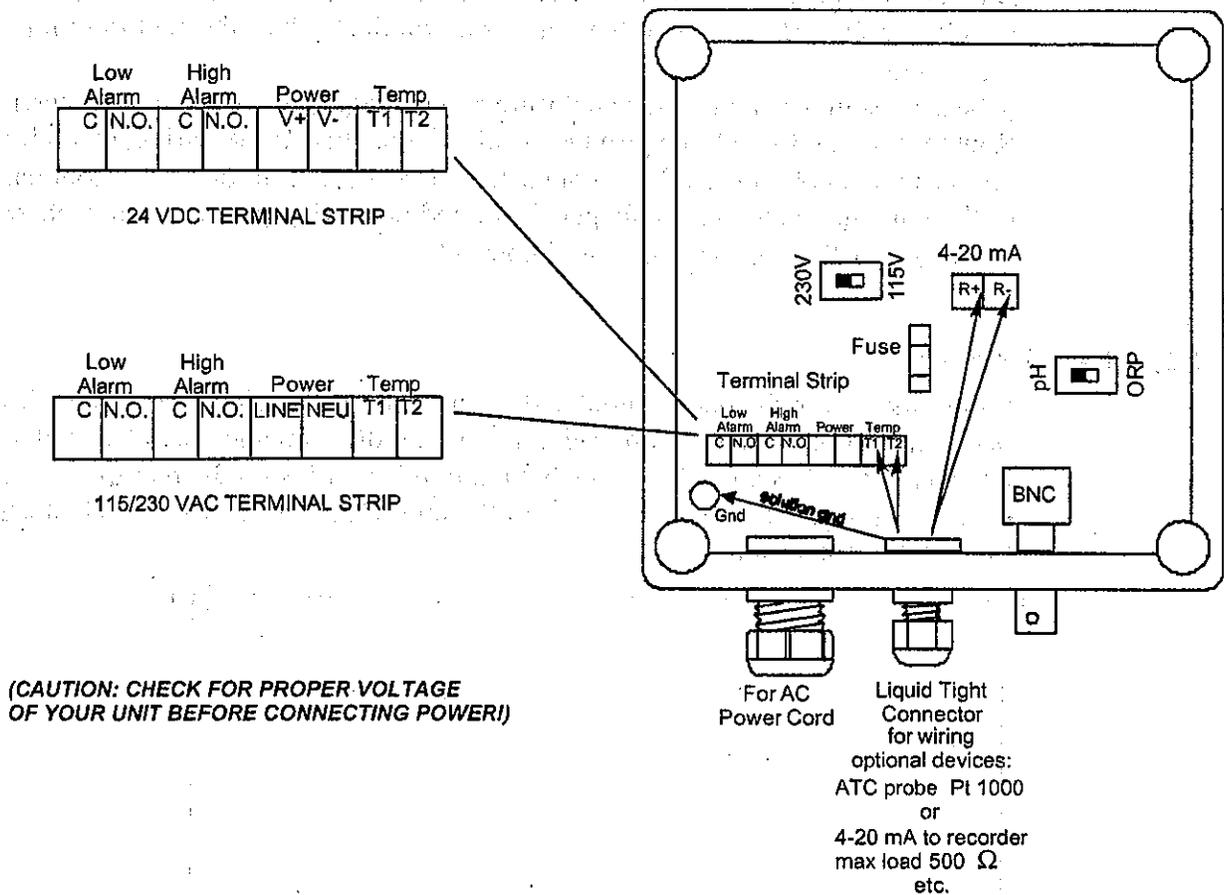


Figure 2A W-130 Wall Mount Circuit Board and Typical Wiring

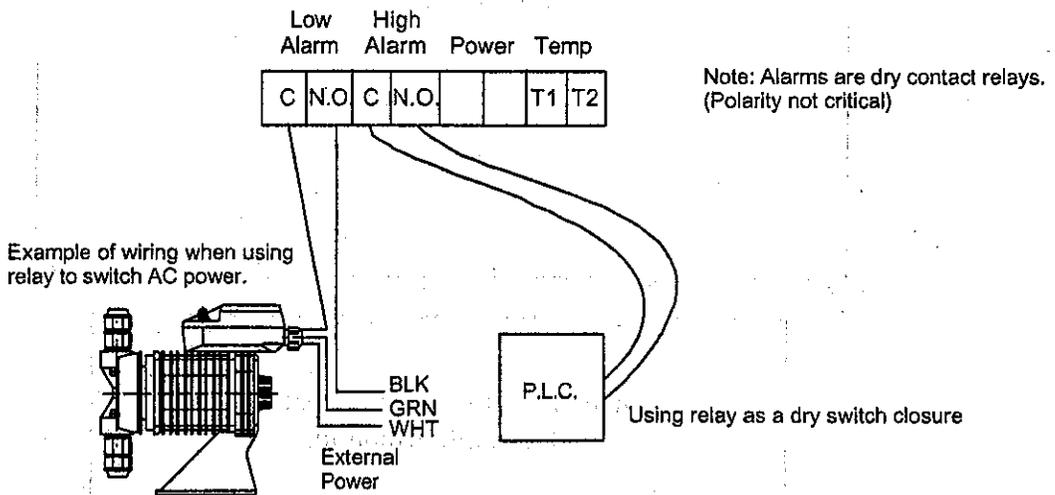
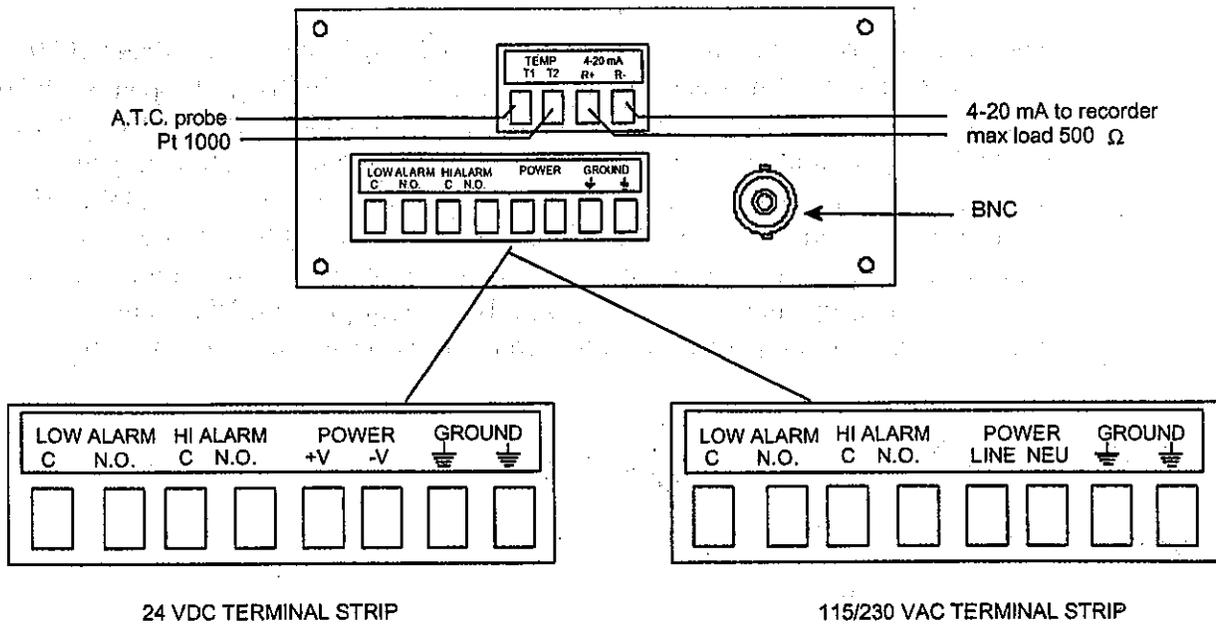
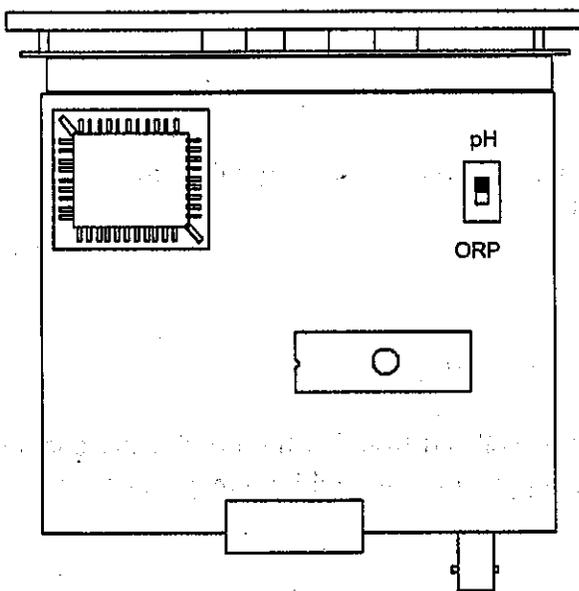


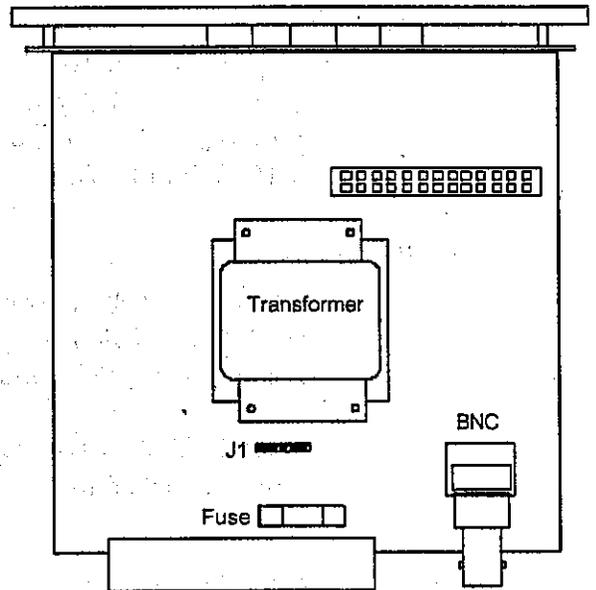
Figure 2B Wiring Alarm Relays
(Wall Mount and Panel Mount)



(CAUTION: CHECK FOR PROPER VOLTAGE OF YOUR UNIT BEFORE CONNECTING POWER!)



UPPER CIRCUIT BOARD



LOWER CIRCUIT BOARD

Figure 3 W-230 Panel Mount Wiring and Circuit Boards

3.3 Initial Startup

The monitor arrives with the alarm limits set to 2 and 12 pH or -1000 and 1000 mV (ORP). The 4-20 mA is also set to represent the entire 0-14 pH span or -2000 to 2000 mV. The unit is calibrated to read a perfect pH electrode at 20°C (68°F) or 0.00 mV. As a minimum you will want to calibrate the monitor to read your specific pH or mV electrode correctly. Power on the unit, calibrate, and for pH, set the process temperature. After the initial calibration, very little effort will be required to keep the transmitter in operation. Calibrations will be required in the future but the frequency will depend entirely on your process. Walchem recommends that you perform a calibration at least once every week to start.

4.0 SPECIFICATIONS



pH Input

Range: 0-14
Resolution: 0.01 pH
Stability: 0.01 pH

ORP Input

Range: -2000 -+2000 mV
Resolution: 1 mV
Stability: 1 mV

Temperature Input

Range: 0-100°C, 212°F
Resolution: 1 degree
Accuracy: ± 1 degree
Pt 1000 ohm RTD: Not required and no fixed resistor required to replace RTD.

Power Requirements

115 VAC ± 20%, 1 Amp
230 VAC ± 20%, 1 Amp
Voltage in 24VDC nominal, range 14-36 VDC

Note: 24 VDC power supply must be isolated from earth ground. Only one unit may be attached to a single power supply, or a ground loop may be created.

4-20mA Output Maximum Load

500 Ohms

Relay Outputs

Unpowered Relays Rated 5 Amps (resistive), @ 115/230VAC, 30VDC (max)
3 Amps (inductive) @ 115/230 VAC, 30 VDC

5.0 PROGRAMMING & KEYPAD

5.1 Overview

Programming is performed using the three function keys, \curvearrowright , \curvearrowleft and **Enter**, located under the LED display panel.

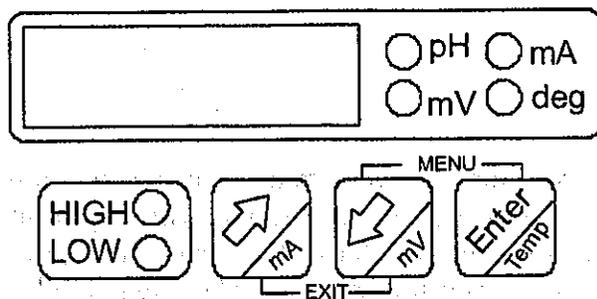


Figure 4 Front Panel (W130 shown)

Press the \curvearrowright and **Enter** keys simultaneously to enter the programming (menu) mode. Press the \curvearrowleft and \curvearrowleft keys simultaneously to exit the programming mode.

Once you are in the programming mode, changing a number is easy. Use the \curvearrowright or \curvearrowleft key to change the value. The effect of the key gets faster the longer you hold down the key. Once the value displayed is what you desire, press **Enter**. If you change your mind press the exit key combination, \curvearrowright and \curvearrowleft . The display will return to the previous setting. (To exit the menu entirely, press \curvearrowright and \curvearrowleft again.)

Each individual key has another function, indicated in the blue area in the right corner.

View mA

When the unit is operating, pressing the \curvearrowright /mA key will change the display to read the current milliamp output, for as long as you depress that key. The corresponding mA LED on the display panel will light.

View mV

Pressing the \curvearrowleft /mV key will change the display to read the current millivolt value, for as long as you depress that key. The corresponding mV LED on the display panel will light.

View Temperature

If you are using an automatic temperature compensated sensor for pH measurement, the current temperature will be displayed. Pressing the **Enter/Temp** key will change the display to show the current programmed process temperature, for as long as you depress that key. A corresponding LED on the display panel will light.

In the paragraphs that follow, the letters shown in bold are what will appear on the display. The values you enter in the programming mode are stored in non-volatile EEPROM memory. You may enter the programming mode at any time and view the set points without disrupting the 4-20 mA output or the alarm condition. If you modify a set point the new value will take affect as soon as you press **Enter**.

5.2 Programming for pH

5.2.1 Calibration

Two Point Calibration

Every time you enter the programming mode you will be presented with the message **CAL 2**. If you press **Enter** you will be presented with a series of instructions prompting you through the calibration process. The steps progress in a logical manner and even attempt to make it impossible for calibration errors to cause any problems.

If using manual temperature compensation, first you will be given the opportunity to set the temperature of the buffers used in the calibration. Press **Enter** and the display will change to **CAL t**. Press **Enter** and you will see **dEg F** or **dEg C**. Use the arrow keys to scroll between **dEg F** and **dEg C**, then select by pressing **Enter**. The temperature value will appear and you may change it up or down using the arrow keys. Press **Enter** to accept temperature value.

If using ATC, place the electrode in the first buffer solution, and let the temperature display stabilize. Then you will be prompted to specify **buFr 1**. Press the **Enter** key to continue. You may accept the value presented to you (probably 7.00) or change it as described above. Press the **Enter** key when the first buffer is correct.

Next the display will change to indicate the mV reading of the pH electrode. When this reading is stable press any key to accept the value and continue with the calibration process. *If the display is flashing, the mV reading does not correspond to the pH buffer value you programmed. Double check to make sure that the electrode is in the correct pH buffer.*

The display will next read **buFr 2**, and the same process is repeated for the second buffer. When you accept the second mV reading the calibration process is complete and the unit tests to see if the process was done correctly. If so, the message **CAL d** is displayed. Otherwise the message **FAiLd** is displayed and the results of the calibration attempt are discarded. Press any key to continue in the programming mode. The display will return to **CAL 2**.

Notice

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*Part Number 180089 (E)
December 2000*

One Point Calibration

Press the \square key and you will see an alternative to the above calibration procedure, **CAL 1**. This procedure is almost identical to the CAL 2 procedure, except only one buffer is used. This method is faster but is not as accurate.

Press **Enter** and the display will change to **CAL t**. Press **Enter** and you will see **dEg F** or **dEg C**. Use the arrow keys to scroll between **dEg F** and **dEg C**, then select by pressing **Enter**. The temperature value will appear and you may change it up or down using the arrow keys. Press **Enter** to accept temperature value.

If using ATC, place the electrode in the buffer solution, and let the temperature display stabilize. The display will next read **buFr**. Use the \square and \square keys the scroll to the pH value of the buffer you will be using. Press **Enter**. (Place the electrode in the buffer solution if it isn't already.) The display will change to indicate the mV reading of the pH electrode. When this reading is stable, press any key to accept the value. *If the display is flashing, the mV reading does not correspond to the pH buffer value you programmed. Double check to make sure that the electrode is in the correct pH buffer.*

Note that buffer 7 may not be used in the CAL 1 procedure.

When you have accepted the mV reading, the calibration process is completed and the unit tests to see if the process was done correctly. If so, the message **CAL d** is displayed. Otherwise the message **FAiLd** is displayed and the results of the calibration attempt are discarded. Press any key to continue in the programming mode. The display will return to **CAL 1**.

5.2.2 Run Temperature Adjustment

Press the \square key until the display reads **run t**. Press **Enter** to adjust (or view) the temperature. The display will change to indicate the current unit of measure (deg C or deg F). Press **Enter** to accept the units or an arrow key to change the units. Then change the displayed temperature to match your process temp. If you installed an ATC sensor, the current temperature will be displayed until you press a key.

5.2.3 Alarm Limit Adjustment

Press the \square key until the display reads **SEtHi pH**. Press **Enter**. This will give you the opportunity to set the pH value that should correspond to a high alarm output. Use the \square or \square key to change the value and press **Enter** to store the new value.

Press the \square key until the display reads **SEtLo pH**. Press **Enter**. This will give you the opportunity to set the pH that should correspond to a low alarm output. Use the \square or \square key to change the value and press **Enter** to store the new value.

5.2.4 4-20 mA Set Points

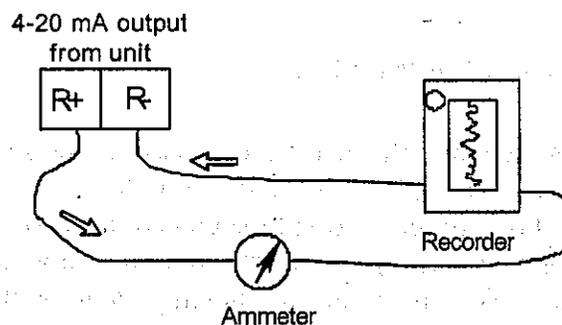
Press the \curvearrowright key until the display reads **SEt 4 mA**. Press **Enter**. This will give you the opportunity to set the pH value that should correspond to a 4 mA output. This is commonly known as the *offset* value. Use the \curvearrowleft or \curvearrowright key to change the value and press **Enter** to store the new value.

Press the \curvearrowright key again to display **SEt20 mA**. Press **Enter**. This will give you the opportunity to set the pH value that should correspond to a 20 mA output. In conjunction with the 4 mA output setting you will determine the *span* of the 4-20 output. Use the \curvearrowleft or \curvearrowright key to change the value and press **Enter** to store the new value.

5.2.5 4-20 Output Adjustment

This function is to allow you to adjust accuracy of the 4-20 mA output. Attach an ammeter to the controller as shown in the figure below. Press the \curvearrowright key until the display reads **ADJSt**. Press **Enter**. The display will change to **ADJ 4**. If the ammeter does not read exactly 4.00, use the \curvearrowright and \curvearrowleft keys to adjust the output until the meter reads 4.00 Press **Enter**.

The display will now read **ADJ20**. If the ammeter does not read exactly 20.00, use the \curvearrowright or \curvearrowleft keys to adjust the output until the ammeter reads 20.00. Press **Enter**.



5.3 Programming for ORP

If you have ordered a W-130-MVxx or W-230-MVxx, the unit is preset as an ORP version, and no further action is required. If not, simply disconnect power and set the pH/ORP switch to the ORP position. The switch is red and is located on the main board inside the unit. See figures 2 and 3 for location. Put the unit back together and power on. The display will now indicate the input as a mV value.

The 4-20mA settings and Alarm settings are similar to the pH mode. However, the complex pH calibration procedures are no longer needed. See programming instructions below.

5.3.1 Calibration

The **CaL** menu is used to adjust the mV reading to match the expected value of a standard solution, or the reading of a previously calibrated meter.

When you enter the programming mode, the first display will be **CaL**. Place the ORP electrode into a solution of known mV value. This may be a standard solution such as a saturated solution of Quinhydrone in pH 4 or pH 7 buffer, or the process solution that has been measured by a previously calibrated meter. Press **Enter** to perform the calibration.

The display will now show the mV output of the electrode. If this is different from the known value, use the \leftarrow and \rightarrow keys to make the reading match the known value. Press **Enter** when the reading is correct.

5.3.2 Alarm Limit Adjustment

Press the \leftarrow key until the display reads **SEtHi** mV. Press **Enter**. This will give you the opportunity to set the mV value that should correspond to a high alarm output. Use the \leftarrow or \rightarrow key to change the value and press **Enter** to store the new value.

Press the \leftarrow key until the display reads **SEtLo** mV. Press **Enter**. This will give you the opportunity to set the mV value that should correspond to a low alarm output. Use the \leftarrow or \rightarrow key to change the value and press **Enter** to store the new value.

5.3.3 4-20 mA Set Points

Press the \leftarrow key until the display reads **SEt 4** mA. Press **Enter**. This will give you the opportunity to set the mV value that should correspond to a 4 mA output. This is commonly known as the *offset* value. Use the \leftarrow or \rightarrow key to change the value and press **Enter** to store the new value.

Press the \leftarrow key again to display **SEt20** mA. Press **Enter**. This will give you the opportunity to set the mV value that should correspond to a 20 mA output. In conjunction with the 4 mA output setting you will determine the *span* of the 4-20 output. Use the \leftarrow or \rightarrow key to change the value and press **Enter** to store the new value.

5.3.4 4-20 mA Output Adjustment

See section 5.2.5 on previous page.

6.0 OPERATION



Once all of the values have been programmed to the desired settings, the 4-20 mA output is continuously updated and the alarm points are monitored.

The 4-20 mA output is capable of driving a maximum load of 500 Ω , which should be suitable for most applications.

The alarm outputs are electro-mechanical relays rated for 5 Amps at 115/230 VAC or 30 VDC.

The alarm relays are activated for high or low alarm conditions and the corresponding indicators on the front panel are lit.

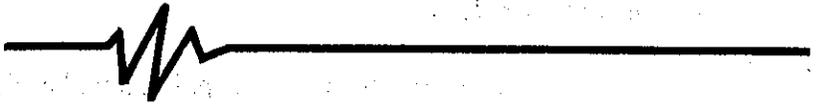
During a given alarm condition, the alarm relay may be de-energized by pressing the \varnothing and **Enter** keys simultaneously. The alarm output will not be re-energized until the current alarm condition is cleared. The front panel LED's are not affected by the alarm acknowledge feature.

The alarm limits have a built in dead band of 0.05 pH (5 mV). This means that once the high alarm is tripped the alarm light will not turn off until the pH is 0.05 less than the high alarm set point (or 5 mV, for ORP).

Press and hold the \varnothing key to display the current mA output value. Releasing this key will restore the display to the current pH value. Similarly, press and hold the \varnothing key to display the input mV reading. Use the **Enter** key to display the current temperature reading. None of these *view* keys affect the operation of the monitor.

Press all three of the front panel keys simultaneously to perform a display test. All of the display characters and indicators should light up. Release the keys to return to normal operation.

7.0 TROUBLESHOOTING



"FAiLd" message

Cause: The calibration process yielded a "slope" less than 35 mV/pH or greater than 80 mV/pH, or an offset from the expected mV reading that is greater than ± 35 mV. This may be caused by an incorrect calibration attempt or defective electrode, cable, buffer solution or wiring.

Correction: Use this table as a guide when calibrating your pH/ORP electrode. It lists the most common buffers and their corresponding mV readings when used at different temperatures.

	Temp = 20°C	Temp = 25°C	Temp = 30°C
pH	mV	mV	mV
4.00	174	177	180
7.00	0	0	0
10.00	-174	-177	-180

If your readings do not match these guidelines, try to determine if the monitor or the pH electrode is at fault. To do this, disconnect the pH/ORP electrode from the BNC connector. Use a pH simulator to give the unit a known mV input. If the unit reads correctly, then the electrode or its cable is at fault. If a simulator is not available, use a bent paper clip to short the outside shell of the BNC to the inside contact of the BNC. This should simulate pH 7 or mV 0.00. Use the \varnothing key to view the mV reading. If the reading is between +10mV and -10mV then the electrode is probably at fault. If the reading does not improve with a new electrode, contact Walchem customer service.

pH doesn't match the pH reading of another meter

Causes: Incorrect calibration of either or both meters.

Inconsistency between electrodes.

Lab meter's electrode is not at the same temperature as the process.

Analysis sample taken from different location than the process sample.

Correction: This is a complex problem that can best be corrected with some simple guidelines. Make sure all process related variables are taken into consideration. Calibrate both meters with the same buffer solutions, carefully following the manufacturers guidelines. If the process measurement is being done at an elevated temperature, make certain that the lab meter's sample has been heated to the same temperature as the process. If all of these suggestions are followed and the pH still does not match, recalibrate the unit using the process value (as read by the lab meter) as the buffer in the CAL 1 procedure.

pH recorder works backwards

Cause: The 4 mA set point is higher than the 20 mA set point.

Correction: Move either or both set points so that the 20 mA setting is greater than the 4 mA setting. The inverse action you were witnessing is provided for use with a proportional valve or pump and not a recorder.

Wild swings in 4-20 mA output

Cause: The 4 mA setting is too close to the 20 mA setting.

Correction: There should be at least a 1 pH unit span between the two set point values. If you have set the 4 mA set point = the 20 mA set point the transmitter will produce 4 mA when the pH is below the set point and 20 mA when the pH is above the set point. This is probably not the action you desired.

"rECAL" message or Set points changed back to default

Cause: The internal memory has been corrupted.

Correction: The unit was designed to be installed and run without human intervention. However, if the EEPROM memory has been corrupted the best the unit can do is reset all of the values you have programmed to the factory defaults. (4-20 mA = 0-14 pH, or -2000 to +2000 mV.) The machine will also recalibrate to the "perfect electrode". This is not likely to match your electrode even right out of the box from the manufacturer. Still this action is usually better than no action at all in the absence of an operator. If no operator is present and the rECAL message has been on the display for about a minute, the unit will begin to run. Turn off the power to the unit, wait a few moments and then turn the power back on. If the rECAL message appears contact Walchem customer service.

8.0 SERVICE POLICY



The W-130/230 series pH & ORP transmitters/monitors have a 2-year warranty on electronic components and a 1-year warranty on mechanical parts (keypad, terminal strip, relays).

We stock circuit boards for immediate exchange after we have isolated the cause of the problem. Factory authorized repairs that are received by "next day air" will be returned within 24 hours. Normal priority for returns is two weeks. Out of warranty repairs or circuit board exchanges are done on a flat fee basis after the warranty is expired.

Appendix H
Chemical Feed Package Information

Instruction Manual

Electronic Metering Pumps



Carefully read and understand all precautions before installing or servicing any metering pump.



Please record the following data:
(Information on Pump Box and Pump Data Plate)

Pump Model Number: _____
Pump Serial Number: _____
Installation Date: _____
Installation Location: _____

When ordering replacement parts for your LMI Metering Pump or accessory, please include the complete model number and serial number of your unit.



8 Post Office Square • Acton, MA 01720 USA
TEL: (978) 263-9800 • FAX: (978) 264-9172
<http://www.lmipumps.com>

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1.0 Introduction

LMI is the world's most versatile manufacturer of economical and efficient metering pumps. This manual addresses the installation, maintenance and troubleshooting procedures for manually and externally controlled pumps. LMI has a worldwide network of stocking representatives and authorized repair centers to give you prompt and efficient service.

Please review this manual carefully. Pay particular attention to warnings and precautions. Always follow good safety procedures, including the use of proper clothing, eye and face protection.

This manual is for Series A, B, C, E, J5, and P pumps.

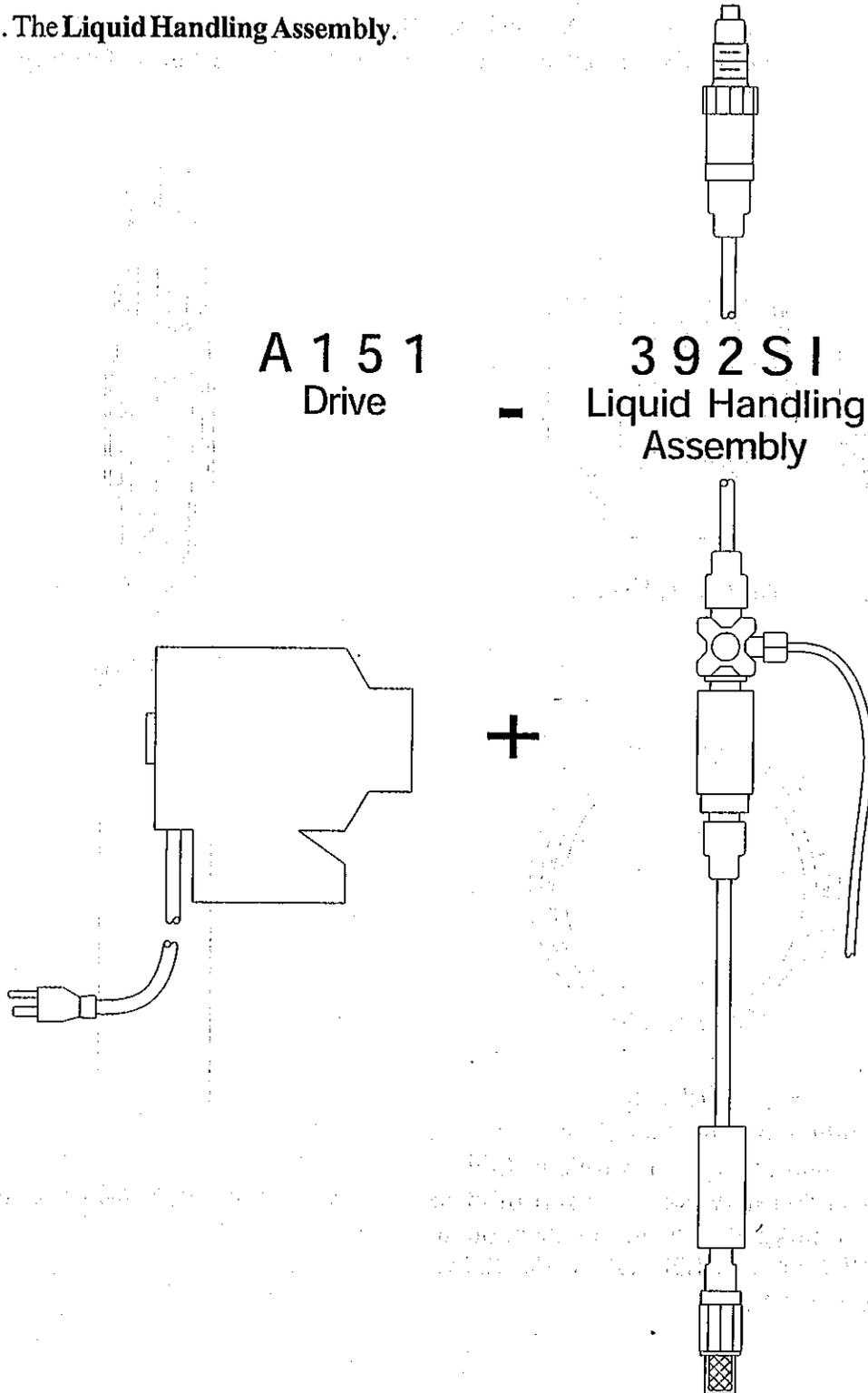
1.1 Spare Parts

LMI recommends replacing the elastomeric components of the pump on an annual basis. RPM Pro Pacs™ and spare part kits are available from your local LMI Master Stocking Distributor.

Example:

Your pump consists of two main components:

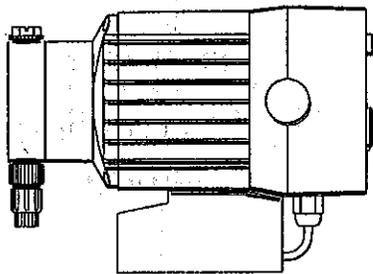
1. The **Drive Assembly**; and
2. The **Liquid Handling Assembly**.



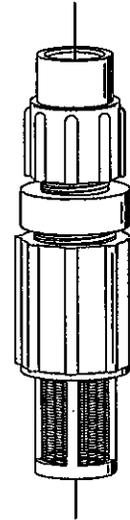
2.0 Unpacking Check List

Your carton will contain many or all of the following items. Please notify the carrier immediately if there are any signs of damage to the pump or its parts.

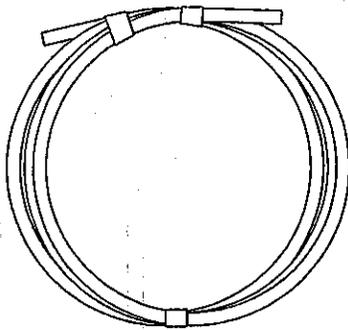
Please refer to the enclosed Drive Assembly Parts List Sheet for an illustration and electrical diagram of your complete pump.



Metering Pump

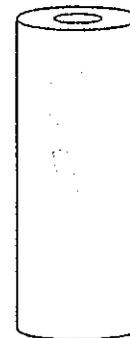


Foot Valve

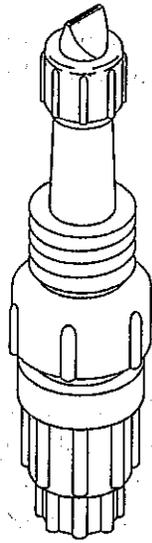


Tubing

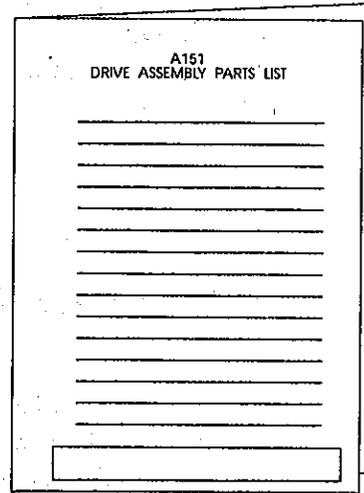
Depending on the model, your carton may contain 0, 1, 2 or 3 rolls of tubing. Your carton may contain a roll of clear vinyl tubing; this is for connection to the **SUCTION SIDE OF THE PUMP HEAD ONLY.**



Ceramic Foot Valve Weight



Injection Check Valve



Drive Assembly Exploded View Drawing

MULTI-FUNCTION Valve and Tubing

* Your carton may or may not contain a 3-FV, 4-FV, or bleed 4-FV accessory.

3.0 Pre-Installation Instructions

The following precautions should be taken when working with LMI metering pumps. Please read this section carefully prior to installation.

Precautions



Protective Clothing

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to MSDS precautions from your solution supplier.



Water Pre-Prime

All LMI pumps are pre-primed with water when shipped from the factory. If your solution is not compatible with water, disassemble the Pump Head Assembly. Thoroughly dry the pump head, valves, seal rings, balls and Liquifram™ (diaphragm). Reassemble head assembly tightening screws in a crisscross pattern. Refill the pump head with the solution to be pumped before priming the pump. (This will aid in priming.)



Solution Compatibility

Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. Should you have any further compatibility questions on your LMI Metering Pump, review the **LMI Chemical Resistance Chart** for compatibility. Contact your local LMI distributor or the LMI Customer Service Department for further information.



Tubing Connections

Inlet and outlet tubing or pipe sizes must not be reduced. Make certain that all tubing is **SECURELY ATTACHED** to fittings prior to start-up (see Section 4.3, Tubing Connections). **ALWAYS** use LMI supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings. It is recommended that all tubing be shielded to prevent possible injury in case of rupture or accidental damage. If tubing is exposed to sunlight, black UV resistant tubing should be installed. Check tubing frequently for cracks and replace as necessary.



Fittings And Machine Threads

All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting contacts the seal ring may be necessary to provide a leak-proof seal. Excessive overtightening or use of a pipe wrench can cause damage to the fittings, seals, or pump head.

All LMI pumps have straight screw machine threads on the head and fittings and are sealed by the seal rings or O-rings. **DO NOT use Teflon® tape or pipe dope to seal threads. Teflon® Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve as well as stainless steel liquid end connections.**



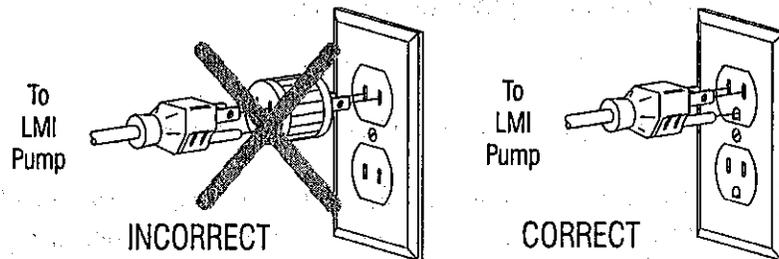
Plumbing

Always adhere to your local plumbing codes and requirements. Be sure installation does not constitute a cross connection. Check local plumbing codes for guidelines. LMI is not responsible for improper installations.



Electrical Connections

To reduce the risk of electrical shock, the metering pump must be plugged into a grounded outlet with ratings conforming to the data on the pump control panel. The pump must be connected to a good ground. **DO NOT USE ADAPTERS!** All wiring must conform to local electrical codes.



4.0 Installation

4.1 Pump Location and Installation

Locate pump in an area convenient to solution tank and electrical supply.

The pump should be accessible for routine maintenance, and should not be subjected to ambient temperatures above 122°F (50°C). If the pump will be exposed to direct sunlight, LMI black, UV resistant tubing should be installed.

4.2 Pump Mounting

The pump can be mounted in one of two ways:

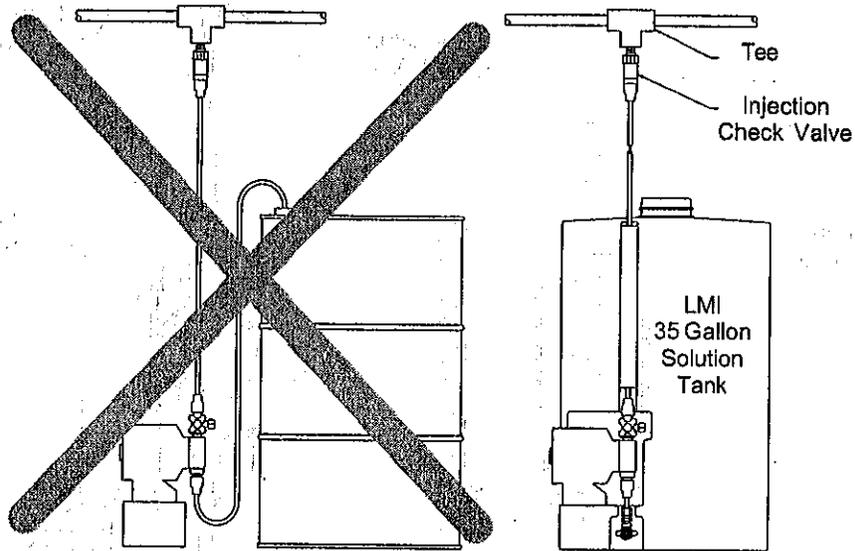
- A. **FLOODED SUCTION** (ideal installation); or
- B. **SUCTION LIFT** - when suction lift is less than 5 feet (1.5 m) for solutions having a specific gravity of water. For denser solutions, consult distributor.

Your LMI metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally.**

4.2.1 Flooded Suction

The pump is mounted at the base of the storage tank. This installation is the most trouble-free, and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced.

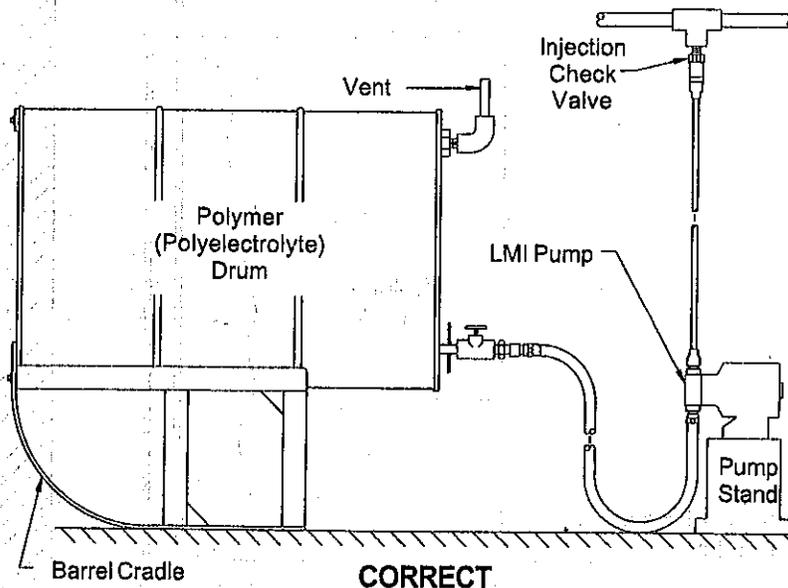
NOTE: Although popular for all solutions, LMI recommends flooded suction installations for all high-viscosity fluid applications.



INCORRECT

CORRECT

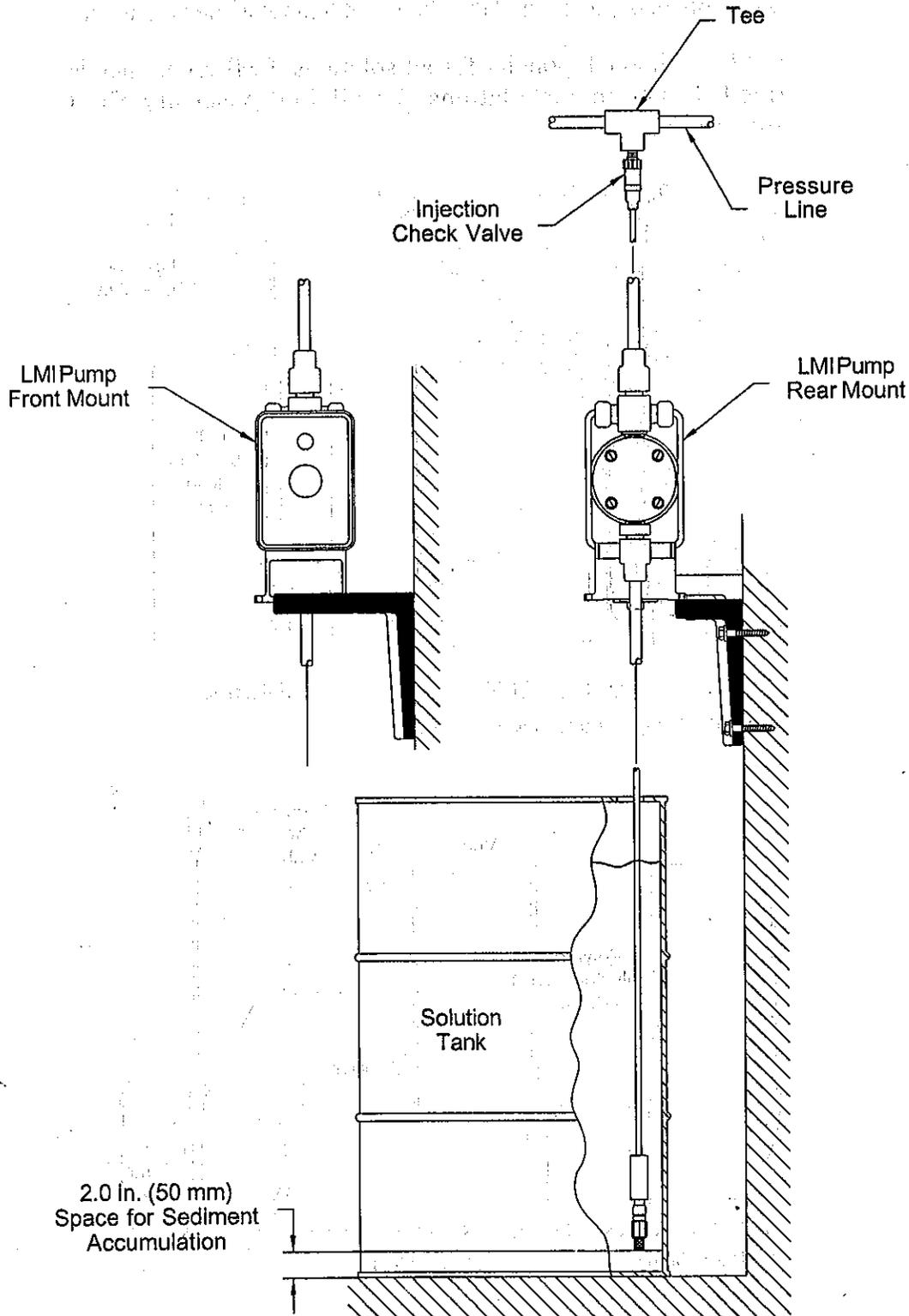
Avoid this type of false flooded suction.



CORRECT

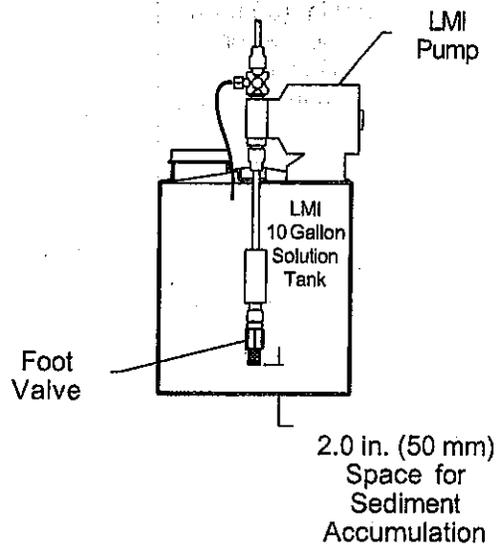
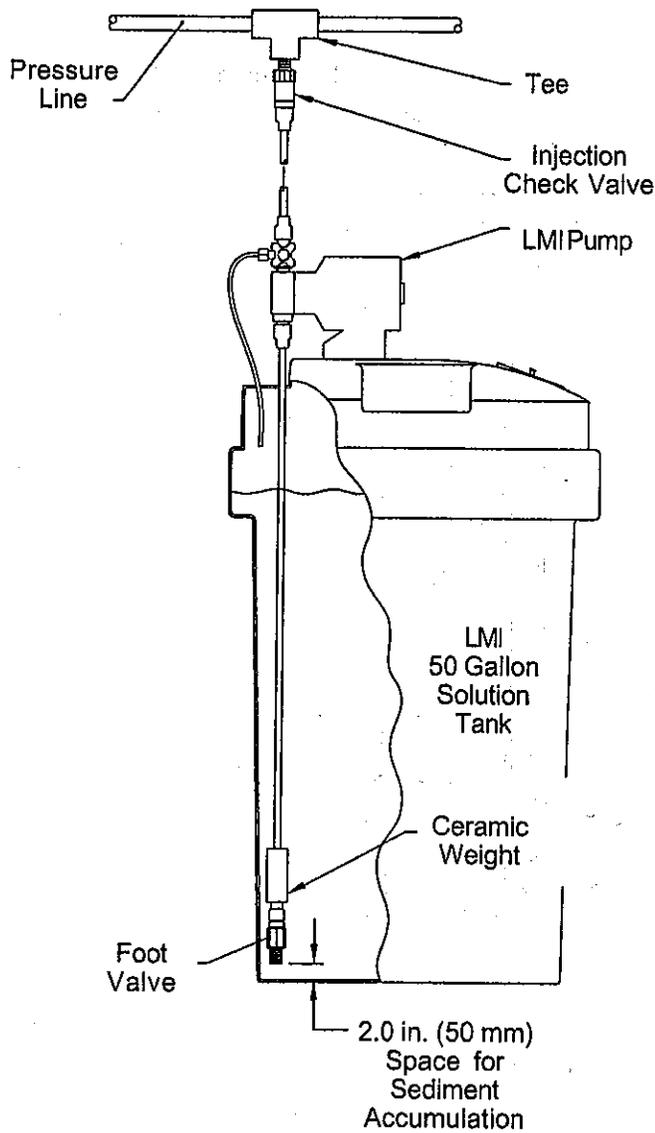
4.2.2 Suction Lift - Wall Bracket Mount

The pump may be mounted using an LMI Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.



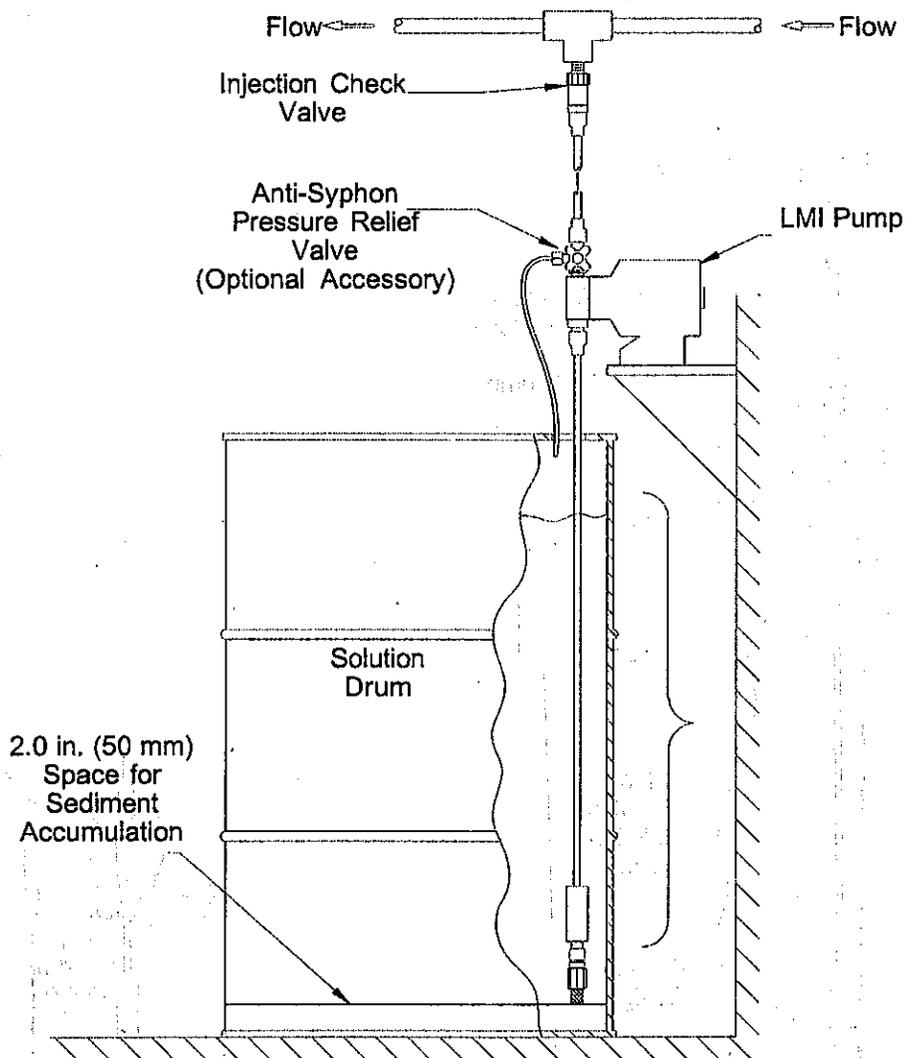
4.2.3 Suction Lift - Tank Mount

The pump may be mounted on a molded tank provided there is a recess to keep the pump stationary. LMI 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350) have molded recesses for pump mounting.



4.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m). An LMI mounting kit (part number 10461) is available for securing the pump to a shelf.



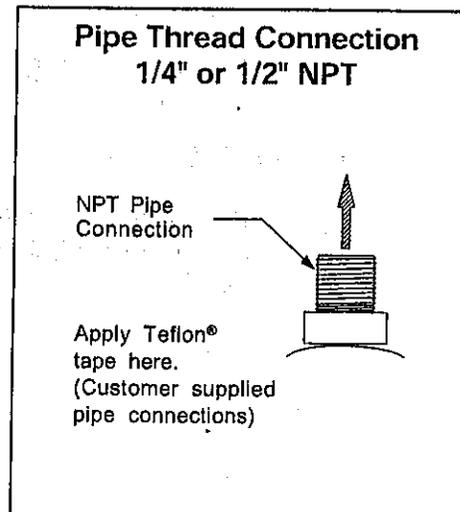
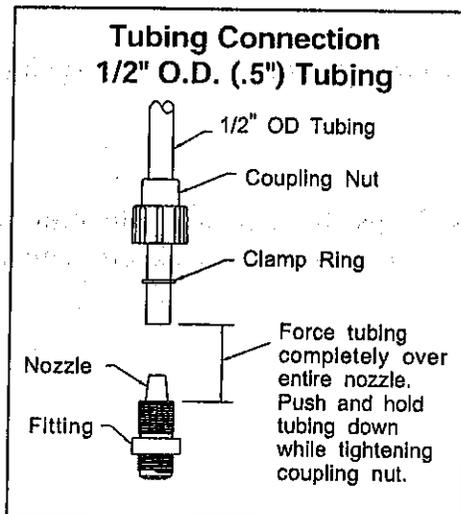
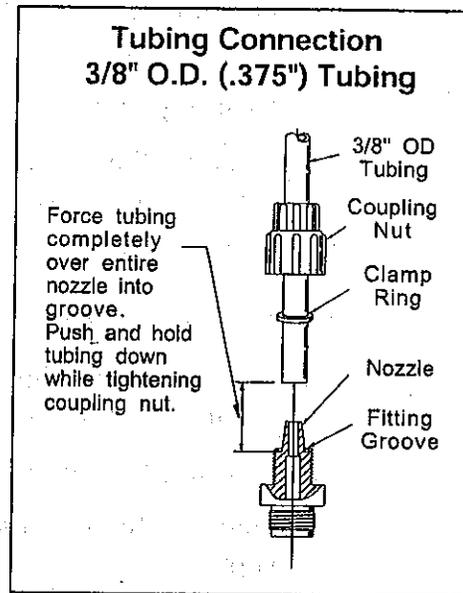
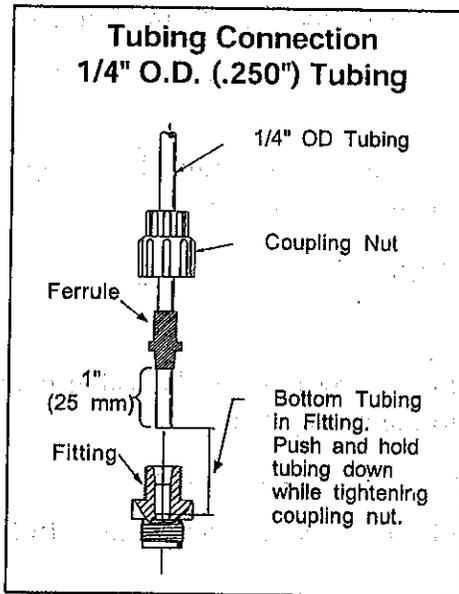
4.3 Tubing Connections



- A. Use only LMI tubing.
- B. **DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP.** The pressure created by the pump can rupture vinyl tubing.
- C. Before installation, all tubing must be cut with a clean square end.
- D. Valve and head connections from the factory are capped or plugged to retain pre-prime water. Remove and discard these caps or plugs before connecting tubing.



DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.



4.4 Multi-Function Valves

Your pump may be equipped with one of the following multi-function valves: 3-FV, 4-FV, Bleed 4-FV, or standard discharge valve. If your pump is not equipped with a multi-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI stocking distributor.

4.4.1 Three Function Valve (3-FV)

1. Pressure Relief

If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.

2. Line Depressurization

Opening the relief knob provides line drain back to the supply tank.

3. Priming Aid

Opening the relief knob assists in priming the pump by venting the discharge line to the atmosphere.

4.4.2 Four Function Valve (4-FV)

1. Pressure Relief

If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.

2. Line Depressurization

Opening the relief knob provides line drain back to the supply tank.

3. Anti-Syphon

Prevents syphoning when pumping solution downhill or into a vacuum.

4. Back Pressure

Supplies approximately 25 psi back pressure to prevent overpumping when little or no system back pressure is present.

4.4.3 Bleed Four Function Valve (Bleed 4-FV)

1. Line Depressurization

Opening the relief port provides line drain back to the supply tank.

2. Anti-Syphon

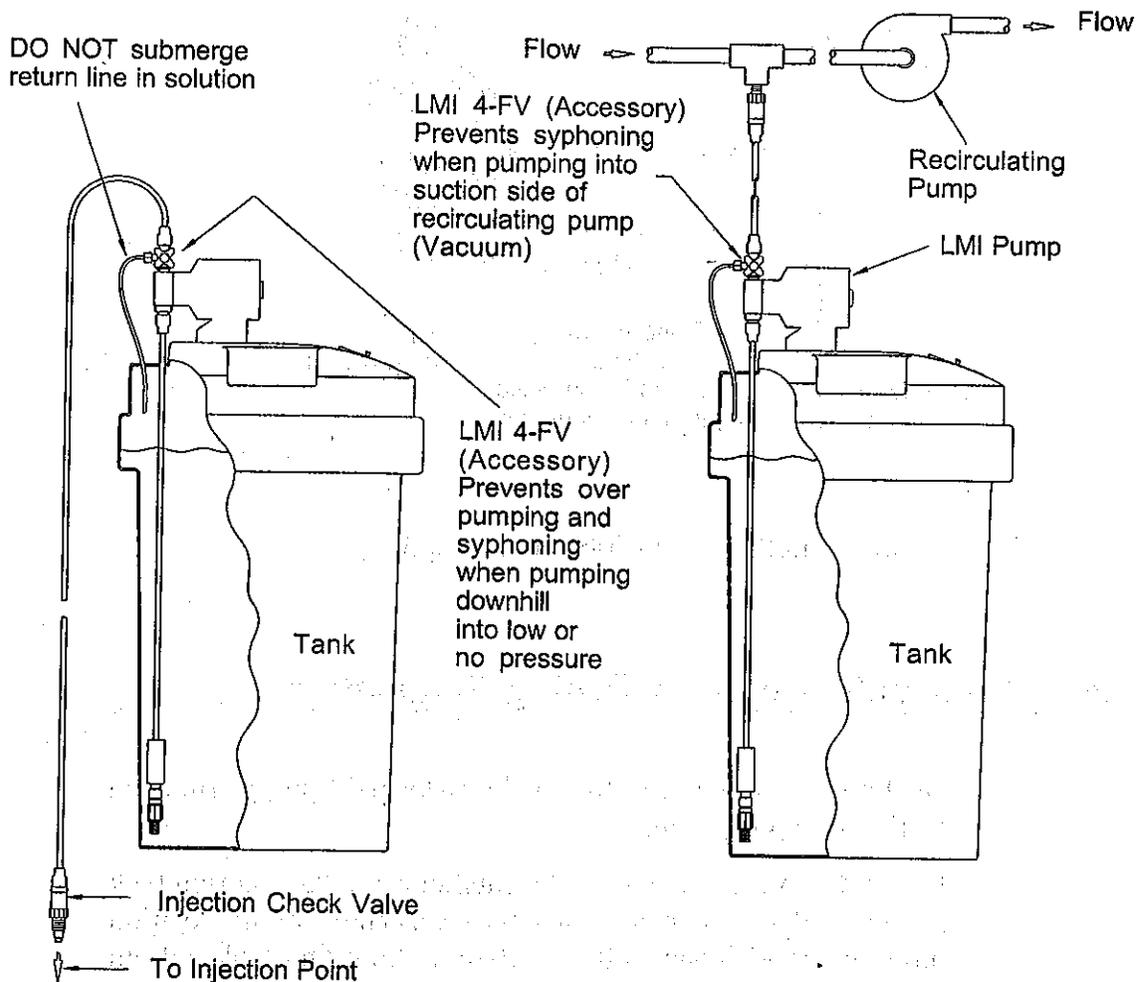
Prevents syphoning when pumping solution downhill or into a vacuum.

3. Back Pressure

Supplies approximately 25 psi back pressure to prevent overpumping when little or no system back pressure is present.

4. Bleed Function

Manually adjusted valve provides continuous bleed of entrapped vapors from Sodium Hypochlorite or Hydrogen Peroxide.



Typical 4-FV Installation

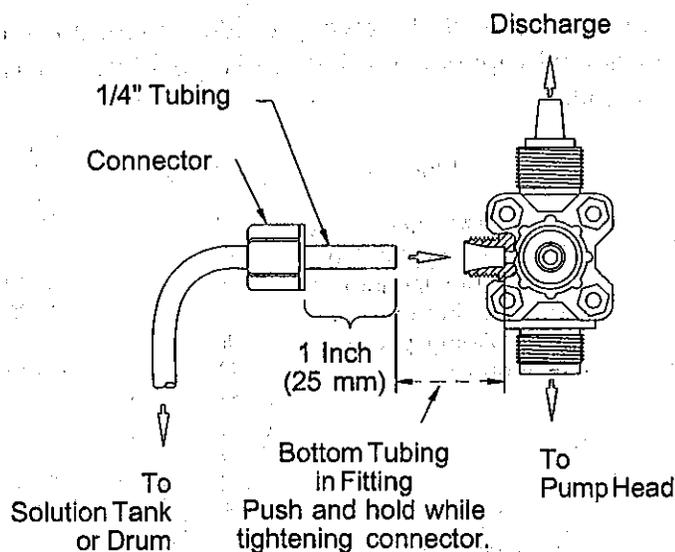
4.5 Multi-Function Valve Installation

To install the multi-function valve, remove the yellow screw cap on the top of the pump head and screw in the valve so that it contacts the seal ring. An additional 1/8 - 1/4 turn may be necessary to prevent leakage.

1/4" O.D. tubing connects to the side of the valve and acts as a return line to the solution tank. To ensure priming, this tubing must **NOT** be submerged in the solution.



This return line tubing must be secured to ensure pumped solution will safely return to supply tank.



Multi-Function Valve Tubing Connection

4.6 Foot Valve/Suction Tubing Installation

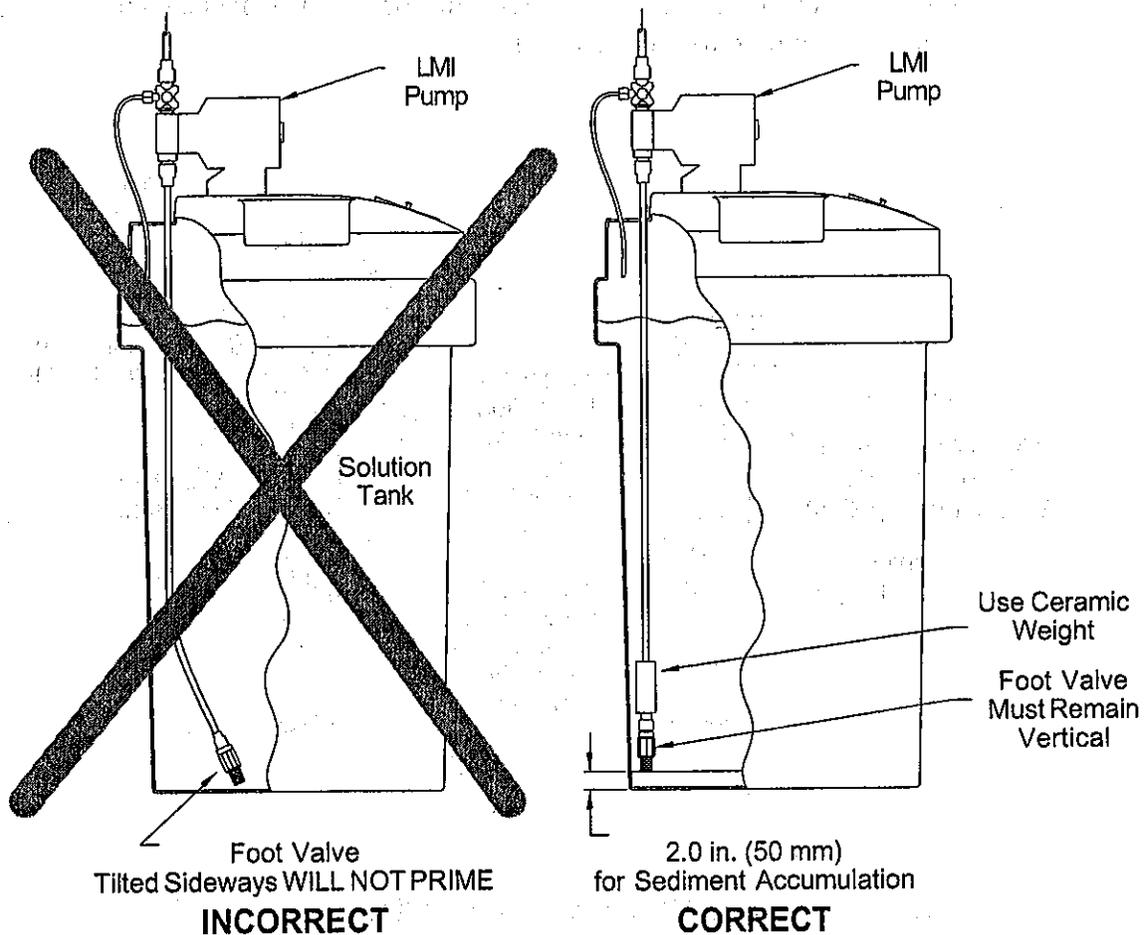
The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

The foot valve is designed to be submersed in the solution tank or drum and must sit in a vertical position at the bottom. Position approximately 2 inches (50 mm) off the bottom if the tank or drum contains sediment.

NOTE: Pump models equipped with high-viscosity liquid ends are not equipped with foot valves. Flooded suction is recommended. A 1/2" NPT connector is included for flooded suction installations.

The ceramic weight, when installed, positions the foot valve in a vertical position.

1. Attach the foot valve to one end of the suction tubing (see Tubing Connections, Section 4.3).
2. Slide the ceramic weight over the tubing end until it contacts the top of the foot valve coupling nut.
3. Place foot valve and tubing into the solution tank. Check that the foot valve is vertical and approximately 2 inches (50 mm) from the bottom of the tank or drum (see illustration). Connect the other end of the tubing to the suction side of the pump head (bottom side) (see Tubing Connections, Section 4.3).



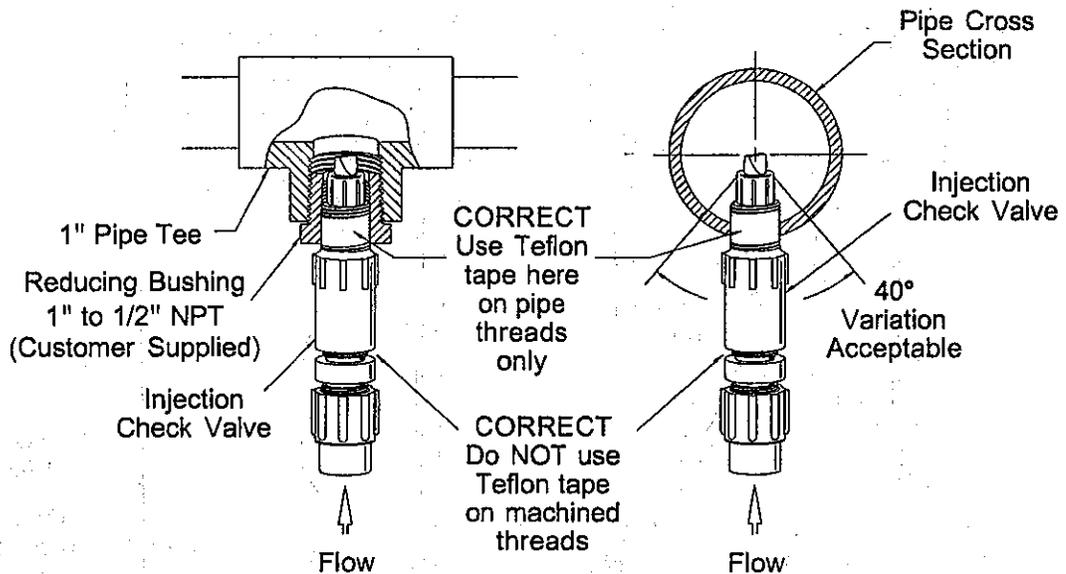
Proper Foot Valve Position

4.7 Injection Check Valve and Discharge Tubing Installation

The Injection Check Valve prevents backflow from a treated line. Connect the Injection Check Valve to your "DISCHARGE" (outlet) line. Any size NPTF fitting or pipe tee with a reducing bushing to 1/2" NPTF will accept the injection check valve. Use Teflon® tape or pipe dope to seal the pipe threads *only*.

When installing the Injection Check Valve, be sure to position it so that the valve enters the bottom of your pipe in a vertical position. Variations left and right within 80° are acceptable (see illustration below).

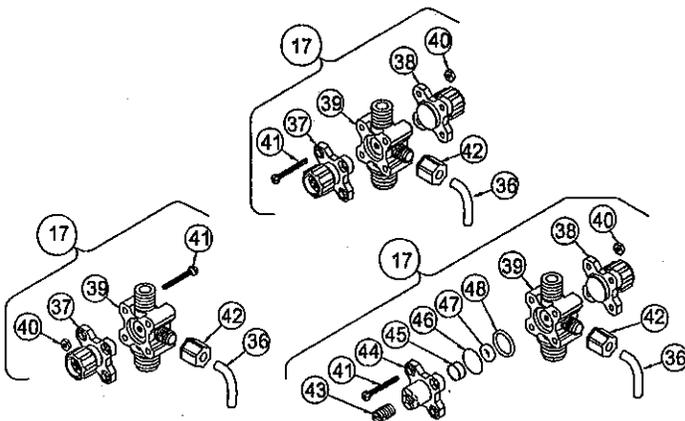
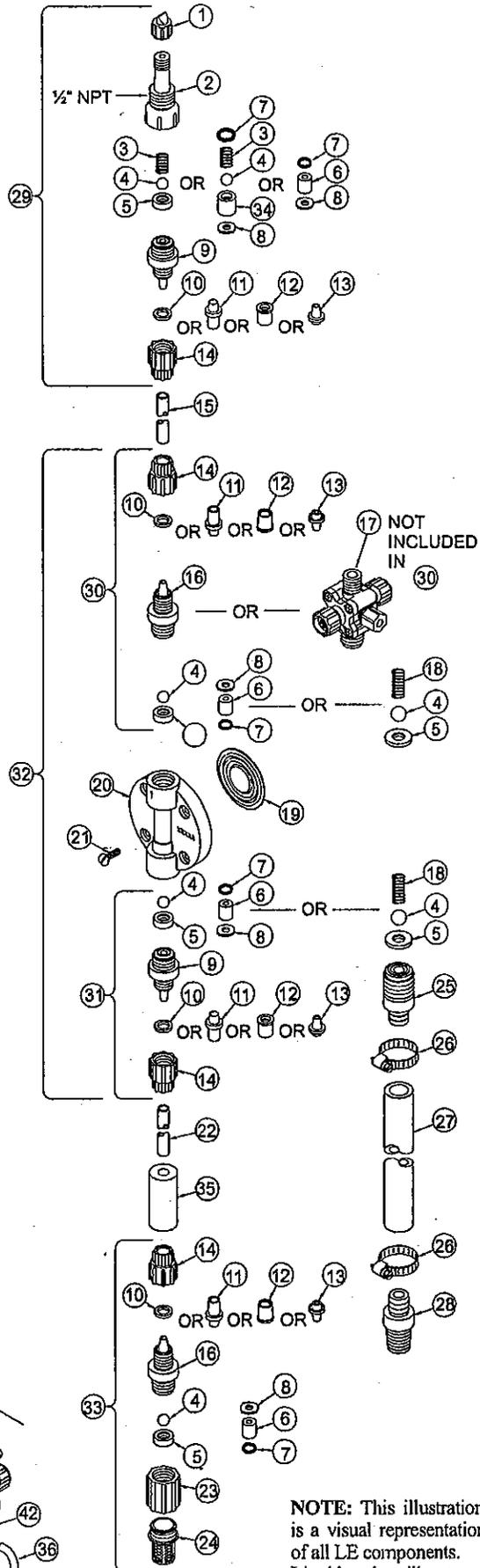
After cutting an appropriate length of tubing, connect tubing to the injection check valve then back to the discharge side of the pump head valve or discharge fitting (top side), making sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections, Section 4.3).



Typical Injection Check Valve Installations

5.0 Liquid End Parts List

- 1 Flapper valve
- 2 Injection check valve body
- 3 Injection check valve spring
- 4 Check valve ball
- 5 Seal ring
- 6 Cartridge valve
- 7 Cartridge valve o-ring
- 8 Cartridge valve washer
- 9 Valve seat
- 10 Clamp ring
- 11 Ferrule
- 12 Clamp sleeve
- 13 Tubing adapter
- 14 Coupling nut
- 15 Discharge tubing
- 16 Valve housing
- 17 Multi-function valve
- 18 High-viscosity spring
- 19 Liquifram
- 20 Pump head
- 21 Pump head screw
- 22 Suction tubing
- 23 Foot valve seat
- 24 Foot valve screen
- 25 High-viscosity valve seat
- 26 H.V. tubing clamp
- 27 H.V. suction tubing
- 28 H.V. Tubing x 1/2 NPT connector
- 29 Injection check valve assembly
- 30 Discharge valve assembly
- 31 Suction valve assembly
- 32 Pump head assembly
- 33 Foot valve assembly
- 34 Injection Seat PTFE
- 35 Ceramic Weight
- 36 Return Line
- 37 Cap ASM (Black Knob)
- 38 Cap ASM (Yellow Knob)
- 39 Multi-Function Valve Body
- 40 Nut Multi-Function Valve
- 41 Screw Multi-Function Valve
- 42 Return Line Coupling Nut
- 43 Adjustment Screw B/4-FV
- 44 Cap B/4-FV
- 45 Plug B/4-FV
- 46 Gasket B/4-FV
- 47 Small O-Ring B/4-FV
- 48 Large O-Ring B/4-FV



NOTE: This illustration is a visual representation of all LE components. Liquid ends will not include all parts shown.

6.0 Start-up and Adjustment



a.) *The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.*

b.) *Pumps are shipped from the factory with water in the pump head to aid in priming.*

6.1 Output Adjustment Controls



Manual series pump controls are not equipped with pressure control.

1. **Pressure Control Adjustment (if equipped):** Pressure control provides the adjustment of the pump's pressure capability and power consumption, reducing heat, pipe shock and pulsation while increasing pump life. See Section 7.0 after priming for proper adjustment settings.
2. **Speed Adjustment (Upper Knob) (if equipped):** Speed control provides adjustment of the percent of maximum strokes per minute. Turning this knob clockwise \odot increases stroke frequency (speed).
3. **Stroke Adjustment (Lower Knob):** Stroke control provides adjustment of the percent maximum of solution discharged during each pump actuation. Turning this knob clockwise \odot increases solution displacement.



A7 and P7 Only: When operating the pump in external mode, the speed control knob should be turned fully counter-clockwise \ominus .

A34 and A37 Only: Pump comes equipped with a range selector switch which provides high or low speed adjustment. The high setting provides speed adjustments between 8 and 100 strokes per minute. The low setting provides accurate speed adjustments between 1 and 12.5 strokes per minute for applications requiring infrequent stroking.

6.2 Start-Up/Priming for Pump Supplied with Multi-Function Valve



Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.



If the pump is equipped with pressure control, turn fully clockwise. ⌚

3. 1/4 turn open the relief side (black knob) of the multi-function valve.

3A. (Bleed 4FV only) With screwdriver rotate bleed adjustment screw counter-clockwise ⌚, 2 full turns. When solution begins to flow through translucent bleed return tubing, the pump is primed. Stop pump.

4. The suction tubing should begin to fill with solution from the tank.

5. A small amount of solution will begin to discharge out the return line of the multi-function valve. Once this happens, 1/4 turn or release the knob and **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord.)

6. The pump is now primed.

6A. (Bleed 4FV only)

a. Start pump and let pump inject solution into the discharge line.

b. Close the bleed adjustment screw by rotating it clockwise ⌚ with a screwdriver.

c. Now adjust the pump stroke length and/or speed (frequency) to a range approximately 25% higher than you would normally want for the process.

d. Slowly rotate bleed adjustment screw counter-clockwise ⌚ until just a small amount of solution begins to trickle

down inside the bleed return tubing. A small amount of solution pumped back to the tank with each stroke of the pump will allow gas and air to escape without air or gas locking in the pump head.

7. Proceed to output adjustment, Section 6.4.



If the pump does not self-prime, remove the multi-function valve on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

6.3 Start-Up/Priming without Multi-Function Valve



Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.



If the pump is equipped with pressure control, turn fully clockwise.

3. The suction tubing should begin to fill with solution from the tank.
4. Once the solution begins to exit the pump head on the discharge side, **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord).
5. The pump is now primed.

6. Proceed to output adjustment, Section 6.4.



If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the ball and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

6.4 Output Adjustment

Once the pump has been primed, an appropriate output adjustment **MUST** be made. Pump output should be calculated and adjustments made accordingly.

6.5 Total Pump Output

Calculate the total output of the pump as follows:

$$\text{PUMP OUTPUT} = \text{MAX PUMP OUTPUT} \times \% \text{ SPEED} \times \% \text{ STROKE}$$

Example: A151-392SI

Use MAX Output (from dataplate on bottom center of pump control panel) = 24 GPD (24 gallons per day).

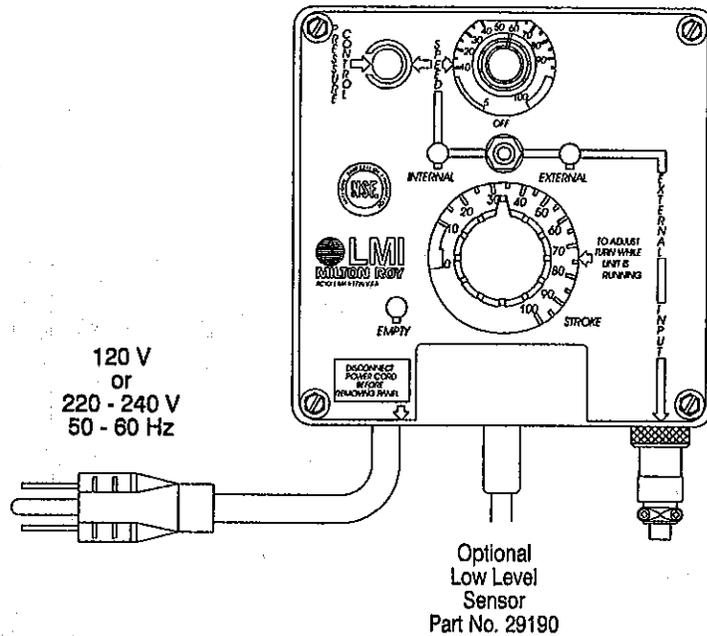
If the pump is set at 60% speed and 70% stroke length, the approximate pump output is:

$24.0 \times 0.60 \times 0.70 = 10.08$ GPD (gallons per day). Divide by 24 (hours in one day) to calculate in gallons per hour.

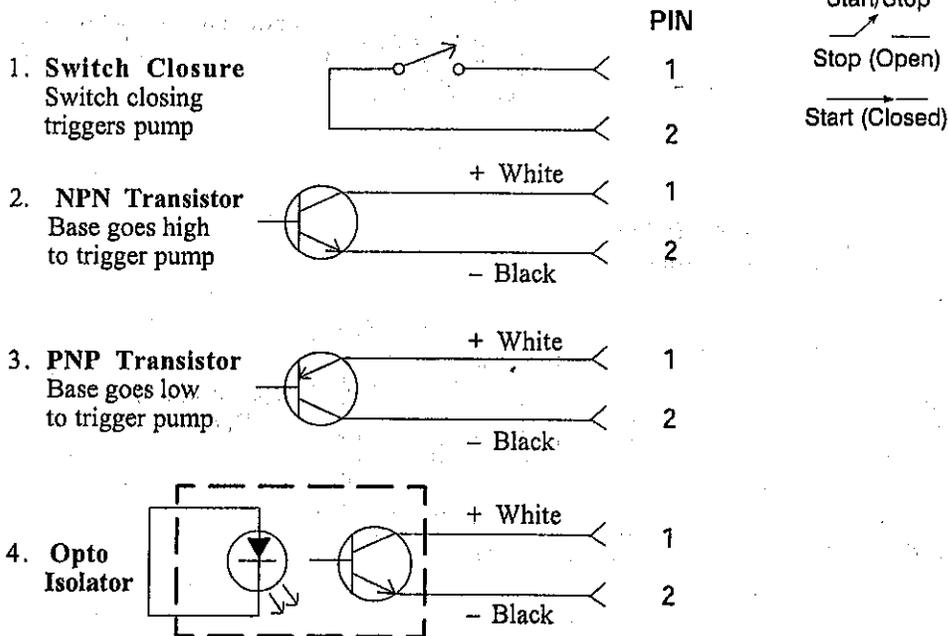


If pump is not equipped with speed adjustment, calculate by Max Pump Output x % Stroke only.

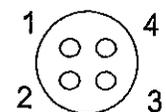
7.0 Methods of Externally Triggering



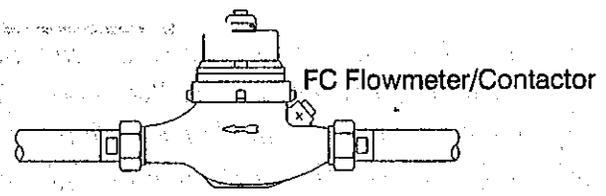
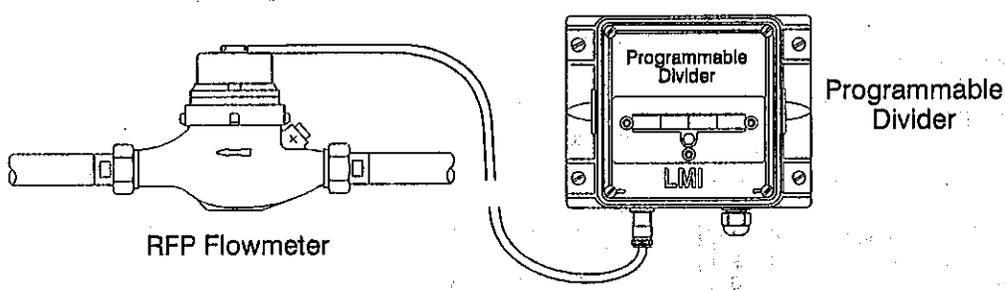
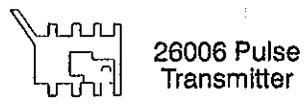
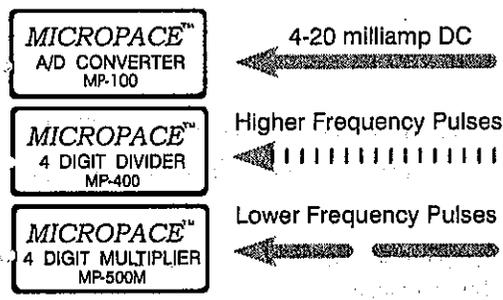
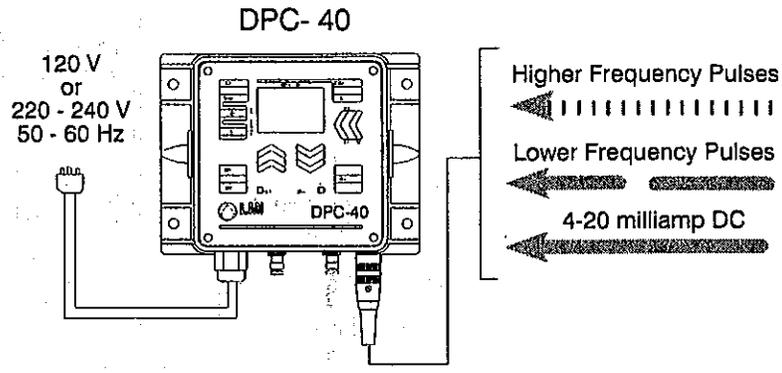
Method of Triggering LMI Pump Through 4-Pin Connector



Switch or transistors must be capable of switching 15V DC at 2 milliamperes. Minimum time in low impedance state (ON) is 50 milliseconds. Minimum time in high impedance state (OFF) is 100 milliseconds.



or Pacing A7, B7, C7 and P7 Pumps



8.0 Calibration

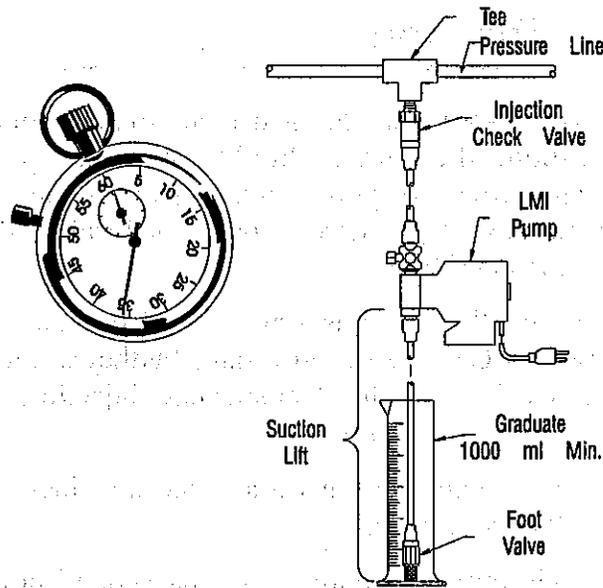
Once installation is complete and the approximate output has been determined, the pump should be calibrated to adjust speed and stroke for your actual desired output. (Calibration cylinders may be purchased from your local LMI distributor, ref. publication 1798.)

1. Be sure the pump is primed, and discharge tubing and Injection Check Valve are installed as they would be in normal service (i.e., including factors such as injection pressure, fluid viscosity, and suction lift).
2. Place the Foot Valve in a graduated container with a volume of 1000 ml or more.
3. Plug in and switch pump to Internal Mode. Pump until all the air is exhausted from the suction line and head.
4. Turn the pump off. Refill graduated container to a level starting point.



If pump is equipped with pressure control, see Section 8.1 before proceeding.

5. Using a stopwatch or timer, turn the pump on for a measured amount of time (50 pump strokes minimum). The longer the time period, the more confident you can be of the results. Be sure to count the number of strokes during the calibration period when making comparisons.
6. Turn the pump off. Note the time elapsed in relation to volume displaced in the graduate. Now, calculate the output in the time unit you choose (minutes, hours, days, etc.).
7. If the output is too low or too great, adjust speed and or stroke, estimating required correction and repeat steps 1-7.

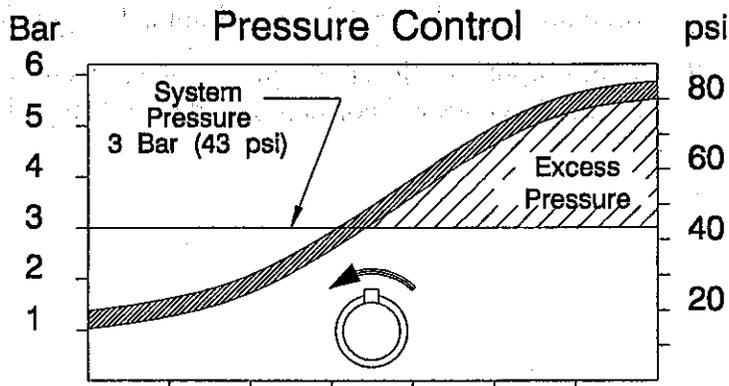


8.1 Pressure Control

Adjust Pressure Control: While unit is running, turn Pressure Control Potentiometer slowly counter-clockwise \odot until unit just begins to stall. From this stall point, now turn Pressure Control Potentiometer clockwise \odot halfway between the stall point and maximum setting. This is the optimum pressure control setting for your application.



Increase setting if backpressure is increased. Adjusting pressure control decreases pressure rating of pump.



Adjust pressure control to reduce heat, shock, and pulsations; and to prolong pump life.

8.2 Calibration Procedure - On-Site Volumetric Calibration in External Mode

1. Since pump output is governed by an external device such as Flowmeter-Pulser, Liquitron™ Controller, or 4-20 mA DC signal from an instrument with an LMI Analog-to-Digital Converter, **only the output per stroke may be calibrated.**
2. With pump primed and discharge tubing connected to the injection point as it would be in normal service, place Foot Valve and Strainer Assembly in a graduated container with a volume of 500 ml or more.
3. Switch pump to **Internal** mode with Speed Knob set at 100 until air is exhausted from suction line and pump head.
4. **Adjust Pressure Control (if desired)** - See Section 8.1.
5. Switch pump **OFF** and note solution level in graduated container. Refill graduate to a starting point.
6. Switch pump **ON** and **count the number of strokes** for exactly one minute, then switch pump **OFF**.
7. Note volume pumped during the calibration period of one minute. Divide into this the number of strokes to determine the volume of solution pumped per stroke.

Example: 500 ml in 100 strokes = 5.0 ml per stroke.

Multiply this by your expected stroke rate per minute, per hour or per day and compare with desired output requirements.

8. Adjust Stroke Length Knob (lower knob) to your best estimate of required correction and repeat calibration procedure.

9.0 Spare Parts Replacement Routine Maintenance

9.1 Depressurizing the Discharge Line (For Pumps Equipped with a 3-FV or a 4-FV only)



ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.



Read steps 1 and 2 below before proceeding.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.



Be sure your relief tubing is connected to your multi-function valve and runs back to your solution drum or tank.

2. 1/4 turn the black knob on the valve. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then 1/4 turn knob to normal position.

9.2 Liquifram™ (Diaphragm) Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

LMI metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the Liquifram™, cartridge valves or seal rings/valve balls, multi-function valve cap assemblies and the injection check valve spring. LMI recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

When replacing the Liquifram™ and the cartridge valves or seal rings/valve balls, the injection check valve spring should also be replaced (see next Section 9.3). A Spare Parts Kit (SP-#) or RPM Pro Pac™ kit containing these parts may be obtained from your local distributor.

Replacing the Liquifram:™

1. Carefully depressurize, drain, and disconnect the discharge line (see Section 8.1 in this manual). Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the Foot Valve out of the solution and continue to pump air into the pump head until the pump head is purged of water or neutralizing solution.



If the liquid cannot be pumped due to Liquifram™ rupture using protective clothing, gloves and face shield, carefully disconnect the suction and discharge tubing. Remove the four screws to the head and immerse the head in water or other neutralizing solution.



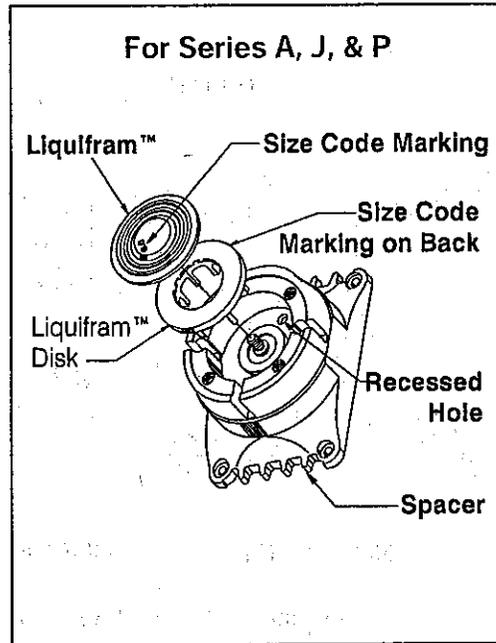
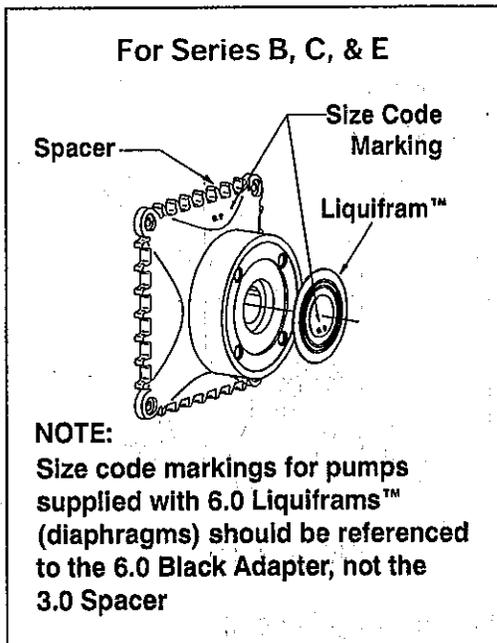
2. Start the pump. While running, set the stroke knob to zero and turn the pump off.

See Section 10.0 for proper zero.

3. With the unit off, unscrew the Liquifram™ by carefully grasping the outer edge and turning it counter-clockwise . Discard old Liquifram™. Remove the Liquifram™ disk if so equipped (located behind the Liquifram™) and check that the size code matches the size code on the replacement Liquifram™ (see illustration).
4. Reinstall the disk so the alignment pin on the disk (if present) seats in the recessed hole in the EPU.



Be careful not to scratch the Teflon® face of the new Liquifram™.



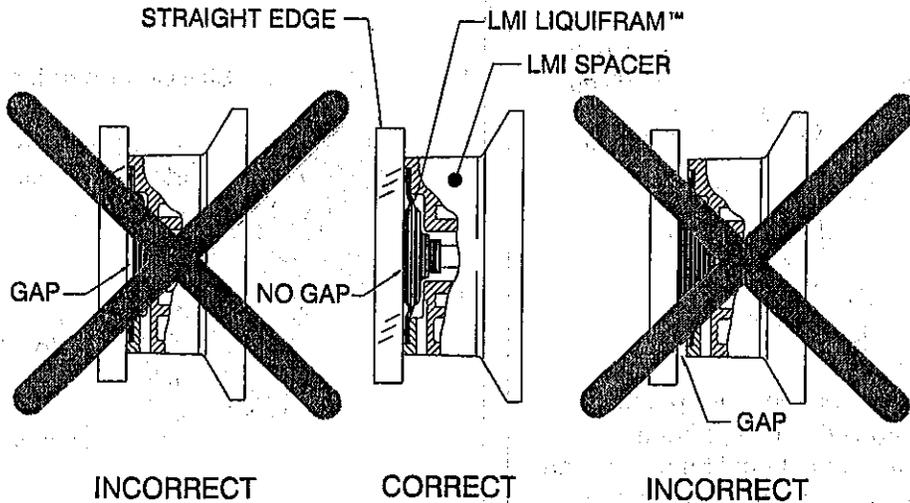
5. Start the pump and turn the stroke knob to the setting indicated on the following Stroke Setting Chart which matches the pump series number located on the pump dataplate. With the pump stroking (running), screw on the new Liquifram™ clockwise  until the center begins to buckle inwards. Stop the pump.

Liquifram™ Stroke Setting Chart

Pump Series	Stroke Knob Setting
All A, B, J, P, Z Series C10, C11, C12, C70, C71, C72, E70, E71, E72	90%
All L Series	85%
C78	50%
C13, C14, C73, C74, C77 E73, E74	70%
All M Series	100% *

* Liquifram™ on M Series pumps only, must be bottomed completely (turned all the way in). **Do Not Use Straight Edge.**

6. Grasp the outer edge of the Liquifram™ and adjust by screwing it in or out so that the center of the Liquifram™ is flush with the outside of the spacer edge (see illustration below).



(Liquifram™ is flush with spacer and straight edge.)

7. Once the Liquifram™ is properly positioned, remount the pump head to the spacer using the four (4) screws. Tighten in a criss-cross pattern. After one week of operation, recheck the screws and tighten if necessary.

9.3 Cartridge Valves, Seal Rings/Valve Balls and Injection Check Valve Spring Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

1. Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.
2. Carefully depressurize and disconnect the discharge line (see Section 9.1 in this manual). Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump has been flushed, lift the Foot Valve out and continue to pump to let air into the pump head until pump is purged of water or neutralizing solution.

Once the pump has been flushed, lift the Foot Valve out and continue to let air into the pump head until pump is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram™ rupture, with protective clothing, gloves and face shield, carefully disconnect the tubing and four screws to remove the head. Immerse the head in water or other neutralizing solution.

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.



IMPORTANT: *Before disassembling the check valves, note the orientation of the valve.*

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve.
If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.
4. Install new check valves in each location.

IMPORTANT: Note correct orientation of each check valve.

5. Install the new spring in the Injection Check Valve.



Depressurize and drain pipeline (or isolate I.C.V. point using valves) so that I.C.V. can safely be disassembled.

10.0 Checking Pump for Proper Zero Position (Stroke Knob)

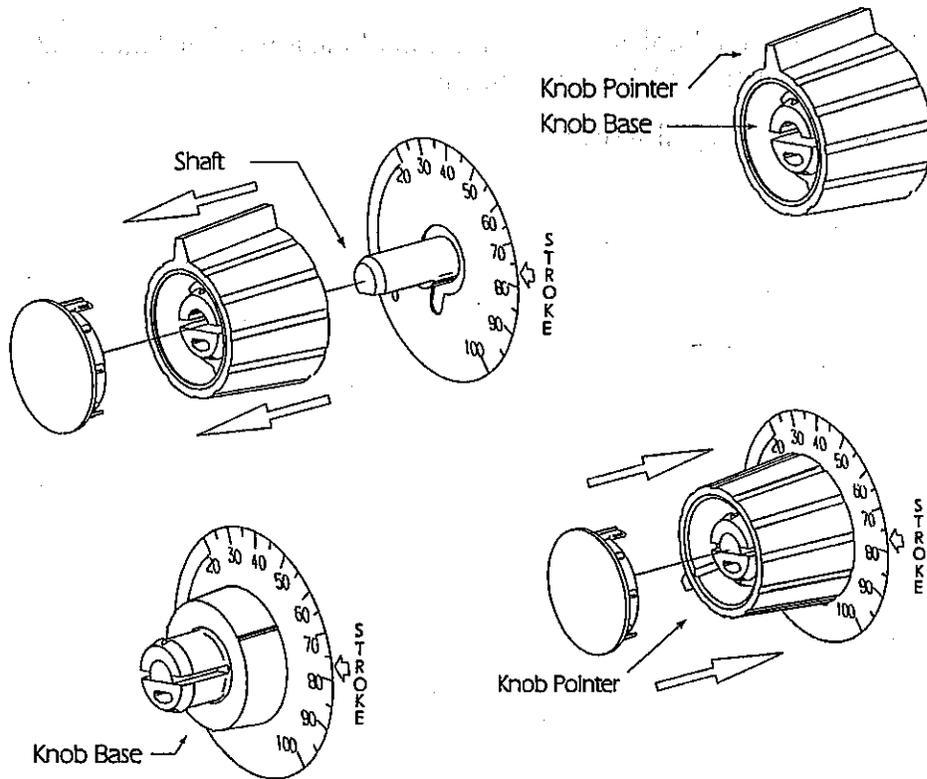
1. With pump running, turn stroke knob counter-clockwise \curvearrowright toward zero or end of black or red band on dial.
2. LISTEN to the clicking as the pump is running. The pump should operate quietly at the zero position (no clicking).
3. If the pump continues to click at zero or stops clicking before zero is reached, the pump zero must be reset (see Section 10.1 or 10.2).

10.1 Type I - Push on Knob Re-Zeroing and Stroke Knob Disassembly and Assembly

1. Remove stroke knob from the pump by grasping the knob firmly and pulling it toward you.
2. Pry off the yellow cap.
3. Place the knob on a flat surface.
4. Using needle-nose pliers, squeeze the inner section together while lifting the outer section up.
5. Push the inner section back onto the "D" shaped stroke shaft.
6. With the pump running, zero the pump by turning the inner section of the knob counter-clockwise \curvearrowright until the pump stops clicking.

7. Position the outer section of the knob so that the pointer aligns with zero on the nameplate or end of the black or red band.
8. Push down on the outer section (a snap sound indicates parts are locked together).
9. Replace the yellow cap over the outer section of the knob, aligning the tabs on the cap with the slots inside the knob.

Stroke Knob Assembly (Type I)



10.2 Type II Collet Knob Re-Zeroing and Stroke Knob Disassembly and Assembly

1. Remove Yellow Cap.
2. Hold knob with soft jaw pliers.
3. Disconnect knob by loosening 5/16" (8 mm) collet nut. There is no need to remove nut.
4. Remove knob by pulling towards you.
5. With pump running, zero the pump using a screw driver to turn the stroke shaft counter-clockwise \odot until the pump just stops clicking.
6. Pump is now zeroed.
7. Position knob at zero, or the end of the low range band, and tighten 5/16" (8 mm) collet nut.
8. Replace yellow cap.

11.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE
Pump Will Not Prime	1. Pump not turned on or plugged in.
	2. Output dials not set properly.
	3. Foot Valve not in vertical position on bottom of tank.
	4. Pump suction lift too high.
	5. Suction tubing is curved or coiled in tank.
	6. Fittings are over tightened.
	7. Air trap in suction valve tubing.
	8. Too much pressure at discharge. (Pumps without multi-function valve.)
Pump Loses Prime	1. Solution container ran dry.
	2. Foot Valve is not in a vertical position on the bottom of the tank.
	3. Pump suction lift is too high.
	4. Suction tubing is curved or coiled in tank.
	5. Fittings are over tightened.
	6. Air trap in suction valve tubing.
	7. Air leak on suction side.

	SOLUTION
	1. Turn on pump/plug in pump.
	2. Always prime pump with speed at 80% and stroke at 100%.
	3. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	6. Do not overtighten fittings. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	7. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve (see Priming Section 6.0). When pump is primed, reconnect discharge tubing.
	1. Refill container with solution and reprime (see Section 6.0).
	2. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	5. DO NOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which caused pump to leak back or lose prime.
	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	7. Check for pinholes, cracks. Replace if necessary.

Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE
Leakage at tubing	1. Worn tubing ends.
	2. Loose or cracked fitting.
	3. Worn seal rings.
	4. Solution attacking Liquid Handling Assembly material.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.
	2. Worn Seal Rings.
	3. Ruptured Liquifram™.
	4. Incorrect stroke length.
	5. Tubing run on discharge may be too long.
	6. Clogged Foot Valve strainer.
Failure to Run	1. Pump not turned on or plugged in.
	2. EPU failure.
	3. Pulser failure.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).
	2. Little or no pressure at injection point.
	3. Excessive strokes per minute.

	SOLUTION
	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Replace fitting if cracked. Carefully hand tighten fittings. <i>DO NOT USE PIPE WRENCH.</i> Once fitting comes into contact with seal ring, tighten an additional 1/8 or 1/4 turn.
	3. Replace balls and seal rings (see Section 8.3) Spare Parts (SP-#).
	4. Consult your local distributor for alternate materials.
	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn seal rings or cartridge valves may need replacement (see Section 9.3). Spare Parts (SP- #), or RPM Pro Pac™ kit.
	3. Replace Liquifram™ (see Section 9.2).
	4. Check zero on pump/Re-zero pump (see Section 10.0).
	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating. Consult factory for more information.
	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
	1. Turn on or plug-in pump.
	2. Disassemble pump and measure the resistance of the EPU across the EPU wires. Resistance reading should be in accordance to the EPU Resistance Chart (see Section 12.0). Also, check EPU leads to ground. Consult supplier or factory.
	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
	1. Move injection point to a pressurized location or install an LMI 4-FV (see Section 4.4).
	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI 4-FV should be installed (see Section 4.4).
	3. Replace pulser or resistor. Consult factory.

12.0 EPU Resistance Chart

Pump Series	Voltage	Coil Resistance (Ohms) @ 20° C (68° F)*
A14, A15, A16, A34 A74, A75, A76 A94, A95, A96 J02, J03, J04, J05, J06 J13, J15, J16 PW4, PW5, PW6 P04, P05, P06 P14, P15, P16 P74, P75, P76 U01, U02, U03	115 VAC 230 VAC	76 - 87 307 - 353
(see Note 1) A17, A37, A77, A97, A18, A78 P02, P03 P12, P13	115 VAC 230 VAC	152 - 176 583 - 671
(see Note 2) A17, A37, A77, A97, A18, A78 P02, P03 P12, P13	115 VAC 230 VAC	76 - 87 291 - 335
J54D, J55D, J56D	12 VDC	1.1 - 1.3
D10, D11, D12, D13, D14 D70, D71, D72, D73, D74	115 VAC 230 VAC	25.7 - 29.6 97 - 112
E70, E71, E72, E73, E74	115 VAC 230 VAC	22.8 - 26.2 91 - 105
B11, B12, B13, B14 B71, B72, B73, B74	115 VAC 230 VAC	43 - 49 167 - 193
C10, C11, C12, C13, C14 C70, C71, C72, C73, C74	115 VAC 230 VAC	22.8 - 26.2 91 - 105
C77, C78	115 VAC 230 VAC	14.4 - 16.6 57.7 - 66.3

* Let pump cool down completely before checking resistance. EPU checked within 10 hours of operation can increase coil resistance reading as much as 20%.

NOTES:

1. Pumps with serial numbers LOWER than: 960113429
2. Pumps with serial numbers HIGHER than: 960113429

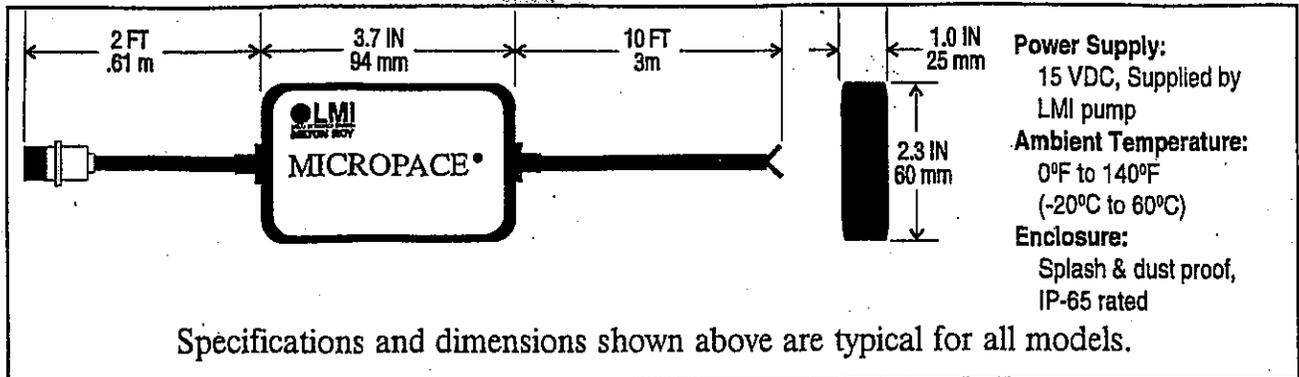


8 Post Office Square
Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
<http://www.lmipumps.com>

MICROPACE®

Electronic Metering Pump Control Modules INSTRUCTIONS • INSTALLATION

- MP-100 Analog to Digital Converter
- MP-400D Pulse Divider
- MP-500M Pulse Multiplier



MP-100 Analog to Digital Converter

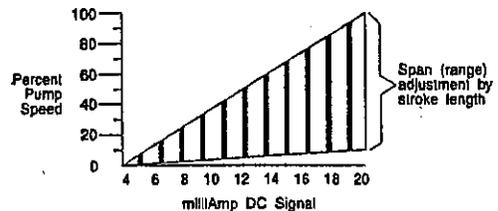
Input Signal Source: 4-20 mA (isolated) only.

Max Input Voltage: 42VDC

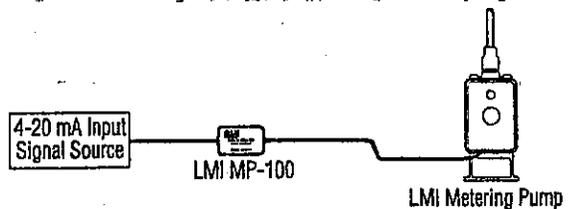
Impedance: 100 Ohms

INSTALLATION

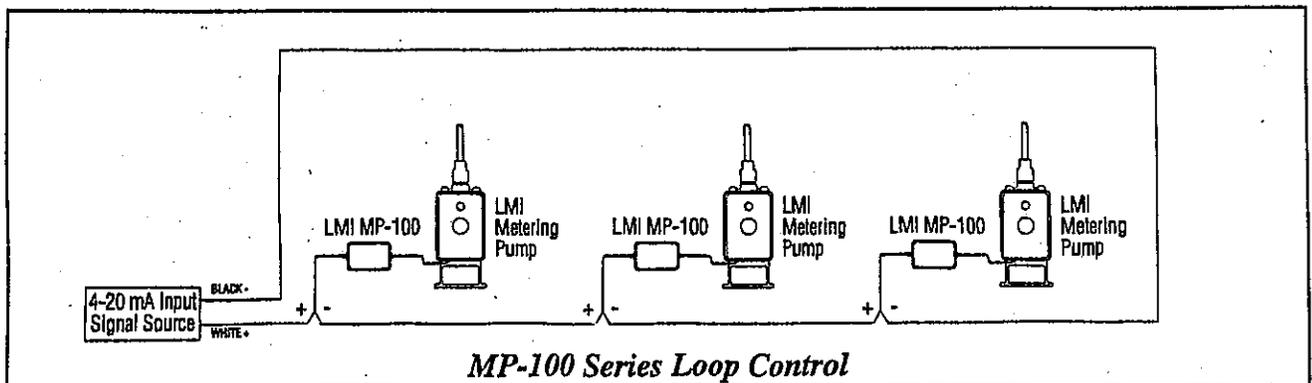
1. Disconnect signal source supply voltage prior to connecting your MP-100. Failure to do so may damage the MP-100 circuit.
2. Insert the 4-pin connector into the socket on your LMI Series A7, B7 or C7 Metering Pump. The socket is located on the bottom right under the pump control panel.
3. Connect the other end of the cable to your input signal source. Polarity is: white = positive (+); black = negative (-).



MP-100 Adjustment Range



MP-100 Typical Installation



LMI
LIQUID METRONICS DIVISION
MILTON ROY

ISO9001 Certified • a unit of Sundstrand Corporation

8 Post Office Square
Acton, MA 01720 USA
TEL: (508) 263-9800
FAX: (508) 264-9172

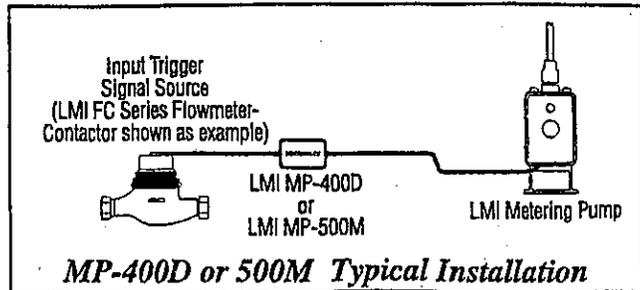
MP-400D Pulse Divider (Counter)
MP-500M Pulse Multiplier (Batch Signal Converter)

Max. batch count or multiplier (MP-500M): 1023 pulses
 Pulse output rate or speed (MP-500M): fixed, 100 ±2 pulses per minute

Switch Input (MP-400D & MP-500M):

- A. 'On' Resistance: 5K ohms max.
- B. 'Off' Resistance: 100K ohms min.

Min. switch closure time (MP-400D & MP-500M)
low impedance state (on) : 10 milliseconds
 Min. switch opening time (MP-400D & MP-500M)
high impedance state (off) : 20 milliseconds
 Max. count speed or frequency (MP-400D):
 1800 pulses per minute (30Hz)



INSTALLATION

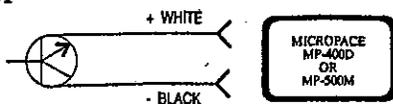
1. The MP-400D and MP-500M Signal Converters may be preset before connection to the pump or signal source, or may also be adjusted after connection.
2. Open the MP-400D or MP-500M cover by removing the four screws that hold the back cover on.
3. Follow the instructions inside the cover to set your Signal Converter. Use a pencil or ball point pen to slide the switches.
4. Replace the cover and the four screws.
5. Insert the 4-pin connector into the socket on your LMI Series A7, B7 or C7 Metering Pump. The socket is located on the bottom right under the pump control panel.
6. Connect the other cable to your input signal source. Polarity is: white = positive(+); black = negative (-).
7. Switch your pump to EXTERNAL. The count, division or multiplication will begin immediately. Switching the pump to OFF or unplugging the pump will reset the count.

METHODS OF TRIGGERING MP-400 AND MP-500M

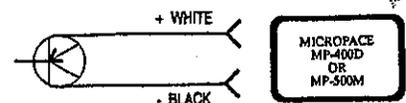
1. Switch closure
 switch closing trigger



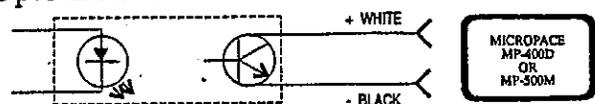
2. NPN Transistor
 Base goes high



3. PNP Transistor
 Base goes low



4. Opto Isolator



NOTE: Switch or transistors must be capable of switching 2 milliamperes @ 15V DC.
 Combining additional MICROPACE® units will increase the milliampere demand.

Liquid End Sheet

LE-151S / 151SU / 152S / 152SU

When pumping solutions, make certain that all tubing is securely attached to the fittings. It is recommended that tubing or pipe lines be shielded to prevent possible injury in case of rupture or accidental damage. Always wear protective clothing and face shield when working on or near your metering pump.

Note: See parts list for materials of construction

A. INSTALLING INJECTION CHECK VALVE

1. The purpose of the injection check valve is to prevent backflow from the treated line.
2. A 1/2" NPT female fitting with sufficient depth will accept the injection check valve.
3. To insure correct seating of the ball inside the injection check valve, the injection check valve should be installed upwards (vertically) into bottom of the pipe.

B. CONNECTING DISCHARGE TUBING

NOTE:

Cut tubing to length needed for discharge line.

1. Route tubing from the injection check valve to the metering pump, making sure it does not touch hot or sharp surfaces, or is bent so sharply that it kinks.
2. Slide the small end of the coupling nut onto tubing.
3. Slide the long, straight end of the ferrule onto tubing such that tubing exits at the cone shaped end of the ferrule.
4. Insert tubing into the valve housing so that tubing butts up against valve housing and will not go any further.
5. Slide ferrule down so that the cone shaped end fits snugly into valve housing.
6. Slide the coupling nut to the threads and engage. While pushing the tubing into valve housing, tighten the coupling nut by hand until tubing is held securely in place.

**EXCESSIVE FORCE WILL CRACK OR DISTORT FITTINGS.
DO NOT USE PIPE WRENCH.**

C. CONNECTING SUCTION TUBING

1. Cut suction tubing to a length so that the foot valve hangs just above the bottom of the solution container. Maximum recommended vertical suction lift is 5 ft (1.5 m).
2. Follow same procedure in connecting suction tubing to suction valve and foot valve (see B. Connecting Discharge Tubing).

D. PRIMING

1. Connect pressure relief tubing to pressure relief port on the four function valve.
2. Route tubing to solution reservoir and anchor with a plastic tie. Do not submerge tubing in solution.
3. Start pump. Set at 80% speed and 100% stroke.
4. Pull on Pressure Relief knob (red or black knob), holding knob out until solution is visible through translucent return tubing.
5. The pump is now primed.

NOTE:

(a) Pump is normally self-priming if suction lift is not more than 5 ft (1.5 m), valves in the pump are wet with water (pump is shipped from factory with water in pump head) and the above steps (D. Priming) are followed.
(b) If the pump does not self prime, remove discharge valve housing and ball and pour water or solution slowly into discharge port until head is filled. Follow step D. Priming thereafter.

E. DEPRESSURIZING DISCHARGE LINE

1. It is possible to depressurize the discharge line and pump head without removal of tubing or loosening of fittings.

Be sure injection check valve is properly installed and is operating. If a gate valve or globe valve has been installed downstream of injection check valve, it should be closed. Be certain relief tubing from the four function valve is connected and run to solution reservoir.

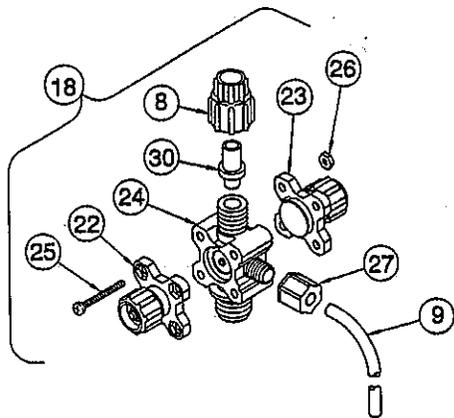
2. Pull on both anti-syphon and relief knobs.
3. The discharge line is now depressurized.
4. If injection check valve is of higher elevation than pump head, disconnecting tubing at injection check valve end will allow air to enter and cause solution to drain back to tank.



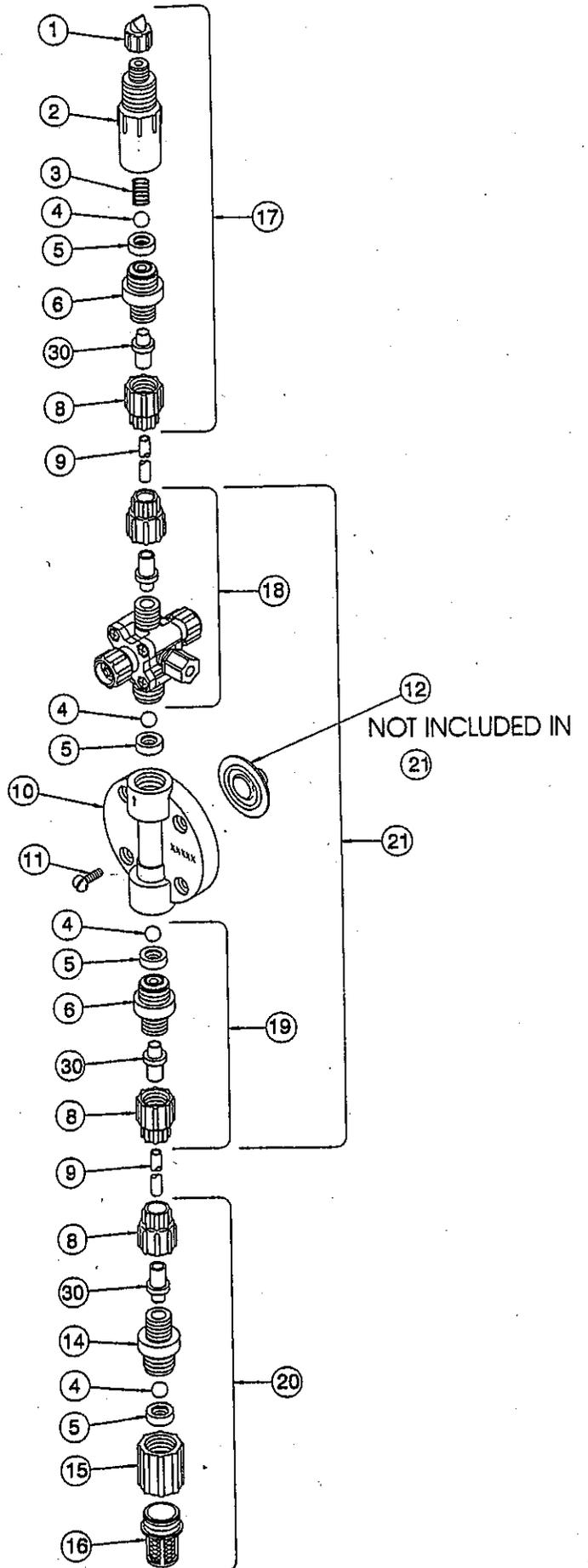
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Replaces same of G 12/94
1396.H 2/97





Note:
 Threaded connects into pump head at 3/4" - 16
 straight threads. Do not use Teflon tape. These joints
 are sealed by seal ring valve seats (item 5 on exploded
 view)



KEY NO.	PART NO.	DESCRIPTION	QUANTITY			
			LE-151S	LE-151SU	LE-152S	LE-152SU
1	27352	Flapper Valve, Flexoprene	1	1	1	1
2	10394	Injector Fitting, Polypropylene	1	1		
	26841	Injector Fitting, PVDF			1	1
3	10339*	Spring, PVDF	1	1	1	1
4	10338*	Ball, Ceramic .375	4	4	4	4
5	29443*	Seal Ring, Polyprel	4	4	4	4
6	28664	Valve Seat, Polypropylene .250	2	2		
	28882	Valve Seat, PVDF .250			2	2
8	10299	Coupling Nut	4	4	4	4
9	25636-16	Tubing, .250" O.D. Polyethylene	1		1	
	25636-10	Tubing, .250" O.D. Polyethylene	1		1	
	28636-16	Tubing, .250" O.D. U.V. Resistant PE		1		1
	28636-10	Tubing, .250" O.D. U.V. Resistant PE		1		1
10	29608	Head, 0.5 SI GFR Polypropylene	1	1		
	29609	Head, 0.5 SI PVDF			1	1
11	10340	Screw, 10-24 x 3/4" SS	4	4	4	4
12	30916*	Liquifram, 0.5 Fluorofilm	1	1	1	1
14	28665	Valve Housing, Polypropylene .250	1	1		
	28883	Valve Housing, PVDF .250			1	1
15	10978	Foot Valve Seat	1	1	1	1
16	10123	Strainer, Polypropylene	1	1	1	1
17	28001	Inj. Check/Back Pressure Valve Asm	1	1		
	28037	Inj. Check/Back Pressure Valve Asm			1	1
18	28010	Anti-Syphon/Pressure Relief Valve Asm	1			
	31693	Anti-Syphon/Pressure Relief Valve Asm		1		
	28046	Anti-Syphon/Pressure Relief Valve Asm			1	
	31694	Anti-Syphon/Pressure Relief Valve Asm				1
19	28004	Suction Valve Asm	1	1		
	28040	Suction Valve Asm			1	1
20	28002	Foot Valve Asm	1	1		
	28038	Foot Valve Asm			1	1
21	28071	Head Asm, LE-151S	1			
	31688	Head Asm, LE-151SU		1		
	28077	Head Asm, LE-152S			1	
	31687	Head Asm, LE-152SU				1
22	25837	Relief Cap Assembly	1	1		
	27044	Relief Cap Assembly			1	1
23	25838	Anti-Syphon Cap Assembly	1	1		
	27045	Anti-Syphon Cap Assembly			1	1
24	28703	Valve Body, Polypropylene .250	1	1		
	28704	Valve Body, PVDF .250			1	1
25	25627	Screw, 6-32 x 1 1/4" SS	4	4	4	4
26	25628	Nut, Hex 6-32 SS	4	4	4	4
27	25631	Coupling Nut	1	1	1	1
30	28663	Ferrule	4	4	4	4
NS	32293	Tubing Straightner Asm.	1	1	1	1

*Parts included in Spare Parts Kit SP-U8



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Information Sheet

Liquid End Installation Instructions

When pumping solutions, make certain that all tubing is securely attached to the fittings. It is recommended that tubing or pipe lines be shielded to prevent possible injury in case of rupture or accidental damage. Always wear protective clothing and face shield when working on or near your metering pump.

Spare Parts: LMI recommends replacing the elastomeric components of the pump on an annual basis. RPM Pro Pacs™ and spare part kits are available from your local LMI Master Stocking Distributor.

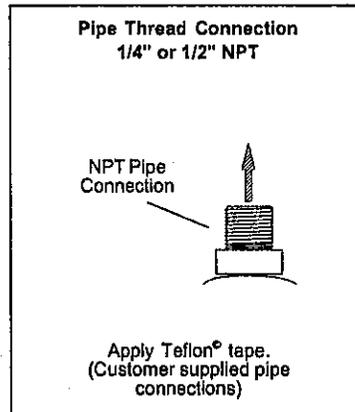
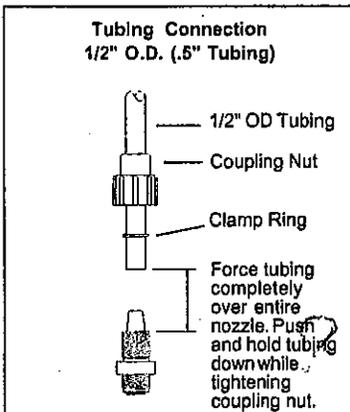
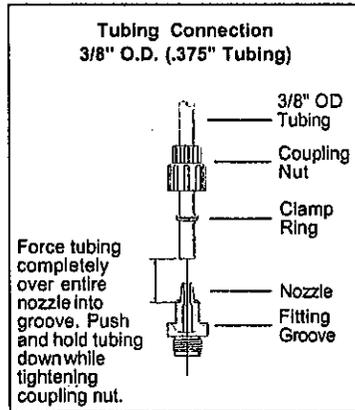
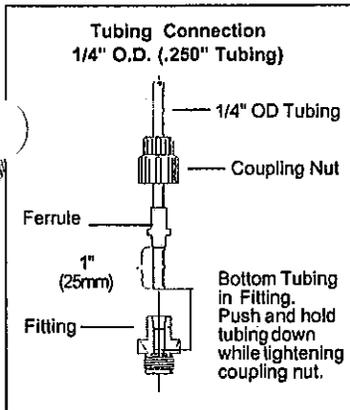
Tubing Connections

Your LMI pump will be supplied with one of the following tubing connections. Before installation, all tubing must be cut with a clean square end. Valve and head connections from the factory may be capped. Remove and discard these caps before connecting the tubing.

DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP.

(Pressure can rupture tubing.)

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

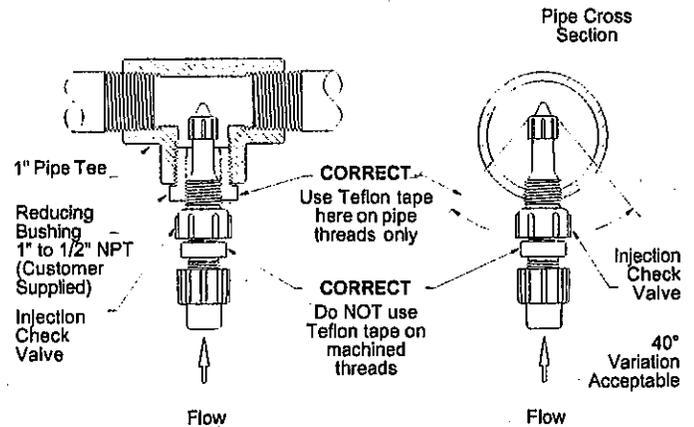


Injection Check Valve and Discharge Tubing Installation

The Injection Check Valve prevents backflow from a treated line. Connect the Injection Check Valve to your "DISCHARGE" (outlet) line. An NPTF fitting or pipe tee with a reducing bushing to 1/2" NPTF will accept the injection check valve. Use Teflon® tape or pipe dope to seal the pipe threads *only*.

When installing the Injection Check Valve, be sure to position it so that the valve enters the bottom of your pipe in a vertical position. Variations left and right within 40° are acceptable (see illustration below).

After cutting an appropriate length of discharge tubing, connect tubing to the injection check valve then back to the discharge side of the pump head valve or discharge fitting. Make sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections).



Typical Injection Check Valve Installations



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Foot Valve/Suction Tubing Installation

The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

The foot valve is designed to be submersed in the solution tank or drum and must sit in a vertical position at the bottom. Position approximately 2 inches (50 mm) off the bottom if the tank or drum contains sediment. The ceramic weight, when installed, positions the foot valve in a vertical position.

NOTE: Pump models equipped with high-viscosity liquid ends are not equipped with foot valves. Flooded suction is recommended. A 1/2" NPT connector is included for flooded suction installations.

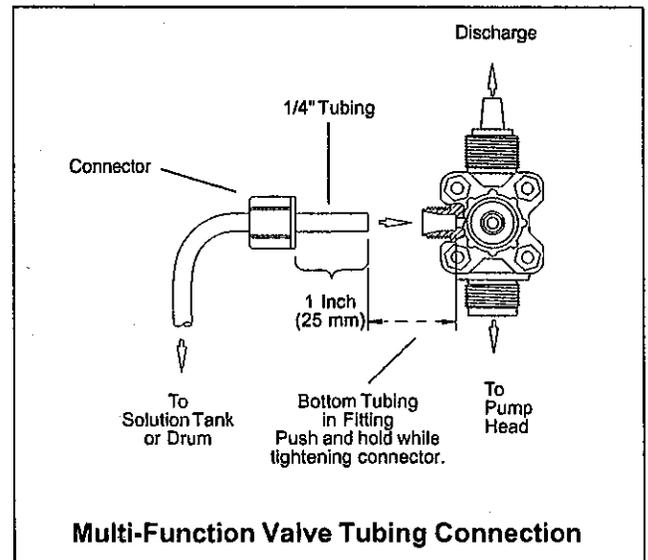
1. Cut a piece of suction tubing to a length so that the foot valve hangs just above the bottom of the solution container. Maximum recommended vertical suction lift is 5 feet (1.5 m).
2. Attach the foot valve to one end of the suction tubing.
3. Slide the ceramic weight over the tubing end until it contacts the top of the foot valve coupling nut.
4. Place foot valve and tubing into the solution tank. Check that the foot valve is vertical and approximately 2 inches (50 mm) from the bottom of the tank or drum (see illustration). Connect the other end of the tubing to the suction side (bottom side) of the pump head (see Tubing Connections).

Multi-Function Valve Installation

To install the multi-function valve, remove the yellow screw cap on the top of the pump head and screw in the valve so that it contacts the seal ring. An additional 1/8 – 1/4 turn may be necessary to prevent leakage.

1/4" O.D. tubing connects to the side of the valve and acts as a return line to the solution tank. To ensure priming, this tubing must NOT be submerged in the solution.

This return line tubing must be secured to ensure pumped solution will safely return to supply tank.

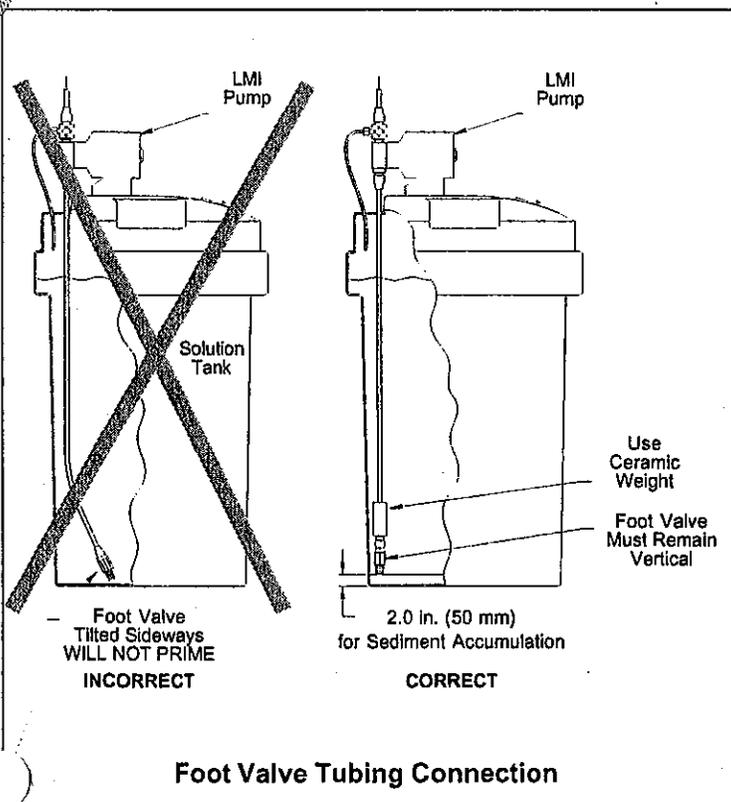


Depressurizing Discharge Line

(pumps equipped with multi-function valves)

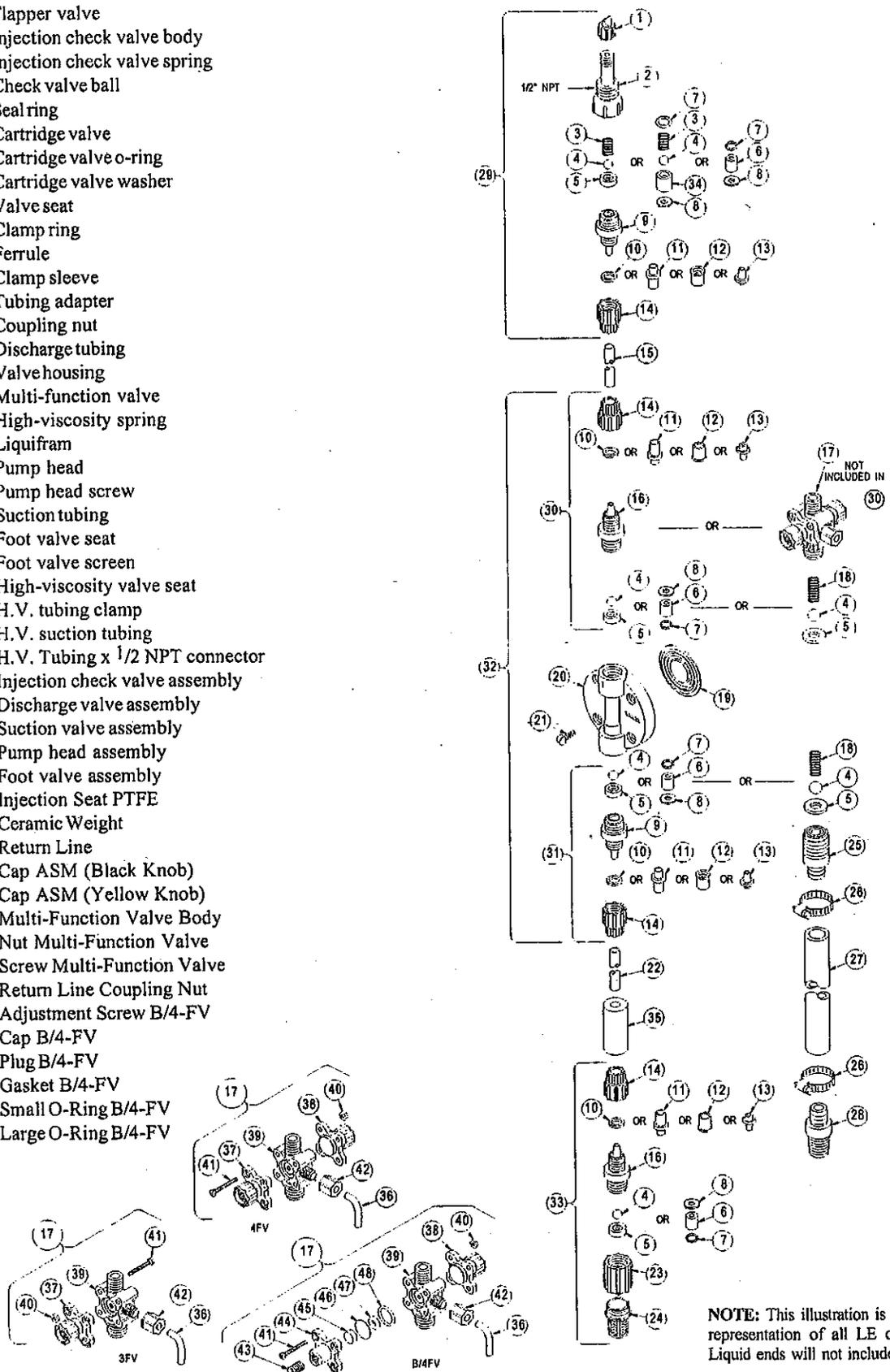
It is possible to depressurize the discharge line and pump head without removal of tubing or loosening of fittings.

1. Be sure injection check valve is properly installed and is operating. If a gate valve or globe valve has been installed downstream of injection check valve, it should be closed. Be certain relief tubing from the multi-function valve is connected and run to solution reservoir.
2. Turn Pressure Relief knob 1/4 turn.
3. Open the anti-syphon valve, if equipped
4. The discharge line is now depressurized.
5. If injection check valve is of higher elevation than pump head, disconnecting tubing at the injection check valve end will allow air to enter and cause solution to drain back to tank.



5.0 Liquid End Parts List

- 1 Flapper valve
- 2 Injection check valve body
- 3 Injection check valve spring
- 4 Check valve ball
- 5 Seal ring
- 6 Cartridge valve
- 7 Cartridge valve o-ring
- 8 Cartridge valve washer
- 9 Valve seat
- 10 Clamp ring
- 11 Ferrule
- 12 Clamp sleeve
- 13 Tubing adapter
- 14 Coupling nut
- 15 Discharge tubing
- 16 Valve housing
- 17 Multi-function valve
- 18 High-viscosity spring
- 19 Liquifram
- 20 Pump head
- 21 Pump head screw
- 22 Suction tubing
- 23 Foot valve seat
- 24 Foot valve screen
- 25 High-viscosity valve seat
- 26 H.V. tubing clamp
- 27 H.V. suction tubing
- 28 H.V. Tubing x 1/2 NPT connector
- 29 Injection check valve assembly
- 30 Discharge valve assembly
- 31 Suction valve assembly
- 32 Pump head assembly
- 33 Foot valve assembly
- 34 Injection Seat PTFE
- 35 Ceramic Weight
- 36 Return Line
- 37 Cap ASM (Black Knob)
- 38 Cap ASM (Yellow Knob)
- 39 Multi-Function Valve Body
- 40 Nut Multi-Function Valve
- 41 Screw Multi-Function Valve
- 42 Return Line Coupling Nut
- 43 Adjustment Screw B/4-FV
- 44 Cap B/4-FV
- 45 Plug B/4-FV
- 46 Gasket B/4-FV
- 47 Small O-Ring B/4-FV
- 48 Large O-Ring B/4-FV



Start-Up/Priming for Pump Supplied with Multi-Function Valve

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.

If the pump is equipped with pressure control, turn fully clockwise.

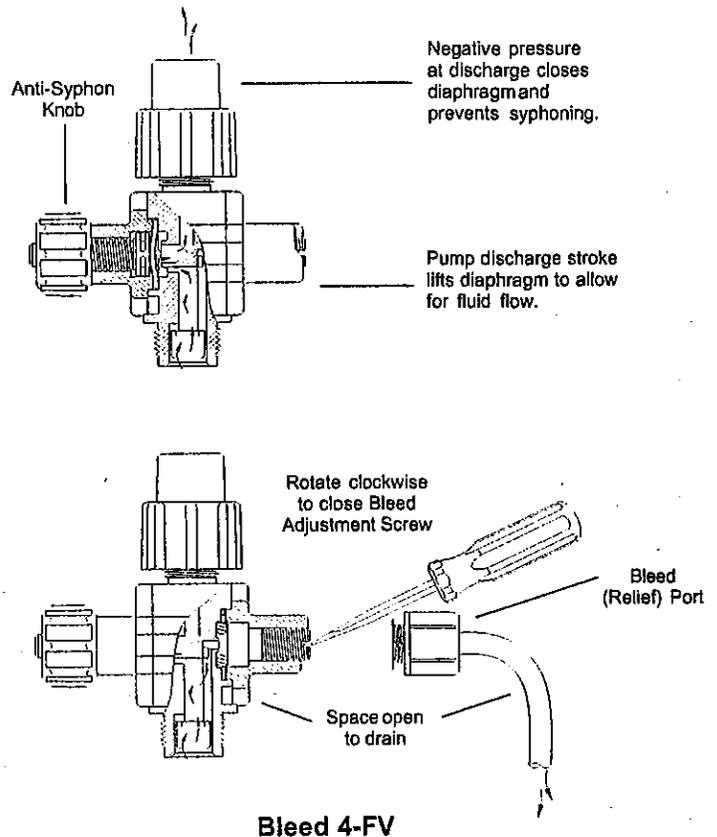
3. 1/4 turn open the relief side (black knob) of the multi-function valve.
- 3A. (Bleed 4FV only) With screwdriver rotate bleed adjustment screw counter-clockwise 2 full turns. When solution begins to flow through translucent bleed return tubing, the pump is primed. Stop pump.
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the multi-function valve. Once this happens, 1/4 turn or release the knob and **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord.)

6. The pump is now primed.

6A. (Bleed 4FV only)

- a. Start pump and let pump inject solution into the discharge line.
- b. Close the bleed adjustment screw by rotating it clockwise with a screwdriver.
- c. Now adjust the pump stroke length and/or speed (frequency) to a range approximately 25% higher than you would normally want for the process.
- d. Slowly rotate bleed adjustment screw counter-clockwise until just a small amount of solution begins to trickle down inside the bleed return tubing. A small amount of solution pumped back to the tank with each stroke of the pump will allow gas and air to escape without air or gas locking in the pump head.

NOTE: *If the pump does not self-prime, remove the multi-function valve on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start-up/priming steps.*



Start-Up/Priming without Multi-Function Valve

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.

If the pump is equipped with pressure control, turn fully clockwise.

3. The suction tubing should begin to fill with solution from the tank.
4. Once the solution begins to exit the pump head on the discharge side, **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord).
5. The pump is now primed.

NOTE: *If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the ball and pour water or solution into the port until the head is filled. Replace valve, then follow start-up/priming steps.*

120V 1-4A

SPARE PARTS KITS INSTRUCTIONS • INSTALLATION

CAUTION

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump.

See MSDS Sheet from solution supplier for additional precautions.

READ ALL STEPS BELOW BEFORE PROCEEDING.

Depressurizing the Discharge Line (For Pumps Equipped with a 4-FV only).

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed to off.

CAUTION: Be sure your relief tubing is connected to your 4-FV and runs back to your solution drum or tank.

2. Depending on the model of your 4-FV, either 1/4 turn or pull on both the yellow and black knobs on the 4-FV. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then release or 1/4 turn knobs to normal position.

Liquifram® (Diaphragm) Replacement

When replacing the Liquifram®, the valve balls, seal rings and the injection check valve spring should also be replaced.

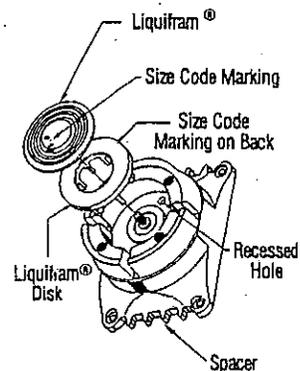
1. Carefully depressurize, drain, and disconnect the discharge line (See pump Instruction Manual). Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the Foot Valve out of the solution and continue to pump air into the pump head until the pump head is purged of water or neutralizing solution.

NOTE: If the liquid cannot be pumped due to Liquifram® rupture, using protective gloves, carefully disconnect the suction and discharge tubing. Remove the four screws to the head and immerse the head in water or other neutralizing solution.

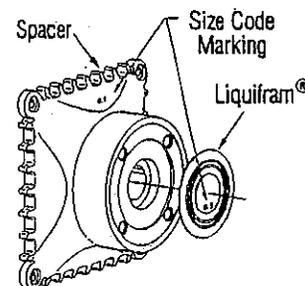
2. Start the pump. While running, set the stroke knob to zero and turn the pump off (See pump Instruction Manual for proper zeroing).

3. With the unit off, unscrew the Liquifram® by carefully grasping the outer edge of the Liquifram® and turning it counter-clockwise. Discard old Liquifram®. Remove the Liquifram® disk if so equipped (located behind the Liquifram®) and check that the size code matches the size code on the replacement Liquifram® (see illustrations below).

For Series A, J, P & Z



For Series B & C



Size code markings for pumps supplied with 6.0 Liquiframs® (diaphragms) should be referenced to the 6.0 Black Adapter not the 3.0 Spacer



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4. Reinstall the disk so the alignment pin on the disk (if present) seats in the recessed hole in the EPU.

CAUTION: Take care not to scratch the Teflon surface of the new Liquifram®.

5. Start the pump and turn the stroke knob to the setting indicated below on Stroke Setting Chart which matches the pump model number located on the pump dataplate. With the pump stroking (running), screw on the new Liquifram® clockwise until the center begins to buckle inwards. Stop the pump.

Liquifram® Stroke Setting Chart	
Pump	Stroke Knob Setting
All A, B, J, P, Z Series C10, C11, C12, C70, C71, C72 E70, E71, E72	90%
All L Series	85%
C78	50%
C13, C14, C73, C74, C77 E73, E74	70%
All U and M Series	100%. But Liquifram® must be bottomed completely. (Turned all the way) Do Not Use Straight Edge.

6. Grasp the outer edge of the Liquifram® and adjust by screwing it in or out so that the center of the Liquifram® is flush with the outside of the spacer edge (see figure 1).

7. Once the Liquifram® is properly positioned, remount the pump head to the spacer using the four (4) screws. Tighten in a criss-cross pattern. After one week of operation, recheck the screws and tighten if necessary.

Seal Ring, Ball and Injection Check Valve Spring Replacement

1. Carefully depressurize and disconnect the discharge line (See pump Instruction Manual). Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump has been flushed, lift the Foot Valve out and continue to pump to let air into the pump head until pump is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram® rupture, with protective gloves, carefully disconnect the tubing and four screws to remove the head. Immerse the head in water or other neutralizing solution.

IMPORTANT: Before disassembling valves, note the orientation of seal ring and ball (see figure 2).

2. Carefully disconnect one tubing connection and fitting at a time and remove the worn seal ring and ball.

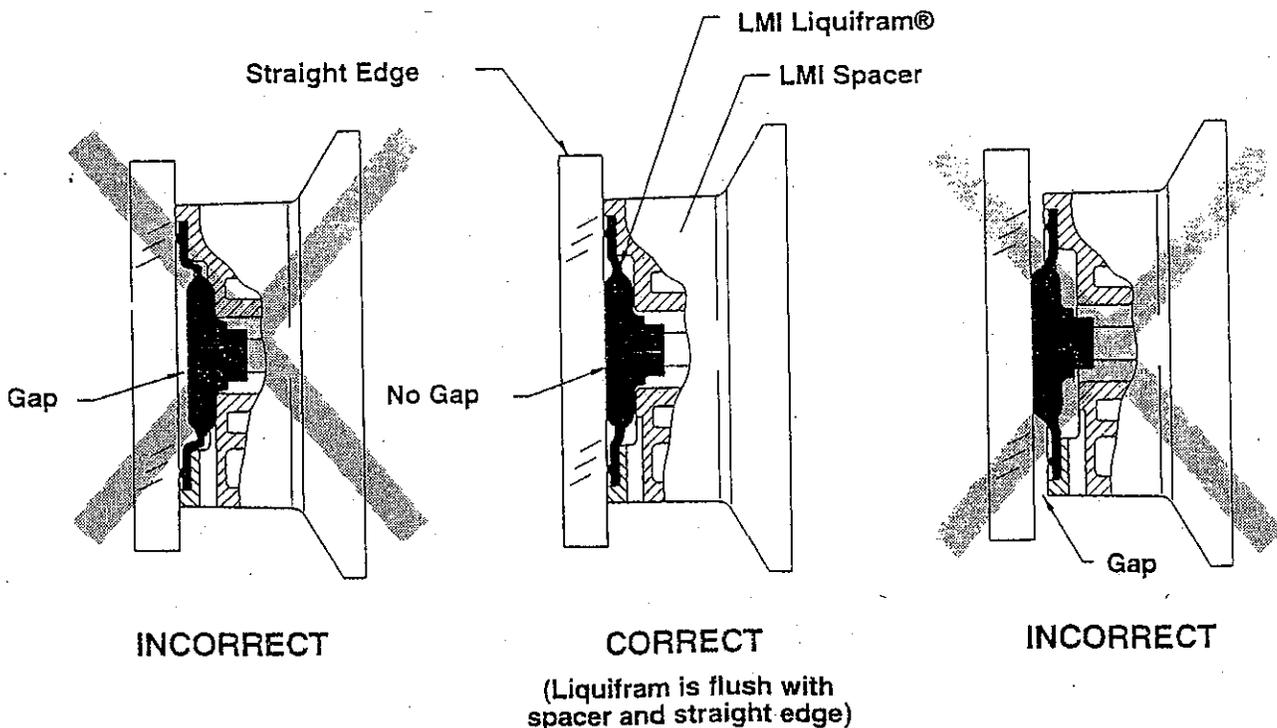


figure 1

Carefully loosen seal ring by prying side to side using a small screw driver through the center hole of the seal ring.

3. Install new seal ring and ball in each location.
IMPORTANT: Note correct orientation.

4. Install the new spring in the Injection Check Valve.

WARNING: Depressurize and drain pipeline so that Injection Check Valve can safely be disassembled.

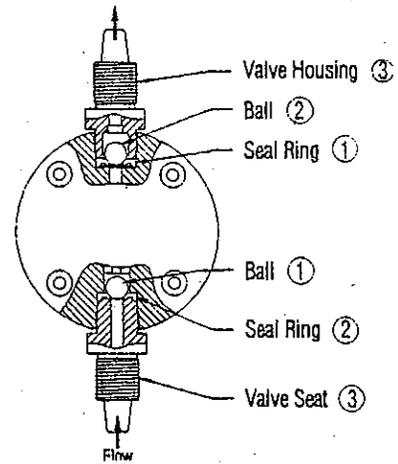
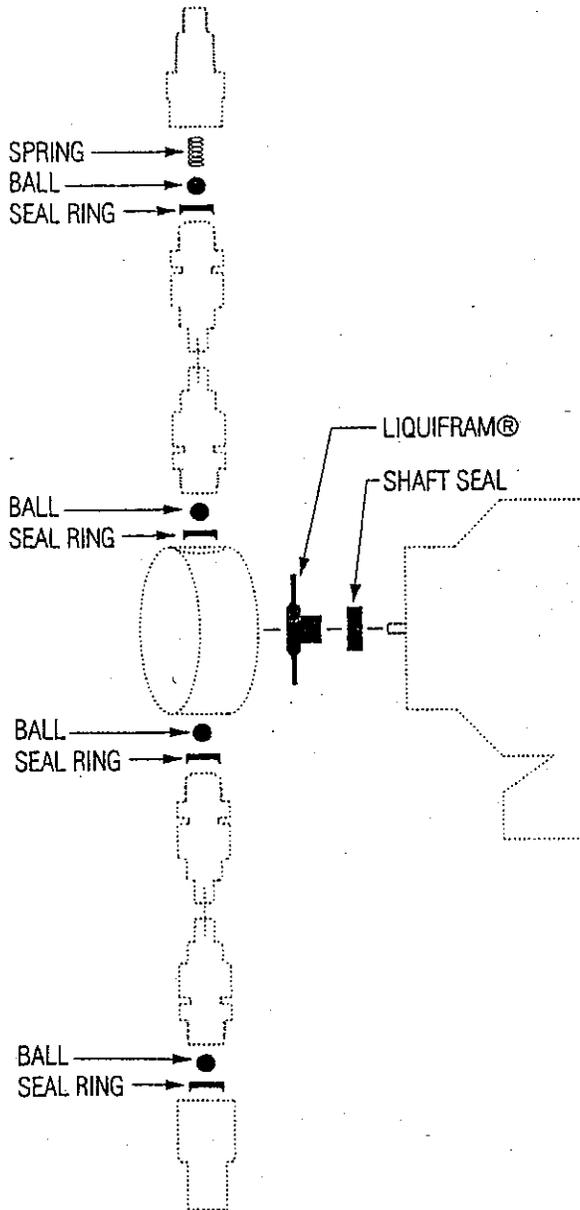


figure 2

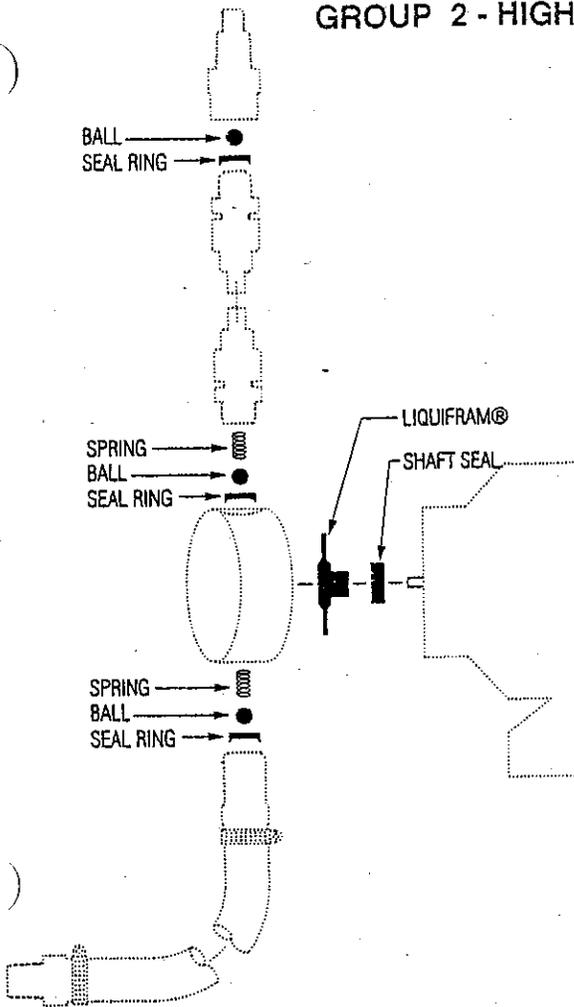
EXPLODED VIEW & PARTS LIST GROUP 1



NOTE: Shaft seal needs to be replaced only if Liquifram® rupture has occurred or if the seal shows signs of damage.

SP KIT NUMBER	SIZE CODE	LIQUIFRAM	SPRING	SEAL RING	BALL	SHAFT SEAL
		1 ea	1 ea	4ea	4 ea	1ea
SP-151FS	0.5	30916	10339	10107	10444	10973
SP-152FS	0.5	30916	10339	29443	10444	10973
SP-U8	0.5	30916	10339	29443	10338	10973
SP-U9	0.5	30916	10339	10407	10338	10973
SP-U14	0.5	30916	10339	29443	10338	10973
<hr/>						
SP-06	0.9	30917	10339	10207	10338	10973
SP-09	0.9	30917	10339	29443	10338	10973
SP-89	0.9	10102		10107	10338	10973
SP-91H	0.9	30917	10339	10107	10338	10973
SP-92L	0.9	30917	10339	29443	10338	10973
SP-92V	0.9	30917	10339	10207	10338	10973
SP-U1	0.9	30917	10339	10407	10338	10973
SP-U3	0.9	10102	10339	10107	10444	10973
SP-U7	0.9	30917	10339	29443	10338	10973
<hr/>						
SP-72L	1.8	31420	10339	29443	10338	10973
SP-79	1.8	10105		10107	10338	10973
SP-U2	1.8	31420	10339	10407	10338	10973
SP-U4	1.8	10105	10339	10107	10444	10973
SP-U10	1.8	31420	10339	29443	10338	10973
<hr/>						
SP-12	3.0	31419	10339	29443	10338	10973
SP-15	3.0	31419	10339	10407	10338	10973
SP-20	3.0	31419	10339	10128	10138	10973
SP-20S	3.0	31419	10339	10128	10138	10973
SP-24	3.0	31419	10339	25128	10138	10973
SP-26	3.0	31419	10339	10228	10138	10973
SP-26S	3.0	31419	10339	10228	10138	10973
SP-29	3.0	31419		10128	10138	10973
SP-U5	3.0	31419	10339	25128	10138	10973
SP-U17	3.0	31419	10339	29443	10338	10973
<hr/>						
SP-U6	6.0	25719	10339	25128	10138	10973

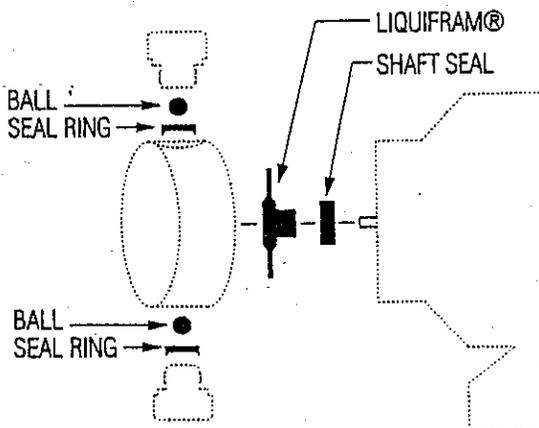
EXPLODED VIEW & PARTS LIST GROUP 2 - HIGH VISCOSITY LIQUID ENDS



NOTE: Shaft seal needs to be replaced only if Liquifram® rupture has occurred or if the seal shows signs of damage.

SP KIT NUMBER	SIZE CODE	LIQUIFRAM	SPRING	SEAL RING	BALL	SHAFT SEAL
		1 ea	2 ea	3ea	3ea	1ea
SP-155HV	0.5	30916	25558	25128	25042	10973
SP-156	0.5	30916	25558	10128	25042	10973
SP-85HV	0.9	30917	25558	25128	25042	10973
SP-86	0.9	30917	25558	10128	25042	10973
SP-75HV	1.8	31420	25558	25128	25042	10973
SP-76	1.8	31420	25558	10128	25042	10973
SP-25HV	3.0	31419	25558	25128	25042	10973
SP-20HV	3.0	31419	25558	10128	25042	10973
SP-30HV	6.0	25719	25558	10128	25042	10973
SP-35HV	6.0	25719	25558	25128	25042	10973

EXPLODED VIEW & PARTS LIST GROUP 3 - STAINLESS STEEL LIQUID ENDS



NOTE: Shaft seal needs to be replaced only if Liquifram® rupture has occurred or if the seal shows signs of damage.

SP KIT NUMBER	SIZE CODE	LIQUIFRAM	SEAL RING	BALL	SHAFT SEAL
		1 ea	2ea	2ea	1ea
SP-157	0.5	30916	10407	10659	10973
SP-97	0.9	30917	10407	10659	10973
SP-77	1.8	31420	10407	10659	10973
SP-27	3.0	31419	25128	25042	10973
SP-37	6.0	25719	25128	25042	10973



LMI
LIQUID METRONICS DIVISION
MILTON ROY

8 Post Office Square
Acton, MA 01720 USA
TEL: (508) 263-9800
FAX: (508) 264-9172

Appendix I
Settling Tank Information



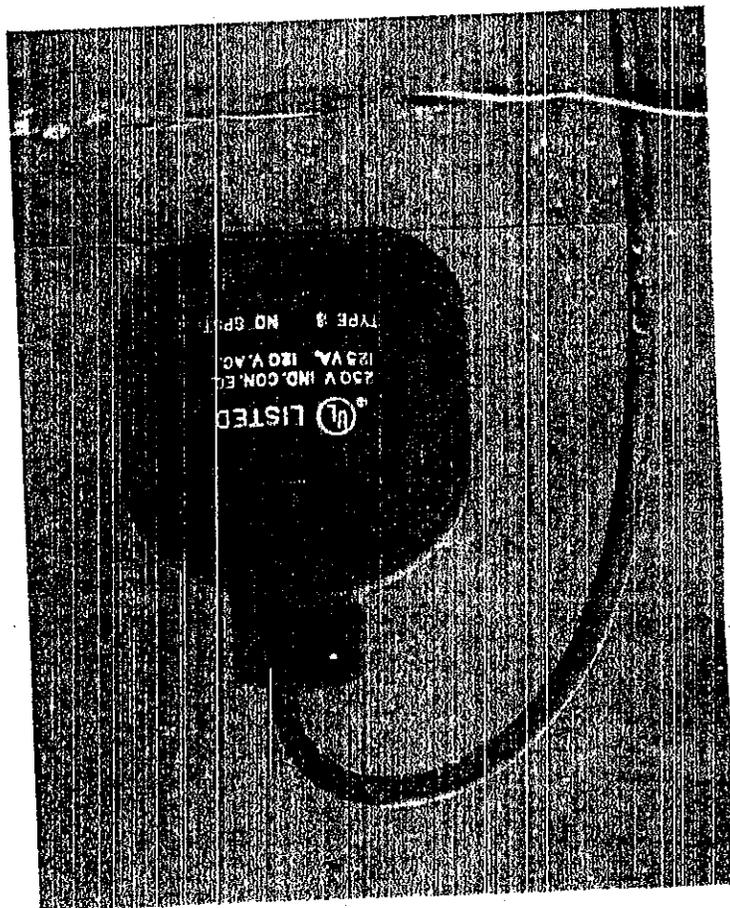
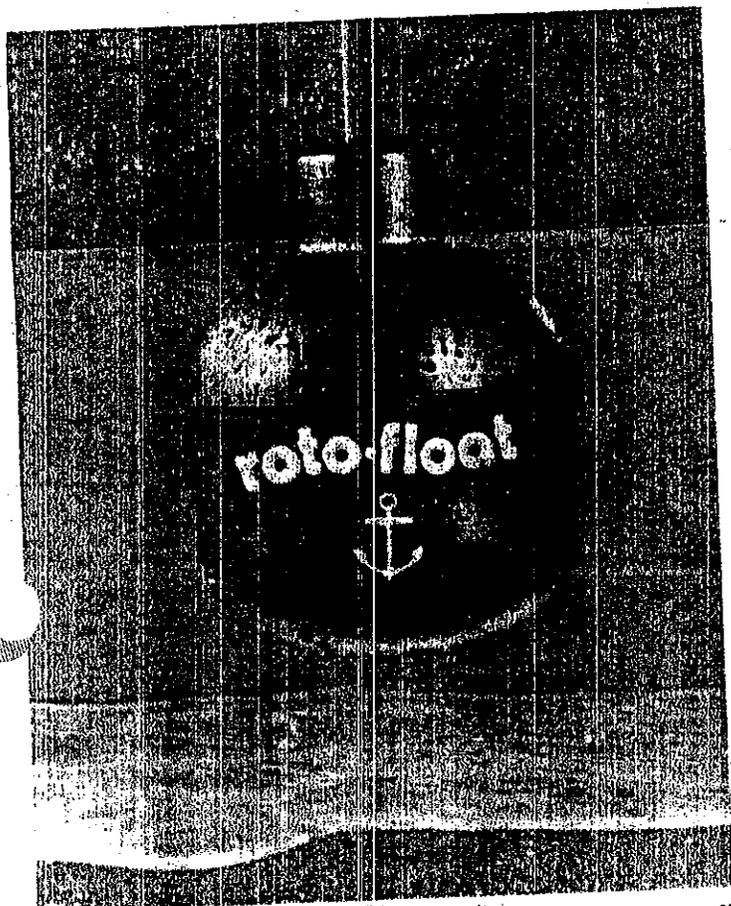
anchor scientific inc.

Box 378, Long Lake, MN 55356 / 612-473-7115 / FAX 612-473-8002

roto-float
Type S - Suspended

Form 2700-B

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

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

Switch Arrangement	Cable Length	Suspended Type & Model No.	Shp. 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#

Effective 4/93

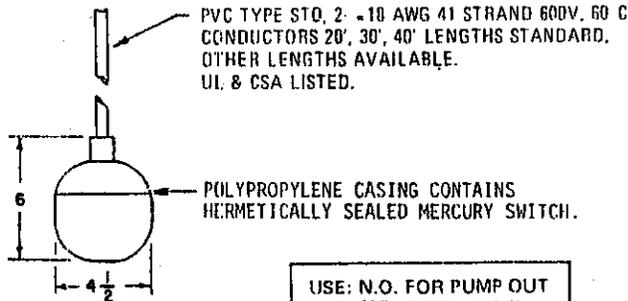
GENERAL DESCRIPTION:

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 POLYPROPYLENE 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:



- UL LISTED, IND. CONT. EO.
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.

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

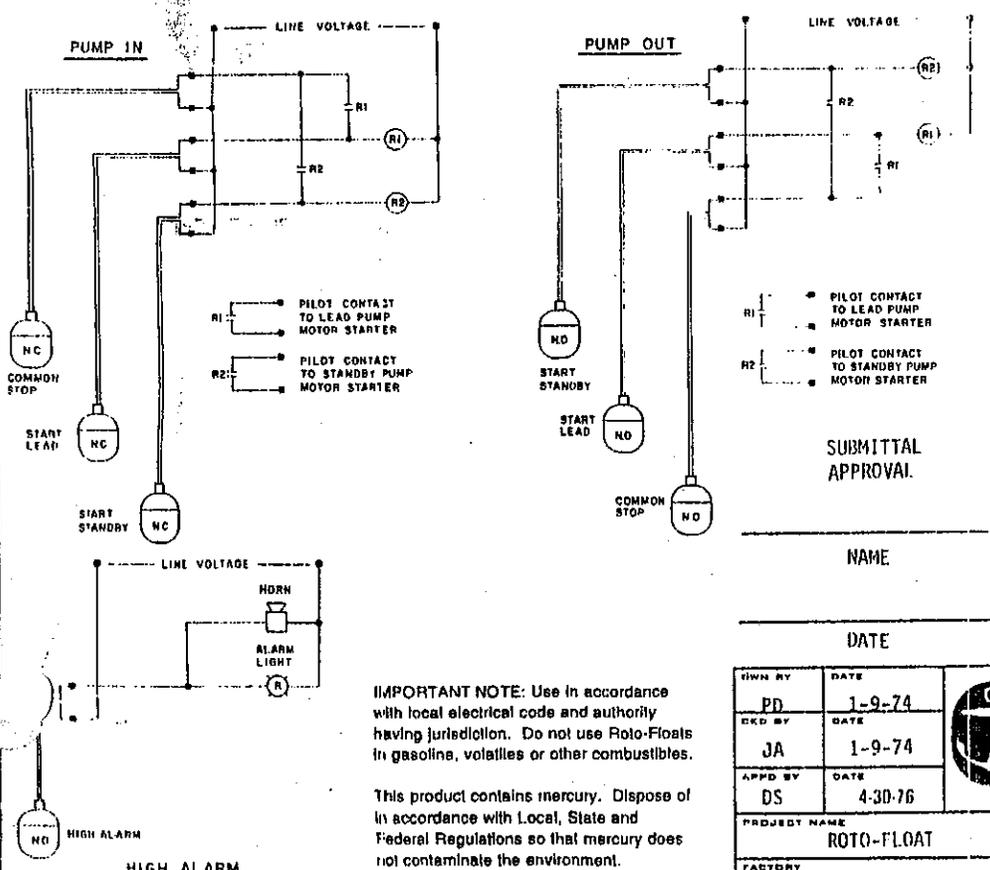
MODELS:

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 1/2"	P30NO	2 3/4"
	40	S40NO	5 1/2"	P40NO	3 1/2"
NORMALLY CLOSED	20	S20NC	4"	P20NC	2"
	30	S30NC	4 1/2"	P30NC	2 3/4"
	40	S40NC	5 1/2"	P40NC	3 1/2"

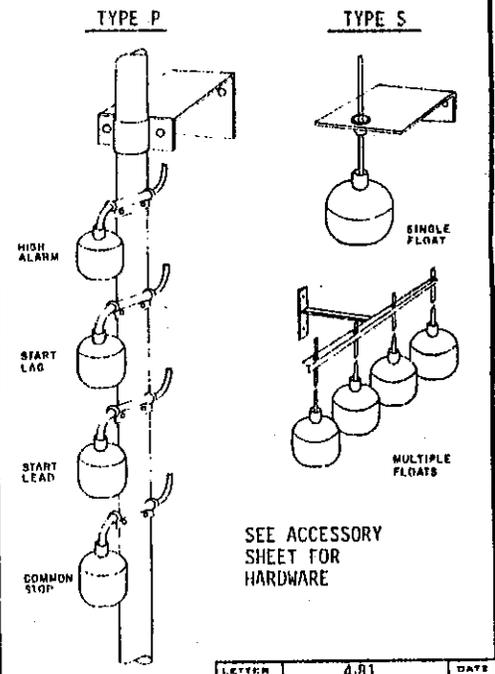
APPLICATIONS:

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 CUTOFF, OR FOR LOW AND HIGH LEVEL ALARMS.

TYPICAL 2 PUMP CIRCUITS



TYPICAL MOUNTING



SEE ACCESSORY SHEET FOR HARDWARE

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

This product contains mercury. Dispose of in accordance with Local, State and Federal Regulations so that mercury does not contaminate the environment.

DATE: _____

NAME: _____

DATE: _____

OWN BY	DATE
PD	1-9-74
CHK BY	DATE
JA	1-9-74
APP'D BY	DATE
DS	4-30-76
PROJECT NAME	
ROTO-FLOAT	
FACTORY ORDER NO.	



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

SPECIFICATION DATA SUBMITTAL AND INSTRUCTION SHEET

DWG. NO. 174-4

LETTER A	4-81	DATE
	REVISIONS	

Appendix J
Sand Filter Package Information

MAINTENANCE:

1. Maintain a clean air filter cartridge to insure optimum flow and performance. The location and the quality of air being ingested dictates the frequency for inspection and replacement. A dirty filter restricts air flow, causes the pump to run hotter and results in longer operating cycles.
2. Drain air receiver regularly. The amount of moisture and how quickly it accumulates inside the air receiver

is proportional to the amount of humidity in the air and how long the pump is in operation. If not drained, the air receiver will fill with water.

3. Clean the pump/motor regularly. A film (oil, dirt, etc.) build up on the outer shell of the pump or motor will reduce the unit's ability to dissipate heat. This unit has been designed to operate between 32° to 100° F.

TROUBLESHOOTING: Pressure and Vacuum Systems

Pump Stalls After Vacuum or Pressure Starts Building Up in Receiver:

Shut unit off, disconnect power. Motor incorrectly wired for high voltage instead of low voltage. Check motor nameplate for voltage compatibility and/or correct wiring configuration. Single voltage motors will only operate on the designated voltage specified on the motor nameplate.

Motor Won't Start:

Nothing happens after power is turned on. [Gauge reads 0 psi (atmospheric pressure)]:

1. Shut unit off, disconnect power. Check that supply voltage is the same as motor nameplate voltage. If the motor has multiple voltage capability, confirm that the motor is properly wired for the supply voltage.

Motor has power. Check that power is on and that electrical cord is not heating up because of being undersized. If electrical cord is longer than approximately 15 feet, contact your local electrician; let him know motor nameplate data; hp, voltage, phase and motor amps.

3. If there is power and it is the correct voltage and phase, contact your local BEVAIR Systems Distributor.

Motor Starts When Gauge Reads 0 Psi. But, Won't Restart When Under Pressure:

This symptom results from a bad check valve, allowing the pressure in the receiver to leak back to the pump, forcing the pump to start under load. When the motor can't start, a high amperage condition will:

1. Trip the thermal overload in the motor (which shuts the motor off).
2. Damage a non-thermally protected motor.

Starts Intermittently:

Disconnect power source to unit. Inspect points in pressure or vacuum switch which may be worn or dirty. Visually inspect for build up or uneven wear. If necessary, contact your local distributor for replacement parts.

Pump Cycles On - Off More Often Than When First Stalled:

1. Air receiver probably filled with water. Drain receiver. The receiver is being used to store condensed water instead of allowing it to fill with compressed air.

Pump/Motor is On (Running) More Often Than When Originally Installed:

1. The air requirement has increased through the use of new or different pneumatic equipment or the system has developed air leaks.
2. Filters are dirty - restricted air flow to pump results in decreased discharge.
3. Inspect head valves and rings. Under normal operating conditions (clean, dry air at recommended ambient and operating pressures), installation of a service kit should be considered at approximately 5,000 hours to maintain peak performance..

Air Receiver Loses Pressure:

1. Check for system (pipe, fitting and seal) leaks.
2. The leak is at the pump. Probable cause, the check valve is allowing the air pressure to leak back from the receiver to the pump.
 - a. On pressure pumps it is common to see bubbles around the head assembly when the pump is in operation. Check for air leaks at the pump after it has been shut off for a few minutes. This will allow the initial pressure between the pump and check valve to bleed off to atmosphere.
 - b. On vacuum systems, the check valve is even more likely to hang up than on pressure systems. Unfortunately, the bubble test cannot be used to test for leak locations. This being the case, remove and perform a visual inspection of the check valve. If necessary, use the AV460 filter prior to the tank to eliminate contaminants.

Warning: Protect the motor from getting wet; water could cause internal damage to some motors.

A Leak is Determined at the Pump:

Relieve all pressure inside of air receiver (until gauge reads 0 psi). Inspect check valve. It must be free from foreign matter, wear and operates freely. Replace if necessary (not serviceable).

INSTALLATION AND INSTRUCTION MANUAL

OHM Remediation Services Corp.
Saunders Supply Site
Chuckatuck, VA
Monarch Project No. 7206

Serial # 03-7206-98

MO

@ syscom.com

For Service Call:
Monarch Water Systems, Inc.
1230 Burnett Drive
Xenia, OH 45385
(937-372-7200)

LIZA -
JOHN GLAZER

1. Specifications
2. Installation Instructions
3. Operating Instructions
 - DV-100 Counter Access Instructions
 - Flow Schematics
 1. Service
 2. Backwash
4. Valves
 - 521 Diaphragm Valves
 - 521-LS-SAC Diaphragm Valves
 - Ball Valves
 - 3 way Solenoid Valve
5. Controls
 - DV-1000 PLC
 - Ladder Diagram
6. Pump
 - Multi-Duty 3000 Sequence Series
7. Resin
 - C-249 Cation Resin
8. Miscellaneous Data Sheets
 - Differential Pressure Switch
 - Starter
 - Flow Meter
 - Pressure Gauge
 - Float Switches
9. MSDS
 - Silica Quartz
 - Anthracite
10. Miscellaneous
 - Recommended Spare Parts List
 - Trouble Shooting Guide
 - Drawings

MONARCH WATER SYSTEMS, INC.

1230 BURNETT DR.

XENIA, OHIO 45385

Phone 937-372-7200

Fax 937-372-4622

LIMITED WARRANTY

One (1) Year

COMMERCIAL/INDUSTRIAL WATER TREATMENT SYSTEM

Monarch Water Systems, Inc. (hereinafter collectively referred to as "Manufacturer") warrants to the original owner, for the periods specified below, that the water system to which this warranty applies is free from defects in material and workmanship when installed, operated, and maintained in accordance with the printed instructions accompanying the water system.

A. THE WARRANTY COVERAGE UNDER THIS WARRANTY IS AS FOLLOWS:

1. All component parts - If any component part proves to be defective in material or workmanship with (1) year from the date of original installation, but in no event after 14 months from the date of shipment from Monarch's plant, Monarch or its representative will, at its option, furnish the original owner a replacement for, or repair the defective part(s).
2. Limitation of warranty period for replacement water systems or component parts - The warranty period for replacement water systems or component part(s) is limited to its unexpired term of the original warranty period applicable to the replaced water system or component part.

B. LIMITATIONS ON WARRANTY COVERAGE

1. Manufacturer shall not be liable for any water damage arising directly or indirectly from any defect in the water system or component part(s) or from the use thereof (*see note). Further, Manufacturer shall not be liable under this warranty, if
 - A. The water system or any of its component parts have been subject to misuse, alteration, neglect, accident, or freezing conditions; or
 - B. The water system has not been installed in accordance with the applicable local plumbing or building code(s) and/or regulations(s).

2. The OWNER, and not Manufacturer or his representative, shall be liable for and pay for all field charges for labor or other expenses incurred in the remove, repair (except when Manufacturer elects to repair the water system or component parts(s) in accordance with Paragraph A (1) above) or replacement of the water system or any component part(s) claimed to be defective or any expense incurred by the owner in order to remedy any defect in the product. Such charges may include, but are not necessarily limited to:
 - A. All freight, shipping and delivery costs of forwarding a new water system or replacement part to the owner
 - B. All costs necessary or incidental in removing the defective water system or component parts(s) and installing a new system or component part(s)
 - C. Any material required to complete, and/or permits required for, installation of a new water system or replacement part and
 - D. All costs necessary or incidental in returning the defective water system or component part(s) to a location designated by Manufacturer or its representative

C. TO SUBMIT A WARRANTY CLAIM

- (i) If you have a warranty claim, contact the dealer who sold the water system covered by this warranty.
- (ii) If the dealer cannot be located, contact any other of our dealer serving your area.

- (iii) If you are unable to readily locate a dealer in your area submit your warranty claim directly to our service manager, at the address listed at the end of this contract, and he will arrange for the handling of your claim.
- (iv) Whenever any inquiry or service request is made, be sure to include the water system's model number and serial number, date of installation, and the dealer's name.

D. EXCLUSIONS

THE COVERAGE OF THIS LIMITED WARRANTY IS RESTRICTED TO MANUFACTURER'S WATER SYSTEM USED BY A COMMERCIAL OR INDUSTRIAL CUSTOMER FOR COMMERCIAL OR INDUSTRIAL PURPOSES IN THE UNITED STATES OF AMERICA, EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, (I) THIS LIMITED WARRANTY SHALL BE THE EXCLUSIVE WARRANTY MADE BY MANUFACTURER AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED (WHETHER WRITTEN OR ORAL), EXCEPT THE IMPLIED WARRANTIES, WHICH INCLUDE, BUT ARE NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND WHICH ARE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY; AND (II) MANUFACTURER SHALL NOT BE LIABLE FOR ANY INCIDENT, CONSEQUENTIAL, SPECIAL, OR CONTINGENT DAMAGES OR EXPENSES ARISING DIRECTLY OR INDIRECTLY FROM ANY DEFECT IN THE WATER SYSTEM OR THE USE THEREOF. THE REMEDIES SET FORTH HERIN SHALL BE THE EXCLUSIVE REMEDIES AVAILABLE TO THE USER AND IN LIEU OF ALL OTHER REMEDIES. MANUFACTURE NEITHER ASSUMES NOR AUTHORIZES ANY REPRESENTATIVE OR OTHER PERSON TO ASSUME FOR IT ANY OBLIGATION OR LIABILITY OTHER THAN EXPRESSLY SET FORTH HERIN.

NOTE: SOME STATES DO NOT ALLOW (i) LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS AND (ii) THE EXCLUSIVE OR LIMITATION OF INCIDENTAL, CONSEQUENTIAL, SPECIAL OR CONTINGENT DAMAGES OR EXPENSES, SO THE ABOVE LIMITATIONS AND EXCLUSIONS MAY NOT APPLY TO YOU. FURTHER, THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

MONARCH WATER SYSTEMS, INC.
1230 Burnett Dr.
Xenia, OH 45385
(937) 372-7200

IMPORTANT: Owner shall keep this certificate!!

*Note: A water system should be installed in such a manner that , if the tank or any connection thereto should leak, the resulting flow of water will not cause damage to the area in which it is installed. A water system brine tank overflow should be piped to the nearest drain in order to avoid damage in the event of overflow. Water systems must not be subjected to freezing conditions. Systems must be installed in areas where temperatures will never drop below freezing. It is the owner's responsibility, not Monarch's to protect equipment from freezing.

1.

MONARCH WATER SYSTEMS, INC.

1230 BURNETT DR.

XENIA, OHIO 45385

Phone: 937-372-7200

Fax: 937-372-4622

- TANKS:** Three 14" Diameter x 65" with base
4" top opening
- DISTRIBUTORS:** Top - Model T481S6 PVC Tank Head
Bottom - Model DSC34126B PVC hub
- SUPPORT BED:** 30 lbs* Coarse Silica Quartz $\frac{3}{4}$ " x $\frac{1}{2}$ "
25 lbs* Medium Silica Quartz $\frac{1}{2}$ " x $\frac{1}{4}$ "
25 lbs* Fine Silica Quartz $\frac{1}{4}$ " x $\frac{1}{8}$ "
25 lbs* X-fine Silica Quartz $\frac{1}{8}$ " x $\frac{1}{16}$ "
* Per tank
- MEDIA:** 200 lbs* Filter Sand - 0.45 mm - 0.55 mm
1 Cu. Ft.* Anthracite - 1.8 mm - 1.2 mm
*Per tank
- VALVES:** 521 Diaphragm Valves
521-LS-SAC Diaphragm Valves
Chemtrol Ball Valves - PVC body,
TFE seats and EPDM seals
Solenoid Valve - Burkert
3 Way for Diaphragm Valves
Part # 453226F
- CONTROLS:** PLC Direct DL240-CPU
Inputs (2) D2-240-CPU
Outputs (2) D2-08NA-1
Base (1) 205-D2-06B
Operator Interface DV-1000

ACCESSORIES:

Pressure Gauge - 0-100 psi
Type Weksler - EA14-C
4-1/2" face, 1/4" NPT bottom connections

Differential Pressure Switch
SqD 9012-GGW 4
100 psi working pressure
0-25 psid range - adjustable

Starter
Furnas Model 14CP12AA
Single Phase, 120/230 Volts
Motor: 120/230 Volts, 16 2/8 amps

Pump
Multi-Duty 3000 Sequence Series
16 gpm at 104 ft. 1 1/2" hp, 115/230 v, single phase
TEFC Motor

Flow Meter - Series VF
Model VFC-5" - EC Scale
Range 1-20 gpm
1" FNPT Connections (top and bottom)

Float Switches
Roto Float - Suspended 20 Ft. NO
P/N S20NO (2ea.)
P/N S20NC (1ea.)

2.

Monarch Water Systems Inc.

1230 BURNETT DR.

XENIA, OHIO 45385

Phone: 937-372-7200

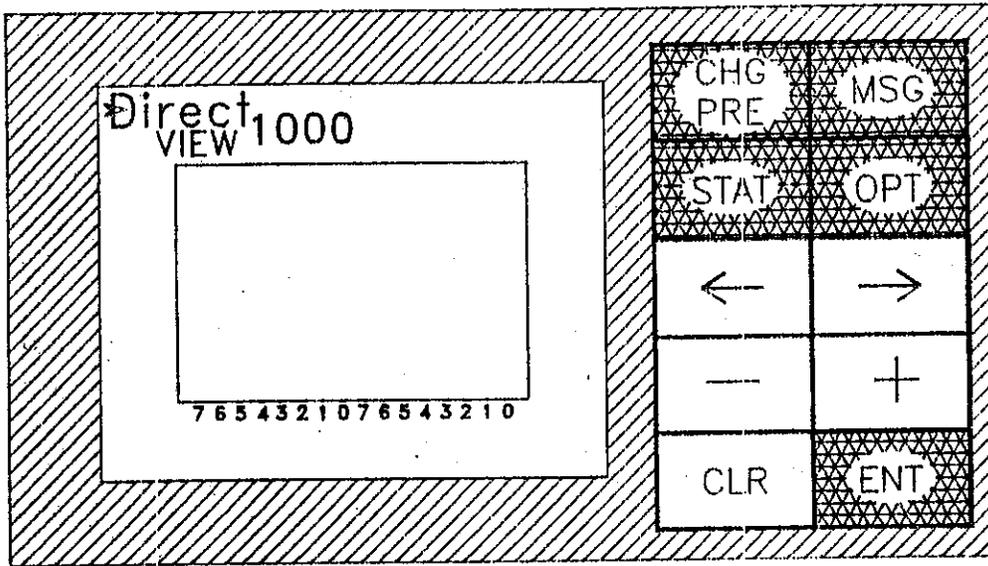
Fax: 937-372-4622

1-800-55-33-MWS

INSTALLATION INSTRUCTIONS

1. Set unit on a flat, level surface, designed to hold the operating weight of the equipment
2. Remove packing material from around filter tanks
3. Floats (3) and pressure gauge shipped in separate cardboard carton
4. Install pressure gauge on ¼" connection on outlet of pump
5. Connect inlet of pump to raw water storage tank. **DO NOT OVERTIGHTEN SUCTION LINE INTO PUMP HOUSING - SEE PUMP INSTRUCTIONS-USE PLASTIC FITTINGS ONLY**
6. Connect outlet to filtered water outlet supply. See Monarch's drawing C-7206-A1, Sand Filter System.
7. Connect drain to dirty water drain connection. **Drain discharge under pressure do not reduce drain line. Line should be as short as possible with a minimum of elbows or restrictions**
8. It is recommended that the diaphragm valves operate off of pneumatic (air) or constant source of clean water pressure for the trouble free operation and minimal maintenance. However a ¼" connection is provided below the pressure gauge.
9. Connect 240 volts/ single phase electric to the two fuse connections as shown on Monarch's drawing C-7206-E2, Control Panel.
10. Connect ground to grounding block, green-yellow, in control panel. **Improper grounding can results in erratic operation. The control ground terminal must be connected to a valid earth ground point with a #14 awg or heavier wire. Water piping or conduit is not always a valid electronic earth ground.**
11. Connect a neutral to the terminals as shown on Monarch's drawing C-7206-E2, Control Panel.
12. Install floats as raw water storage tank. **Bottom float must be installed high enough to provide a flooded suction to the filter pump system at all times.**

3.

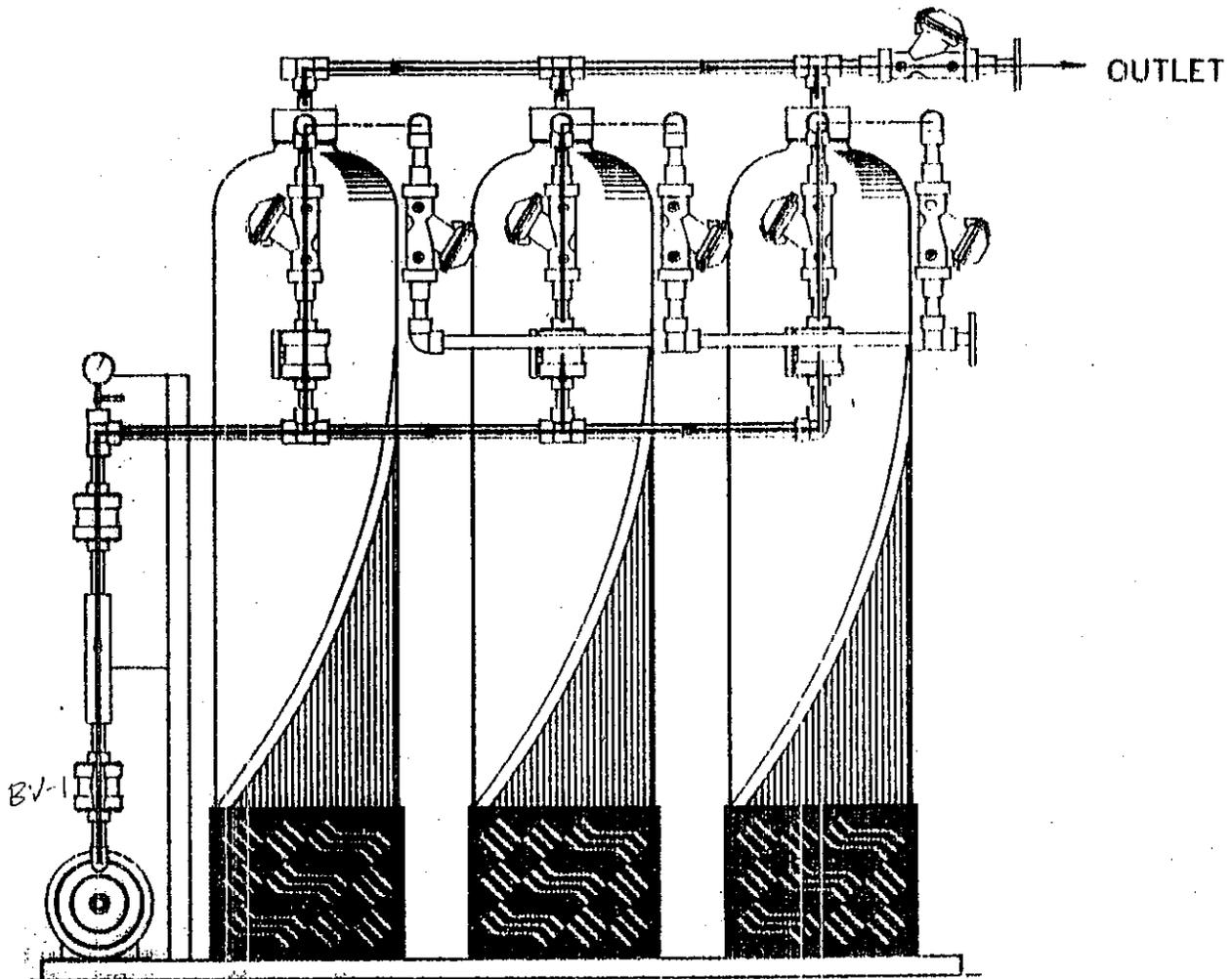


 - BLUE BUTTONS

COUNTER ACCESS INSTUCTIONS FOR PLC DV1000

CHANGE VALUE IN COUNTER

- Press "CHG - PRE" to change present value.
- Press "←" for counter.
- Press the "+" or "-" key to find the appropriate counter.
- Press "ENT" - enter, allowing the cursor to move to the selected value.
- Adjust by using the "+" or "-" keys.
- After value is set, press (ENT) - to enter.
- After the value has been changed, press "MSG" button to return to the main screen.



* DRAIN MOVED AND OUTLET ROTATED FOR CLARITY

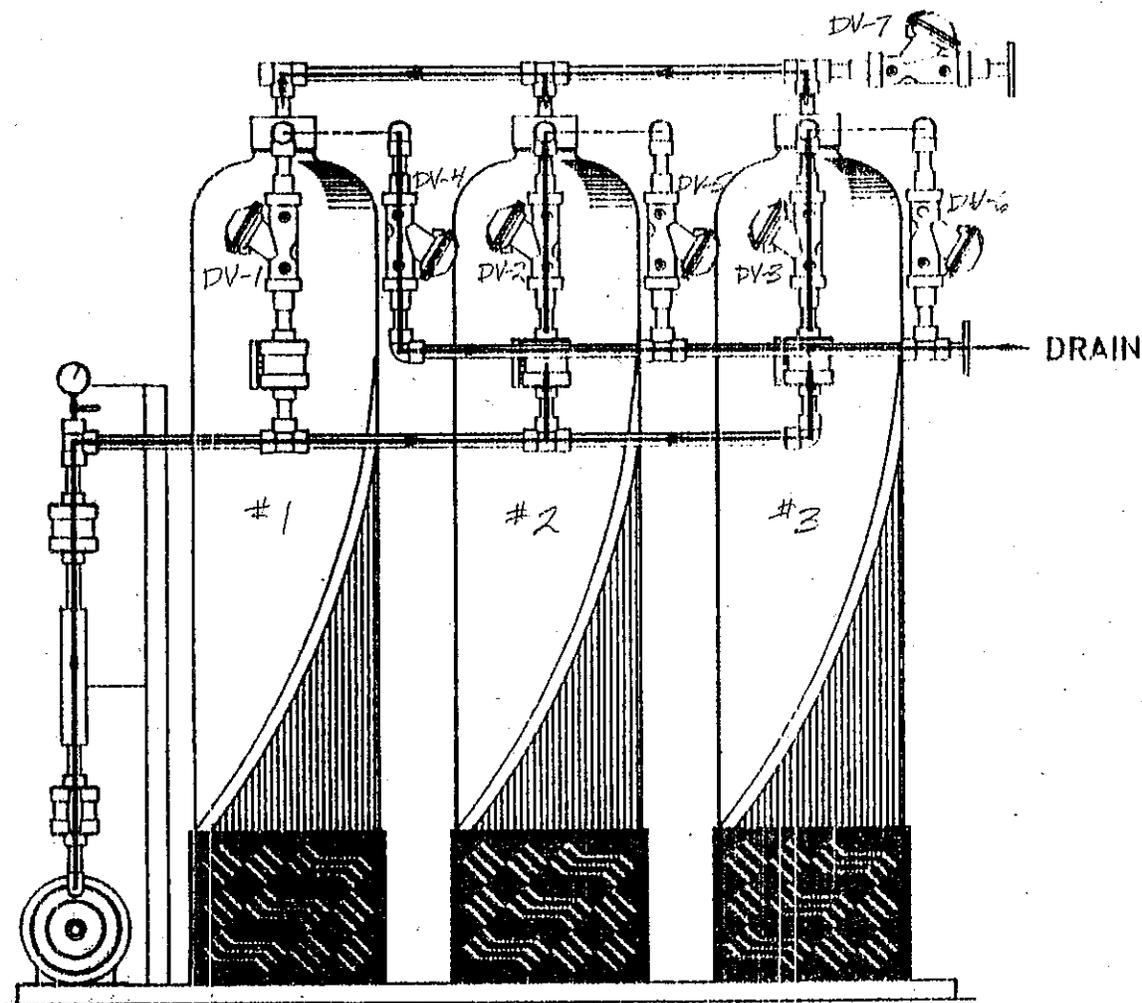
FILTERS IN SERVICE

The filter pump will start when the water level reaches the upper float assembly and continues to operate until the water level reaches the lower float assembly. Flow rate through the system is controlled by adjusting the ball valve (BV-1) located on the outlet of the pump. The filter system will continue to operate until the water level is below the low float switch or a high differential pressure is measure across the filter system.

Monarch Water Systems, Inc.

1230 Burnett Dr.
Phone: 937-372-7200

Xenia, Ohio 45385
Fax: 937-372-4622



* DRAIN MOVED AND OUTLET ROTATED FOR CLARITY

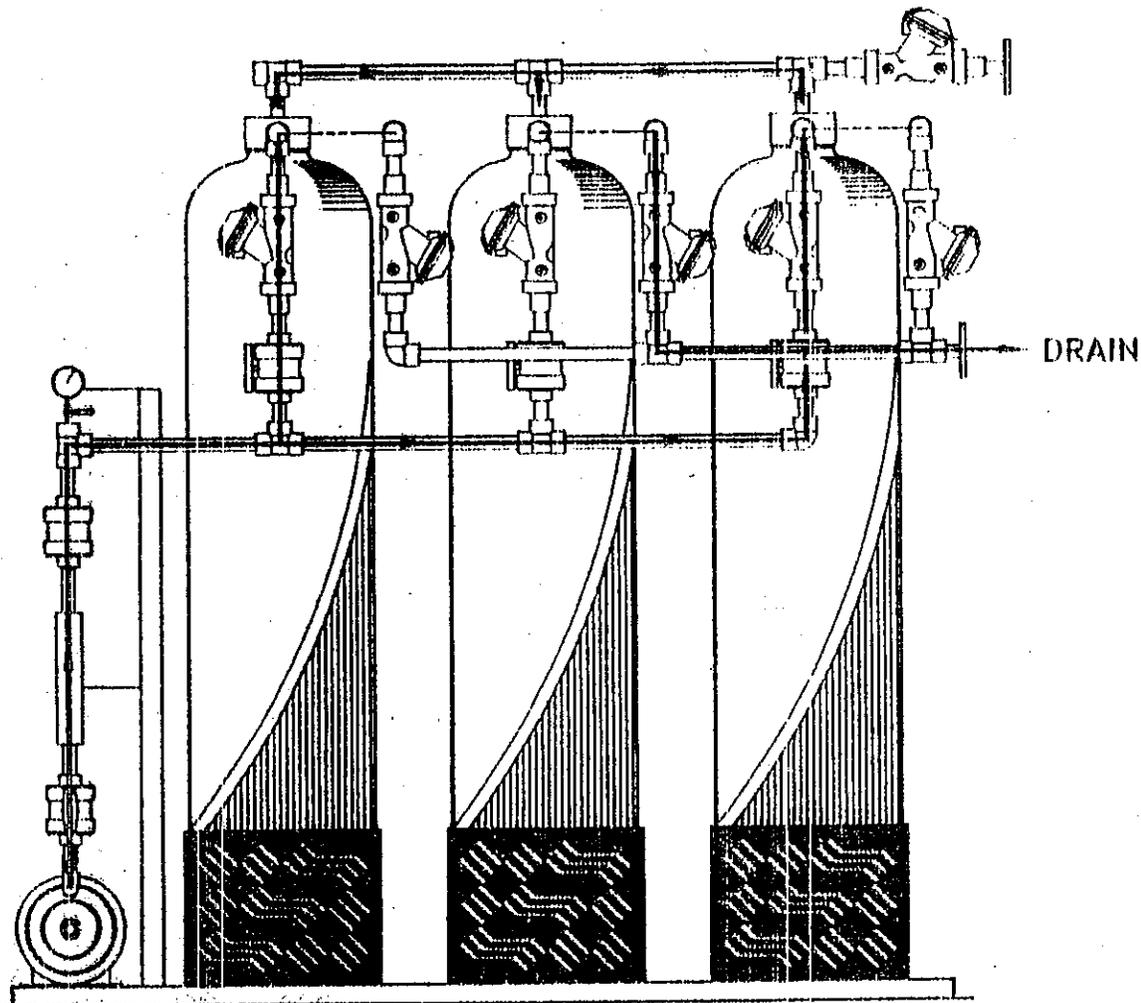
FILTER #1 IN BACKWASH

FILTER #1
Counter
Preset Value

BACKWASH
CT-1
10 minutes

When the differential pressure reaches a preset limit the filter system will automatically start a backwash cycle. Filter number #1 is the first unit to backwash. #1 Solenoid is energized which closes the inlet valve (DV-1) on filter #1 and opens the drain valve (DV-4) on filter #1. Filter water produced by Filters #2 & #3 supply water to the outlet of Filter #1. The water enters the filter tank at the bottom and flow upward to rinse the dirt from the media. Solenoid #4 is energized which closes the outlet valve (DV-7). Backwash flow rate is controlled by the limited stop on drain valve (DV-5) for #2, (DV-6) for #3 (DV-4) for #1

Monarch Water Systems, Inc.
 1230 Burnett Dr. Xenia, Ohio 45385
 Phone: 937-372-7200 Fax: 937-372-4622



↑ DRAIN MOVED AND OUTLET ROTATED FOR CLARITY

FILTER #2 IN BACKWASH

FILTER #2
Counter
Preset Value

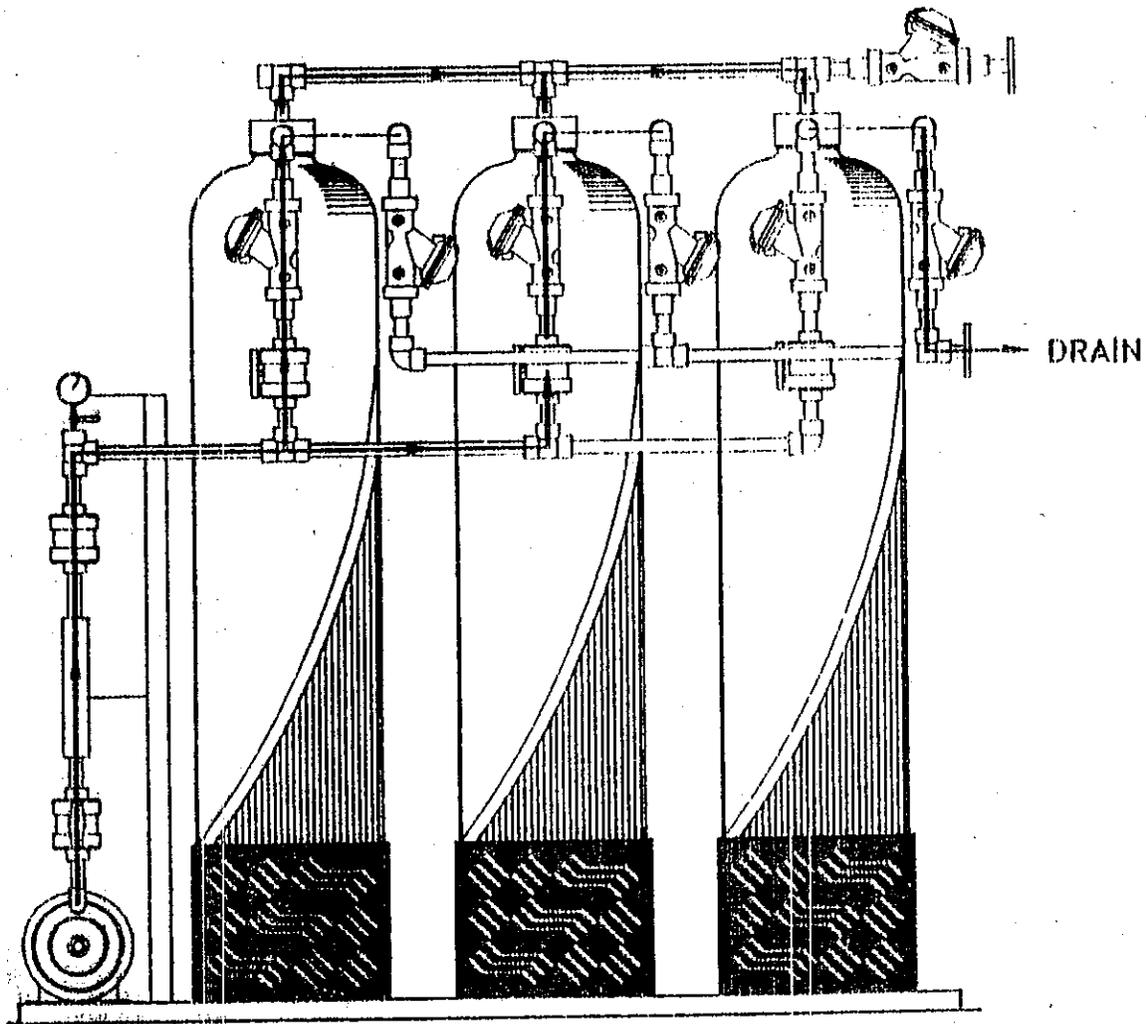
BACKWASH
CT-2
10 minutes

After Filter #1 has completed its backwash Filter #2 will automatically start a backwash cycle. Filter number #2 is the second unit to backwash. #2 Solenoid is energized which closes the inlet valve (DV-2) on filter #2 and opens the drain valve (DV-5) on filter #2. Filter water produced by Filters #1 & #3 supply water to the outlet of Filter #2. The water enters the filter tank at the bottom and flows upward to rinse the dirt from the media. Solenoid #4 remains energized which closes the outlet valve (DV-7). Backwash flow rate is controlled by the limited stop on drain valve (DV-5).

Monarch Water Systems, Inc.

1230 Burnett Dr.
Phone: 937-372-7200

Xenia, Ohio 45385
Fax: 937-372-4622



* DRAIN MOVED AND OUTLET ROTATED FOR CLARITY

FILTER #3 IN BACKWASH

FILTER #3
Counter
Preset Value

BACKWASH
CT-3
10 minutes

After Filter #2 has completed its backwash Filter #3 will automatically start a backwash cycle. Filter number #3 is the third and final unit to backwash. #3 Solenoid is energized which closes the inlet valve (DV-3) on filter #3 and opens the drain valve (DV-6) on filter #3. Filter water produced by Filters #2 & #3 supply water to the outlet of Filter #3. The water enters the filter tank at the bottom and flows upward to rinse the dirt from the media. Solenoid #4 remains energized which closes the outlet valve (DV-7). Backwash flow rate is controlled by the limited stop on drain valve (DV-6).

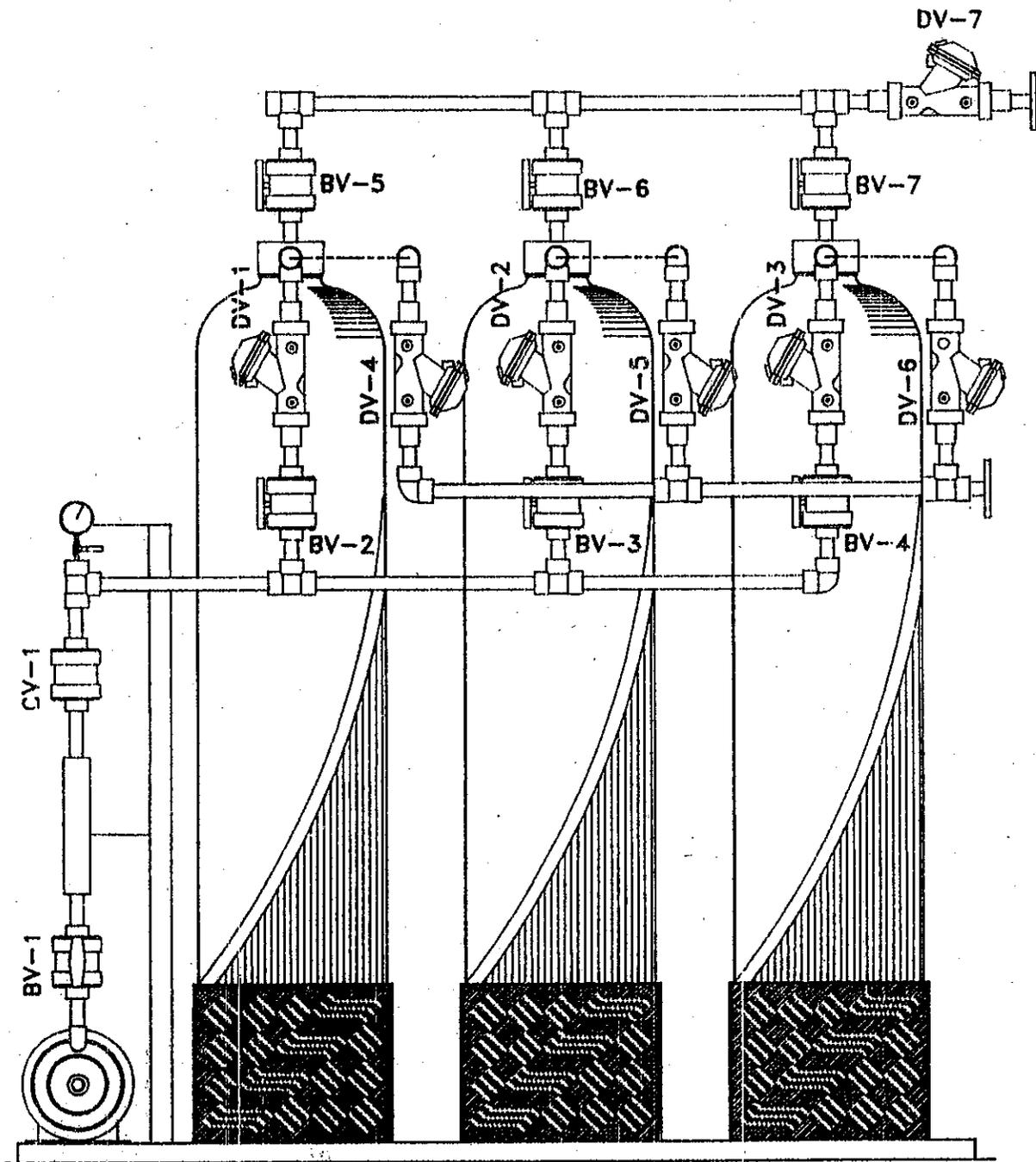
Monarch Water Systems, Inc.

1230 Burnett Dr.

Xenia, Ohio 45385

Phone: 937-372-7200

Fax: 937-372-4622



* DRAIN MOVED AND OUTLET ROTATED FOR CLARITY

Monarch Water Systems Inc.

1230 BURNETT DR.

XENIA, OHIO 45385

Phone: 937-372-7200

Fax: 937-372-4622

1-800-55-33-MWS

To produce water flow through the filter system adjust the ball valve (BV-1) on the outlet of the filter *pump*

To adjust the backwash flow rate through Filter #1, adjust the limited stop on the diaphragm drain valve (DV-4). By turning the screw clockwise reduces the flow rate, counter-clockwise to increase the flow rate. DO NOT TIGHTEN, SCREW SHOULD TURN FREELY

To adjust the backwash flow rate through Filter #2, adjust the limited stop on the diaphragm drain valve (DV-5). By turning the screw clockwise reduces the flow rate, counter-clockwise to increase the flow rate. DO NOT TIGHTEN, SCREW SHOULD TURN FREELY

To adjust the backwash flow rate through Filter #3, adjust the limited stop on the diaphragm drain valve (DV-6). By turning the screw clockwise reduces the flow rate, counter-clockwise to increase the flow rate. DO NOT TIGHTEN, SCREW SHOULD TURN FREELY

Solenoid #1 = When energized opens DV-4 and closes DV-1.
Solenoid #1 is only energized when Filter #1 is in backwash.

Solenoid #2 = When energized opens DV-5 and closes DV-2.
Solenoid #2 is only energized when Filter #2 is in backwash.

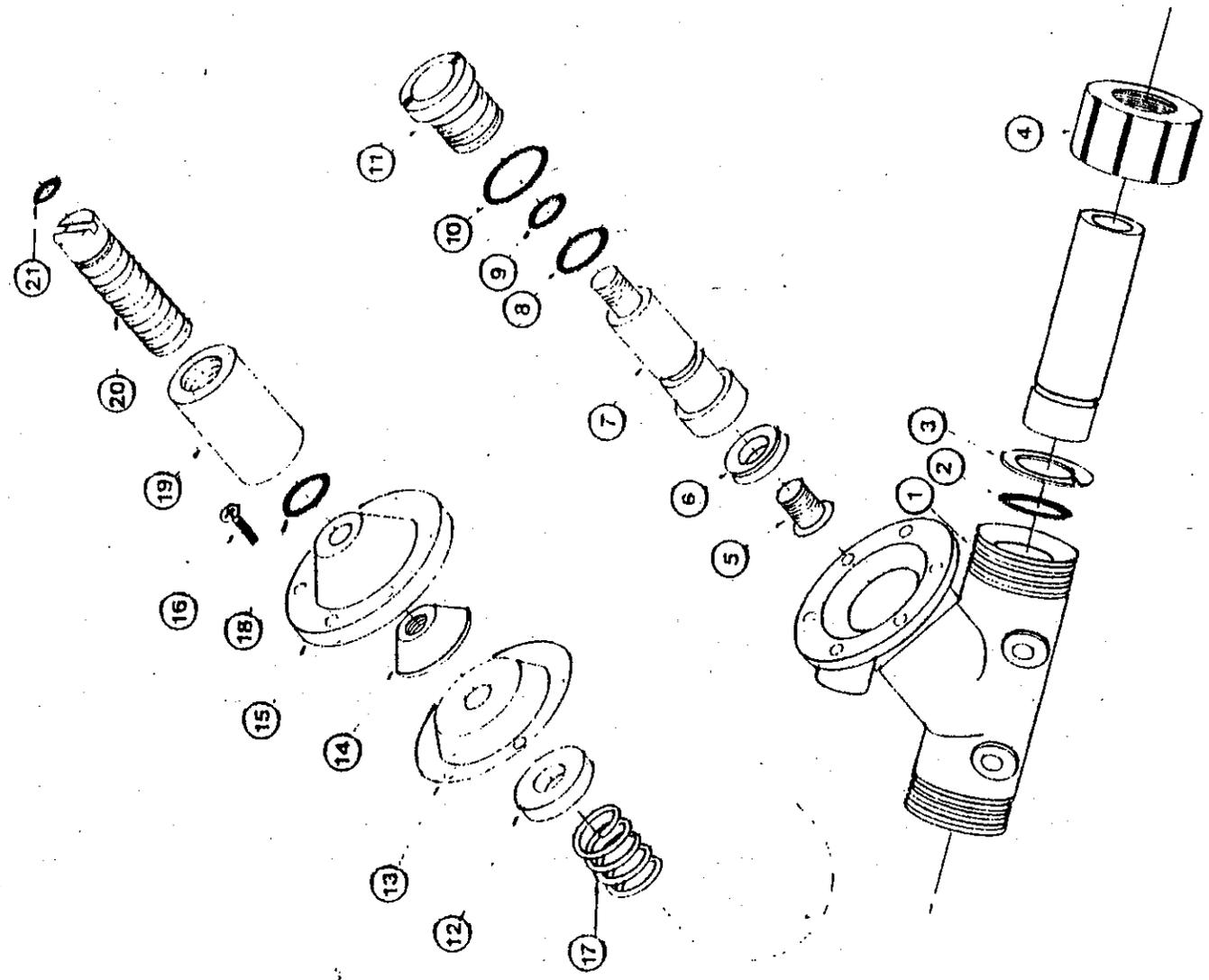
Solenoid #3 = When energized opens DV-6 and closes DV-3.
Solenoid #3 is only energized when Filter #3 is in backwash.

Solenoid #4 = When energized closes DV-7.
Solenoid #4 is only energized when any filter is in backwash.

See Drawing No. A-7206-F5

4.

NO.	DESCRIPTION	NO.	QTY.
1	Body	521-A	1
2	End Seal	ORE-117	2
3	Split Ring	521-N	2
4	Retainer Nut	521-M	2
5	Disc Plate Screw	521-E	1
6	Disc	521-J	1
7	Shaft	521-C	1
8	Dynamic O'Ring	ORE-111	1
9	Static Gasket	ORB-012	1
10	Static Gasket	ORE-018	1
11	Shaft Guide	521-G	1
12	Lower Diaphragm Plate	521-D	1
13	Diaphragm	521-FB	1
14	Upper Diaphragm Plate	521-DD	1
15	Cap	521-B	1
16	Mach. Screw 10-32	3/4" L	8
	Hex Nut	10-32	8
<i>Optional</i> SPRING ASSIST OPEN			
17	Spring	424-SS	1
LIMIT STOP			
15	Cap	521-BB	1
18	Static Seal	ORB-016	1
19	Limit Stop Nut	521-Y	1
20	Adj. Screw	521-X	1
21	Static Seal	ORB-012	1



Mammoth Water Systems

521 Diaphragm Valve

DRAWN BY: *John E. Johnson*
 CHECKED BY: *G.S.R.*
 DATE:

487

Installation and Maintenance Instructions

UNION-END BALL VALVES

- Tru-Bloc — True Union (Mod. "C")
- Tru-Bloc — Single Union (Mod. "C")
- Multi-Port* (3-Way 3-Position) (Mod. "B")
- Diverter* (3-Way 2-Position) (Mod. "B")

INSTALLATION

Chemtrol union-end ball valves can be fitted with socket, threaded, or flanged end connections. When joining union-end valves, or when flanging End Connectors, NEVER MAKE THE JOINT TO THE END CONNECTORS WHILE THEY ARE ATTACHED TO THE VALVE BODY. Remove the Union Nuts and End Connectors from the valve cartridge first. In order to prevent mishaps with the Union Nut, slide it (smallest bore first) over the pipe or Nipple-and-Flange hub (when flanging) before making the joint to the End Connector.

Threaded-End Valves — Refer to the plastic thread joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Do not overtighten threads. Usually, one to two turns beyond hand tight using a suitable strap-wrench if necessary, is sufficient. (ANSI B1.20.1 defines hand tight as 4 to 5 threads for sizes through 2" and 5 to 5 1/4 threads for sizes over 2".)

Socket-End Valves (PVC/CPVC and Chem-Aire) — Refer to the solvent cement joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Do not allow Purple Primer or Solvent Cement to come in contact with the sealing face of the End Connectors. When joining the fixed end of a Single Union Valve, place the Ball in the open position to allow for proper drying and to avoid Primer or Solvent Cement contacting internal components of the valve.

For PP or PVDF valves, refer to the heat fusion joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Chemtrol valves require special heat fusion tools to make proper connections. These tools can be found in the Chemtrol Fitting Guide.

Flanged-End Valves — Refer to the elastic flange joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Do not overtighten flanges. When flanging the fixed end of Single Union Valves, care should be taken to properly align the Flange bolt holes, unless Van Stone type Flanges are used.

Valve Cartridge — After allowing the proper joint curing time, end connectors may be joined to the valve cartridge. The Ball should be turned so that the Handle is perpendicular to the Body "O"-rings provide the seal between the valve faces and the End Connectors faces. Ensure that these "O"-rings are clean and in their proper grooves before slipping the valve cartridge between its End Connectors. Slide the Union Nuts over the End Connectors and screw onto the valve cartridge threads, no more than hand tight. **Caution:** The "Adjust" end of the valve should normally be installed facing upstream.

Adjustment — With the Handle still in the closed or perpendicular position, tighten the Union Nuts on the valve ends. Each of the Union Nuts must apply adequate force on its End Connector to prevent shell leaks at the "O"-ring face seats on each end of the body. Obviously, further tightening of the Union Nuts should stop shell leaks at these locations if the "O"-rings have been properly seated in their grooves. If unable to adjust the Nut by hand, a suitable strap-wrench may be used. **Caution:** Do not overtighten. Usually, 1/4 turn or less adjustment is sufficient to restore the valve to sealing condition. Immediately after adjustment, return the handle to the open position, allowing solvent vapors to dissipate.

Note: Misalignment of adjacent piping can result in loss of seal at end connections. Always properly adjust union ends prior to final bolt-up of flanges or hangers and supports.

MAINTENANCE

Should a valve need repair, depressurize and drain the system on both sides of the valve. Loosen the valve Union Nuts and slide them back over the End Connections. To minimize downtime, it may be advisable to have a replacement valve cartridge ready to install in place of the one to be repaired. Disassemble valve cartridge as follows:

- 1) Set Ball in closed position.
- 2) Using a suitable spanner wrench, remove the Seal Carrier by rotating counterclockwise, if the valve is not a Mod. "C" Tru-Bloc style, this step may be omitted.
- 3) Insert a soft blunt instrument into the valve end marked with the Flow arrow and push the Ball and Seal Carrier out of the valve end marked with the Adjust arrow.
- 4) Remove the Handle from the Stem by pulling upward and away from the Body.
- 5) Push the Stem into the body and remove through the open Body end.
- 6) Examine all parts and replace any damaged or worn components. If the Body is damaged, we recommend replacing the entire valve cartridge.
- 7) Reassemble valve in reverse order.

Replacement Parts Lists for Chemtrol union-end type ball valves may be found in this page. The valve repair be properly identified before selecting replacement parts. **Caution:** Valve repair should only be performed by qualified maintenance personnel. Contact your nearest Chemtrol distributor should further information be required.

"O"-Ring Kits - In the event o-ring replacement becomes necessary, contact factory for proper size and material information.

TFE Seat Kits — Each kit contains two seats. Note correct seal orientation before removing old seats.

To determine suitability of Chemtrol valves in your application, consult the Chemtrol Chemical Resistance Guide.

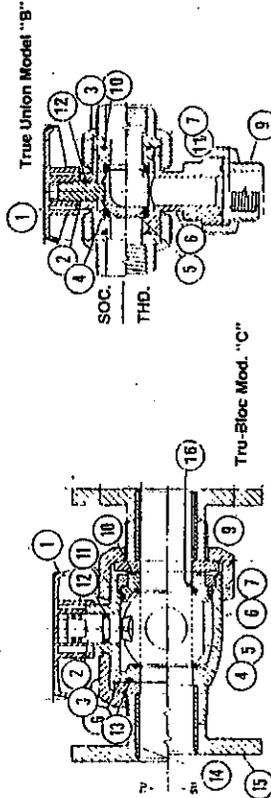
Do not use or test PVC, CPVC, PP OR PVDF Valves with compressed air or other gases. See Chemtrol Chem-Aire™ literature for more information about a shatter-resistant thermoplastic piping system specifically designed for compressed air and other gases. (See Chem-Aire PSI rating this page).

REPLACEMENT PARTS LIST

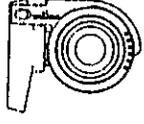
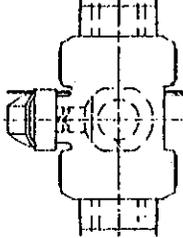
- | PART | TRUE UNION | SINGLE UNION |
|--|------------|--------------|
| 1. Handle Lever | | |
| 2. Stem | | |
| 3. Union Nut | | |
| 4. Seal (2) | | |
| 5. Ball | | |
| 6. Body — TU or SU, Socket or Thread or SU, Socket or Thread | | |
| 7. Seal Carrier | | |
| 9. End Connector — Socket or Thread | | |
| 10. "O"-Ring — Carrier End (TU or SU) | | |
| 11. "O"-Ring — Carrier O.D. (TU or SU) | | |
| 12. "O"-Ring — Stem (TU or SU) | | |
| 13. "O"-Ring — Body End (TU only) | | |
| 14. Plain End Pipe Nipple — SPG x SPG | | |
| 15. Flange — Socket | | |
| 16. "O"-Ring — Carrier Seat Energizer (Mod. "C" only) | | |
| 17. Stem Friction Washer (4" & 6") | | |
| 18. Handle Bolt (4" & 6") | | |



TRUE UNION



Safety vent lock-out valve (shown below) is used for Chem-Aire service as optional equipment on 1/2, 3/4 and 1" sizes. Must be installed with flow arrow in correct orientation.



PRESSURE RATINGS

The maximum pressure rating for Chemtrol valves, regardless of size, is 150 psi at 73 F. As with all other thermoplastic piping components, the maximum non-stock operating pressure is related to temperature. Above 100 F refer to the chart below. **Note:** For vacuum or throttling service, consult factory.

Maximum Operating Pressure (psi) vs. Temperature

Operating Temperature (F)	PVC	CPVC	PP	PVDF	CHEM-AIRE
100	150	150	150	150	150
110	135	140	140	150	140
120	110	130	130	150	130
130	85	120	118	150	110
140	50	110	105	150	80
150	N.R.	100	93	140	N.R.
160	N.R.	90	80	130	N.R.
170	N.R.	80	70	125	N.R.
180	N.R.	70	50	115	N.R.
190	N.R.	50	N.R.	105	N.R.
200	N.R.	50	N.R.	97	N.R.
250	N.R.	N.R.	N.R.	50	N.R.
280	N.R.	N.R.	N.R.	25	N.R.

N.R. — Not Recommended * 3" & 4" N.R. above 120 F

FOR SERVICE INFO CALL 800-343-5455 OR 502-775-6431

Installation and Maintenance Instructions

True-Union Ball Check and Foot Valves

INSTALLATION

Chemtrol union-end check-foot valves can be fitted with socket, threaded, or flanged end connections. When joining union-end valves, or when hanging End Connectors, NEVER MAKE THE JOINT TO THE END CONNECTORS WHILE THEY ARE ATTACHED TO THE VALVE BODY. Remove the Union Nuts and End Connectors from the valve cartridge first. In order to prevent mishaps with the Union Nut, slide it (smallest bore first) over the pipe or Nipples-and-Flange nub (when flanging) before making the joint to the End Connector.

Check valves should be installed at least four feet from the discharge side of a pump. Ball manner and minor damage may result if fluid flow is too turbulent. Also, in keeping with good mechanical design practices, the upper threshold of fluid flow recommended from Chemtrol products is five feet per second.

Caution: The valves may be installed vertically or horizontally (refer to table on this page for minimum seating head requirements), but the molded-in flow arrow on the valve cartridge must be installed in the direction of the fluid flow such that reverse flow will be checked. For vent valve applications contact customer service for PP floating ball arrangement.

Threaded-End — Refer to the plastic thread joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Do not overtighten threads. Usually, one to two turns beyond hand tight using a suitable strap-wrench if necessary, is sufficient. (ANSI B1.20.1 defines hand tight as 4 to 5 threads for sizes through 2" and 5 to 6 1/2 threads for sizes over 2".)

Socket-End Valves (PVC/CPVC and Chem-Aire) — Refer to the solvent cement joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Do not allow Purple Primer or Solvent Cement to come in contact with the sealing face of the End Connectors or Internal components of the valve.

For PP or PVDF valves, refer to the heat fusion joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Chemtrol valves require special heat fusion tools to make proper connections. These tools can be found in the Chemtrol Fitting Guide.

Flanged-End valves — Refer to the plastic flange joining instructions in the Chemtrol Thermoplastic Piping Technical Manual for proper joining techniques. **Caution:** Do not overtighten flanges.

Valve Cartridge — After allowing the proper joining curing time, and connections may be joined to the valve cartridge. "O"-rings provide the seal between the valve faces and the End Connectors faces. Ensure that these "O"-rings are clean and in their proper grooves before slipping the valve cartridge between its End Connectors. Slide the Union Nuts over the End Connectors and screw onto the valve cartridge threads, no more than hand tight. See adjustment section this page.

Foot Valve Conversion — Foot Valves may be obtained as factory assemblies or they can be field converted from Ball Check Valves Screen Housing Assemblies may be installed in place of the regular Union Nut and End Connector on the subop side of the valve to convert it to a Foot Valve.

REPLACEMENT PARTS LIST

PART

1. Union Nut (2)*
2. End Connector — Socket (2)* or Thread (2)*
3. Ball
4. Body
5. Seal Carrier
6. "O"-Ring — End Seal (2)
7. "O"-Ring — Carrier Seal
8. "O"-Ring — Seat Seal
9. Plain End Pipe Nipple (2)*
10. Flange — Socket (2)*
11. Foot Valve Screen Housing Assy.

* Ball Check Valves have two (2) of each end connection component. One Set of end connection components if replaced with a Screen Housing Assembly on the receiving end of the Body to create a Foot Valve

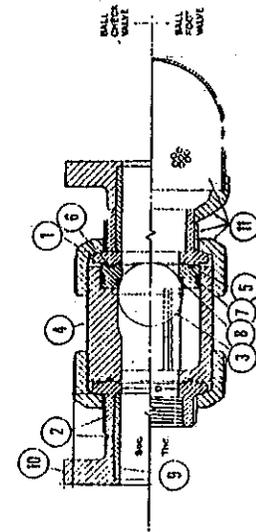
VALVE MODELS



BALL CHECK



BALL FOOT



PRESSURE RATINGS

The maximum pressure rating for Chemtrol valves, flanges, and unions, regardless of size, is 150 psi at 73°F. As with all other thermoplastic piping components, the maximum non-shock operating pressure is related to temperature. Above 100°F refer to the chart below.

Maximum Operating Pressure (psi) vs. Temperature

Operating Temperature (°F)	PVC	CPVC	PP	PVDF
100	150	150	150	150
110	135	140	140	150
120	110	130	130	150
130	75	120	118	150
140	50	110	105	150
150	N.P.	100	95	140
160	N.P.	90	80	133
170	N.P.	80	70	125
180	N.P.	70	50	115
190	N.P.	60	N.P.	106
200	N.P.	50	N.P.	9
250	N.P.	N.P.	N.P.	50
280	N.P.	N.P.	N.P.	28

N.P. — Not Recommended.

MAINTENANCE

Should a valve need repair, depressurize and drain the system on both sides of the valve. Loosen the valve Union Nuts and slide them back over the End Connections. To minimize downtime, it may be advisable to have a replacement valve cartridge ready to install in place of the one to be repaired. Disassemble valve cartridge as follows:

1. Insert a soft blunt instrument into the downstream end of the valve and push the Ball and Seal Carrier out of the upstream end of the valve.
2. Examine all parts and replace any damaged or worn components with new replacement parts. If the Body is damaged, we recommend replacing the entire valve cartridge.

Replacement Parts List for Chemtrol union-end type ball Check and Foot valves may be found on this page. The valve should be properly identified before selecting replacement parts. **Caution:** Valve repair should only be performed by qualified maintenance personnel. Contact your nearest Chemtrol distributor should further information be required.

Valve Seat — The fluid seal between the Ball and Body seat (chamfered shoulder) is affected by a standard "O"-ring located in a groove in the Body seat. This Seal Seal is included in the "O"-ring Kit which is identified in the Replacement Parts List.

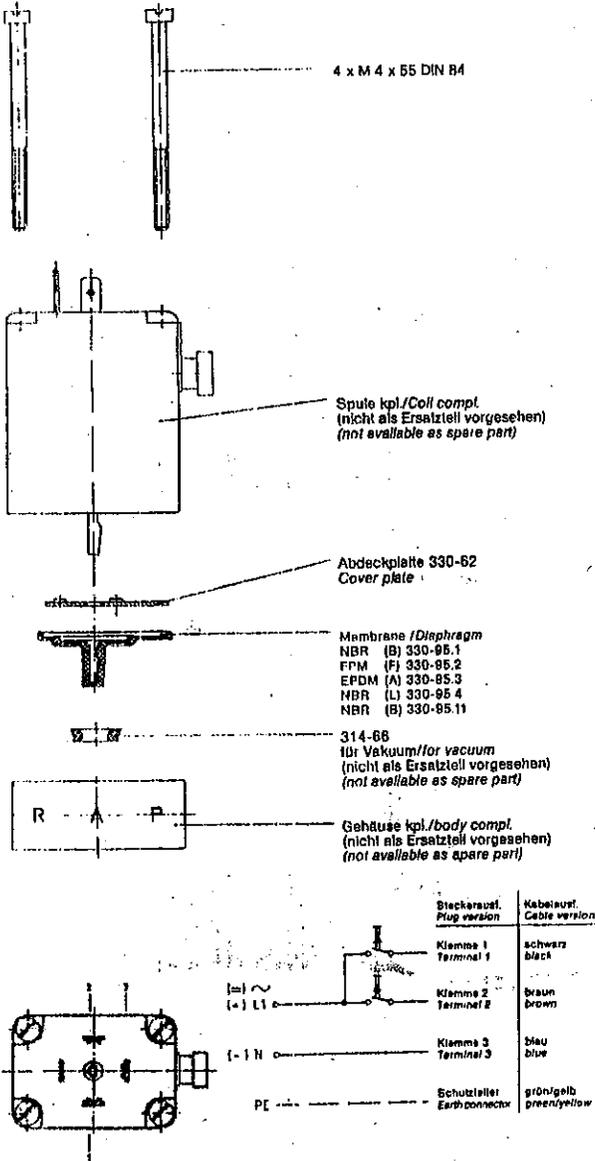
"O"-Ring Kits — In the event o-ring replacement becomes necessary, contact factory for proper size and material information.

To determine suitability of Chemtrol valves in your application, consult the Chemtrol Chemical Resistance Guide.

Valve Size	Minimum Seating Head Ft. — H ₂ O	
	Vert.	Horiz.
1/2	6	7
3/4	6	7
1	4	5
1 1/4	4	5
1 1/2	4	5
2	4	5
3	4	5

Ersatzteilsätze Typ 330, 332
Spare part sets type 330, 332

Ventil Typ 330 und 332 sollte vorzugsweise in Werk repariert werden.
 Bei entsprechenden Voraussetzungen kann die Membrane ausgetauscht werden,
 wodurch allerdings geringe Abweichungen von den Listenwerten auftreten können.
Solenoid valve Type 330 und 332 should be repaired preferably in the factory.
A replacement of the diaphragm requires certain knowledge and may result in
variations of the data sheet values.



4 x M 4 x 55 DIN 94

Spule kpl./Coil compl.
 (nicht als Ersatzteil vorgesehen)
 (not available as spare part)

Abdeckplatte 330-62
 Cover plate

Membrane /Diaphragm
 NBR (B) 330-85.1
 FPM (F) 330-85.2
 EPDM (A) 330-85.3
 NBR (L) 330-85.4
 NBR (B) 330-85.11

314-68
 für Vakuum/for vacuum
 (nicht als Ersatzteil vorgesehen)
 (not available as spare part)

Gehäuse kpl./body compl.
 (nicht als Ersatzteil vorgesehen)
 (not available as spare part)

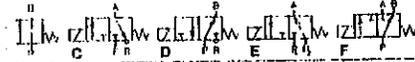
Steckeranz. Plug version	Kabelanz. Cable version
Klemme 1 Terminal 1	schwarz black
Klemme 2 Terminal 2	braun brown
Klemme 3 Terminal 3	blau blue
Schutzleiter Earth connect	grün/gelb green/yellow

Korea: Seoul 136-270, Tel. (02) 34-67-53-92
 Malaysia: 11720 Sungai Dua, Pulau, Tel. (03) 6 57-68-49
 Netherland: NL-3606 AV Maarsse, Tel. (0341) 639-5311
 New Zealand: Mt. Wellington, Auckland, Tel. (09) 570-25-59
 Norway: Oslo, Tel. (02) 76 43 11
 Poland: Warszawa 31 15, Tel. (0080) 32 8 19 05 36
 Portugal: P-2300 Oeiras, Tel. (02) 422-26-96
 Singapore: Singapore 367998, Tel. 333-5112
 South Africa: East Rand 1462, Tel. 333-5112
 Spain: Madrid 28014, Tel. (91) 430-11-10
 Sweden: S-12349 Malmö, Tel. 0401 6445100
 Switzerland: CH-Hönggberg, Tel. (041) 795-6666
 Thailand: Bangkok 10110, Tel. (0066) 2315-26279
 Taiwan: T.O. Taipei, Tel. (02) 2314-4953
 USA: Irvine, CA 92614, Tel. (714) 223-1100
 Japan: Saito 167, Tel. (03) 32-073-11

Australia: Seven Hills NSW 2127, Tel. (02) 337-6166
 Belgium: B-2100 Dourbe, Tel. (03) 325 09 00
 Brazil: S-21422 São Paulo, Tel. (011) 552 8377
 Canada: Oakville, Ontario L6L 6G5, Tel. (905) 3 97 56
 China: Shanghai 20000, Tel. (86 21) 228190
 Denmark: DK-2750 Høvelund, Tel. (044) 507500
 France: F-83012 Bagnols-sur-Croze, Tel. (04) 43 31 15
 Greece: Zografou Athens, Tel. (01) 71 5037
 Hong Kong: Kowloon Chung N.T., Tel. (852) 24 801202
 Indonesia: 10140 Jakarta, Tel. (021) 3 98 24 85
 India: 110060 New Delhi, Tel. (011) 261 1040
 Israel: Saito 167, Tel. (03) 32-073-11

Berlin, Tel. (030) 979717-0
 Dresden, Tel. (0351) 363 00
 Frankfurt, Tel. (069) 94 14-0
 Hamburg, Tel. (04103) 94 14-0
 Mannheim, Tel. (0621) 90825-0
 München, Tel. (089) 322228-0
 NRW, Dortmund, Tel. (02373) 3681-0
 Stuttgart, Tel. (07141) 45110-0

St. Gallen
 Steyr- und Regensburg
 Christian-Böcker-Str. 12-17
 74653 Ingelheim
 Telefon (079 40) 13-0
 Telefax (079 40) 10-24



Operating Instructions type 330, 332

These installation and operating instructions must be followed. Similarly, the exact conditions of use must be taken into account and the performance data of the device must be observed in accordance with the data sheet. The operator must ensure that these instructions are followed so as to guarantee the problem-free operation and long service life of the device.

Construction

Type 330: Direct-acting solenoid valve with ported base, circuit functions A to F (see symbols).
 Type 332: Bistable solenoid valve, direct-acting with plunger-type armature and 2 coil windings. Circuit functions A to F.

Operating principle (Type 332)

- A pulse applied to terminals 2 and 3 of the operating coil pulls in the armature. The valve output is opened. After the pulse, the armature remains in the operated position.
- A pulse applied to terminals 1 and 3 of the throw coil enables the armature to drop out. The valve output is closed. After the pulse, the armature remains in the non-operated position.

Fluids handled

Neutral gases and liquids, providing medium does not attack brass body or selected seal material. The seal material is coded after the orifice size on valve label, (A=EPDM, B=NBR; F=FPM). Pressure range as quoted on valve label.

Installation

Before installing valve ensure all pipework etc. is free of foreign matter (metal filings, sealing material, welding scale etc.). Teflon tape is recommended for sealing parts: maximum thread depth 9 mm. Installation position as required. Fixation by means of four tappings M 4 x 8 mm in underside of valve body.

Manual override

The manual override can be retained in position if, after depressing the button, it is turned in a clockwise direction.

Spare parts

Basically repairs should only be carried out by the manufacturer. If any parts are replaced by the user malfunctions can result without proper re-setting.

Electrical Connection

Ensure supply voltage/frequency corresponds with that on label. Voltage tolerance ± 10 %.
 Type 330: Electrical connection via Böcker cable plug. Order number 1050-S-001-021. Cable 3 x 0.75 mm².
 Type 332: Electrical connection via Böcker cable plug. Order number 1050-S-001-221. Cable 4 x 3 x 0.75 mm².
 Classification IP 65. Note earth connector. Flat terminal = earth. Cable plug insert can be positioned at 90° intervals. Tightening torque for cable plug 1 Nm.

Note

Avoid simultaneous pulsing to both coil windings. No further loads (relays etc.) must be connected in parallel with the terminals.
 If two or more valves are to be connected in parallel, two-pole or multipole switches should be used to ensure that the non-pulsed coil is electrically isolated. Malfunctions may occur if this measure is not taken.

Trouble-shooting

Check port connections, operating pressure and voltage. If armature does not pull in check for short circuit or coil burn-out. A jammed armature on AC version causes coil overheating.

5.

DV-1000™

DirectVIEW

Manual Number D-24VIEW-M

Operator's Guide to Change Preset Mode

This 2-page guide contains condensed instructions for machine operators on how to use Change Preset Mode. It assumes the DV-1000 installation and programming are complete.

To enter Change Preset Mode, just press the **Change Preset Key** on the keypad. The User-titled Presets will appear.

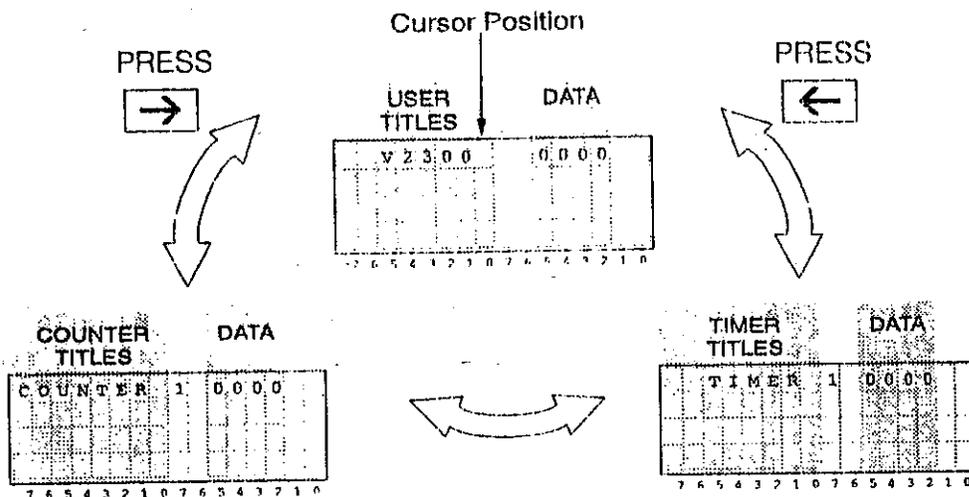
PRESS **CHG PRE** 

Set Point	0	4	2	5
Actual	0	4	3	2
Hi Alarm	0	4	5	0
Lo Alarm	0	3	9	5

7 6 5 4 3 2 1 0 7 6 5 4 3 2 1 0 05

Selecting the List to Display

Three change preset lists are accessible in a circular list. Refer to the figure below. Upon entry to Change Preset Mode, the first display is automatically the User-titled list. From there, use the **Right Arrow** and **Left Arrow** Keys to move to the timer titles and counter titles displays.



Cursor Positioning On Title or Data

Press the **Enter Key** to toggle the cursor between the title and data fields. When the cursor is in the data field you are ready to edit the data.

NOTE: If pressing the **Enter Key** does not move the cursor to the data position, access to change presets is locked. You must first enter the correct password (see next page).

PRESS **ENT**
Title Position \longleftrightarrow toggles \longleftrightarrow Data Position

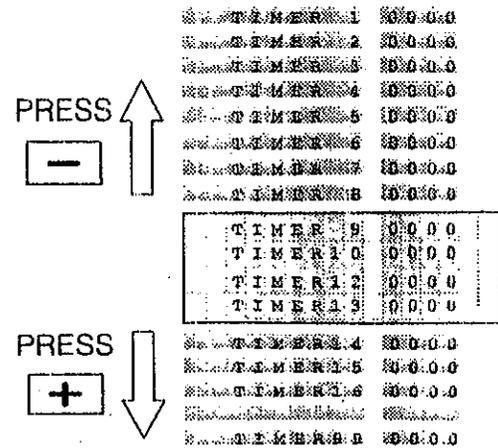
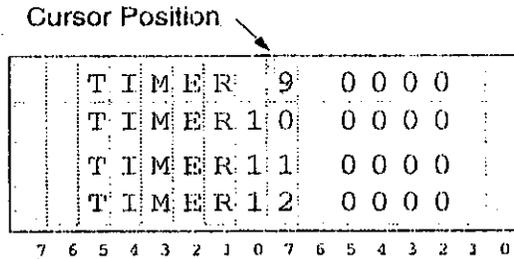
Set Point	0	0	0	0
Actual	0	0	0	0
V 2302	0	0	0	0
V 2303	0	0	0	0

7 6 5 4 3 2 1 0 7 6 5 4 3 2 1 0

WARNING: Changing the preset value on the display immediately changes the value in PLC V-memory (the display is not buffered). Equipment damage or personnel injury may occur from improper use of this mode. Be sure to pause a moment after each keystroke to allow for the DV-1000 display update, so that you are viewing current values of Change Preset variables.

Scrolling Through Change Preset Lists

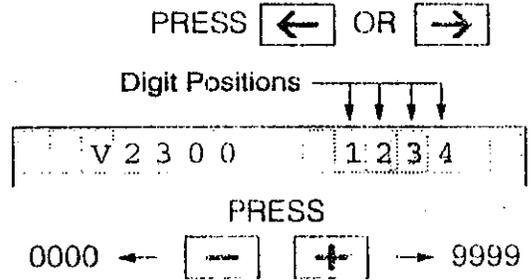
To scroll the display window downward or upward through a selected list, position the cursor over the title (use the **Enter** Key to toggle its position between the title or data. Then use the **Plus (+)** and **Minus (-)** Keys to scroll the display.



Changing the Preset Value

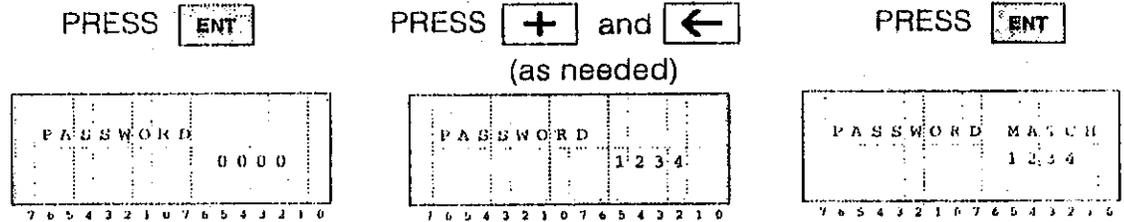
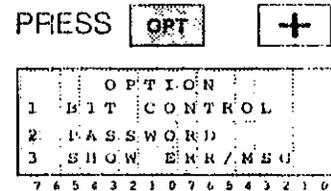
With the cursor in the data position, use the **Cursor Right** and **Cursor Left** keys to move it among the four digit positions.

Press the **Plus (+)** Key to increment a digit, and the **Minus (-)** Key to decrement it. The range of input change is from 0000 to 9999, BCD. Incrementing past 9 or decrementing past 0 carries to or borrows from (respectively) the digit(s) to the left of the cursor position.



Entering a Password

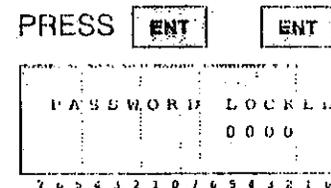
To enter a password, press the **Options** Key to view the Options menu. Press the **Plus (+)** Key to move the cursor to the password option. Then press the **Enter** Key. Use the **Plus (+)** Key and **Cursor** Keys to increment the password code to the correct value. Then press **Enter**.

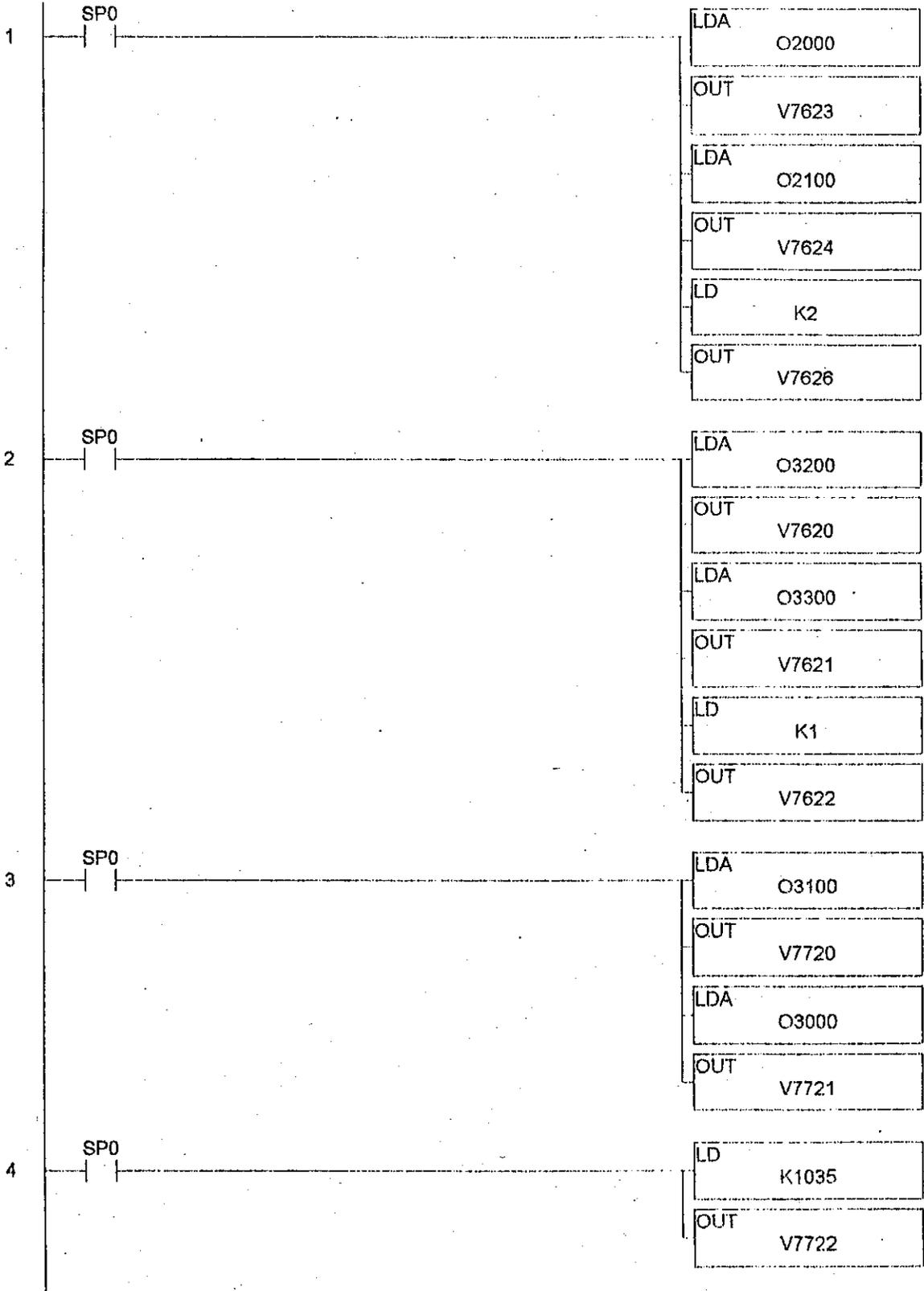


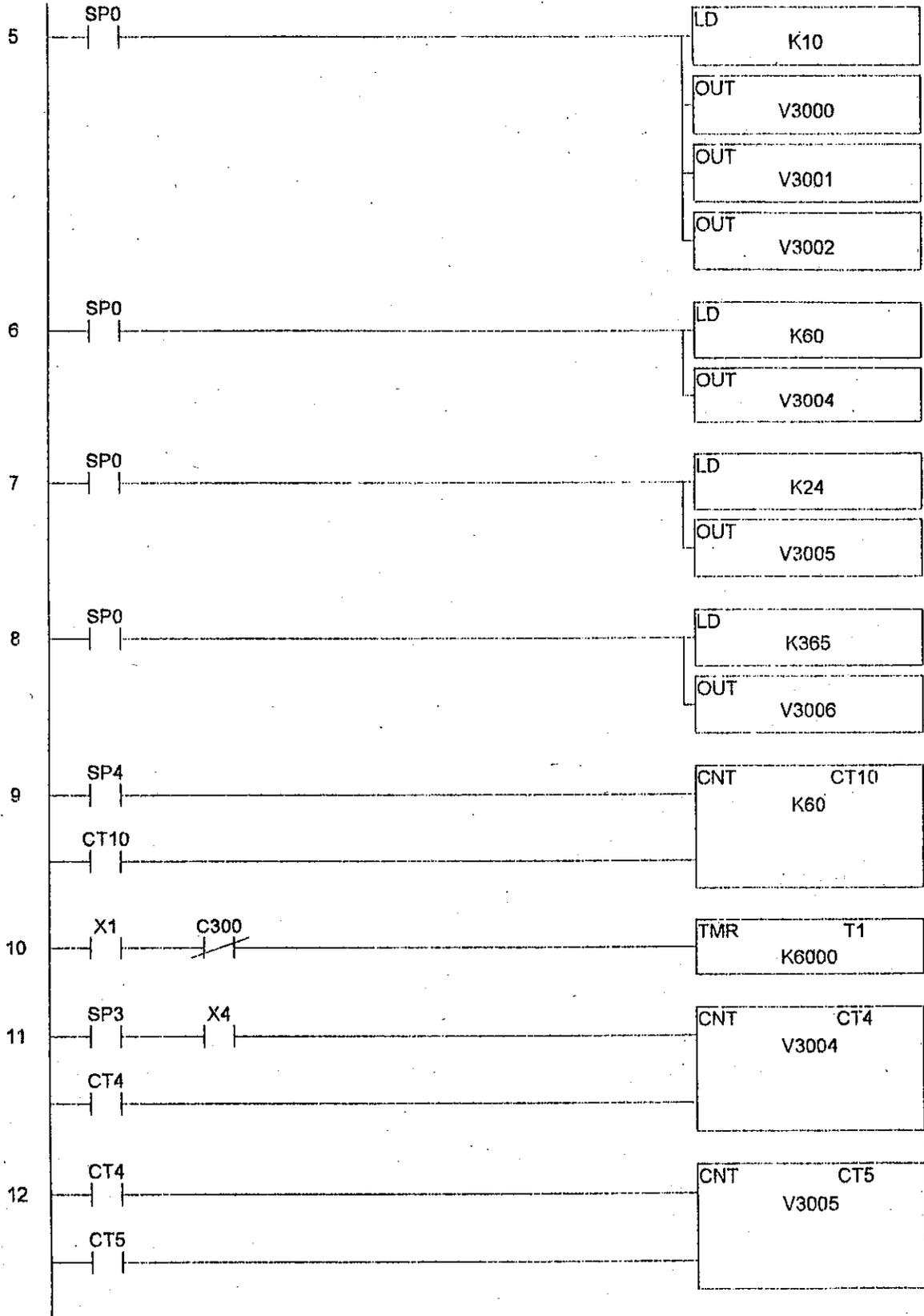
For correct password entries, the message "PASSWORD MATCH" is briefly displayed. The DV-1000 returns to the previous (Change Preset) Mode. Incorrect passwords yield the message "WRONG PASSWORD".

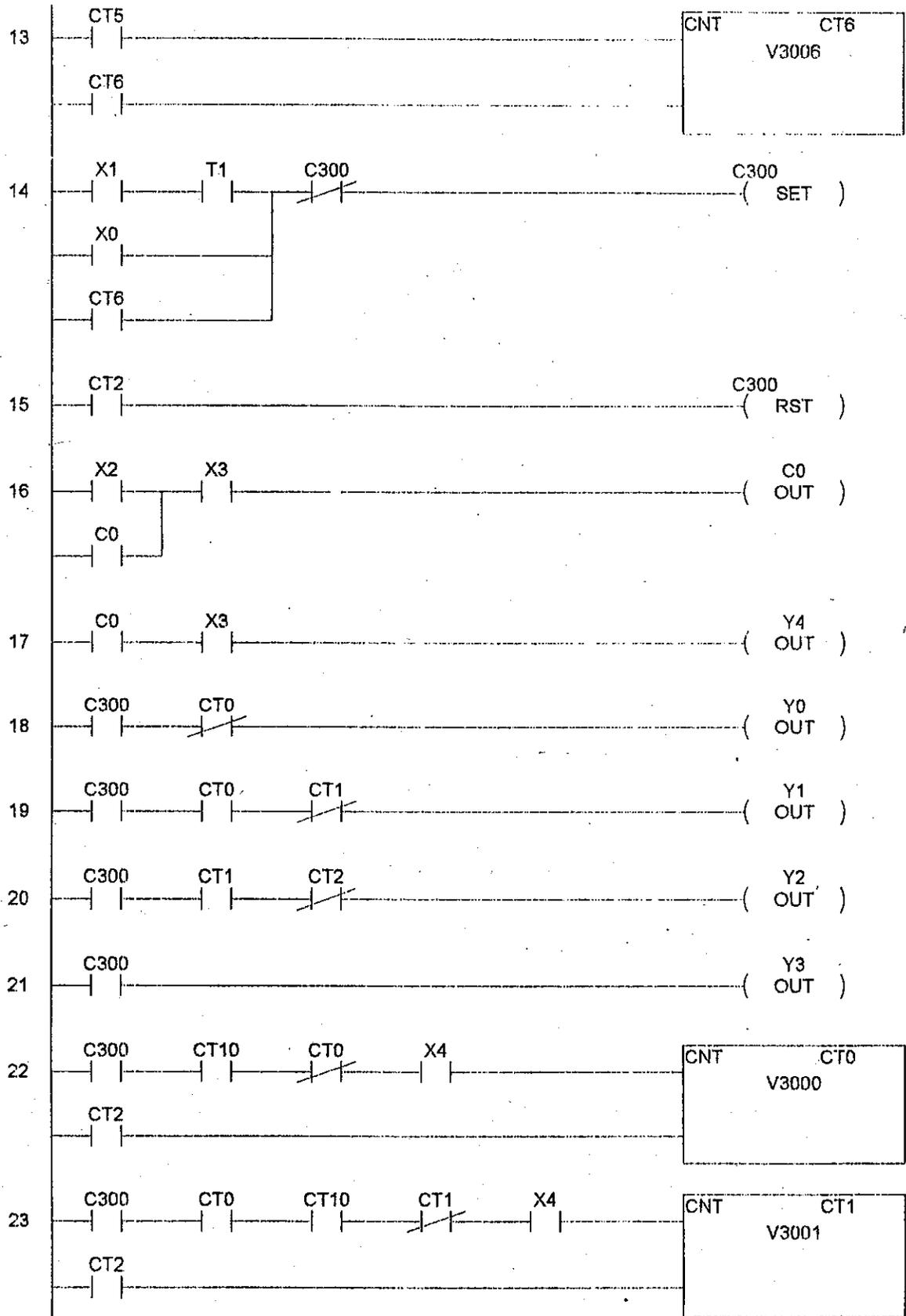
Locking Access to Change Presets

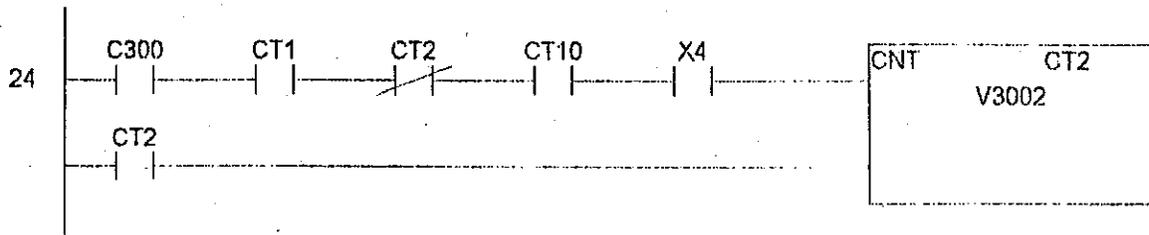
If your DV-1000 setup requires a password, you can lock access again after changing presets. Just follow the instructions above for entering a password, but enter "0000" for the password. The message "PASSWORD LOCKED" confirms your action. Now access to changing presets is locked.









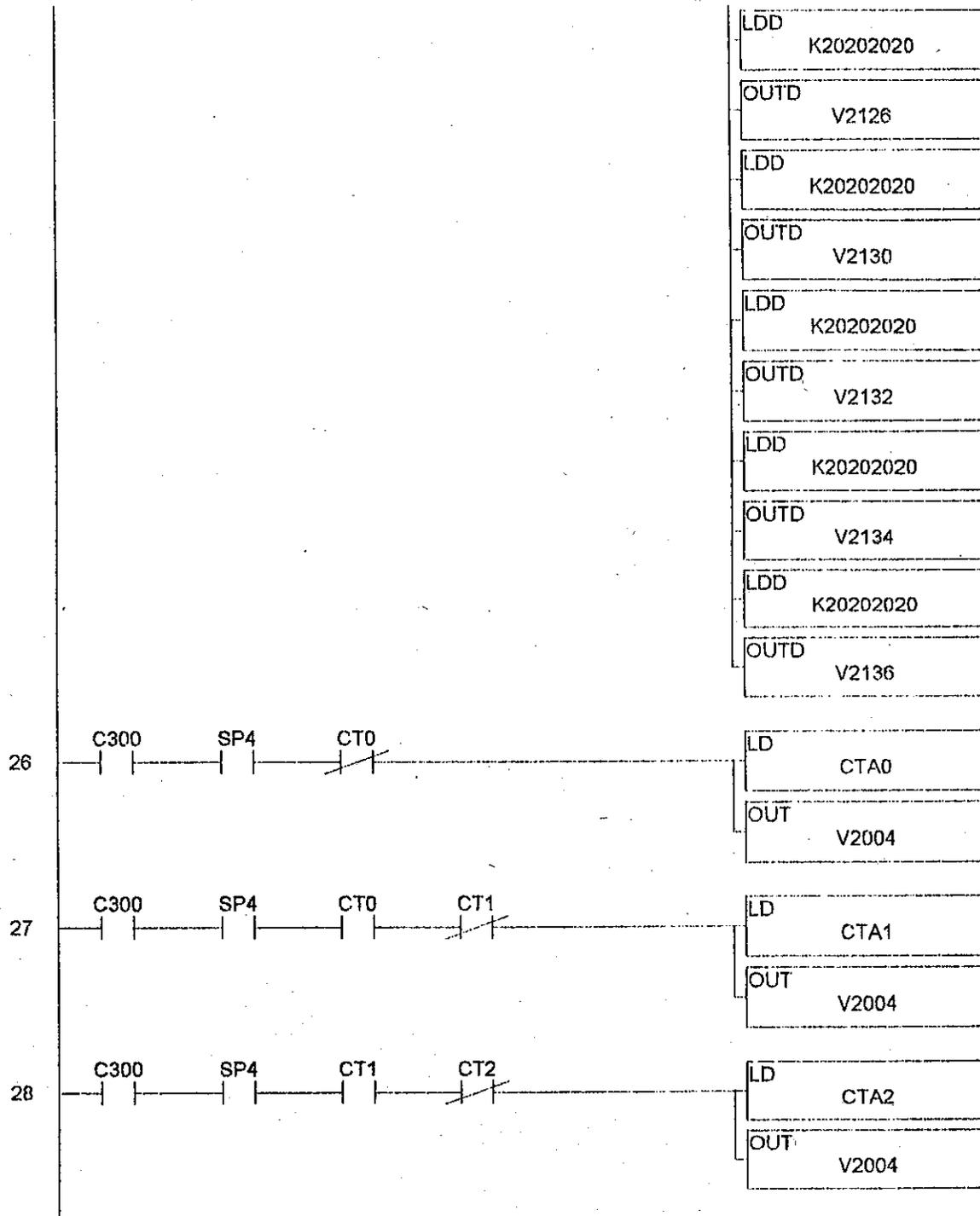


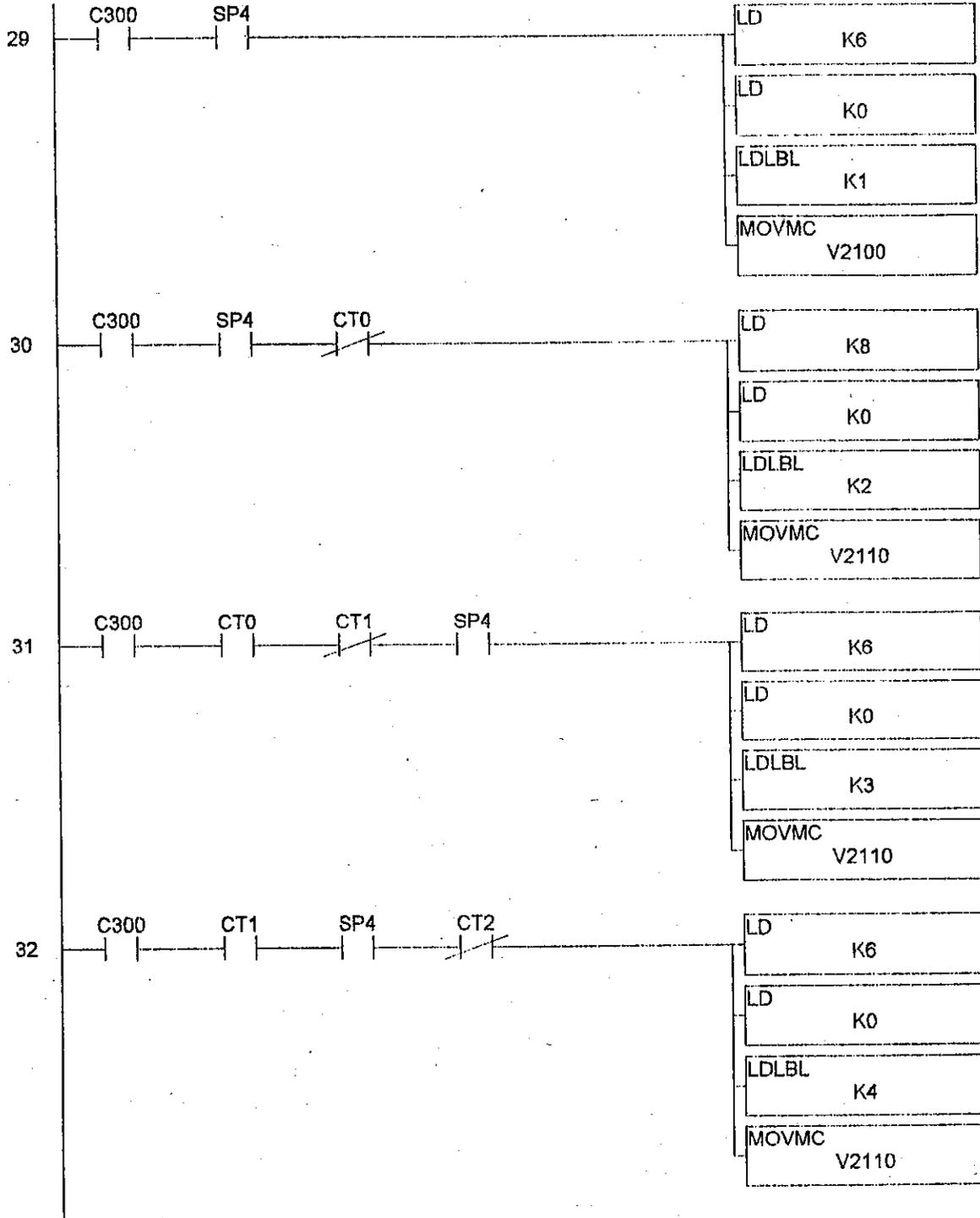
25

C300

SP4

LD	K6
LD	K0
LDLBL	K7
MOVMC	V2100
LDD	K20202020
OUTD	V2106
LDD	K20202020
OUTD	V2104
LDD	K20202020
OUTD	V2110
OUTD	V2112
LDD	K20202020
OUTD	V2114
LDD	K20202020
OUTD	V2116
LDD	K20202020
OUTD	V2120
LDD	K20202020
OUTD	V2122
LDD	K20202020
OUTD	V2124

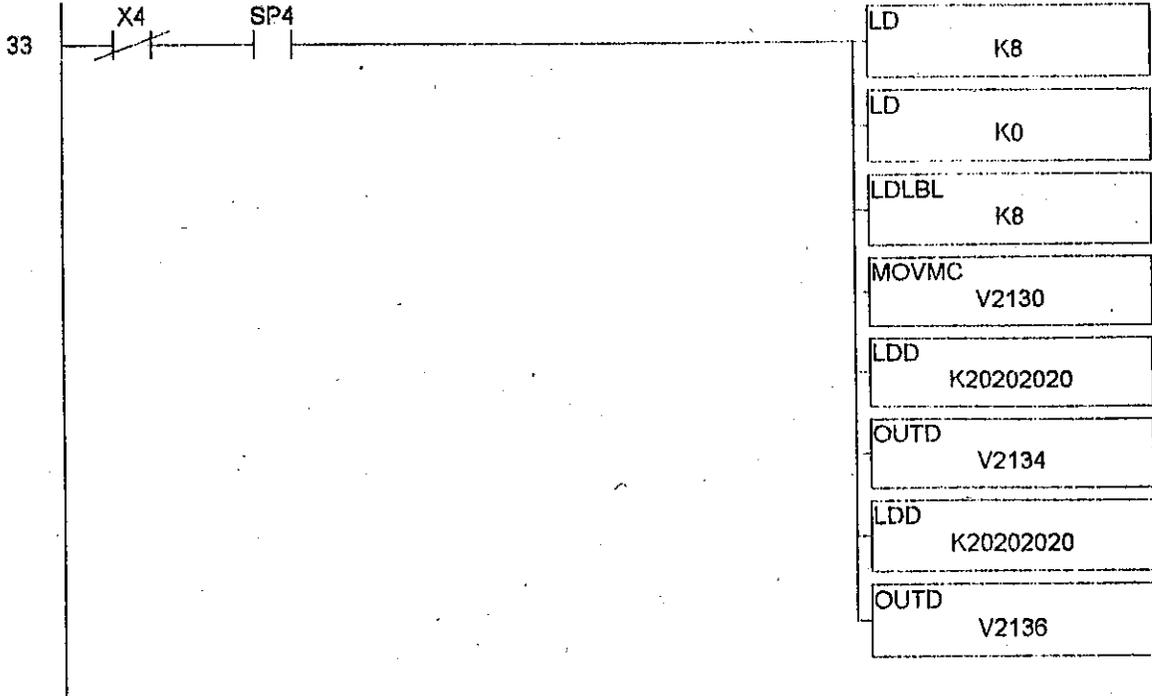


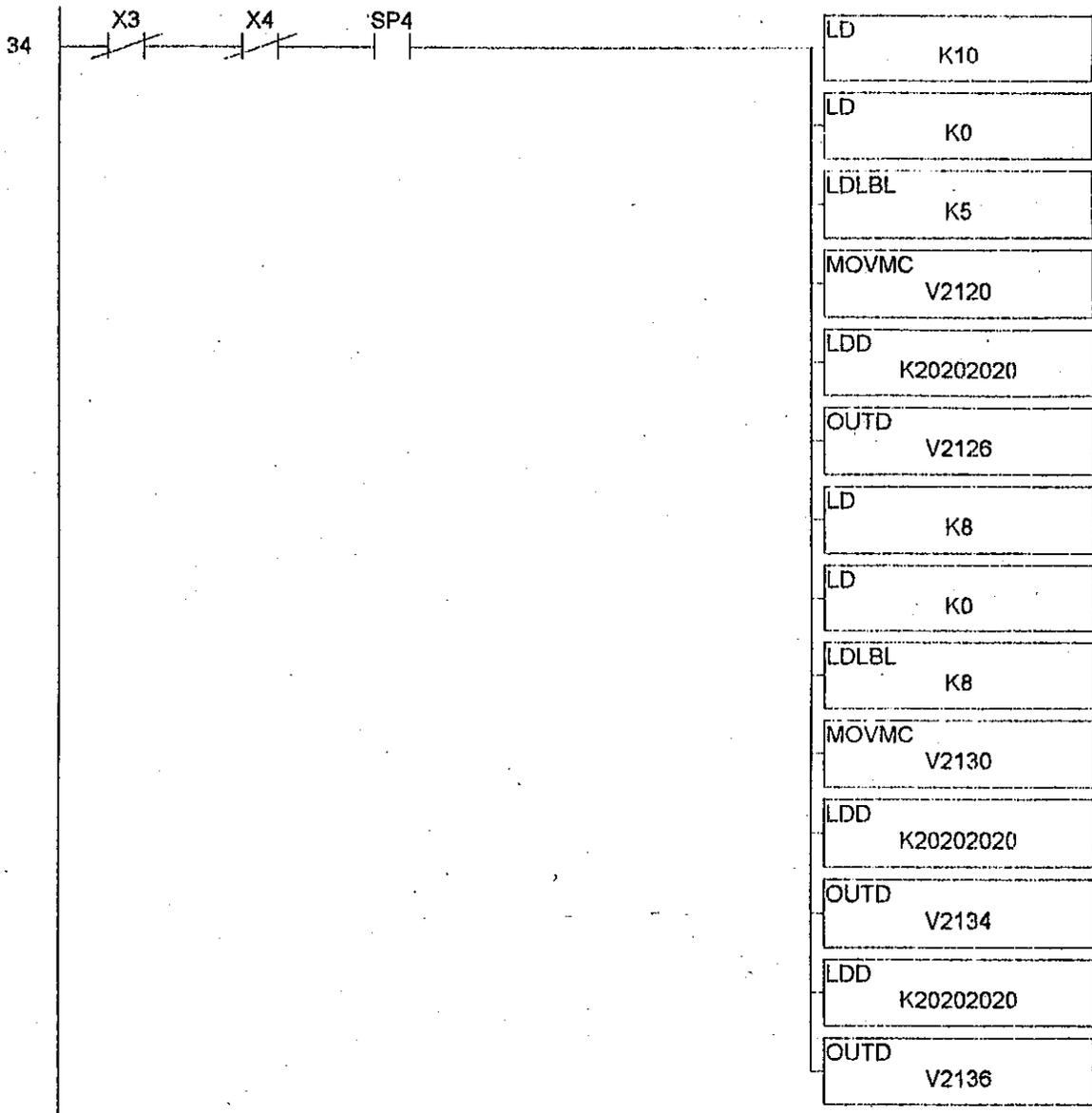


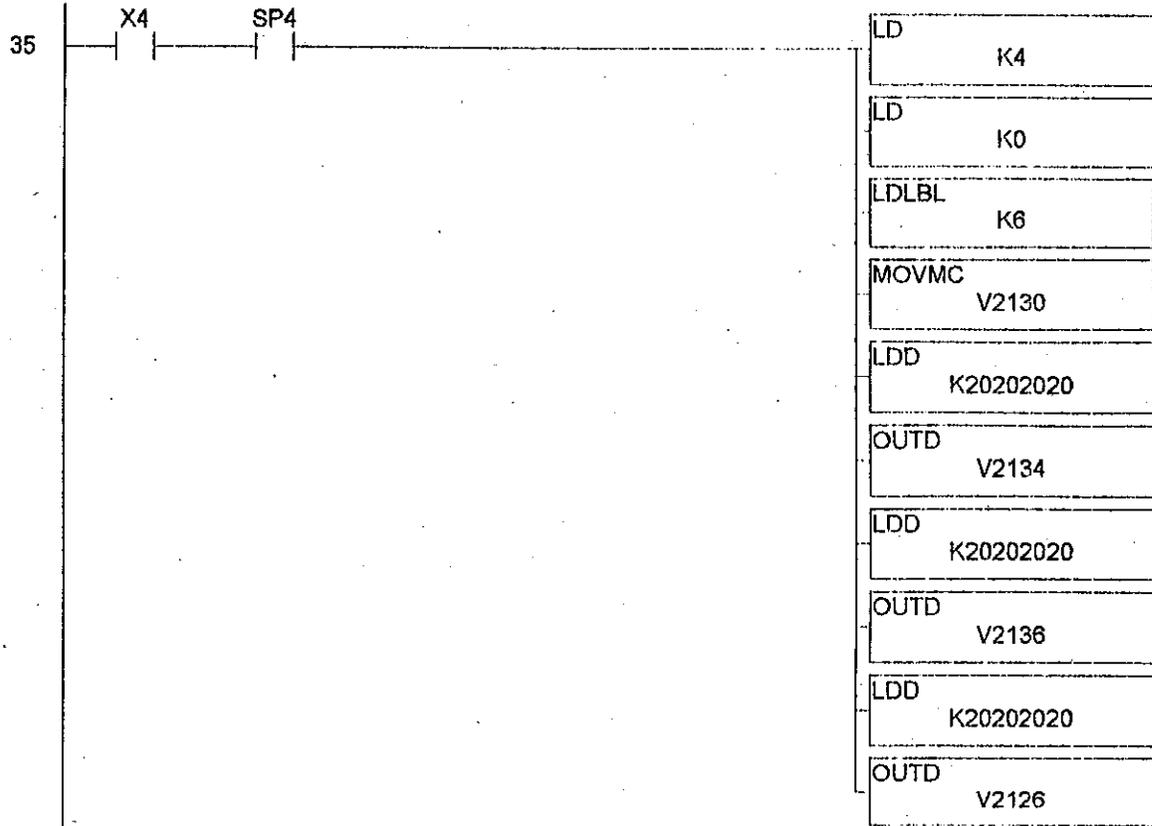
1/13/90

240

7206







36 (END)

DLBL K1

38

ACON BACKWASH

DLBL K2

40

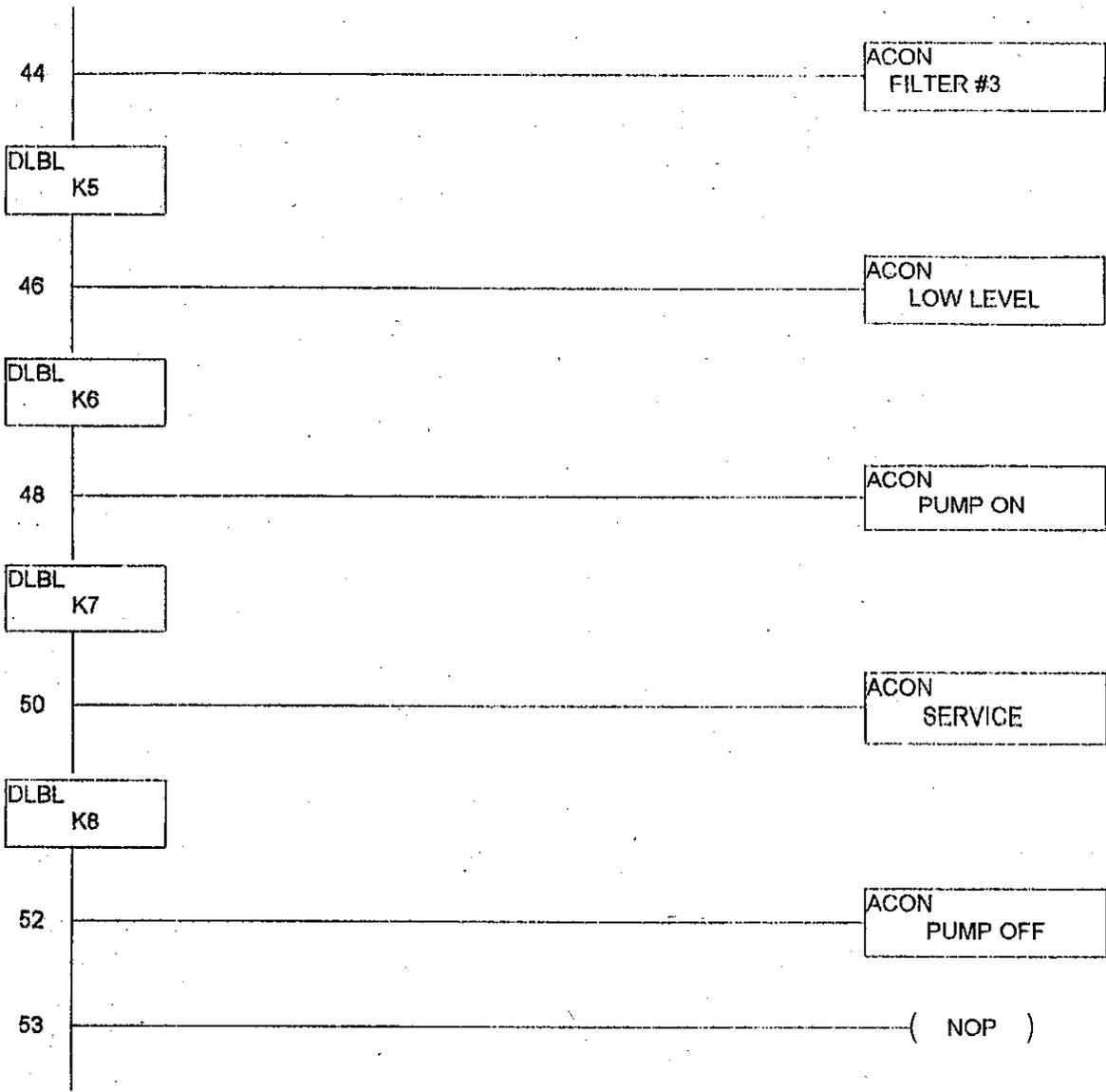
ACON FILTER #1

DLBL K3

42

ACON FILTER #2

DLBL K4



6.

194 44
93

Grangers 757-853-3153



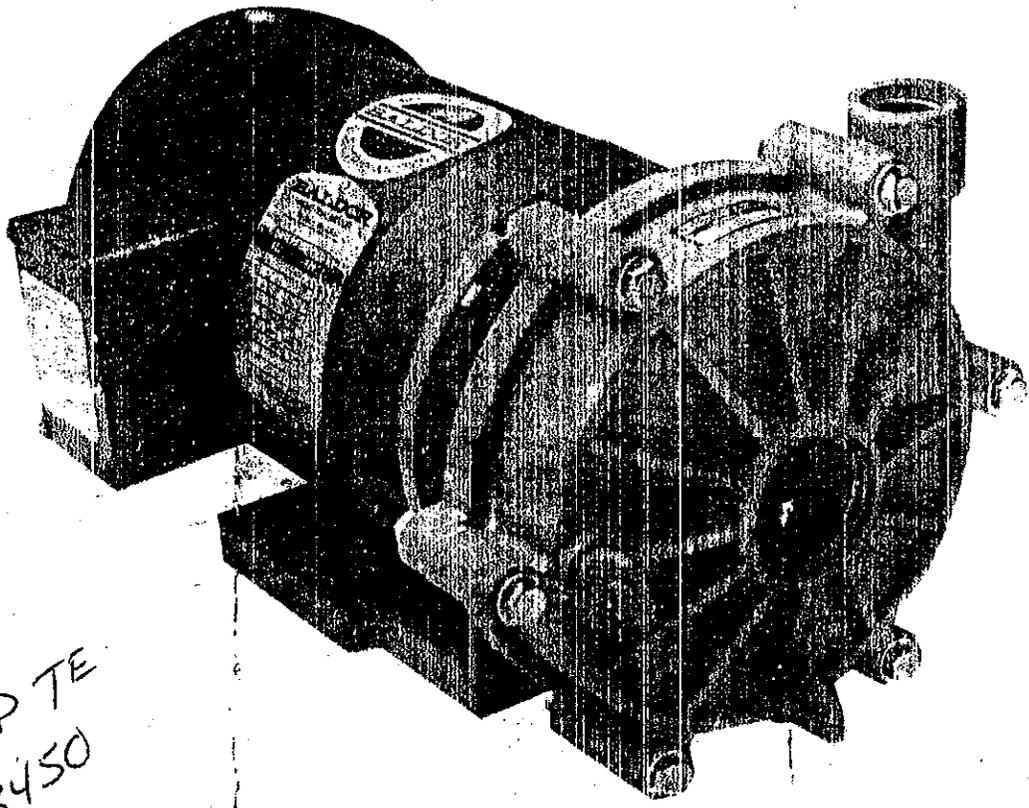
SEQUENCE 3000

Reliable, Corrosion Resistant Chemical Pumps

INSTALLATION AND SERVICE MANUAL

- Mellusca -

6K 600



frame Motor
56J
1/2 HP TE
RPM 3450

SEQUENCE 3000 PUMP
TYPE: Straight Centrifugal
HORSEPOWER AVAILABLE: 1/4, 1/3,
1/2, 3/4, 1, 1 1/2, 2, 3
MOTOR: NEMA C Face, 56J

PORT SIZE: 1 1/2" Intake and
3/4" Discharge
MATERIAL: 30% Glass-Filled Noryl
OPTIONS: Stainless Steel Seal With
Viton, Impenetra Seal, Stainless
Steel Hardware, Pedestal Mount

WARNING: Please Read Completely Before You Install or Operate Your New Pump!
Never Run Pump Dry — Never Reverse Rotation
Never Exceed an Internal Case Pressure of 100 PSI.

We congratulate you on your choice of the Sequence 3000 Centrifugal Pump! It has been carefully designed using the advantages of today's technology and carefully constructed to give you excellent dependability.

To insure proper performance, we urge you to carefully follow the instructions in this manual. If you have any questions, call your nearest distributor or M.D.M. for assistance.

PUMP END ASSEMBLY

1. Clean and inspect all pump parts (O-ring, seal seats, motor shaft, etc.).
2. Apply sealant in bracket bore hole (and around seal case for SS seals), according to sealant instructions. We recommend using Gasgasinch. Note: For SS seal, chamfer the edge of the bracket bore hole to accommodate the radius under the seal collar.
3. Press seal body into bracket while taking care not to damage carbon graphite face.
4. Place slinger (rubber washer) over motor shaft and mount bracket to motor.
5. Carefully lubricate boot or O-ring around ceramic piece and press into impeller. (If ceramic has O-ring, the marked side goes in.) Note: Use glycerine for EPDM.
6. Sparingly lubricate carbon-graphite and ceramic sealing surfaces. Water, glycerine, or a light-weight machine oil may be used, depending on the elastomers used in the pump. *Do not use silicon lubricants or grease!*
7. Thread impeller onto shaft and tighten! If required, remove motor end-cap and use a screwdriver on the back of motor shaft to prevent shaft rotation while tightening. Replace motor end cap.
8. Electrically, connect the motor so that the impeller will rotate CCW when facing the pump with the motor toward the rear. *Incorrect rotation will damage the pump and void the warranty! For 3Ø power, electrically check rotation of impeller with volute disassembled from bracket. If pump end is assembled and rotation is incorrect, serious damage to pump end assembly will occur even if the switch is "quickly bumped." If rotation is incorrect, simply exchange any two leads.*
9. Seat O-ring, in bracket gland and assemble volute to bracket.
10. Install drain plugs with their O-rings in volute drain holes.

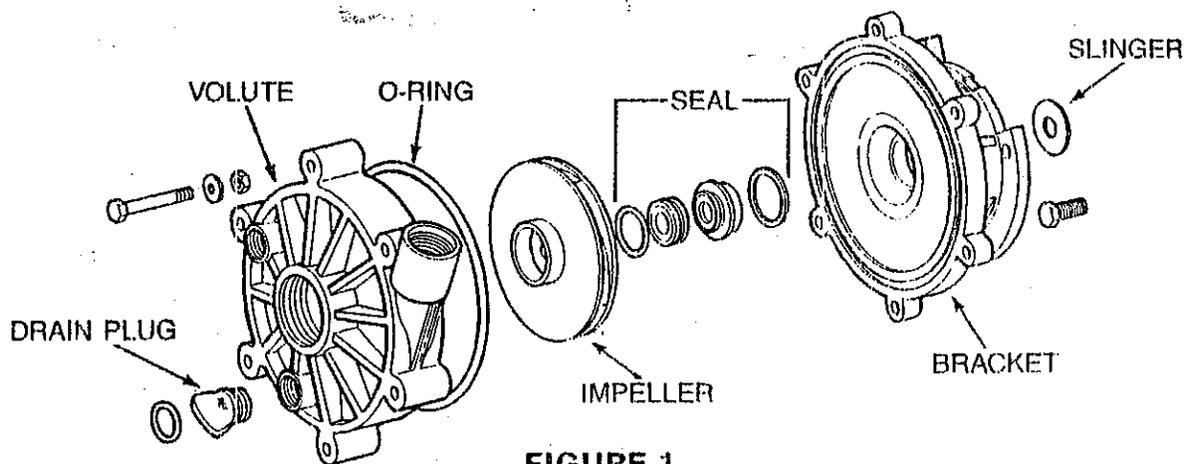


FIGURE 1

DISASSEMBLY

1. Shut off power to motor before disconnecting any electrical wiring from the back of the motor.
2. Disassemble the bracket-motor assembly from the volute, by removing the six- $\frac{1}{4}$ " cap screws. (The volute may be left in-line if you wish.)
3. Remove cap covering shaft at back of motor and with a large screwdriver, prevent shaft rotation while unscrewing impeller.
4. Remove ceramic piece from impeller.
5. Detach bracket from motor.
6. Remove carbon-graphite seal from bracket by pressing out from the back. *Do not dig out from the front!*

INSTALLATION

Please read carefully! When properly installed the Sequence 3000 will provide dependable trouble-free service.

1. Locate pump as near the source to be pumped as possible. A flooded suction situation is preferred. The pump is *not* self-priming, therefore, if the fluid level is below the pump, a foot valve must be installed and the pump primed prior to start-up. (Figure 2)
2. Mount motor base to a secure, immobile foundation.
3. Use only plastic fittings on both the intake and discharge ports. Seal pipe connections with teflon paste. These fittings should be self-supported and in neutral alignment with each port. (i.e. Fittings must *not* be forced into alignment which may cause premature line failure or damage to the pump volute.)
4. Never restrict the intake. Keep both input and discharge lines as free of elbows and valves as possible. Always use pipe of adequate diameter. This will reduce friction losses and maximize output.
5. The Sequence 3000 is *non self-priming!* It must *not be run dry!* We recommend a flooded suction installation.

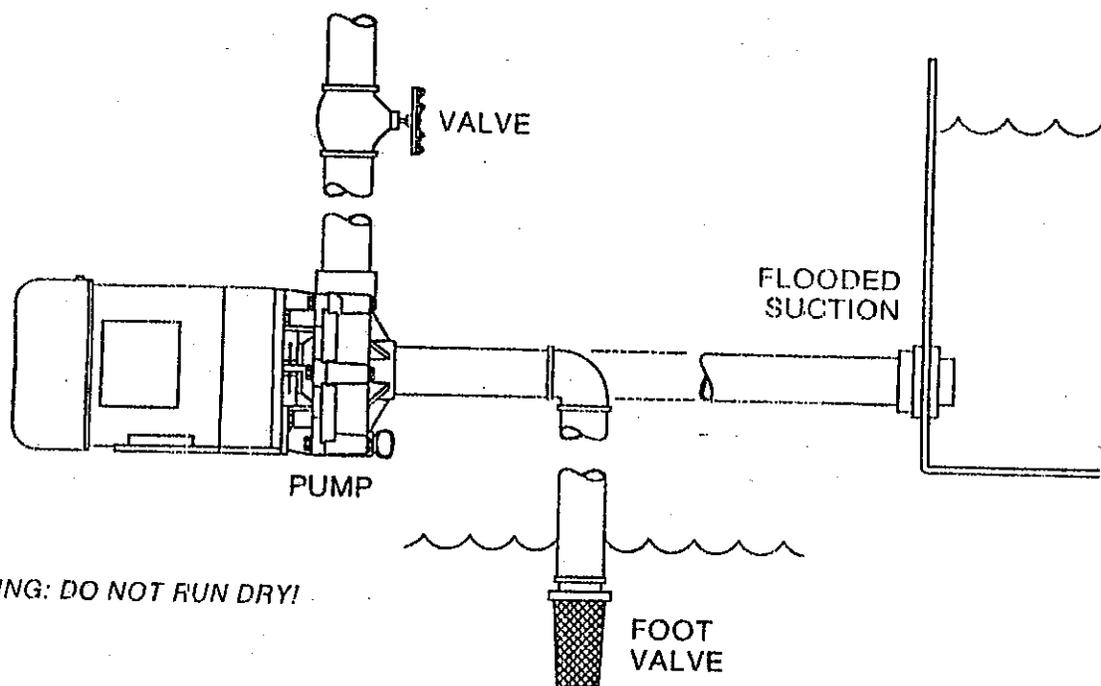


FIGURE 2

ELECTRICAL HOOK-UP

All electrical wiring should meet state and local ordinances. Improper wiring may not only be a safety hazard but may permanently damage the motor and/or pump!

1. Check that supply voltages match the motor's requirements.
2. Check motor wiring and connect, according to instructions on motor, to match supply voltage. *Be sure of proper rotation!* (Refer to pump end, assembly instruction #8.) *Improper rotation will severely damage pump and void warranty!*
3. Power cord should be protected by conduit or by cable and be of proper gauge. It should be no longer than necessary.
4. Power should be drawn directly from a box with circuit breaker protection or with a fused disconnect switch.
5. Always switch off power before repairing or servicing pump and/or motor.

MAINTENANCE

Lubrication:

- Motor - Lubricate as per instructions on motor.
- Rotary Seal - Requires no lubrication *after* assembly.

Pump must be drained before servicing or if stored below freezing temperatures. Periodic replacement of seals may be required due to normal carbon wear.

TROUBLE SHOOTING AID

Motor Will Not Rotate

1. Check for proper electrical connections to motor.
2. Check main power box for blown fuse, etc.
3. Check thermal overload on motor.

Motor Hums Or Will Not Rotate At Correct Speed

1. Check for proper electrical connections to motor and proper cord size and length.
2. Check for foreign material inside pump.
3. Remove bracket and check for impeller rotation without excessive resistance.
4. Remove pump and check shaft rotation for excessive bearing noise.
5. Have authorized serviceman check start switch and/or condenser.

Pump Operates With Little Or No Flow

1. Check to insure that pump is primed.
2. Check for leaking seal.
3. Improper line voltage to motor or incorrect rotation.
4. Check for clogged inlet port and/or impeller.
5. Defective check or foot valve.
6. Check inlet lines for leakage, either fluid or air.

Pump Loses Prime

1. Defective check or foot valve.
2. Seal leaking.
3. Inlet line air leakage.
4. Fluid supply low.

Motor Or Pump Overheats

1. Check for proper line voltage and phase, also proper motor wiring.
2. Binding motor shaft or pump parts.
3. Inadequate ventilation.
4. Fluid being pumped should not exceed 194° F (90° C) for extended periods of time.

MULTI-DUTI MANUFACTURING, INC. LIMITED WARRANTY

This product is warranted to the purchaser to be free of defects in construction and workmanship at the time of purchase. In the event this product malfunctions within one year from the date of purchase, the sole obligation of MULTI-DUTI MANUFACTURING, INC. (hereinafter referred to as MDM) will be to replace or make this product capable of being operated for ordinary purposes for which the product is used without charges for labor and parts to the purchaser, and subject to the following conditions:

1. The malfunction is proved attributable to a defect in construction or workmanship, including repairs performed under this warranty. Malfunction for any other reason—including but not limited to misuse, negligence, accident, or tampering with parts, incorrect wiring, or improper installation—will not be remedied under this warranty.
2. All warranty repairs must be performed by MDM. Purchaser must retain the purchase receipt and present it with this certificate as proof of ownership and entitlement to warranty repairs. Unauthorized repairs will not be compensated by MDM, and are not the responsibility of MDM, and if such repairs damage the product, such damages are not remediable under this warranty.
3. Purchaser shall bear all shipping, packing, and insurance costs and all other costs, excluding labor and parts necessary to effectuate repairs under this warranty.
4. Purchaser shall also retain and present to MDM evidence of purchaser's compatibility tests under actual operating conditions.
5. Periodic check-ups are not covered by this warranty.
6. This warranty is in lieu of all other express warranties which now or hereafter might otherwise arise with respect to this product. Any and all limited warranties, including the warranties of merchantability and fitness for particu-

lar purposes, shall have no greater duration than the duration period of the express written warranty applicable to this product, and shall terminate automatically the expiration of such duration period. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. No action shall be brought for breach of any implied or express warranty after one year subsequent to the expiration of the duration period of the express written warranty.

7. Incidental and consequential damages caused by malfunction, defect, or otherwise, and with respect to breach of any express or implied warranty, are not the responsibility of MDM, and, to the extent permitted by law, are hereby excluded both for property damage and, to the extent not unconscionable, for personal injury damage. 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.

8. This warranty does not apply to any malfunction arising out of any application of this product other than normal use, unless such application is upon request specifically approved in writing by MDM.

9. The provisions of this warranty are severable and if any provision shall be deemed invalid, the remaining provisions shall remain in full force and effect.

10. Rights under this warranty are not assignable without the express prior consent in writing by MDM and, regardless of the terms of such consent in writing, such assignee shall have no greater rights than his assignor had against MDM.

M.D.M. MFG., INC.
14140 Live Oak Ave., Suite A
Baldwin Park, CA 91706
Phone (818) 960-6327
FAX (818) 960-7648

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7.

SYBRON CHEMICALS INC.

SYBRON CHEMICALS INC.
BIRMINGHAM ROAD, PO. BOX 66, BIRMINGHAM, NEW JERSEY 08011 (609) 893-1100

IONAC® C-267 (HYDROGEN FORM IONAC C-249) CATION EXCHANGE RESIN COCURRENT STEPWISE H₂SO₄ REGENERATION

IONAC C-267 is a premium grade cation resin (hydrogen form of IONAC C-249) especially suited for the cation removal step in high purity water demineralization. Produced from crosslinked styrene-divinylbenzene polymer and classed as a strong acid cation exchanger, IONAC C-267 possesses high exchange capacity combined with excellent stability. It is supplied in fully swollen moist bead form and contains a minimum amount of fines (~50 mesh size) — minimizing pressure loss in column operation.

IONAC C-267 may be regenerated with strong acids, such as sulfuric, hydrochloric or even nitric to operate the cation exchanger in the hydrogen form.

Many variables affect the operation capacity and performance of IONAC C-267, such as:

- Acid Regenerant Levels
 - Acid Strength
 - Type of Acid
- Acid Contact Time
 - Bed Depth of Resin Column
 - Composition of Influent
 - Ratio of Cations
- Alkalinity
- Maximum Leakage Permissible

Each of these variables must be considered in rating the resin operation capacity.

The characteristics, design data and rating curves of IONAC C-267 given in this bulletin will provide the guidelines in determining appropriate capacity and operational rating.

IONAC C-267 is produced and specially purified to meet the requirements of paragraph 173.25 of the Food Additives Regulations of the F.D.A. It has also been approved by the Meat Inspection Division of the U.S. Department of Agriculture for use in the treatment of water for meat packaging plants. IONAC C-267 also meets the stringent specifications for extractable limits set by the French Ministry of Health for cation exchange resins used in potable water supplies and for food industry uses.

The excellent qualities of IONAC C-267 make it highly suitable for non-water applications such as: solid catalysts, pharmaceutical processing, metal recoveries.

The data presented herein are applicable to hydrogen cycle operation of IONAC C-249 strong acid gel type cation exchanger.

For sodium cycle operation of IONAC C-267 see IONAC C-249 Bulletin.

TYPICAL CHARACTERISTICS Hydrogen Cycle Operation

Polymer Structure	Crosslinked styrene/divinylbenzene
Functional Structure	R-SO ₃ -H ⁺
Form (Physical)	Spherical beads
Form (Ionic), as shipped	H ⁺
Screen Size, U.S. Std. (wet)	16-50
Particle Size	1.2 - .35 mm
Total Capacity	Volumetric: 1.9 meq/ml Weight: 4.9 meq/gm
Swelling (Na ⁺ → H ⁺)	5-7%
Water Retention	49 - 54%
Moisture Content, as shipped	49 - 55%
pH Range (Stability)	0-14
Solubility	Insoluble in all common solvents
Approximate Shipping Weight	50 lb/cu. ft. (800 gm/l)
Standard Packaging	7 cu. ft in polyethylene lined fiber drums

SUGGESTED OPERATING CONDITIONS

	U.S. Units	Metric Units
Maximum Operating Temperature	280°F	140°C
Minimum Bed Depth*	24"	60 cm
Standard Operating Flow Rate	2 gpm/cu. ft.	16 l/hr l
Design Rising Space	50%-75%	50%-75%
Backwash Expansion		50%-75%
Regenerants	H ₂ SO ₄	HCl HNO ₃
Percent Concentration	0.5-10%	4-10% 3-6%
Regenerant Flow Rate	0.5 gpm/cu. ft.	4 l/hr l
Regenerant Injection Time	30 minutes	30 minutes
Slow Rinse Volume	20 gal/cu. ft.	2.7 l/l (BV)
Slow Rinse Rate		@ regen. flow rate
Fast Rinse Rate		@ service flow rate
Fast Rinse Volume	30 gal/cu. ft.	4 l/l (BV)

INFLUENT LIMITATIONS

Maximum Free Chlorine	1.0 ppm
Maximum Turbidity	5 NTU's

* For high total solids water or where effluent quality is critical, 30" (76 cm) minimum bed depth recommended.

8.



SQUARE D

Instruction Bulletin

65013-009-32B
August, 1992
Raleigh, NC, U.S.A.

Differential Pressure Switches

Type/Tipo/Typ GGW, GHW, GJW
Class/Classe/Klasse 9012

Series C

USE LIMITATIONS

Pressure Ratings

NOTE

If the pressure actuators are exposed to system or surge pressures greater than the maximum pressure rating printed on the device nameplate, leakage from the actuator and/or a change of operating set points may result.

Maximum Allowable Pressure is the maximum pressure, including surges, to which a pressure switch may be exposed for brief or extended periods of time without altering the performance characteristics of the switch. For types GGW periodic retorquing of actuator mounting screws to 8-10 in-lb is recommended.

NOTE

Pressure on a switch during use should be within the stated range of the switch. For maximum mechanical life, maximum system pressure applied on a continual basis, including surges, should not exceed maximum stated range. The mechanical life of any diaphragm actuated switch will be decreased if pressure exceeds the stated maximum range value. The more frequent the application and the greater the value of excessive pressure, the more diaphragm life will be decreased.

Temperature Ratings

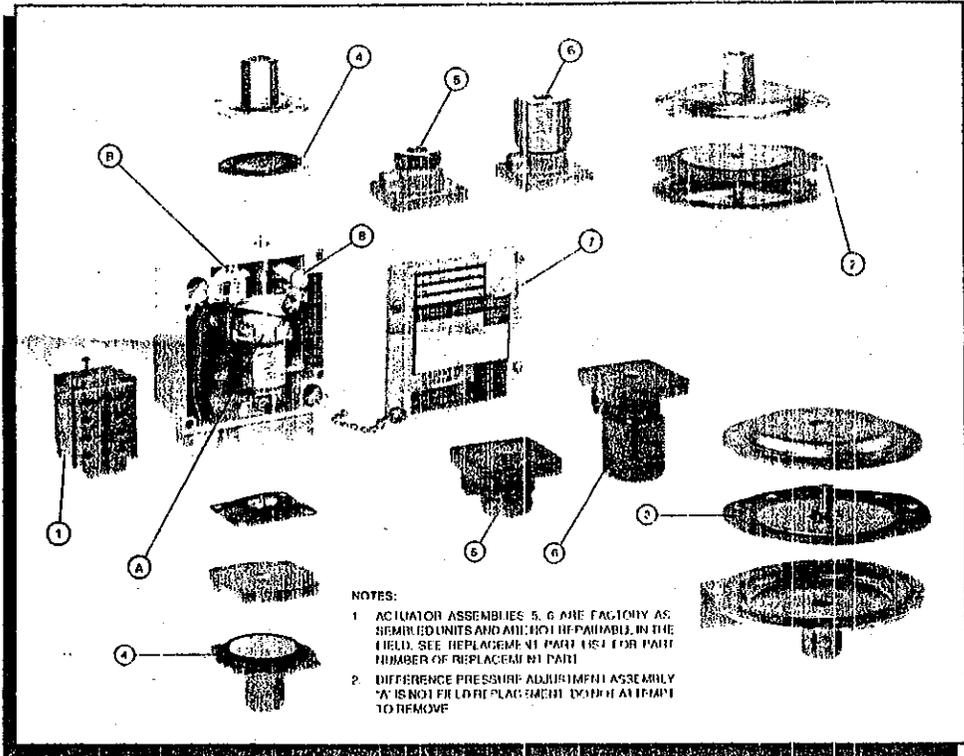
These devices are continuous use rated as below, provided that the media fluid does not freeze and the conditions of application do not give rise to the formation of frost or ice inside the pressure switch.

Table 1

	Ambient		Pressure Media	
	C	F	C	F
Minimum	-25	-10	-25	-10
Maximum	+85	+185	+120	+250

Use on Steam

Do not use directly on steam in excess of 15 psig (1 bar). Indirect use may be accomplished by attaching a minimum of 10 feet of capillary tubing between the steam source and the actuator. Class 9049 A7 is recommended. This permits use on steam up to 250 psig (17 bars) subject to maximum allowable pressure and temperature ratings of the switch.



⚠ WARNING

HAZARDOUS VOLTAGE CAN CAUSE SEVERE INJURY OR DEATH

To reduce the hazard of electrical shock always disconnect power from the circuit before installing the pressure switch or exposing the electrical terminals for maintenance.

Per ridurre il pericolo di infortuni da shock elettrico, prima di installare l'interruttore a pressione o prima di accedere ai terminali per manutenzione togliere sempre tensione dal circuito.

Um die Gefahr von Stromschlägen zu mindern, vor Einbau des Druckwächters oder Öffnen des Klemmendeckels zu Wartungszwecken die Versorgungsspannung abschalten.

Avant toute intervention sur ce matériel, couper l'alimentation électrique de l'appareil afin d'éviter tout risque d'électrocution.

ANTES de instalar el interruptor a presión o ANTES de exponer las terminales eléctricas para darles mantenimiento, DESCONECTE LA ENERTIA y reduzca el peligro de una sobrecarga eléctrica.

MOUNTING

It is not recommended to mount the switch by its pressure connection only. The holes identified as "M" are for surface mounting the switch. When connecting the switch to the pressure system piping, turn the switch onto the pipe using a wrench on the hexagonal body of the actuator. Do not apply leverage through the switch housing.

For type G*W, the standard pressure connection is 1/4-18 NPTF, the dryseal thread should seal against a new external 1/4 NPT thread without the use of sealing tape or compounds. Alternate pressure connections include: Form Z for GGW only which is 1/4-18 NPT external thread, Form Z16 for GGW only is 1/2-14 NPT external and 1/4-18 NPTF internal thread, Form Z18 for all G*W is 7/16-20 UNF-2A.

SET POINT ADJUSTMENTS

The pressure switch is set at the factory to the operating point(s) marked on the outside of the mechanism housing. It is good practice to cycle the switch to determine actual operating points before proceeding with readjustment. Refer to the illustration on page 2 for location of adjustment.

In order for the switch to operate, the pressure applied to the Y actuator must always be greater than the pressure applied to the X actuator.

Difference Pressure Adjustment

The difference pressure adjustment for all types GGW, GHW, and GJW is used to set the operating point on decreasing pressure difference and must be set first. To increase the operating point on decreasing pressure, with the switch mounted as shown in the illustration on page 3 and facing the switch, place a flat bladed screwdriver in the slots of range adjustment nut (A) and rotate from right to left.

Differential Adjustment

An independent adjustment of the set point on increasing pressure difference is available. This adjustment must be performed after the decreasing pressure difference set point has been adjusted. Turn adjusting screw (B) clockwise to raise the set point on increasing pressure difference. The decreasing pressure difference set point is not affected by this adjustment.

REPLACEMENT PARTS

Note: When ordering any of these replacement parts, Class, Type, and Form of switch on which the replacement is to be used must be specified with the order.

Table 2

Item	Description	Class	Order	Type	Form	Used On
1	Snap Switch Assembly	9998	PC 313			Types 1, 4
		9998	PC 314			Types 2, 24
2	Diaphragm Assembly only (x)	9998	PC 233			P1, P2, O1, O4, Q14 GGW-1, 21; All forms except 01
3	Diaphragm Assembly (y)	9998	PC 265			GGW-1, 21
4	Diaphragm Assembly	9998	PC 267			GGW-4, 24
5	Diaphragm Actuator Assy	9998	PC 177			GHW-1, 21
6	Piston Actuator Assy	9998	PC 270			GJW-1, 21
7	Cover Assembly	9998	PC 302			Class, Type, Form, to be printed on nameplate must be included in order
8	Pilot Light Kits	9998	PC 303	G17, G18		For replacement 120 V
		9998	PC 304	G19, G20		For replacement 240 V
		9998	PC 305	G21, G22		For replacement 24 VDC
		9998	PC 306	G17, G18		Field conversion 120 V
		9998	PC 307	G19, G20		Field conversion 210 V
		9998	PC 308	G21, G22		Field conversion 24 VDC

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HEATER ELEMENTS FOR TYPE "H"
MELTING ALLOY STANDARD TRIP RELAY

Starters shown in the table provide a maximum trip rating of 125% of the motor nameplate amperes, which is suitable for 40° C. motors. For all other motors select heaters lower than specified in the table, which give a maximum trip rating of approximately 115%.

The tripping current of any heater in a 40° C ambient is 25% greater than the lower value of motor amperes shown in table.

Starters do not provide protection from short circuits. A protective device should be provided in accordance with the N.E.C. and not exceed the values shown in the table if shown.

Full Load Motor Amps.	Heater Code No.	Max. Rat. of Prot. Device Amps*	INSPECTED	
			Min.	Max.
.47	.52	H3	2	
.53	.57	H4	2	
.58	.63	H5	2	
.64	.70	H6	3	
.71	.77	H7	3	
.78	.85	H8	3	
.86	.95	H9	3	
.96	1.06	H10	4	
1.07	1.17	H11	4	
1.18	1.34	H12	4	
1.35	1.50	H13	5	
1.51	1.63	H14	5	
1.64	1.80	H15	6	
1.81	1.99	H16	6	
2.00	2.26	H17	8	
2.27	2.47	H18	8	
2.43	2.71	H20	10	
2.72	3.08	H21	10	
3.09	3.37	H22	12	
3.38	3.73	H23	12	
3.74	4.14	H24	15	
4.15	4.66	H25	15	
4.67	5.28	H26	20	
5.29	6.35	H28	25	
6.56	7.05	H29	25	
7.66	7.97	H30	30	
7.98	8.85	H31	30	
8.86	9.88	H32	35	
9.89	11.1	H33	40	
11.2	12.5	H34	40	
12.6	13.4	H35	45	
13.5	14.5	H36	45	
14.6	15.4	H37	60	
15.5	17.5	H38	60	

*Maximum Rating of Fuse or Time Limit Circuit Breaker Amps.

D25603-2A1

SINGLE PHASE STARTER

USE COPPER WIRE ONLY

MODIFICATION KITS CAT. NUMBER
 AUXILIARY CONTACT NORMALLY OPEN..... 49SAF0
 AUXILIARY CONTACT NORMALLY CLOSED..... 49SAFC
 TIMER..... 49SAT
 HAND-OFF-AUTO SELEC FOR SWITCH..... 49SB5B1
 PILOT LIGHT (120,240,480 & 600V)..... 50D2498B
 START-STOP-PUSHBUTTON..... 49SAF85

CONNECTIONS FOR SELECTOR SWITCH

OFF

AUTO HAND

(A) (C) (E) (H)

2A 1 3

GROUND LUG KIT MEETS CSA STANDARD 22.2 NO 14

GROUND WIRE RANGE 2-14 AL-CU KIT NUMBER
 2 CONDUCTOR #9028179001
 3 CONDUCTOR #9028180001

DUAL VOLTAGE COIL CONNECTIONS

HIGH VOLTAGE LOW VOLTAGE

CONNECTIONS FOR REMOTE TWO WIRE CONTROL

1 3

CONNECTIONS FOR REMOTE AUTOMATIC SWITCH USED WITH SELECTOR

1 3 2A

POWER TERMINAL WIRING

SIZE	TORQUE (Lb-in)	WIRE (Cu only)
00-0	30	60/75°C
1	35	60/75°C
1 3/4 - 2 1/2	45	60/75°C
3-3 1/2	120	75°C

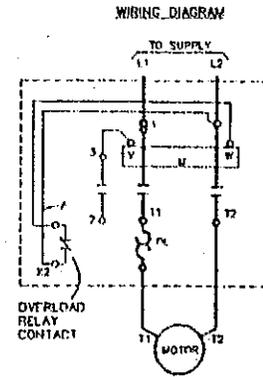
CONNECTIONS FOR BUILT-IN PUSHBUTTON SWITCH

START STOP

1 2 3

CONNECTIONS FOR PILOT LIGHT (IF REQUIRED)

V W



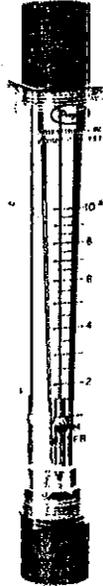
- NOTES:**
- 1 A MAXIMUM OF 4 NO OR NC AUXILIARY INTERLOCKS MAY BE SUPPLIED AS REQUIRED.
 - 2 FOR SEPARATE CONTROL VOLTAGE SOURCE REMOVE JUMPER "A" AND CONTROL WIRE FROM "1" ON STARTER. CONNECT SOURCE TO "1" ON CONTROL DEVICE AND TO "X2" ON OVERLOAD RELAY.
 - 3 FOR PROTECTION OF CONTROL CIRCUIT CONDUCTORS IN ACCORDANCE WITH THE N.E.C. AND C.E.C. USE FUSE KIT 49WAFH2
- SUITABLE FOR USE ON CIRCUITS CAPABLE OF DELIVERING NOT MORE THAN 10,000 RMS SYMMETRICAL AMPERES, 600 VOLTS MAXIMUM WHEN PROTECTED BY A CIRCUIT BREAKER HAVING AN INTERRUPTING RATING NOT LESS THAN 10,000 RMS SYMMETRICAL AMPERES, 600 VOLTS MAXIMUM.
- WHEN PROTECTED BY CLASS "R" OR "J" FUSES THIS CONTROLLER IS SUITABLE FOR USE ON A CIRCUIT CAPABLE OF DELIVERING NOT MORE THAN 100,000 RMS SYMMETRICAL AMPERES, 600V MAXIMUM.
- DANGER:** UNLESS CLASS "R" OR "J" FUSES ARE USED THE CONTROLLER MAY BECOME A FIRE, SHOCK AND CASUALTY HAZARD IF INSTALLED ON CIRCUITS CAPABLE OF DELIVERING MORE THAN 10,000 RMS AMPERES, 600V MAXIMUM.
- MAXIMUM CURRENT RATING FOR THERMAL MAGNETIC BREAKERS IS 250% OF MAXIMUM MOTOR F.L.A.
- MAXIMUM CURRENT RATING OF FUSES IS:**
- A 150% OF MAXIMUM MOTOR F.L.A. FOR CLASS R,H,K, OR L (TIME DELAY)
 - B 250% OF MAXIMUM MOTOR F.L.A. FOR CLASS H,K, OR L (NON-TIME DELAY)
 - C 300% OF MAXIMUM MOTOR F.L.A. FOR CLASS J (NON-TIME DELAY).
- IF THE CALCULATED RATING IS BETWEEN STANDARD SIZES, THE NEXT LARGER SIZE MAY BE USED.

Furnas
 Furnas Electric Co. Batavia, Ill. U.S.A.
D29221-1
 Rev J

VFC Series Visi-Float[®] Flowmeter Installation and Operating Instructions




Back
Connections



End
Connections

SPECIFICATIONS

Meter Body:	Acrylic Plastic Metering tube machined into body
Wetted Metal Parts:	Stainless Steel
Floats:	Stainless Steel
Fittings:	PVC
Guide Rod Holder:	Mineral reinforced nylon bonded in fitting with epoxy (EC models only)
Pipe Connections:	1" N.P.T. female, horizontal or vertical
"O" Rings:	Buna-N
Mounting Inserts:	10-32 x 3/8" deep
Scale:	Hot pressed into acrylic body
Pressure Rating:	100 P.S.I. maximum
Temperature Rating:	120°F maximum
Accuracy:	+ 2% of full scale

PIPING

INLET PIPING:

It is good practice to approach the flowmeter inlet with as few elbows, restrictions and size changes as possible. Inlet piping should be as close to the flowmeter connection size as practical to avoid turbulence which can occur with drastic size changes. The length of inlet piping has little effect on normal pressure fed flowmeters.

For vacuum service, the inlet piping should be as short and open as possible to allow operation at or near atmospheric pressure and maintain the accuracy of the device. Note that for vacuum service, any flow control valve used must be installed on the discharge side of the flowmeter.

DISCHARGE PIPING

Piping on the discharge side should be at least as large as the flowmeter connection. For pressure fed flowmeters on air or gas service, the piping should be as short and open as possible. This allows operation at or near atmospheric pressure and assures the accuracy of the device. This is less important on water or liquid flowmeters since the flowing medium is generally incompressible and back pressure will not affect the calibration of the instrument.

Dwyer Series VFC Visi-Float[®] flowmeters are available in two basic styles, either back or end connected with direct reading scales for air or water. Installation, operation, and maintenance are simple and require only a few common sense precautions to assure long, accurate, trouble-free service.

CALIBRATION

All Dwyer flowmeters are calibrated at the factory and normally will remain within their accuracy tolerance for the life of the device. If at any time you wish to re-check its calibration, do so only with instruments or equipment of certified accuracy. Do not attempt to check the Dwyer Visi-Float[®] flowmeter with a similar flowmeter as even minor variations in piping and back pressure can cause significant differences between the indicated and actual readings. If in doubt, your Dwyer flowmeter may be returned to the factory and checked for calibration at no charge.

LOCATION

Select a location where the flowmeter can be easily read and where the temperature will not exceed 120°F (49°C). The mounting surface and piping to the flowmeter should be free from vibration which could cause fatigue of fittings or mounting inserts. Piping must be carefully arranged and installed to avoid placing stress on fittings and/or flowmeter body. Avoid locations or applications with strong chlorine atmospheres or solvents such as benzene, acetone, carbon tetrachloride, etc. Damage due to contact with incompatible gases or liquids is not covered by warranty. Compatibility should be carefully determined before placing in service.

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DWYER INSTRUMENTS, INC.

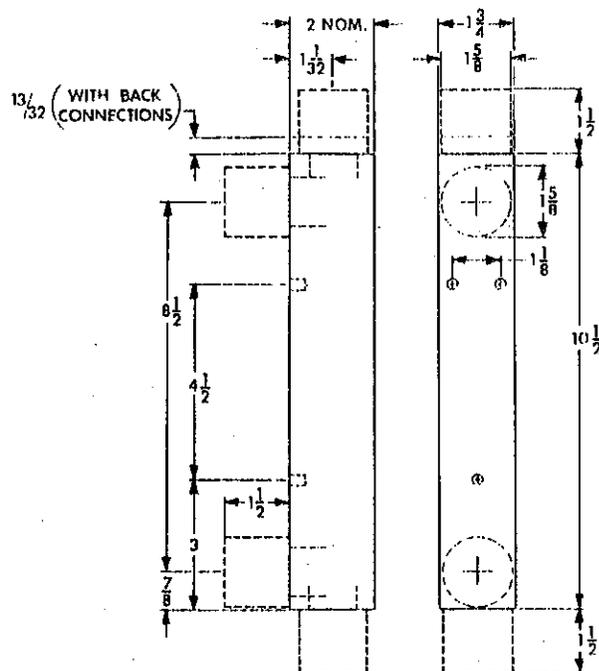
P. O. BOX 373 • NICHIGAN CITY, INDIANA 46360, U.S.A.

Telephone 219/878-8000

Fax 219/872-9057 Telex 25916

SERIES VFC

Visi-Float^(R) Flowmeters



DIMENSIONS

POSITION AND MOUNTING

All Visi-Float[®] flowmeters must be installed in a vertical position with the inlet connection at the bottom and outlet at the top.

SURFACE MOUNTING:

Drill three holes in panel using dimensions shown in drawing. Holes should be large enough to accommodate #10-32 machine screws. If back connected model, drill two additional holes for clearance of fittings. Install mounting screws of appropriate length from rear. Attach piping using RTV silicone sealant or Teflon[®] tape on threads to prevent leakage.

CAUTION: Do not overtighten fittings or piping into fittings. Maximum recommended torque is 10 ft/lbs. Hand tighten only.

IN LINE MOUNTING:

Both end connected and back connected models may be installed in-line supported only by the piping. Be sure that flowmeter is in a vertical position and that piping does not create excess stress or loading on the flowmeter fittings.

OPERATION

Once all connections are complete, introduce flow as slowly as possible to avoid possible damage. With liquids, make sure all air has been purged before taking readings. Once the float has stabilized, read flow rate by sighting across the largest diameter of the float to the scale graduations on the face of the device.

MAINTENANCE

The only maintenance normally required is occasional cleaning to assure proper operation and good float visibility.

DISASSEMBLY:

The flowmeter can be completely disassembled by removing the connection fittings and top plug. When lifting out the float guide assembly, be careful not to lose the short pieces of plastic tubing on each end of the guide rod which serve as float stops.

CLEANING:

The flowmeter body and all other parts can be cleaned by washing in a mild soap and water solution. A soft bristle bottle brush will simplify cleaning of the flow tube. Avoid benzene, acetone, carbon tetrachloride, gasoline, alkaline detergents, caustic soda, liquid soaps, (which may contain chlorinated solvents), etc., and avoid prolonged immersion.

RE-ASSEMBLY:

Install the lower fitting and then the float and float guide. Finally install the upper fitting and plug being certain that both ends of the float guide are properly engaged and the float is correctly oriented. A light coating of silicone stop cock grease or petroleum jelly on the "O" rings will help maintain a good seal as well as ease assembly.

ADDITIONAL INFORMATION

For additional flowmeter application information, conversion curves, correction factors and other data covering the entire line of Dwyer flowmeters, write for bulletin F-41.



9.

MONARCH WATER SYSTEMS, INC.

1230 BURNETT DR.

Phone 937-372-7200

XENIA, OHIO 45385

Fax 937-372-4622

Recommended Spare Parts List For Sand Filters OHM Remediation Services Corp. Saunders Supply Site Chuckatuck, VA

- 2 ea. 521-RA - Repair Kit (Diaphragm & Seal Kit)
- 1 ea. 521-RF - Internal Parts (plastic parts) Repair Kit for
a Normally Open 521 Diaphragm Valve
- 1 ea. 521-RG - Internal Parts (plastic parts) Repair Kit for
a Normally Closed 521 Diaphragm Valve
- 1 ea. Burkert Solenoid Valve P/N 453226F
Normally Closed Solenoid W/Manual By Pass
(#330-C-5/64-F-BR-1/4-08-U-H-000)

MONARCH WATER SYSTEMS, INC.

1230 BURNETT DR.

XENIA, OHIO 45385

Phone 937-372-7200

Fax 937-372-4622

TROUBLE SHOOTING GUIDE

Filter

No Product Water

1. Low level in storage tank
2. Filter in backwash cycle
3. Outlet valve held closed

High Differential

1. Low level in storage tank
2. Differential pressure switch set too high
3. Low backwash flow rate
4. Plugged or restricted drain

Processor Display Does Not Work

1. Power to the processor
2. Display disconnected or loose
3. Poor ground connection
4. Blown fuse

System Works Erratic

1. Poor ground connection

MONARCH WATER SYSTEMS, INC.

1230 BURNETT DR.

Phone: 937-372-7200

XENIA, OHIO 45385

Fax: 937-372-4622

TROUBLE SHOOTING GUIDE

Pump

Motor Will Not Rotate

1. Check for proper electrical connections to motor.
2. Check main power box for blown fuse, etc.
3. Check thermal overload on motor.
4. Low Level in storage tank

Motor Hums Or Will Not Rotate At Correct Speed

1. Check for proper electrical connections to motor and proper cord size and length.
2. Check for foreign material inside pump.
3. Remove bracket and check for impeller rotation without excessive resistance.
4. Remove pump and check shaft rotation for excessive bearing noise.
5. Have authorized serviceman check start switch and/or condenser.

Pump Operates With Little Or No Flow

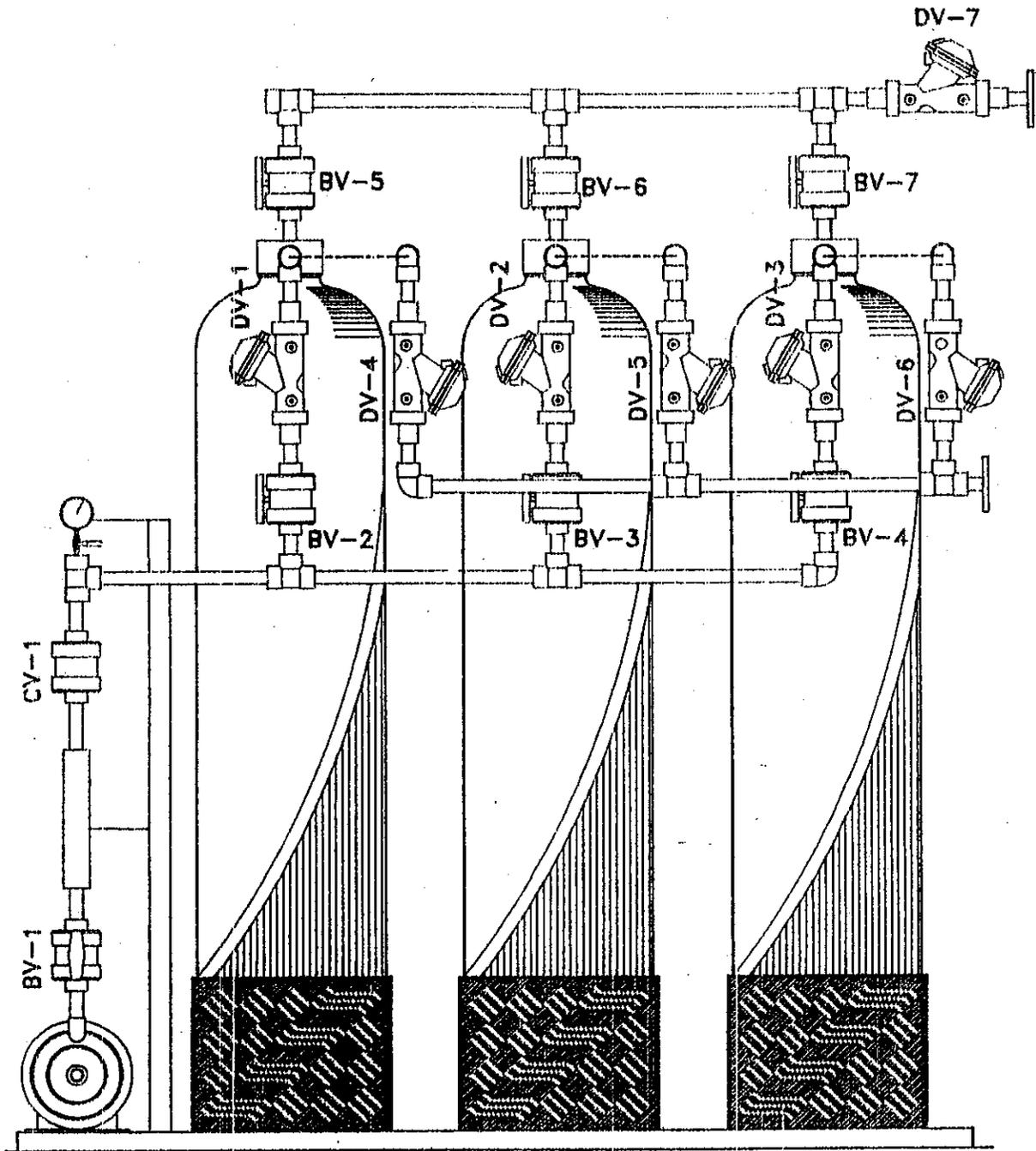
1. Check to insure that pump is primed.
2. Check for leaking seal.
3. Improper line voltage to motor or incorrect rotation.
4. Check for clogged inlet port and/or impeller.
5. Defective check or foot valve.
6. Check inlet lines for leakage, either fluid or air.

Pump Loses Prime

1. Defective check or foot valve.
2. Seal leaking.
3. Inlet line air leakage.
4. Fluid supply low.

Motor or Pump Overheats

1. Check for proper line voltage and phase, also proper motor wiring.
2. Binding motor shaft or pump parts.
3. Inadequate ventilation.
4. Fluid being pumped should not exceed 194° (90°C) for extended periods of time.



* DRAIN MOVED AND OUTLET ROTATED FOR CLARITY

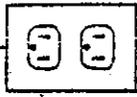
LINE 1 N

LINE F-3

120 VOLTS

F-1

5 AMP



F-2

1 AMP

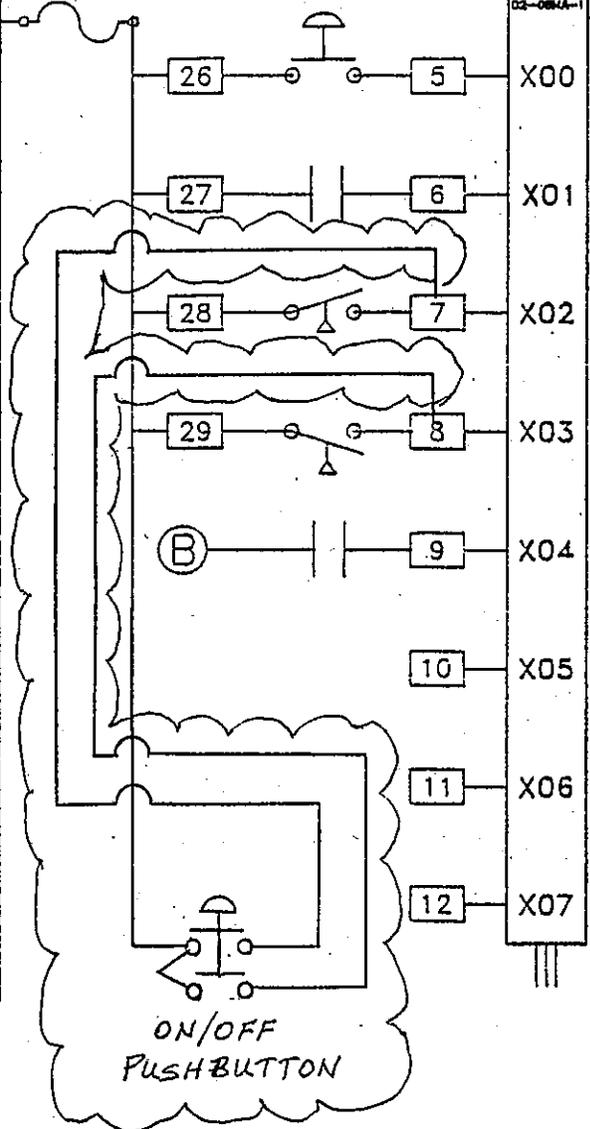
DIRECT LOGIC 205
PROGRAMMABLE CONTROL
D2-09B

DATA
ACCESS PANEL
DV-1000

CPU
DL-240

F-3

1 AMP



INPUT
MODULE
D2-08A-1

INPUT MODULE #1

MANUAL START
(PUSHBUTTON)

DP CELL

HIGH LEVEL START

LOW LEVEL STOP

PUMP-RUN

SPARE

SPARE

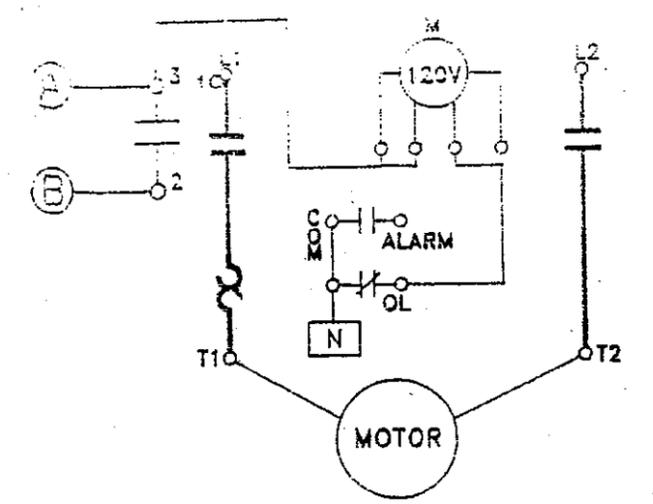
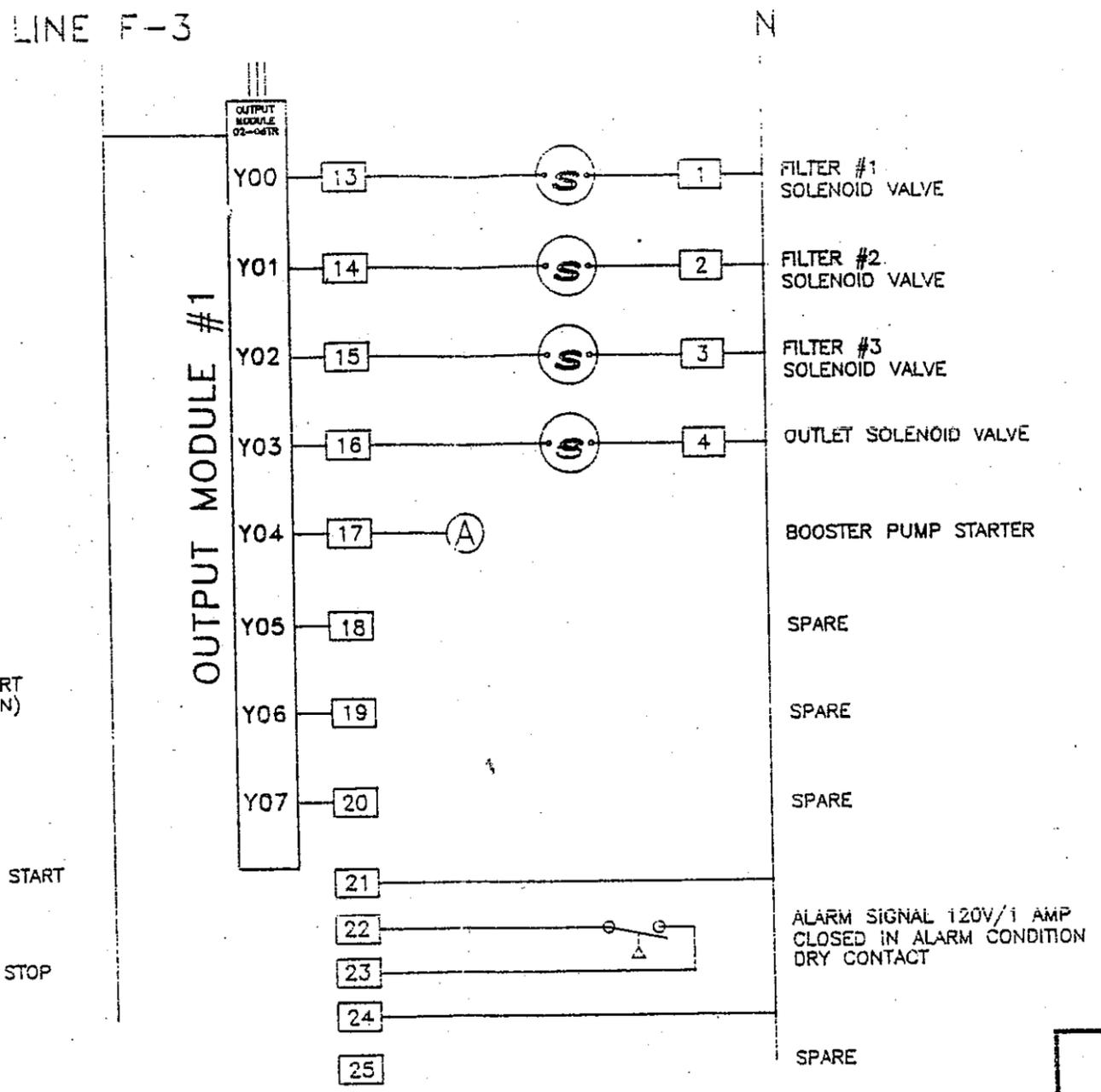
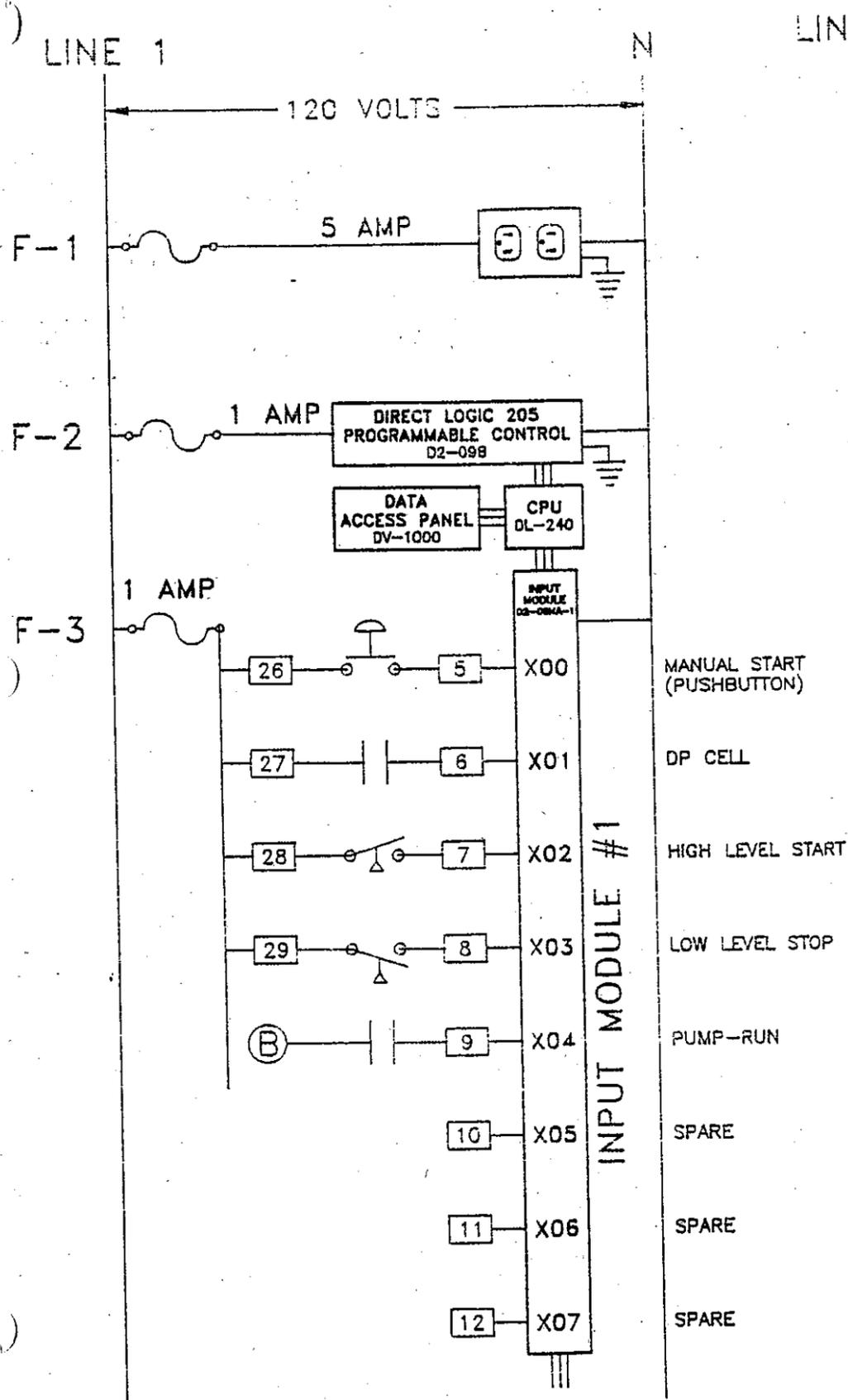
SPARE

OUTPUT MODULE #1

OUTPUT
MODULE
D2-08TR

Y00
Y01
Y02
Y03
Y04
Y05
Y06
Y07

13
14
15
16
17
18
19
20
21
22
23
24
25



- WARNING -

IMPROPER GROUNDING CAN RESULT IN ERRATIC OPERATION. THE CONTROL GROUND TERMINAL MUST BE CONNECTED TO A VALID EARTH GROUNDING POINT WITH #14 AWG OR HEAVIER WIRE. WATER PIPE IS NOT ALWAYS A VALID ELECTRONIC EARTH GROUND. CONDUIT IS NEVER A VALID ELECTRONIC EARTH GROUND.

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NO.	REVISIONS		TITLE
	DATE	BY	
1			ELECTRIC SCHEMATIC
2			
3			
4			
5			

MONARCH

1250 Burnett Drive
Xenia, Ohio 45385

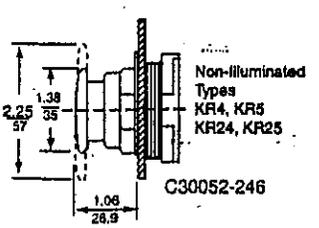
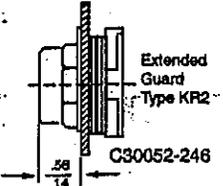
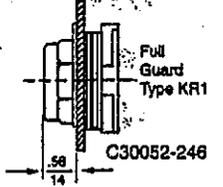
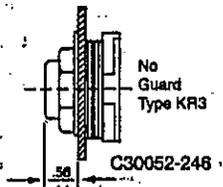
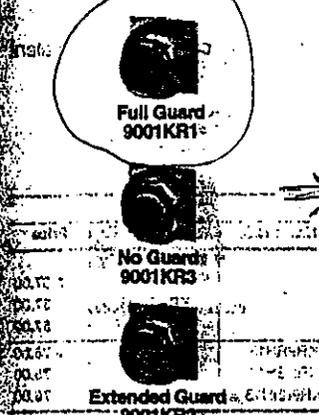
JOB
OHM REMEDIATION SERVICE CORP.
SAUNDERS SUPPLY SITE
CHUCKATUCK, VA.

DESIGNED BY JEFF WETZEL	SCALE NONE	DRAWING NO. B-7206-E1
APPROVED	DATE 3/12/98	

Type K, 30mm - Class 9001 Heavy Duty Non-Illuminated Operators

Non-Illuminated Momentary Push Button Operators - UL Types 4, 13/NEMA Types 4, 13

For use in hazardous locations - See Page 15-67.
Contact blocks and legend plate not included unless otherwise noted.



Description	Color	None	Price	Contact Arrangements				
				1 N.O.	1 N.C.	Price	1 N.O./1 N.C.	Price
Full Guard	Black	KR1B	\$ 17.10	KR1BH5	KR1BH6	\$ 26.50	KR1BH13	\$ 36.10
	Green	KR1G	17.10	KR1GH5	KR1GH6	26.50	KR1GH13	36.10
Extended Guard	Green	KR2G	17.10	KR2GH5	KR2GH6	26.50	KR2GH13	36.10
	Universal	KR2U	17.10	KR2UH5	KR2UH6	26.50	KR2UH13	36.10
No Guard	Red	KR3R	17.10	KR3RH5	KR3RH6	26.50	KR3RH13	36.10
	Other	KR3(1)	17.10	KR3(1)H5	KR3(1)H6	26.50	KR3(1)H13	36.10
1 3/8" Diameter	Black	KR(2)B	36.10	KR(2)BH5	KR(2)BH6	45.50	KR(2)BH13	55.00
Mushroom Head	Red	KR(2)R	36.10	KR(2)RH5	KR(2)RH6	45.50	KR(2)RH13	55.00
	Black	KR(2)B	36.10	KR(2)BH5	KR(2)BH6	45.50	KR(2)BH13	55.00
2 1/4" Diameter	Red	KR(3)R	36.10	KR(3)RH5	KR(3)RH6	45.50	KR(3)RH13	55.00
Mushroom Head	Black	KR(3)B	36.10	KR(3)BH5	KR(3)BH6	45.50	KR(3)BH13	55.00
	Red	KR(3)R	36.10	KR(3)RH5	KR(3)RH6	45.50	KR(3)RH13	55.00

- Choose Button Color from table below.
- Choose Snap-in or Screw-on style mushroom head from table below.
- Choose Snap-in or Screw-on style mushroom head from table below.

9001 KR

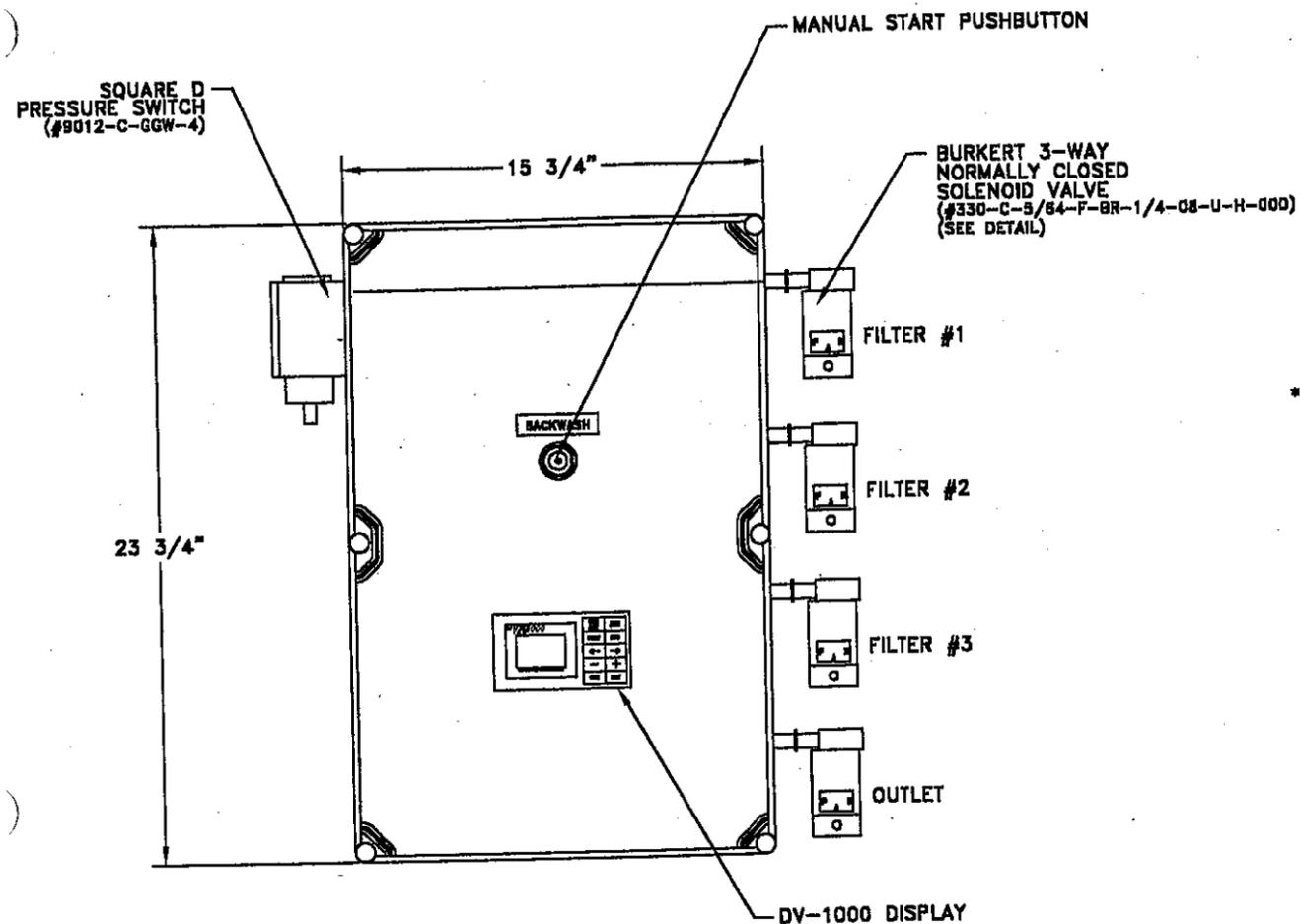
Type of Guard or Mushroom Head	Price
Full Guard	\$ 17.10
Extended	17.10
No Guard	17.10
(2) † 1 3/8" Snap-in Mushroom Head	36.10
(3) † 2 1/4" Snap-in Mushroom Head	36.10
(2) † 1 3/8" Screw-on Mushroom Head (with set screw)	36.10
(3) † 2 1/4" Screw-on Mushroom Head (with set screw)	36.10
No Mushroom Head for Screw-on Operator	17.10
Button Color	
Black	NC
Green	NC
Blue	NC
Red	NC
Red with "Emergency Stop" in raised white letters (snap-in mushroom buttons only - 1 3/8" and 2 1/4")	2.10
Red with "Emergency Off" in raised white letters (2 1/4" snap-in mushroom buttons only)	2.10
Orange	NC
White	NC
Yellow	NC
Universal A: Contains one insert each of Black, Green, Blue, Red, Orange, White, Yellow	NC
No Color	NC
"H" Code Contact Block Assembly to Operator	*
No Contact Blocks	Blank NC

- ▲ Not available in mushroom buttons.
- * Select from "H" code table on page 15-68. Maximum contact block usage is 3 blocks mounted in tandem on both sides (6 blocks total). Prices based on total Contact Blocks used.
- † Must specify a color with a mushroom head selection.

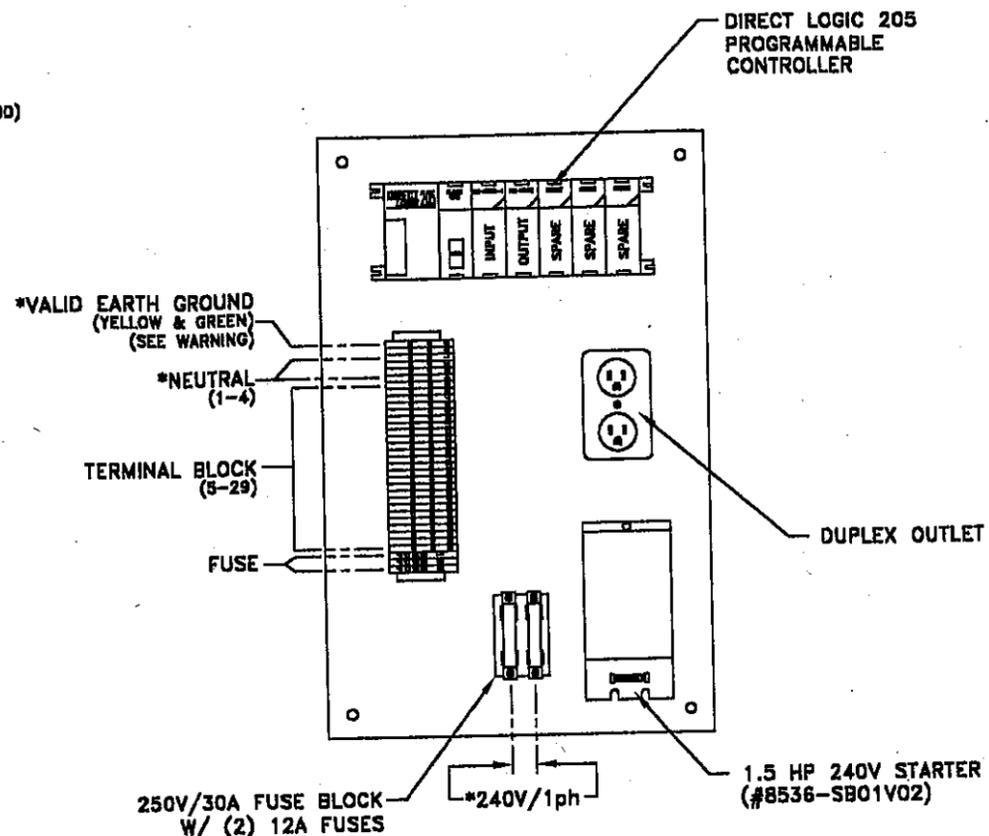
Boots	Page 15-71
Color Inserts and Mushroom Knobs	Page 15-72
Contact Blocks and Ratings	Pages 15-66 - 15-67
Hazardous Locations Application	Page 15-67
"H" Contact Block Assembly Codes	Page 15-68
Legend Plates	Pages 15-69 - 15-70
Lockouts	Page 15-71
Replacement Parts	Page 15-73
Ring Nuts	Page 15-73

For additional information, reference: Catalog Number 9001CT9701 or D-Fax™ #1548.

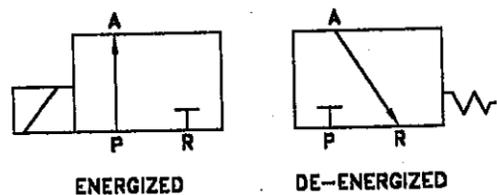
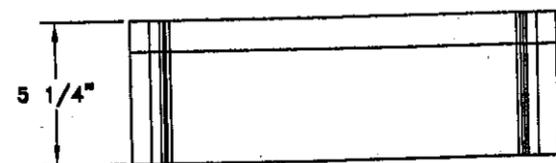
15 - PUSH BUTTONS AND



DOOR LAYOUT
HOFFMAN NEMA 12 ENCLOSURE #Q-604018ABI



INTERNAL PANEL LAYOUT



SOLENOID VALVE DETAIL

- WARNING -
IMPROPER GROUNDING CAN RESULT IN ERRATIC OPERATION.
THE CONTROL GROUND TERMINAL MUST BE CONNECTED TO A
VALID EARTH GROUNDING POINT WITH #14 AWG OR HEAVIER WIRE.
WATER PIPE IS NOT ALWAYS A VALID ELECTRONIC EARTH GROUND.
CONDUIT IS NEVER A VALID ELECTRONIC EARTH GROUND.

* REQUIRED FIELD CONNECTIONS

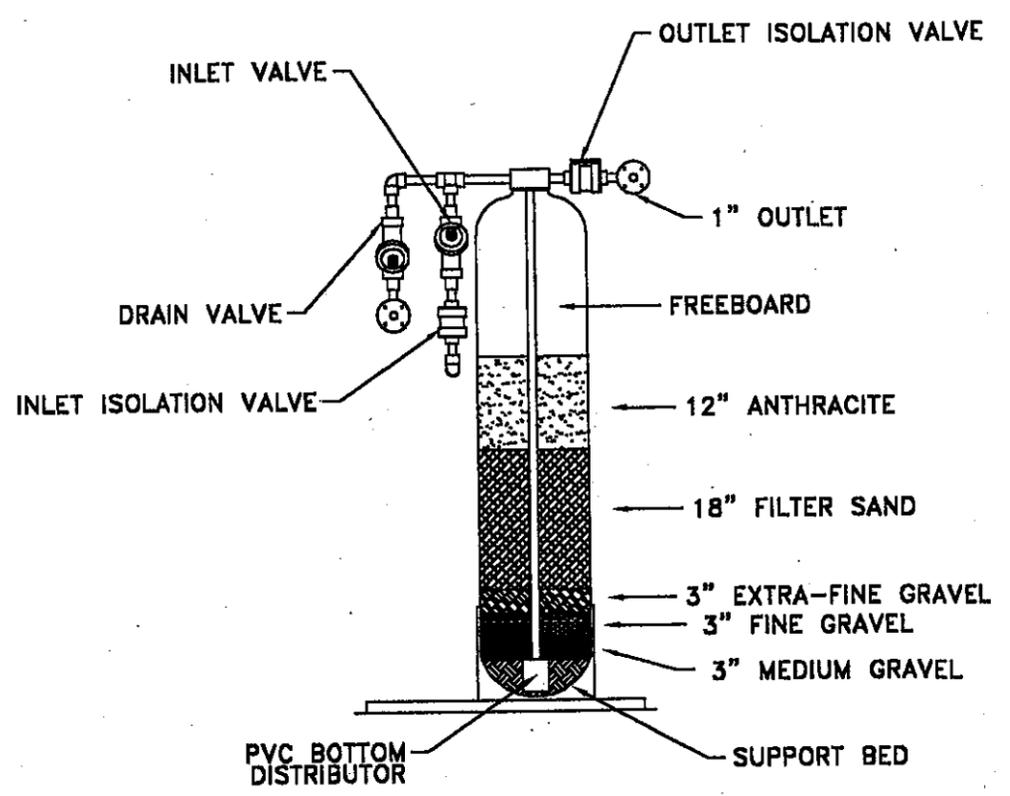
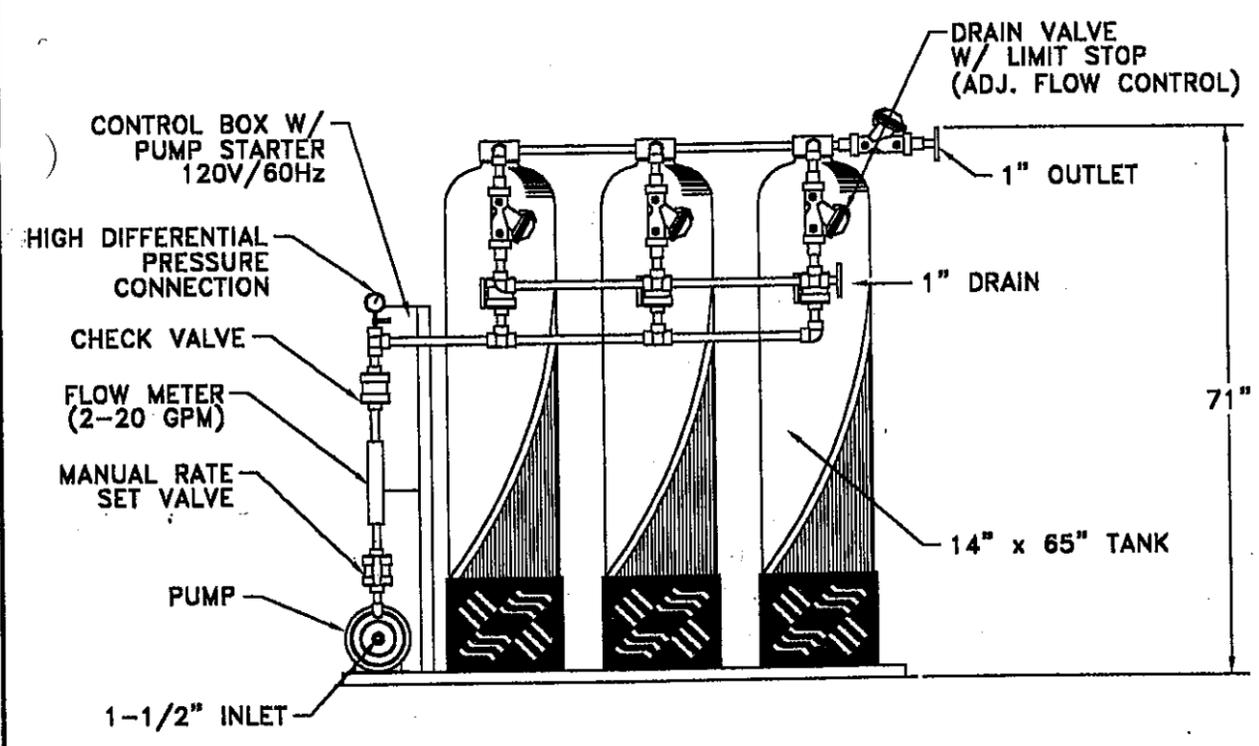
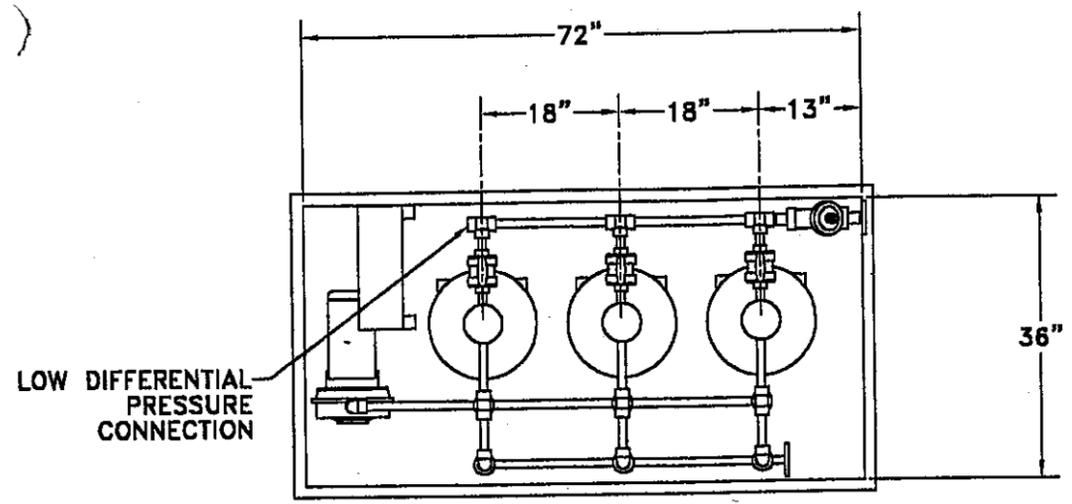
	Monarch Water Systems, Inc. 1230 Burnett Drive Xenia, Ohio 45388 (637) 372-7200 FAX (637) 372-4822		CONTROL PANEL OHM REMEDIATION SERVICE CORP. SAUNDERS SUPPLY SITE CHUCKATUCK, VA.	
	DATE: 5/12/88 DRAWN BY: JFF CHECKED BY: NONE DATE: 5/12/88	PROJECT NO.: SHEET NO.: TOTAL SHEETS:	DRAWING NO.: C-7208-E2	CONFIDENTIAL INFORMATION <small>This drawing and design are confidential and are the property of Monarch Water Systems. This drawing may not be copied, in whole or in part, or released to other parties without the written consent of Monarch Water Systems.</small>

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NOTES

1. FLOW RATE 10-16 GPM
 ● 10 PSI DISCHARGE PRESSURE.
2. THREE FLOATS FURNISHED FOR
 FILTER SUPPLY TANK (T-2)
 (NOT SHOWN).
 HIGH ALARM
 LOW LEVEL-STOP
 HIGH LEVEL-START



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	Monarch Water Systems, Inc. 1230 Burnett Drive Xenia, Ohio 45385 (937) 372-7200 FAX (937) 372-4822		SAND FILTER SYSTEM		
	OHM REMEDIATION SERVICE CORP. SAUNDERS SUPPLY SITE CHUCKATUCK, VA.		DATE: 2/24/88 DRAWING NO: C-7208-A1		
	DESIGNED BY:	CHECKED BY:	DATE:	SCALE:	SHEET NO:
	DRAWN BY:	APPROVED BY:	DATE:	SCALE:	SHEET NO:
	DATE:	DATE:	DATE:	SCALE:	SHEET NO:

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Appendix K
Activated Carbon Unit Information

Appendix L
Effluent Tank and Pump Information



REV 1

SHEET 1 of 1

W.O. NO. 03347-142-001

TASK NO. 2305-02

DATE 1/29/98

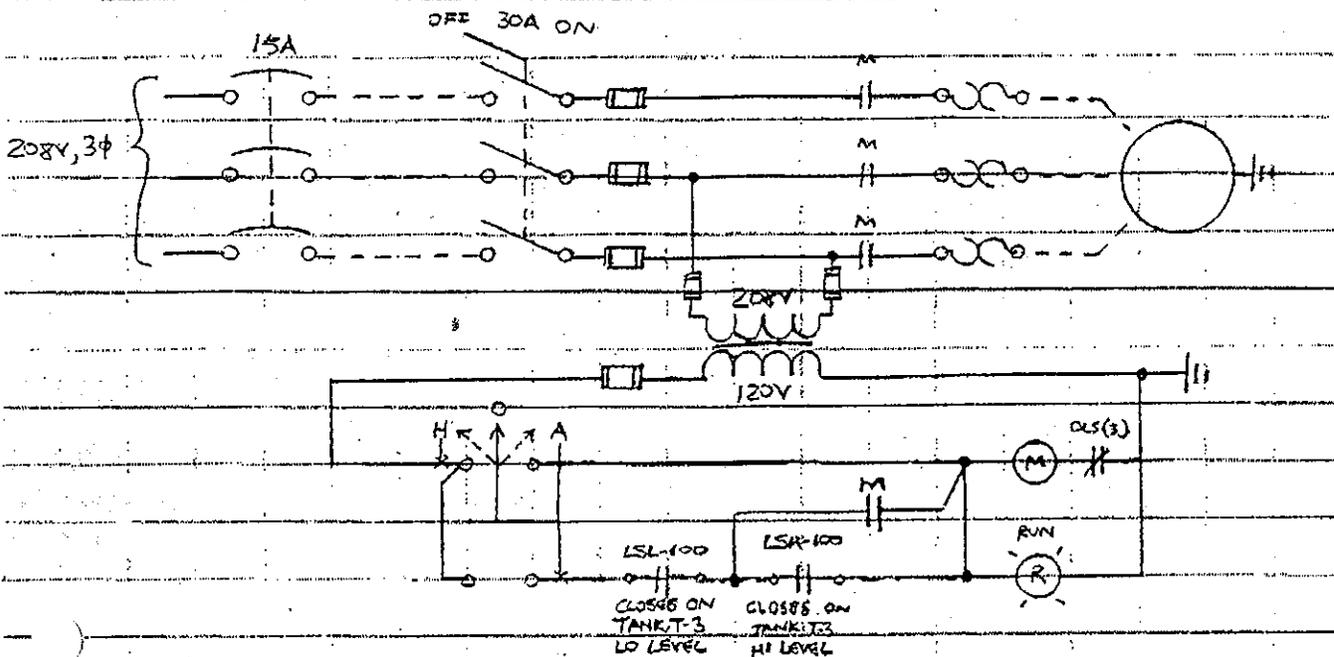
DATE

DATE

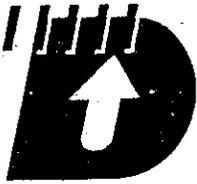
APPROVED BY

DEPT

DATE



EFFLUENT PUMP P-2 SCHEMATIC



DREXELBROOK

Engineering Company

504-1000-LM
EDO # 11-95-251

**INSTALLATION AND OPERATING
INSTRUCTIONS
for the
Drexelbrook 504-1000 Series VeriGAP™**

For factory service,
call toll-free 1-800-527-6297

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205 Keith Valley Road
Horsham, PA 19044

www

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SECTION 1 - INTRODUCTION

The instructions in this manual are for the Drexelbrook point level ultrasonic VeriGAP™ switch, 504-1000 Series.

1.1 General Description

The 504-1000 Series ultrasonic VeriGAP™ switch is an integral assembly which senses liquid presence by ultrasonic techniques and energizes a relay which can be utilized to indicate and/or control the liquid at a predetermined level.

1.2 Theory of Operation

A high frequency acoustic signal is transmitted through the sensor gap when liquid is present. See Figure 1-1. When a signal is received, an electronic circuit produces a relay output. The ultrasonic sensor does not contain moving components. It is not affected by electrical or physical parameters of the process material and will operate over a wide temperature range. These characteristics make the 504-1000 a very reliable and economical solution to industrial liquid level control operations.

Inherent benefits of the 504-1000 VeriGAP™ switches include high reliability and minimum maintenance. They are not affected by variations in liquid viscosity, density, pressure, temperature, and electrical properties. For applications where the sensor will be coated, consult your local Drexelbrook representative or the factory at 1-215-674-1234.

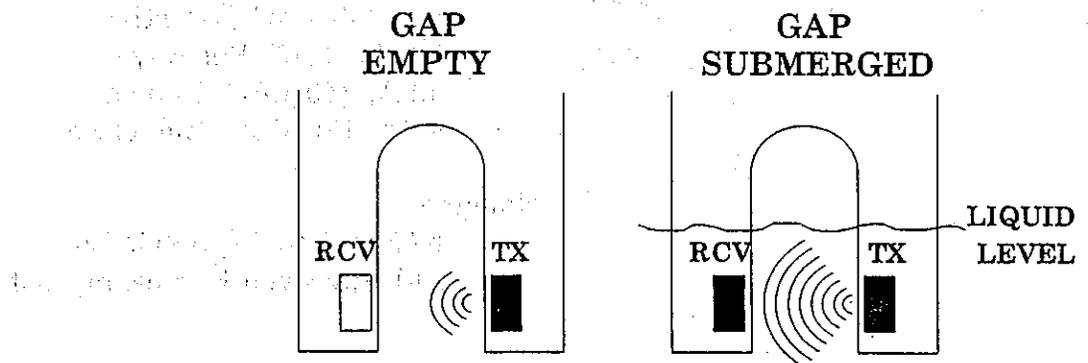


Figure 1-1
VeriGAP™ Switch Operation

**SECTION 2 -
SPECIFICATIONS****2.1 Electronics****A. Power Requirements**

120 VAC \pm 50/60 Hz
240 VAC \pm 10% 50/60 Hz
18-30 VDC

B. 24 VDC Unit 2.5 Watts

120 VAC Unit 2.5 Watts

240 VAC Unit 1.5 Watts

C. Ambient Temperature

-40°F to 160°F

D. Repeatability

1/16"

E. Response Time

2 Second (Time Delay standard)

F. Fail Safe

High Level or Low Level
(Field Selectable)

G. Relay

DPDT

H. Contact Rating

5A, 240 VAC, Resistive

5A, 30 VDC, Resistive

4.9A, 240 VAC, Inductive

4.4A, 120 VAC, Inductive

I. Housing

NEMA 1 to 4X, 5 and 12

FM Approved Explosionproof

SECTION 3 - INSTALLATION

3.1 Unpacking

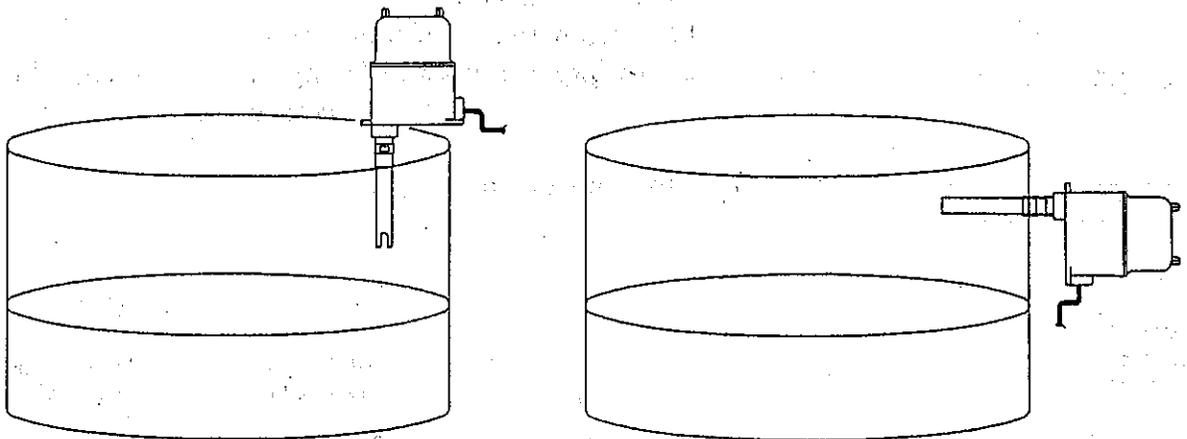
Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it immediately to the factory (1-215-674-1234).

3.2 Mounting the Electronic Unit

The 504-1000 electronic unit was designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage. For convenience at start-up, place the instrument in a reasonably accessible location. Ambient temperatures should be between -40°F and 160°F (-40°C to 70°C).

3.2.1 Orientation

The 504-1000 VeriGAP™ switches can be mounted in any orientation vertically.



*Figure 3-1
Mounting Orientation*

If the unit is side-mounted (horizontal), rotate the unit so that the electrical hub is down and the sensor slot is vertical. This allows any product buildup on the sensor to fall free. Note orientation of wrench flats relative to the gap.

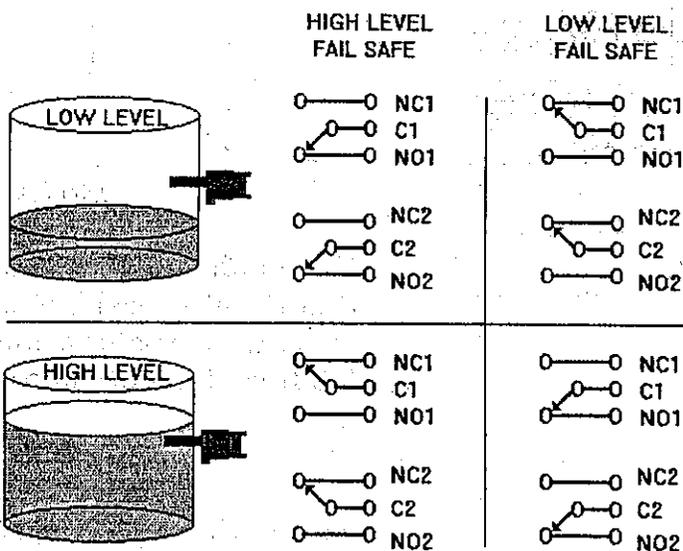
CAUTION

Ensure that all wiring, electrical fittings and conduit connections conform to your local electrical codes for the location and environment of use. If the 504-1000 Gap Switch is located in a HAZARDOUS environment, never open the enclosure cover or make/break any electrical connections without first disconnecting electrical power at the source.

3.3 Wiring

Use the following procedure to wire the 504-1000 VeriGAP™ Switch

1. Ensure that the power is off.
2. Remove the cover.
3. Make all electrical connections to the 504-1000 VeriGAP™ Switch per the wiring diagram shown in Figure 3-3, using 14-gauge or smaller wiring. All connections are made on the terminal strips.
4. The PC board mounting screws can be removed to allow movement of the PC board during wiring.
5. After connections are secured and dressed, reinsert the PC board and close the enclosure cover.
6. Review Checklist:
 - Wiring correct?
 - Proper input voltage used?
 - Proper relay state (relays will be in the alarm condition)?
7. Turn power on.



RELAY CONTACT CHART
(power applied to instrument)

**SECTION 4 -
OPERATION**

Ensure that actual operating conditions do not exceed the specifications described in Section 2 - Specifications.

No calibration or adjustments are needed for the 504-1000 Ultrasonic VeriGAP™ Switch.

A. Fail-safe

Fail-safe is factory preset for the 504-1000 Series systems and is field changeable by changing the setting on the fail-safe switch on the PC board (Figure 3-3).

B. Time Delay

Time delay is factory preset for the 504-1000 Series at 2 seconds, and no adjustments are provided.

**SECTION 5 -
PREVENTIVE
MAINTENANCE**

The 504-1000 Ultrasonic VeriGAP™ Switch is a solid-state device with no moving parts other than its relay, and requires no maintenance or adjustments. The units are designed to give years of unattended service.

A spare electronic chassis is recommended for every 10 units. In the event of a failed unit, this will prevent the interruption of a critical application while the unit is returned to the factory for repair.

In applications where liquids/products can coat or build up on the sensor tip over a period of time, it is recommended to use the Drexelbrook RF Admittance Point Level switches, which are not affected by coatings.

SECTION 7 - FACTORY AND FIELD SERVICE

7.1 Factory Service Assistance

If you are having difficulty with your Drexelbrook equipment, and attempts to locate problems have failed, notify your local Drexelbrook representative, or call the factory direct and ask for the Service Department. Drexelbrook Engineering Company is located at 205 Keith Valley Rd., Horsham, PA 19044. The telephone number for the service department is 1-800-527-6297. To help us solve your problem quickly, please have as much of the following information as possible when you call.

Instrument Model # _____
 P.O. # _____
 Date _____
 Insertion Length _____
 Process Material _____

 Temperature _____
 Pressure _____
 Agitation _____
 Brief problem description _____

7.2 Equipment Return

Do not return equipment without first contacting the factory for a return authorization number. Any equipment being returned must include the following information:

Reason for return _____
 Return Authorization # _____
 Person to contact at your company _____
 Your correct shipping address _____

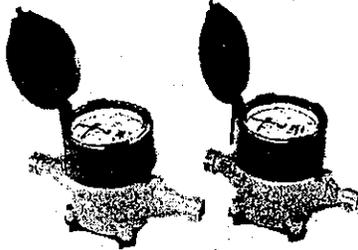
If available, please include the original P.O. # and the original Drexelbrook order # also.

To keep the paperwork in order, please include a purchase order with returned equipment even though it may be coming back for warranty repair. You will not be charged if covered under warranty. Please return your equipment with freight charges prepaid. We regret that we cannot accept collect shipments.

Drexelbrook usually has exchange units available for faster turnaround of repair orders. If you prefer your own unit repaired rather than exchanged, please mark clearly on the return unit "Do Not Exchange."

**Industrial Positive Displacement
Meter Model C-700 Bronze,
Magnetic Drive, External
Threaded Spuds**

Sizes 3/4" x 3/4" & 3/4" x 1"



DESCRIPTION

Operation. The C-700 is an oscillating piston style, positive displacement water meter. Product utilizes a piston which the water rotates in a measuring chamber, each piston revolution being equivalent to a known volume of water. The piston movement is transferred by a magnetic drive to a straight reading sealed register which contains the appropriate reduction gearing.

Compliance to Standards. The C-700 bronze meter fully complies with the American Water Works Association Standard C700 as most recently revised.

Installation. The meter must be installed in a clean pipeline, free from any foreign materials. Install the meter with direction of flow as indicated by the arrow cast in the meter case. The meter may be installed in horizontal or inclined lines with register facing upward.

Application. *The meter is for use only with POTABLE COLD WATER up to 120°F (50°C) and working pressures up to 150 psi.* The meter will register accurately to 100% ± 1 1/2% within the normal flows. Both pressure loss and accuracy tests are made before shipment. No adjustments need to be made before installation.

Construction. The meter consists of a straight through-flow designed main case, dual inlet measuring chamber, vertically grooved oscillating piston, high capacity strainer, removable bottom plate, full rubber liner, body bolts with integral washers and a magnetically driven register. The main case is cast in AWWA bronze with raised characters designating model, size and direction of flow. A choice of frostproof or standard bottom plates are available. The 2-piece snap-fit measuring

SPECIFICATIONS

	Sizes: 3/4" x 3/4"	3/4" x 3/4"S	3/4" x 1"
95%- 101% Accuracy GPM	1/4	1/4	1/4
98.5% - 101% Accuracy GPM	1/2	1/2	1/2
98.5% -101.5% Accuracy GPM	3-30	3-30	3-30
Continuous Flow GPM	15	15	15
Maximum Flow GPM	30	30	30
Operating Pressure psi	150	150	150
Operating Temperature °F	120	120	120

Sweep Hand Registers:

US Gallons	10	10	10
Cubic Feet	1	1	1
m ³ Cubic Meters	1/10	1/10	1/10
Imperial Gallons	10	10	10

Capacity of Register:

US Gallons (millions)	10	10	10
Cubic Feet (millions)	1	10	10
m ³ Cubic Meters (millions)	1/10	1/10	1/10
Imperial Gallons (millions)	10	10	10

Register Type: Permanently sealed direct reading register

Materials:

Main Case	Bronze
Bottom Plate	Bronze, Cast Iron or Synthetic Polymer
Bottom Gasket-Liner	Nitrile
Body Bolts	Stainless Steel
Measuring Chamber	Compounded Polymer
Division Plate	Loaded Nylon
Piston	High Impact Polymer
Thrust Bearing Insert	Loaded Nylon
Driving Bar	Loaded Nylon
Strainer	Polypropylene
Register Can	90% Copper Alloy
Register Lens	Tempered Glass
Register Housing and Lid	Synthetic Polymer or Bronze



chamber is of a top and bottom inlet, side outlet design and features a unique self-flushing sediment well. Other features include a removable contoured division plate, captive drive bar and high torque magnet complete with a nylon bushing. The flow stream balanced piston has a unique thrust bearing insert and features a Turbulence Seal™ system which passes debris while sustaining the most linear accuracy curve in the industry. Each register is secured to the main case with a tamperproof TORX® screw to eliminate tampering.

Register. The register is contained within a 90% copper seamless can which is vacuum purged then filled with a dry nitrogen gas to eliminate condensation. The 1/4" true tempered glass lens is secured with an "L" shaped gasket, then roll sealed to produce a permanently sealed design. To assure easy reading, the totalizer wheels are large and color coded. The applicable size, model, registration, part number and date code are printed on the calibrated dial face. Moving clockwise during operation, the extra thin center sweep hand does not interfere with meter reading, and the 1:1 piston ratio low-flow indicator will detect plumbing leaks.

Magnetic Drive. The magnetic drive design facilitates coupling between the measuring chamber and the external register. The coupling is absolute at all rated flows.

Connections. Meter casing spuds have external straight threads conforming to ANSI B2.1. Bronze coupling nuts and tailpieces are available. Both coupling nuts and tailpieces have external taper pipe threads conforming to ANSI B2.1. Their lengths and thread sizes are as specified by AWWA Standards.

Maintenance. The measuring chamber assembly can be removed, repaired or replaced without removing the main

case from the service line. Prestested measuring chamber assemblies are available for exchange or purchase, and spare parts are available from our central warehouse or designated regional locations. ABB Water Meters, Inc. staffs and operates a repair facility at its U.S. manufacturing plant in Ocala, Florida.

Pulsar Type "B" (2P). The "B" pulsar is a limit switch device which requires power from an external source, (2 wire). Contact closure: 1 contact= 1 USG. The switch is rated to 3 amps at 125 VAC max. For full details see specification sheet #C7-PUL-001.

Pulsar Type "SF" (2P). The "SF" pulsar is a solid state device which requires 6-24 VDC from an external source, (3 wire). Contact closure:

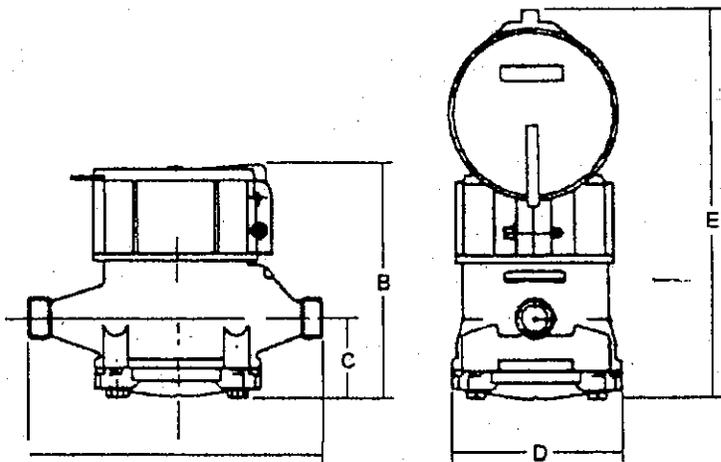
3/4" x 3/4"	66.6 cont/USG Std.	133.2 cont/USG Opt.
3/4" x 3/4" S	66.6 cont/USG Std.	133.2 cont/USG Opt.
3/4" x 1"	66.6 cont/USG Std.	133.2 cont/USG Opt.

For full details see specification sheet #C7-PUL-001 .

DIMENSIONS AND NET WEIGHTS

Meter Size	Dimensions (inches)					Weight (lbs.)
	A	B	C	D	E	
3/4" x 3/4" S	7 1/2	5 13/16	2 1/16	3 7/8"	10 7/16	4 7/8
3/4" x 3/4"	9	5 13/16	2 1/16	3 7/8"	10 7/16	5 1/8
3/4" x 1"	9	5 13/16	2 1/16	3 7/8"	10 7/16	5 1/8

*Add 1/2" for polymer housing



The company's policy is one of continuous product improvement and the right is reserved to modify the specifications contained herein without notice. These products have been manufactured with current technology in accordance with applicable AWWA Standards.

INDC7-BZ-114/8-98

C700 WATER METERS - 1/2" THRU 2"

INSTALLATION/START-UP INSTRUCTIONS

INTRODUCTION

The meter is a volumetric type operating on the oscillating piston principle. This utilizes a piston which the water rotates in a measuring chamber, each piston revolution being equivalent to a known volume of water. The piston movement is transferred by appropriate reduction gearing and a magnetic drive to a straight reading sealed register calibrated in U.S. Gallons, Cubic Feet or M³ (liters).

All materials in the meter have been selected for their ability to withstand wear and corrosion and to have a long working life with a minimum of maintenance.

INSTALLATION

The meter must be installed in a clean pipeline, free from any foreign materials.

The meter must be inserted with the flow in the direction of the arrow molded, or cast, into the meter body. Meter may be installed in horizontal or inclined lines.

Couplings are provided, which allow for connection with NPT threads in sizes 1/2" thru 1". The 1-1/2" and 2" meters have NPT internal threaded ends.

MAINTENANCE/LUBRICATION

There are no maintenance or lubrication requirements.

START-UP PROCEDURE

The meter piston can be damaged if the meter is subjected to full flow conditions prior to expelling all the air from the piping. Accordingly, turn on the flow gradually.

W/A" PULSER

Self-powered pulse generator produces one pulse per 100 gallons in 5/8" x 1/2" thru 1" and one pulse per 1000 gallons in 1 1/2" - 2"

To be wired with no regard as to polarity.

W/B" PULSER

To be wired in series.

The transmitting element is a 3 AMP limit switch, giving a closure rate as follows:

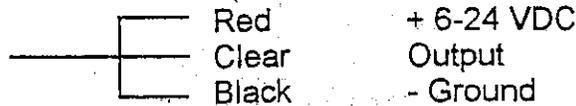
5/8"	1 CONTACT PER GALLON
3/4"	1 CONTACT PER GALLON
1"	1 CONTACT PER GALLON
1 1/2"	1 CONTACT PER 10 GALLONS
2"	1 CONTACT PER 10 GALLONS

W/ "SF" PULSER (NEMA 4)

To be wired in series.

The transmitting element is a Solid State sensor (3 wire) which requires 6-24 VDC power from an external source.

Wiring diagram:

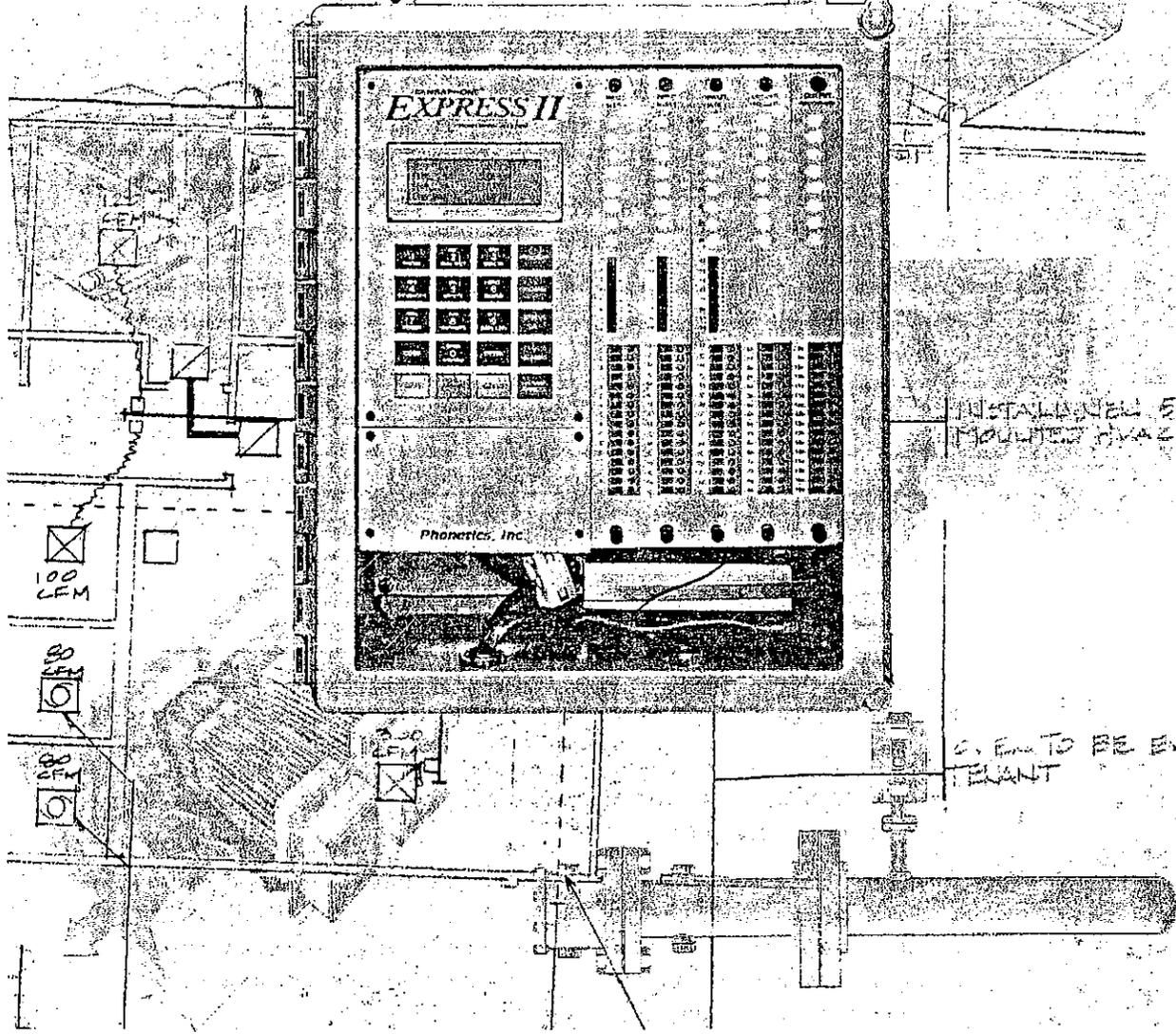


CONTACT CLOSURE RATES: PPG

<u>Size</u>	<u>Standard</u>	<u>Optional</u>
5/8"	100.0	200.0
3/4"	66.6	133.2
1"	24.6	49.2
1 1/2"	11.3	22.6
2"	5.6	11.1
5/8" Impr Brz	115.2	230.4

Appendix M
Autodialer Information

HEAD REPAIR AND RESTORE
INSTALL 5 TON HVAC UNIT



SENSAPHONE® EXPRESS II

.....
USER'S MANUAL
.....
version 2.01
.....

Phonetics, Inc.

.....

Important Safety Instructions

Your Sensaphone Express II has been carefully designed to give you years of safe, reliable performance. As with all electrical equipment, however, there are a few basic precautions you should take to avoid hurting yourself or damaging the unit:

- Read the installation and operating instructions in this manual carefully. Be sure to save it for future reference.
- Read and follow all warning and instruction labels on the product itself.
- To protect the Sensaphone Express II from overheating, make sure all openings on the unit are not blocked. Do not place on or near a heat source, such as a radiator or heat register.
- Do not use your Sensaphone Express II near water, or spill liquid of any kind into it.
- Be certain that your power source matches the rating listed on the AC power transformer. If you're not sure of the type of power supply to your facility, consult your dealer or local power company.
- Do not allow anything to rest on the power cord. Do not locate this product where the cord will be abused by persons walking on it.
- Do not overload wall outlets and extension cords, as this can result in the risk of fire or electric shock.
- Never push objects of any kind into this product through ventilation holes as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electric shock.
- To reduce the risk of electric shock, do not disassemble this product, but return it to Phonetics' Customer Service, or another approved repair facility, when any service or repair work is required. Opening or removing covers may expose you to dangerous voltages or other risks. Incorrect reassembly can cause electric shock when the unit is subsequently used.
- If anything happens that indicates that your Sensaphone Express II is not working properly or has been damaged, unplug it immediately and follow the procedures in the manual for having it serviced. Return the unit for servicing under the following conditions:
 1. The power cord or plug is frayed or damaged.
 2. Liquid has been spilled into the product or it has been exposed to water.
 3. The unit has been dropped, or the enclosure is damaged.
 4. The unit doesn't function normally when you're following the operating instructions.



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NOTES

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STRAIN RELIEF

Strain relief clamps are provided on the Express II enclosure to prevent wiring from being pulled from the circuit board or damaged when passing through the enclosure. To use the strain relief, thread wires through the clamp and the clear rubber bushing. Position the bushing in the clamp and tighten the screws on either side so that the wiring does not move. See Figure 2 below:

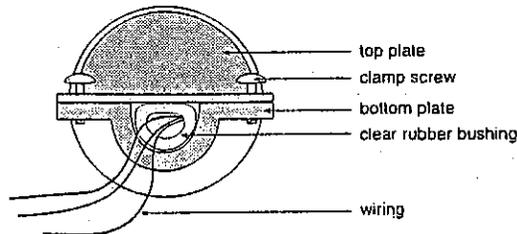


Figure 2: Strain relief clamp

POWERING UP

Express II is provided with a 12V AC power transformer. This should be plugged into a 117V AC outlet, $\pm 20\%$, 60HZ.

The transformer is pre-wired to the terminals labelled AC.

GROUNDING AND POWER SURGE PROTECTION

Express II should be earth grounded by connecting a true earth ground to the terminal labeled EG. This is not essential for Express II to operate, but it is necessary to prevent possible damage by a lightning strike.

The Sensaphone® Express II can be damaged by power surges and lightning through the telephone line and the power supply. Although Express II has built-in surge protection, we strongly recommend that additional protection be obtained for the unit and for any electronic equipment that is attached to your power supply and telephone lines. Power surge protection is especially important if you live in a lightning-prone area. Surge protection is available through Phonetics. Call for details.

BACKUP BATTERY

Express II has a 12V 3AH sealed lead-acid Gel-Cell rechargeable battery. This will provide approximately 6-12 hours backup time. Actual backup time will depend upon the number of input/output cards installed in the unit, the number of sensors being powered from the unit, temperature, battery age, and dialing activity. The battery comes pre-wired with the red wire attached to the BAT IN(+) terminal and the black wire attached to the BAT IN(-) terminal.

Express II will automatically charge the battery whenever the power switch is turned on and the power transformer is plugged in. The unit also includes special circuitry to prevent the battery

PHONE LINE INSTALLATION

Connect Express II to a standard 2-wire analog phone line. Express II dials using pulse or tone, with loop start only. Express II will operate with all standard telephone systems that accept pulse or tone dialing and will recognize ringer frequencies from 16 to 60 Hz.

NOTE:

Certain private telephone systems and public switching equipment may not accept Express II dialing or may generate an unacceptable ring signal. In those cases, a dedicated line may be required for Express II. Consult the supplier of your telephone system if you encounter problems.

CAUTION: Never install telephone wiring during a lightning storm. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface. Use caution when installing or modifying telephone lines.

POWER SUPPLIES

Express II will provide battery-backed 12 Volts DC (100 mA max.) and 24 Volts DC (400 mA max.) to power current loops and other external devices.

RS232 Printer Port

Express II comes with a cable and DB25 connector for connection to a serial printer. This can be used to perform data logging of input values and/or unit activity directly to a printer (see Chapter 5). You may also print the unit's programming parameters (see Chapter 7). The RJ11 connector at the end of the cable must be connected to the RJ11 jack labeled RS232 on the main board, located below the access panel. The default baud rate of the RS232 port is 9600 baud. The baud rate may be changed from the System menu under Unit Configuration (see Chapter 5). The communications protocol is 8 data bits, no parity, and 1 stop bit. Shown below are the RS232 pin descriptions for the DB25 connector.

Pin	Signal	Symbol	Direction
1	Frame Ground	FG	N/A
2	Transmitted Data	TD	From Printer
3	Received Data	RD	From Express II
6	Data Set Ready	DSR	From Express II
7	Signal Ground	SG	N/A
20	Data Terminal Ready	DTR	From Printer

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device to prevent overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100. For the Sensaphone Express II the Load Number is 7.

0-5 Volts - This configuration connects the input signal directly to Express II's analog to digital converter for measuring the output of 0 to 5V transducers. Any sensor that puts out 0-5V can be wired. Any input range can be specified by the user. Typical sensors include pressure gauges, voltage meters, and flow meters. Express II can read the voltage between 0 Volts and 5 Volts in increments of .00122 Volts. Input resolution is 12 bits.

Thermistor - Two kinds of thermistors may be used with Express II: a 2.8K thermistor or a 10K thermistor. The range for an input measuring temperature for 2.8k is -65.0° to 93.33° C (-85° F to 200° F), and for 10k is -62.22° C to 148.89° C (-80° F to 300° F). This configuration type connects the input signal to a 5V reference through a 6.34K pull-up resistor.

Time accumulator - The time accumulator works only with N.O. Dry Contacts. As the name suggests, it will accumulate and tally the total amount of time--in hours, minutes, and seconds--that the input sensor is in the closed position. This would be useful, for instance, in maintaining total run time for a given device.

LEDs

Each input has a corresponding LED that indicates input status. The LEDs are located above the terminal block. When an LED is *steady green*, that indicates that the input is OK and no alarms exist. When an LED is *blinking green*, the input is in alarm condition, but the preset recognition time has not been met to qualify as an unacknowledged alarm. When an LED is *blinking red*, that indicates that an unacknowledged alarm exists on the corresponding input. When an LED is *steady red*, it indicates that an alarm has been acknowledged but still exists on the corresponding input. If the input is disabled, the LED goes off for that input. NOTE: If the LED changes from blinking green directly to steady red, the input is not set up properly to dial out with an alarm.

CONFIGURING THE INPUTS

Each of the inputs must be configured so that Express II will know what type of signal it must read. To configure the inputs, you must position the shunts that are located on the input card directly above the input terminal block. The inputs may be set in one of three configurations:

1. 4-20mA
 2. Thermistor, dry contact, or pulse
 3. 0-5V
1. To configure the input as 4-20mA, place the shunt to enclose the two bottom pins (B position).
 2. To configure the input as thermistor, dry contact, or pulse, place the shunt to enclose the two top pins (A position).
 3. To configure the input as 0-5V, remove the shunt.
- See Figure 4:

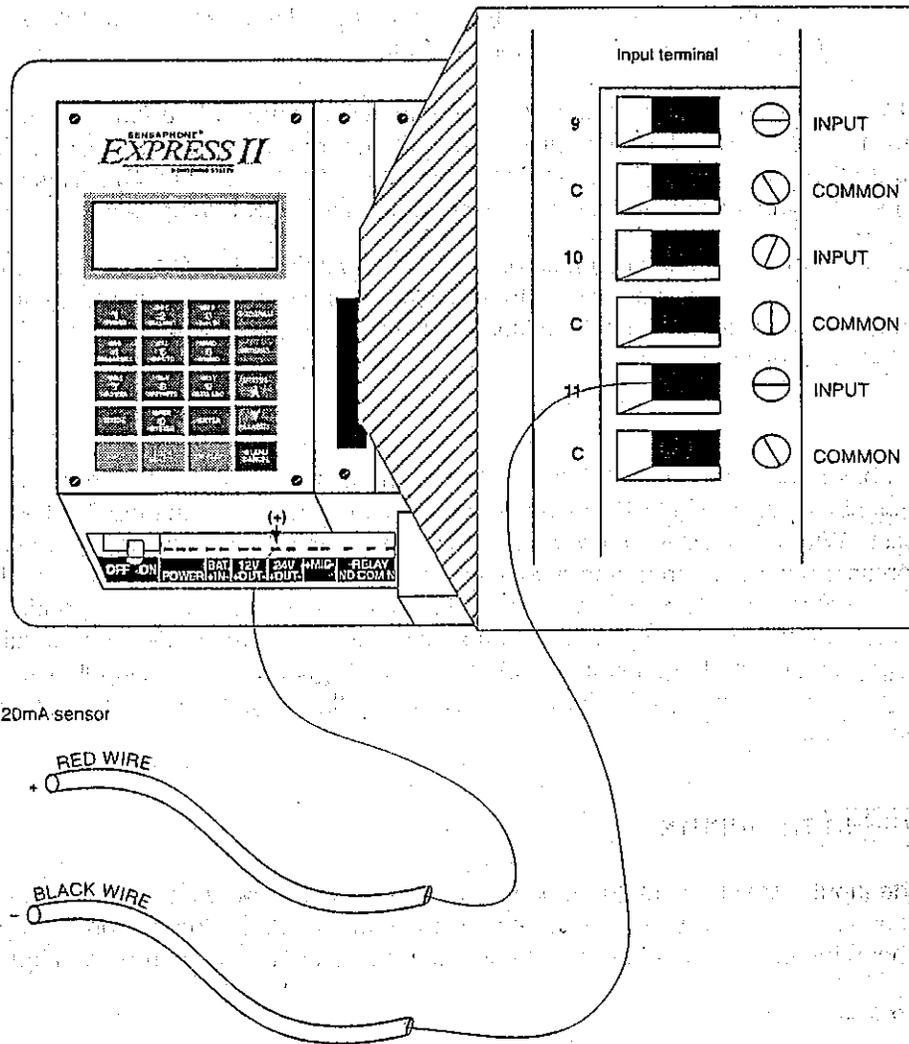


Figure 6: 4-20mA transducer using internal power supply

To use an *external* power supply, wire the positive lead from the sensor to the positive terminal on the external power source. Wire the negative lead from the sensor to a numbered input screw on Express II. Next, connect the power supply to Express II by wiring the negative terminal on the power supply to the corresponding common screw on Express. See Figure 7.

STRAIN RELIEF

Strain relief clamps are provided on the Express II enclosure to prevent wiring from being pulled from the circuit board or damaged when passing through the enclosure. To use the strain relief, thread wires through the clamp and the clear rubber bushing. Position the bushing in the clamp and tighten the screws on either side so that the wiring does not move. See Figure 9 below:

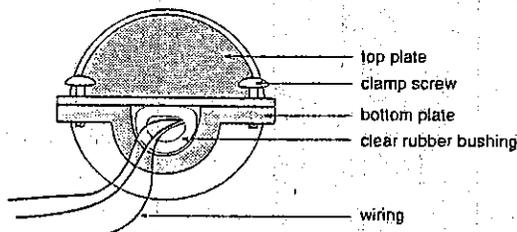


Figure 9: Strain relief clamp

SHIELDED WIRE

Express II is designed to work in most installations without the need for shielded wire. However, this does not apply to wire run outdoors or in conduit that has other noise-generating conductors such as 60 Hz AC. It is strongly recommended that input wiring be run in a conduit separated from AC power or output wiring. When wire runs are long or are in close proximity to large power consuming, power generating or power switching equipment, it is recommended that shielded wire be used.

WIRE LENGTH

Temperature - It is recommended that long wire runs be avoided when using a thermistor as a sensor. A long run of wire could alter the resistance of the circuit therefore providing an inaccurate temperature reading of the input. Below is a chart of recommended gauges and wire lengths:

MIN WIRE GAUGE	MAX WIRE LENGTH
#26	250 ft.
#24	700 ft.
#22	1500 ft.
#20	2500 ft.

Dry contact - The total resistance of the loop cannot exceed 50 Ohms. Use the appropriate gauge wire for your application.

Analog current - Long wire runs will not affect the accuracy of the input because there is constant current being driven through the sensor wire.

Analog voltage - Wire runs should be kept as short as possible to avoid voltage drops and noise susceptibility. Use the gauge chart above as a guideline.

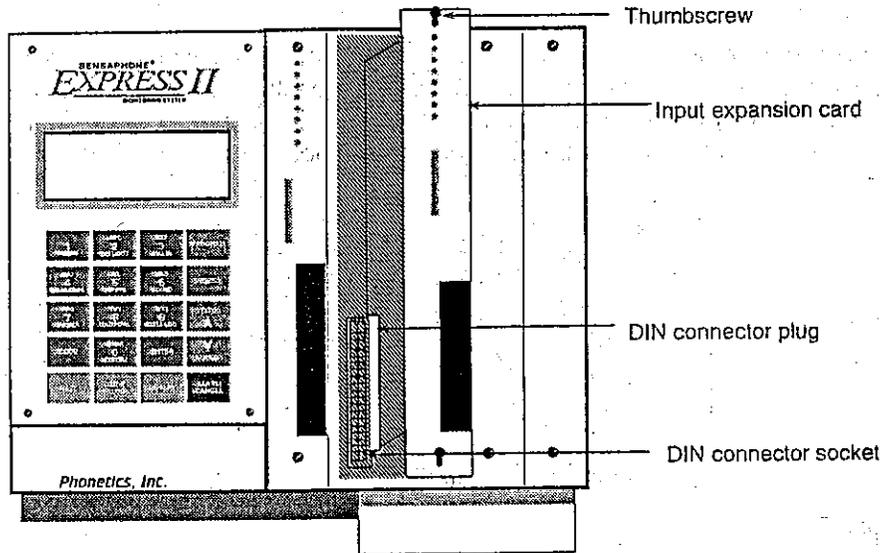


Figure 11: Line up and insert card

4. Insert the DIN connector plug into the DIN connector socket and press down slightly to connect.
5. Re-tighten the thumbscrews.
6. Turn the unit on.
7. Configure and wire the inputs as described in this chapter.

NOTE: When installing a combination of input and output cards, always install the input cards grouped together in the left slots and the output cards to the right of them. If you install an input expansion card after an output card has been installed, you must disconnect the output card, install the input card in its place, and reinstall the output card to the right of it.

INPUT SPECIFICATIONS

Voltage Range:	0 to +5 VDC
Input Resolution:	12 Bit or 0.00122V
A/D Converter Typical Total Unadjusted Error	± 1 LSB
Accuracy (Temperature)	$\pm 1^\circ\text{F}$ typical using 2.8K temperature sensor
Accuracy (4-20mA)	$\pm 1.25\%$
Min/Max Input Voltage	-0.5VDC to +5.5VDC
Max Pulse Frequency	1.0Hz
Noise Filtering	2300Hz low pass filter -20db/Decade

10K THERMISTOR LOOK-UP TABLE

DEGREES (Celsius)	DEGREES (Fahrenheit)	RESISTANCE (Ohms)
-37	-35	203.60K
-35	-30	173.60K
-32	-25	148.30K
-29	-20	127.10K
-26	-15	109.20K
-23	-10	94.07K
-21	-5	81.23K
-18	0	70.32K
-15	5	61.02K
-12	10	53.07K
-9	15	46.27K
-6	20	40.42K
-4	25	35.39K
-1	30	31.06K
2	35	27.31K
4	40	24.06K
7	45	21.24K
10	50	18.79K
13	55	16.65K
16	60	14.78K
18	65	13.15K
21	70	11.72K
24	75	10.46K
27	80	9.35K
30	85	8.38K
32	90	7.52K
35	95	6.75K
38	100	6.08K
41	105	5.48K
44	110	4.95K
47	115	4.47K
49	120	4.05K
52	125	3.67K
55	130	3.33K
58	135	3.31K
60	140	2.76K
63	145	2.52K
66	150	2.30K
69	155	2.10K
71	160	1.92K
74	165	1.76K
77	170	1.61K
80	175	1.48K
83	180	1.36K
86	185	1.25K
88	190	1.16K
91	195	1.07K
94	200	0.98K
97	205	0.91K

It is labeled "Output Relay." It is a single-pole, single-throw, latching relay. See "Outputs" in Chapter Five for more information.

NOTE: All wiring should comply with section 17 of the UL requirements.

STRAIN RELIEF

Strain relief clamps are provided on the Express II enclosure to prevent wiring from being pulled from the circuit board or damaged when passing through the enclosure. To use the strain relief, thread wires through the clamp and the clear rubber bushing. Position the bushing in the clamp and tighten the screws on either side so that the wiring does not move. See Figure 13.

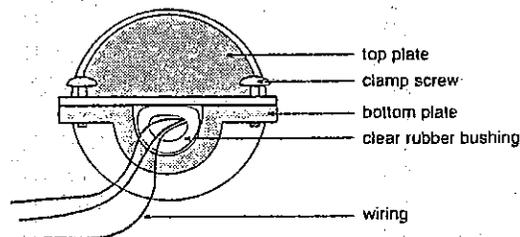


Figure 13: Strain relief clamp

INSTALLING OUTPUT EXPANSION CARDS

To install an output expansion card:

1. Turn the unit off. Damage may occur to the motherboard or to the output card if installed while power is still on.
2. Remove the screws and blank plate of the first available slot from left to right.

NOTE: Always install cards side by side — do not skip a slot.

3. Hold the card with the LEDs at the top with the DIN connector plug on the card lined up with the DIN connector socket on the motherboard.
4. Insert the DIN connector plug into the DIN connector socket and press down slightly to connect.
5. Turn the unit on.

Wire the outputs for the configuration you want--manual or auto--as described above. See Chapter 5 for programming information.

NOTE: When installing a combination of input and output cards, always install the input cards grouped together in the left slots and the output cards to the right of them. If you install an input expansion card after an output card has been installed, you must disconnect the output card, install the input card in its place, and reinstall the output card to the right of it.

NOTES

- 1 -
- 2 -
- 3 - RW1 (FAILURE / RUN)
- 4 - RW2
- 5 - RW3
- 6 - RW4 (FAILURE / RUN)
- 7 -
- 8 -

PAGER 1804 5939604 CODE1 ~~CODE1~~ ~~CODE1~~
757 255 0814 CODE5 CODE6



Programming PHONE Parameters [1]

The PHONE parameters allow you to program when, how and to which location Express II will dial out during an alarm. Express II is capable of dialing out to 48 different locations.

Phone parameters are divided into two separately-programmed categories— Calling Schedule and Phone Contacts. We'll deal with Communications Type a little later.

1. **Calling Schedule** – the day and time settings during which specified groups of Phone Contacts will be called, in the event of an alarm.
2. **Phone Contacts** – the telephone numbers to which Express II will dial out, in the event of an alarm. Up to 48 telephone numbers can be used, and may include Special Dialing codes.

1. Calling Schedule

Calling Schedule allows you to assign Phone Contacts to specific calling groups to accommodate shift work schedules. Time is measured using the "24 hour" format. There are 3 calling schedules from which to choose. The default is "All," indicating that no grouping of Phone Contacts is in effect and that dial-out will occur around the clock, at all times. Selecting Calling Schedule brings up the following choices:

1. All

This schedule programs Express II to call all the Phone Contacts that are programmed regardless of the time of day, or day of week. This is the default setting. Phone Contacts from 1-48 are called regardless of time, day or day of week

2. Days and Nights

This schedule allows Express II to create two groups for dialing out: a daytime set of Phone Contacts (Monday to Friday), and a nighttime/weekend set of Phone Contacts (Friday night to Monday morning).

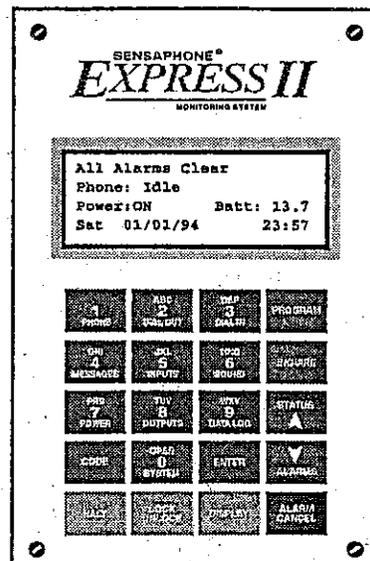


Figure 5-1: Express II Local Display and Keypad

PHONE PARAMETERS

Calling Schedule:

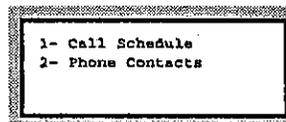
- 1) Press PROGRAM



- 2) Press PHONE.



- 3) A new list appears in the local display.



Press 1 for Call Schedule.



2. Phone Contacts

Express II can store up to 48 telephone numbers, with up to 40 digits permitted for each one. These numbers will be dialed in the event of an alarm. Special dialing codes that reflect a pause, pound, asterisk or other similar code may be incorporated into the telephone number as required, to access various phone and beeper systems.

Once you've set the schedule times, choose "2" from the previous menu to select Phone Contacts. Remember that you can program up to 48 phone numbers (contacts); however, if you are using a calling schedule other than ALL, you will have to program those phone numbers in the appropriate group of contact numbers (e.g., Contact numbers 1-24 for day, 25-48 for night & weekend). Note that all contact numbers in the group will be called in numerical order, so *program the most important numbers first*. If you want someone called regardless of time of day, simply program that phone number in each contact group.

On the "Enter Phone Number Selection" screen, select the contact number you want to program by pressing a number or set of numbers on the keypad, followed by the [Enter] key.

The Express II will then give you a choice between two types of phone calls for it to make.

Communications Type

Express II is capable of dialing out over standard telephone lines in either Voice or Beeper mode. When dialing out in Voice mode, Express II will recite the prerecorded alarm message when its outgoing call is answered. The default setting is Voice.

When Dialing out in Beeper mode, no message will be recited. The Express II delivers a Touch-Tone code message to your beeper or pager. The two choices come up as:

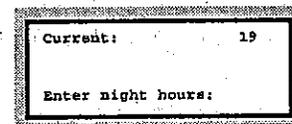
- 1 - Voice
- 2 - Beeper

Special Dialing Codes

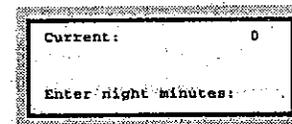
Special Dialing Codes are commonly used when accessing a beeper or pager system, or in order to reach a dial tone for connection to an outside line. To incorporate a Special Dialing Code into the phone number you are programming, press the blue CODE key, followed by the corresponding number key from the

- 6) Next, current starting times for night hours and night minutes are displayed, along with the option to reset these times. *To keep current settings, press the ENTER key.*

To change settings, use the number keys on the keypad and press ENTER. When Express II says, "Enter night hours," enter the hour (0 to 23); then press ENTER. (Remember..."19" is the same as 7:00 pm, using a 24-hour system.)

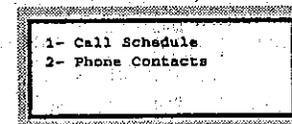


When Express II says, "Enter night minutes," enter the new time; then press ENTER.



Phone Contacts:

After the Call Schedule has been set, the local display returns to the previous menu.



- 1) Press 2 for Phone Contacts.



DIAL OUT [2]

The following parameters control how Express II communicates when it dials out for an alarm.

1. Dialing Method - This parameter determines whether Express II will dial out using tone or pulse dialing. The programming choices for this parameter are Pulse, Tone, or Automatic.

Automatic instructs Express II to determine whether to dial out in tone or pulse automatically.

NOTE: You must have a dedicated phone line for Express II to use the Automatic method. If you have Express II installed on an office system that requires dialing an access number to reach an outside line, you **MUST** program this parameter as Tone or Pulse.

The default setting is AUTOMATIC. The choices under "Dialing Method" are:

1 = Pulse; 2 = Tone; 3 = Automatic.

2. Retries on Busy - This determines how many times Express II will hang up and attempt to recall a phone number when it detects a busy signal. This parameter may be programmed from 0-15. The default is 0. **NOTE:** Each retry applies toward the Maximum number of calls.

3. Message Repeat - When Express II dials out and the call has been answered, this parameter determines how many times the unit will recite the recorded alarm message per call. This parameter may be programmed from 0 to 10 repetitions. The default is 3.

4. Maximum Number of Calls - This parameter determines the maximum number of calls Express II will make if the unit does not receive acknowledgment. The maximum calls may be programmed from 0 to 65,535. The default is 100. If the Express II has only one phone number programmed to dial out for a particular alarm, it will limit the maximum calls to 15 regardless of the Maximum number of calls programmed.

5. Call Delay Time - This parameter is the length of time that Express II will wait after an alarm is recognized before it starts the dial out sequence. (Note: This is not the same as input recognition time.) The call delay time dictates the delay before the *first* call. To set the delay time between calls, see Intercall Delay Time. This parameter may be programmed from 0 to 12 hours. The default for the call delay time is 30 seconds. During call delay, the unit will announce the message locally.

DIAL OUT PARAMETERS

1-Dialing Method:

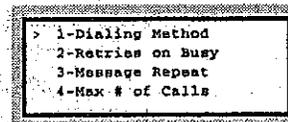
- 1) Press PROGRAM.



- 2) Press DIAL-OUT.



DIAL-OUT menu will then appear on local display.



- 3) Press 1 for Dialing Method.



Press 1 for Pulse.

Press 2 for Tone.

Press 3 for Automatic.

2-Retries on Busy:

Return to Dial-Out menu.

- 1) Press 2 for RETRIES ON BUSY.



- 2) Press the amount of retries desired using the number keys. Press ENTER.



3-Message Repeat:

Return to Dial-Out menu.

- 1) Press 3 for MESSAGE REPEAT.

DIAL IN [3]

The following parameters determine how Express II will communicate when the unit is called.

1. Rings Until Answer - This parameter determines the number of rings that must occur before Express II will answer. This value can be from 1 to 15. The default is 1 ring.

2. Telephone Answering Device compatibility (TAD) - Express II can be used on the same telephone line that also has a telephone answering device, such as an answering machine, modem or FAX. The TAD feature is especially useful because it integrates the operation of the Express II with your telephone answering device in a way that retains the full flexibility of each system. This allows you to have on-demand telephone access to the Express II, for obtaining a Status Report, or for issuing call-in commands, while your telephone answering device is set to receive outside calls. Programming for use with a telephone answering device (TAD) is always used in conjunction with RINGS UNTIL ANSWER, detailed on this page.

NOTE: The TAD feature only applies to answering devices connected to the same telephone line as the Express II.

USING TAD:

By enabling this feature, you will be able to bypass the answering device and access Express II for a status report or programming. If there are no other devices hooked up to the phone line, this feature should be disabled. The default is disabled.

- 1) Make sure the TAD feature is enabled. The default setting is disabled, so you must enable it initially.
- 2) Determine the number of rings your telephone answering device uses to answer the telephone. Most answering devices require 4 rings; others are selectable.
- 3) Program the Express II RINGS UNTIL ANSWER to a greater number than that of the number of rings set on your answering device.

Example:

Telephone answering device: rings = 4.

Express II: RINGS UNTIL ANSWER = 6.

DIAL IN PARAMETERS

1-Rings Until Answer:

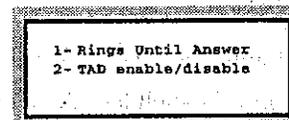
- 1) Press Program.



- 2) Press DIAL IN.



DIAL IN menu will appear on local display.

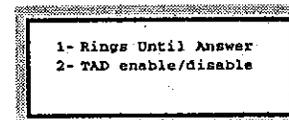


- 3) Press 1 for RINGS UNTIL ANSWER.
- 4) Enter the number of rings desired before EXPRESS II answers.(1-15)

Read section on TAD, pg. 26 - 27, before programming RINGS UNTIL ANSWER.

2-TAD enable/disable:

Return to DIAL IN menu.



- 1) Press 2 for TAD.
- 2) Press 1 to disable.
Press 2 to enable.

MESSAGES [4]

Recording your own messages provides a valuable, expeditious communication link between the Express II and service personnel.

Voice messages - Express II allows you to program your own voice for the ID (identification) and dial-out alarm messages. This means that when Express II calls you or someone on your staff during an alarm, your personalized voice message will indicate exactly which alarm condition exists. Depending on what the input is monitoring, you might program a warning message, or provide brief vital monitoring data.

The voice message choices are:

- 1 - Record ID Message (default length: 10 seconds)
- 2 - Record Input Message (default length: 5 seconds)
- 3 - Record Output Message (default length: 5 seconds)
- 4 - Message length

The ID Message allows you to identify the Express II and/or the system it's monitoring as the caller.

The Input Message is the alarm message corresponding to each specific input that the Express II is monitoring. You must program this by entering the number of the Input (1-8 on the first card, etc.) to identify it, and then recording the relevant alarm message for it.

The Output Message feature can only be used if you've purchased and installed an Output Card in the Express II.

Message length - This parameter determines how many seconds long each message can be. A message can be 5, 7, or 11 seconds long. However, you can cut any message short if you finish recording it, by pressing [Enter].

(Note: The shorter the message length, the better the quality of the recording. We recommend that you program this parameter to 5 seconds for optimum clarity.)

NOTE: Do not change the message length parameter after you have recorded voice messages. If you do so, you will automatically erase all programmed voice messages and reset them to the default.

MESSAGE PARAMETERS

Messages:

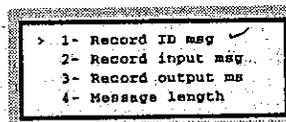
- 1) Press Program.



- 2) Press Messages.



Messages menu will then appear on local display.



- 4) Press 1 to record ID message.

Speak message after beep.

- 5) Press 2 to record input messages.

Enter the input number to which the message corresponds.

Speak message after beep.

- 6) Press 3 to record output message.

Enter the output number to which the message corresponds.

Speak message after beep.

- 7) Press 4 for message length.

Enter 5, 7, or 11. (the default is 5)

Messages can be cut short by pressing Enter during recording.

4. **High and Low Limits** - Express II allows you to program high and low limits for inputs defined as an analog input type or pulse count. Inputs defined as normally open or normally closed cannot be programmed to have high or low limits. During voice prompted programming, high and low limits will only be prompted when the input is defined as an analog type or pulse count. The limits are -9999 to +9999. Express II defaults to these limits.

NOTE: The Pulse Count Low Alarm Limit is set at -1. You cannot go below zero on a pulse count, but the *Alarm* limit is -1 to be distinct from the possible value of 0. DO NOT change this Low Limit.

5. **Alarm Reset Time** - After an alarm is acknowledged, Express II stops the dial out sequence. However, the alarm condition will still exist until the alarm clears itself or some action occurs to clear the alarm. If the alarm is not cleared after a certain amount of time, Express II can be programmed to restart the dial out sequence. This is called the alarm reset time. This parameter may be programmed from 0 seconds to 12 hours.

Setting the alarm reset time to 0 seconds will disable it. This means that once the alarm has been acknowledged, it will not retrip an alarm regardless of how long it exists. The default for this parameter is 0 seconds.

For example, you program the alarm reset time for input 1 to 2 hours. An alarm occurs on input 1 and Express II dials out. The alarm is acknowledged but the condition still exists. Two hours later, the alarm condition still has not been cleared. Express II will restart the dial out.

6. **Dial Out Selection** - You may program Express II to dial specific phone contacts according to which input is in alarm. This is the Dial Out Selection. For example, input 6 can be programmed to initiate calling to Phone Contact 1, 3, 4, and 16. Meanwhile, an alarm on input 2 can initiate calling to Phone numbers 2 - 13. This parameter allows you to have specialized personnel being called only for specific alarms. To return to the default, all contacts, press '9' '9' and then press ENTER.

A list of Input Types will then appear on the local display.

```
> 1- Normally closed
  2- Normally open
  3- Pulse count
  4- 4-20 mA
```

```
5- 0-5 Volts
> 6- Temperature
  7- Time accumulator
```

2) Key in the appropriate Input type.

(the default is 2; normally open dry contact)

Press 1 for normally closed.

Press 2 for normally open.

Press 3 for pulse count.

Press 4 for 4-20 milliamp.

-Enter table low limit, press Enter.

-Enter table high limit, press Enter.

Press 5 for 0-5 Volts.

-Enter table low limit, press Enter.

-Enter table high limit, press Enter.

Press 6 for temperature.

-Press 1 for 2.8K °F thermistor.

-Press 2 for 2.8K °C thermistor.

-Press 3 for 10K °F thermistor.

-Press 4 for 10K °C thermistor.

Press 7 for time accumulator.

3-Recognition Time:

1) Return to Input menu. Press 3 for Recognition Time.

2) Enter hours.
Enter minutes.
Enter seconds.

4-High/Low Limits:

1) Return to Input menu. Press 4 for High/Low Limits.

SOUND [6]

Express II allows you to listen to sound levels through its built-in microphone when you call in for a status report. Express II also monitors the sound levels through its built-in microphone. When the current sound level suddenly exceeds the normal sound level, Express II can be programmed to dial out with a high sound alarm.

1. Listen-in Time - The listen-in time is the amount of time you can listen to sounds at the microphone site when you call in for a status report. The programming range is from 0 to 255 seconds. The default time is 15 seconds.

2. Enable/disable Sound Monitoring - This parameter determines whether Express II will initiate the dial out sequence if it detects a high sound. If the sound is enabled, Express II will dial out. If the sound is disabled, Express II will not dial out for high sound. 1 = enabled; 0 = disabled. The default is enabled.

3. Sound Sensitivity - This parameter allows you to change the sensitivity of the sound monitoring. This may be useful to desensitize Express II if it is installed in an area with relatively high sound level, or where loud noises occur but are not associated with an alarm. Also, this feature allows you to increase sensitivity in situations where you want to monitor lower sound levels. The sensitivity range for sound alarm monitoring is 1 to 100. A value of 1 is the most sensitive; 100 is the least sensitive. The default is 50.

4. Sound Recognition Time - The sound recognition time is the length of time that a high sound condition must exist continuously before Express II will recognize the condition. If the high sound stops before the recognition time is up, it is not recognized as a valid alarm. Express II will not dial out. This feature is useful to prevent dial outs for momentary occurrences of high sound. You may program the recognition time from 2 seconds to 1 minute. The default is 8 seconds.

5. Sound Alarm Reset Time - After a sound alarm is acknowledged, Express II stops the dial out sequence. However, the high sound condition will still exist until the alarm clears itself or some action occurs to clear the alarm. If the high sound is not cleared after a certain amount of time, Express II can be programmed to restart the dial out sequence. This is called the sound alarm reset time. This parameter may be programmed from 2 seconds to 12 hours.

SOUND PARAMETERS

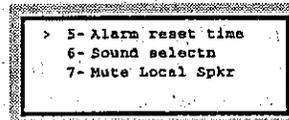
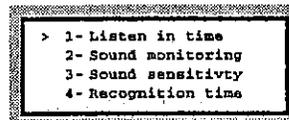
- 1) Press Program.



- 2) Press Sound.



The Sound Parameters menu will then appear on the local display.



1-Listen-in Time:

- 1) Press 1 for Listen-in Time.
- 2) Enter seconds.(0-255)

2-Sound Monitoring:

- 1) Press 2 for Sound Monitoring.
- 2) Press 1 to enable.
Press 0 to disable.

3-Sound Sensitivity:

- 1) Press 3 for Sound Sensitivity.
- 2) Enter value.(0-100)

4-Recognition Time:

- 1) Press 4 for Recognition.
- 2) Enter hours.
Enter minutes.
Enter seconds.

POWER [7]

Express II monitors AC power failure and low battery condition. Power monitoring and low battery monitoring is explained below.

1= AC Power

2= Battery

Power Failure

1. Power Failure Monitoring enable/disable - This command enables or disables the power failure detection. When enabled, Express II will monitor power and dial out if a valid failure occurs. When disabled, Express II will not dial out for a power failure. 1 = disable, 2 = enable. The default is enabled.

2. Power Recognition Time - The power recognition time is the length of time that a power failure must exist continuously before Express II will recognize it as an actual alarm and initiate the dial out sequence. Power recognition time may be programmed from 0 seconds to 12 hours. The default is 5 minutes.

3. Alarm Reset Time - After power failure is acknowledged, Express II stops the dial out sequence. However, the power failure condition will still exist until power is restored. If the power is not restored after a certain amount of time, Express II can be programmed to restart the dial out sequence. This is called the alarm reset time. This parameter may be programmed from 0 seconds to 12 hours.

If the alarm reset time is programmed to 0 seconds, the feature is disabled. Express II will not restart the dial out regardless of how long the alarm exists.

4. Dial Out Selection - You may program Express II to call a specific set of Phone Contacts for power failure only. This is called the Dial out selection. To return to the default setting, all contacts, press '9', and then press ENTER.

POWER PARAMETERS

AC POWER

- 1) Press Program.

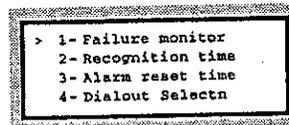


- 2) Press Power.



- 3) Power menu will appear. Press 1 for AC Power Parameters.

The AC Power menu will then be displayed.



1-Failure monitoring:

- 1) At the AC Power menu press 1 for Failure Monitor.

- 2) Press 1 to disable.
Press 2 to enable.

2-Power Recognition time:

- 1) Press 2 at the AC Power menu.
- 2) Enter hours.
Enter minutes.
Enter seconds.

3-Alarm reset time:

- 1) Return to the AC Power menu. Press 3 for Alarm Reset time.
- 2) Enter hours.
Enter minutes.
Enter seconds.

4-Dialout Selection:

- 1) Press 4 at the AC Power menu for Dial Out Selection.

3) Enter list of dial out selection.

Press individual position numbers.
(1-48)

Press Enter.

4) When all position numbers in list are entered, press Enter again.

5) The default is all contacts.

Press 99 for the default.

DATA LOG [9]

Express II has two logging features, the Input Log and the Activity Log. The Data Log features require the use of a printer with a serial port. If either data log is enabled, Express II will send information to the serial port to be printed via the RS232 socket located to the right of the phone jack and above the orange terminal block at the bottom of the unit.

1. **Input/Output Log** - Logs the input (or output) values on a user-defined basis. The menu offers four choices:

1. **Enable/Disable:** 1=disable; 2=enable

2. **Time between logs:** set the hours, minutes, and seconds. The minimum allowed time is 5 seconds; the maximum is 12 hours, 59 minutes, 59 seconds.

3. **Number of inputs:** the maximum this can be set to is 40.

4. **Line length:** this determines the number of characters that a data log printout will allow on each line. The default setting is 80 characters per line. Check your printer setup before changing this number.

2. **Activity Log** - Logs all system and alarm activity. This includes programming changes, alarms occurring and clearing, acknowledgments, any call-ins to the unit and alarm dial outs.

NOTE:

Once datalogging is enabled, the system will automatically default to an RS232 rate of 9600 baud. If your target printer is not configured to 9600 baud, refer to your printer manual to adjust the printer's baud rate. (See also "Unit configuration" in the following section.)

DATA LOG PARAMETERS

1-Input/Output Log:

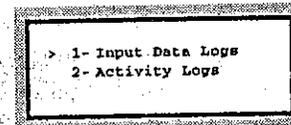
- 1) Press Program.



- 2) Press Data Log.



Data Log menu will appear on local display.



- 3) Press 1 for Input/Output Log.
- 4) Press 1 for Enable/Disable.
Press 1 to Disable; 2 to Enable
- 5) Press 2 Time Between Log.
Enter hours, minutes, seconds.
- 6) Press 3 for Number of Inputs.
Enter the number of inputs to be monitored.
- 7) Press 4 for Line length.
Enter number of characters you want per line in your printout.

2-Activity Log:

- 1) Return to the Data Log menu.
Press 2 for Activity Log.
- 2) Press 1 to disable.
Press 2 to enable.

6. **Call Cancel** - This feature determines whether or not Express II will continue dialing out for an alarm after the alarm has physically cleared.

When Call Cancel is enabled, Express II will stop dialing out when the alarm clears, even if the alarm has not yet been acknowledged. When Call Cancel is disabled, Express II will continue dialing out for the alarm until it receives acknowledgment, even if the alarm clears in the meantime.

7. **Auto Test** - This feature allows you to simulate an alarm on an input to test the dial out procedure. When you call Auto Test, it will ask you to specify an input number to test. NOTE: Auto test will make actual phone calls to the Phone Contacts using the specifications you programmed. You must acknowledge the alarm as if it were real.

Also, the Auto Test feature will not work if "Call Cancel" is enabled (see #6 above).

8. **Unit reset**- Generally for factory use, the Unit Reset feature will reset the various unit parameters you've programmed in. Should you want to reset the unit, enter a reset code of "159," and press Enter. Choose from Full Reset, Programming Reset, or Voice Reset.

Note: only "Voice reset" offers options. Selecting the other two will clear system parameters.

9. **Unit configuration**- The Unit Configuration menu offers you three choices:

1 - **RS232 Rate** (default: 9600 baud): This is the baud rate for the RS232 port to which you would connect a printer. Its default setting is 9600 baud. You can reset it in a range from 1200 to 38,400.

2 - **Callback Rings** (default: 10): As mentioned under the "Callback Acknowledgment" section above, the Express II will not answer your call to acknowledge an alarm until the phone has rung ten times. This is the default setting. If you wish, you can change that number here.

3 - **Ack over voice** (default: disabled): This feature, when activated, allows you to punch in a code number of "555" while the unit is speaking to cut off the message. This is a factory testing feature and in practice is not a dependable override. Generally it should be left disabled. (See Chapter 5: System, Acknowledgement Code for more information on setting the code number.)

5. **Callback acknowledgment:**

- 1) Press 5 for Callback Acknowledge.
- 2) Enter 1 to enable.
Enter 0 to disable.

6. **Call Cancel:**

- 1) Press 6 for Call Cancel enabling.

7. **Auto Test:**

- 1) Press 7 for Auto Test.
- 2) Enter input number.
- 3) Press Enter.

Note that Call Cancel and Auto Test are mutually exclusive.

8. **Unit Reset:**

- 1) Press 8 for Unit Reset
- 2) Full reset: "Enter" clears everything.

Programming reset: clears programming settings you've entered and returns them to the defaults.

Voice messages reset: resets individual expansion card messages and/or the voice ID message.

9. **Unit Configure**

- 1) Press 9 for Unit configuration. Choose from:

RS232 rate: Set this rate from 300-38,400 bauds

Callback rings to answer: choose a new number if you don't want 10.

Ack over voice: choose from disabled/enabled.

NOTES

I. Express II Detects a Change at the Sensor	Variable Factors	Indicator Light
<ul style="list-style-type: none"> Express II detects a change in the monitored condition (from the sensor wired to one of the inputs). This is considered an <i>alert condition</i>, and does not qualify as a valid alarm at this point. The condition continues throughout the programmed Recognition Time. If the condition (or sensor) reverts to its normal state before the Recognition Time is reached, no alarm will occur. 	<p><i>Input Type and Configuration</i></p> <p><i>Recognition Time: Activated</i></p>	<p><i>Changes from steady green to blinking green</i></p>
II. A Valid Alarm Is Recognized	Variable Factors	Indicator Light
<ul style="list-style-type: none"> The condition must persist long enough to meet or exceed the programmed Recognition Time. When Recognition Time has expired, (or if set to zero), and the alarm condition continues, the Express II will determine that a valid alarm exists. When a valid alarm is determined, Call Delay is activated (if not set to zero), forcing the Express II to wait for a programmed period of time before starting the dial-out process. Call Delay applies to the period just prior to dial-out, before the first telephone call is made. Call Delay provides the opportunity to cancel a valid alarm at the Express II's installation site, before dial-out occurs. An audible voice message indicates which of the inputs is in alarm. If on-site personnel acknowledge the alarm within the Call Delay time, the Express II will not dial out. (Local Voice Mute is disabled, so that alarm messages can be heard at the site.) 	<p><i>Recognition Time: Expired</i></p> <p><i>Valid Alarm: Exists</i></p> <p><i>Call Delay: Activated</i></p> <p><i>Alarm Message: Audible, On-site Activated</i></p> <p><i>Local Voice Mute: Disabled</i></p>	<p><i>Changes from blinking green to blinking red.</i></p>

IV. The Alarm is Acknowledged	Variable Factors	Indicator Light
<ul style="list-style-type: none"> • At any time after a valid alarm is determined, the alarm may be acknowledged at the Express II's installation site, by pressing ALARM CANCEL. • When the Express II dials out and the call is answered using a Touch-Tone telephone, it may be instantly acknowledged by pressing "555" (the default code) or by entering a programmable code. • The alarm message repeats for the number of programmed Voice Repetitions. If "555" has been entered, the Express II will say: "OK." The alarm is considered acknowledged and the dialout will stop. (If the alert condition continues to exist, then Reset Time may reactivate the dial out process—refer to Reset Time, page 32-33.) • If the Express II does not receive the Touch-Tone code, it recites the following: "No Acknowledgment." • After the acknowledgment period, it says: "Press any key for unit activity." If a key is pressed, the unit enters command mode. If no key is pressed it will hang up. • The recipient of this message must call the Express II back within the period programmed for Intercall Time, in order to acknowledge the alarm. If local voice mute is off, the unit will beep at the installation site while waiting for this call. 	<p><i>Local, On-site Acknowledgment</i></p> <p><i>Touch-Tone Acknowledgment: Fast Code 555</i></p> <p><i>Touch-Tone Acknowledgment: Default Code 555</i></p> <p><i>Tone or Pulse Callback Acknowledgment: Within Intercall Time</i></p>	<p><i>Red light blinks until alarm is acknowledged</i></p>

NOTES



Inquire Alarms:

To check alarm information, press INQUIRE and then ALARMS. If there are any unacknowledged alarms, the Express II will recite which input alarms have not been acknowledged. Otherwise it will tell you that no alarms are active.

Halt Mode Delay Time

Halt mode allows you to disable all inputs and prevent dial out for a user-programmed time. Halt mode is useful if you must perform periodic tests or other activities that would trip false alarms and initiate dial out. The Input lights will flash red for the duration. Halt mode can be programmed from 0 seconds to 12 hours.

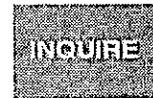
To initiate Halt mode press the orange HALT button. To exit Halt mode press ALARM CANCEL.

NOTE: If you program the halt mode time to zero, the halt mode feature is disabled. The default setting is 1 hour. (See also "Halt mode delay time" as part of the System programming section of Chapter Five.)

6) Dump Programming is useful only when a printer with a serial port is connected to the Express II. It does not reset or clear settings. For that, consult "System" in Chapter 5.

Inquire Alarms:

- 1) Press Inquire



- 2) Press Alarms



Special Keys:

Press the "star" button(*) once to repeat the current menu.

Press the "star" button(**) twice to repeat the previous menu.

Use the "pound" button(#) as the Enter key.

Notes regarding uses of the "Star" Button[*]: During the programming of Phone Contact Numbers, the "Star" [*] button is the Code Key--i.e., for Code 1 you would press "**1". If, on the other hand, you are inputting analog tables or alarm limits, if you press the "star" button [*] before a digit, it acts as a minus [-] sign; if you press the "star" button[*] after a digit, it acts as a decimal point.

Security:

The unit's local keypad may not be "Unlocked" or "Locked" over the phone. This will not affect any Phone-in parameters; however, if the local keypad is "Locked" you must know the System Password to gain access and change programming over the telephone. Press the pound sign (#) after the password.

Note: The ID message must be recorded after installation. There is no default ID message. However, it can be recorded over the phone. Just remember that message time limits apply. (See "Messages" section of Chapter 5.)
Input Calibration cannot be programmed over the phone

Phone Contact List

#	NAME	PHONE NUMBER	SCHEDULE*		
			All/Day	Night	Weekend
25.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Schedule Options:

Schedule 1: ALL. Schedule 2: 1-24=DAY, 25-48=NIGHT.
 Schedule 3: 1-16=DAY, 17-32=NIGHT, 33-48=WEEKENDS
 for further information see "Phone Parameters" in Chapter 5.



II. DIAL OUT

A. Dialing method

1. pulse
2. tone
3. automatic

B. Retries on Busy

1. enter number of retries on busy

C. Message Repeats

1. enter number of times alarm message will repeat for each call

D. Maximum Number of Calls

1. enter total number of outgoing calls during an alarm

E. Call Delay Time

1. enter hours
2. enter minutes
3. enter seconds

F. Intercall Delay Time

1. enter hours
2. enter minutes
3. enter seconds

.....

IV. MESSAGES

- A. Record ID Message
 - 1. speak message
- B. Record Input Message
 - 1. enter input number
 - 2. speak message
- C. Record Output Message
 - 1. enter output number
 - 2. speak message
- D. Message Length
 - 1. enter 5
 - 2. enter 7
 - 3. enter 11



VI. SOUND

- A. Listen-in Time
 - 1. enter seconds (0-255)
- B. Sound Monitoring
 - 1. disable
 - 2. enable
- C. Sound Sensitivity
 - 1. enter value (0-100)
- D. Recognition Time
 - 1. enter hours
 - 2. enter minutes
 - 3. enter seconds
- E. Alarm Reset Time
 - 1. enter hours
 - 2. enter minutes
 - 3. enter seconds
- F. Dial Out Selection
 - 1. enter position numbers (1-48)
- G. Mute Local Speaker
 - 1. disable
 - 2. enable

VIII. OUTPUTS

A. Enter Output Number

- 1. on-board output (output 0)
 - a. manual
 - b. automatic
- 2. optional outputs--manual
 - a. off
 - b. on

.....

X. SYSTEM

- A. Password
 - 1. enter password (up to 6 digits)
- B. Date and Time
 - 1. enter month
 - 2. enter day
 - 3. enter year
 - 4. enter hours
 - 5. enter minutes
 - 6. enter seconds
- C. Acknowledgment Code
 - 1. enter code (3 digits; default=555)
- D. Halt Mode Delay Time
 - 1. enter hours
 - 2. enter minutes
 - 3. enter seconds
- E. Callback Acknowledgment
 - 1. disable
 - 2. enable
- F. Call Cancel
 - 1. disable
 - 2. enable
- G. Auto Test (only if call cancel is disabled)
 - 1. enter input number
- H. Unit Reset
 - 1. enter code 159
 - a. full reset
 - b. programming reset
 - c. voice reset
 - 1-5* d. expansion cards (1-5)
 - 6* 2. ID message -6
- I. Unit Calibration
 - 1. RS232 rate (default 9600 baud)
 - a. baud rates 300-38,400
 - 2. callback rings (default 10)
 - 3. ack over voice
 - a. disabled
 - b. enabled

NOTES

Problem	Cause	Solution
<p>2. The Express II will not answer the telephone when called for a status report.</p> <p>3. The Express II will not answer the telephone when called back for alarm acknowledgment.</p> <p>4. The Express II dials out correctly but fails to audibly recite its alarm message when you answer the call.</p>		<p>Check the telephone number programming. Does your telephone system require a "9" to connect with an outside line?</p> <p>If you are on an older phone system, try setting the dialing method to "pulse." If this doesn't work, try setting it to "tone." (See also "Dial Out Parameters" in Chapter Five.)</p> <p>Increase maximum number of calls to a number greater than or equal to one. (See Dial Out Parameters)</p> <p>The Express II must be connected to a standard (2-wire analog) telephone line, and NOT a digital extension to a phone system.</p> <p>If the unit will not dial out and the factors previously listed have been ruled out, try connecting the unit to a standard residential telephone line and see if it will operate on that line.</p> <p>Recheck the programming of "rings until answer" feature. (See "Dial In Parameters" in Chapter Five.)</p> <p>Allow the telephone to ring ten times.</p> <p>Reprogram voice repetitions to 1 or greater.</p>

Problem	Cause	Solution
IV. OTHER 1. Alarm status of input is incorrect.	Incorrect input normality.	Reprogram the input type to the correct normality. See "Inputs" in Chapter Five.
2. The unit won't perform an autotest.	The call-cancel feature is enabled. An auto test won't execute if this feature is enabled.	Disable the Call Cancel feature. (see Chapter Five)
3. The unit calls again with the same alarm after I acknowledge it.	Alarm reset time is set at too short an interval.	Increase the "Alarm reset" value. See "Alarm Reset Time" sections in Chapter Five and "Alarm is Acknowledged" in Chapter Six.
	Alarm condition is sporadic, going on and off.	Lengthen recognition time. See various "Recognition Time" sections in Chapter Five.

.....

All monitored channels, including built-in monitoring features, shall allow keyboard and remote touch-tone programming of pertinent operational data including, but not limited to:

1. Input type (NO/NC, 4-20mA and 0-5V analog, pulse count, thermistor, time accumulator)
2. High and Low limits (-9999 to +9999)
3. Input recognition time (0 seconds to 12 hours)
4. Alarm reset time (0 seconds to 12 hours)
5. Phone Contacts list for each channel
6. Enable/disable for each channel to dialout for alarm

B. Outputs

The system shall have one built-in SPST latching 2A 250VAC relay output. The output may be programmed to switch automatically on alarm or manually via keyboard or Touch-Tone™ phone. Up to 16 additional relay output channels may be installed by the user.

III. Communications Features

A. Telephone Specifications

The system shall connect to a standard 2-wire telephone line using pulse or tone dialing methods, with loop start only. The system shall recognize ringer frequencies from 16 to 60 Hz. No leased or dedicated lines shall be required. The system shall also be capable of being used on the same telephone line as other answering devices. Call progress detection shall ensure that the alarm dialout is not hindered by no-answers or busy signals.

B. Telephone Numbers

The system shall be capable of dialing up to 48 telephone numbers, 40 digits each. There shall be a capacity to program, retain and use three separate lists based on a calling schedule of weekday, weeknight and weekend. Each list shall contain up to 16 phone numbers. In addition, individual phone contact lists may be programmed for each input channel.

The system shall allow local keypad and remote touch-tone programming of the following telephone dialing information:

1. Dialing method (Automatic, pulse, tone)
2. Retries on busy (0 to 15)
3. Message repetitions (0 to 10)
4. Maximum number of calls (0 to 65,535)
5. Call delay time (0 seconds to 12 hours)
6. Intercall delay time (0 seconds to 12 hours)

the absence of AC power. (Actual battery backup performance is dependent upon the age of the battery, the ambient temperature, the charge condition, and the number of external devices being powered by the system.)

C. Local Visual Indication

Each input shall have a corresponding LED that will indicate the alarm and acknowledgment status of each input. The system shall also have an LCD display that will list information about the current system status and input/output status.

D. Data Log

The system shall be capable of logging the input values on a user-defined time period via a serial printer. The system shall also log all system and alarm activity including, but not limited to: programming changes, alarms occurring and clearing, acknowledgments, call-ins, and alarm dialouts. The system shall be able to print the log information to a printer hooked up to its built-in RS232 serial port.

E. Halt Mode

The system shall be capable of entering a halt mode upon user command in which all inputs shall be disabled and dialout prevented. Halt mode shall end automatically after a preprogrammed time period.

F. Diagnostics and Testing

System diagnostics shall be performed each time the unit is started. The system shall be capable of performing a simulated alarm dialout for testing. The dialout can be requested locally or remotely.

G. Security

The system shall allow the user to lock the keypad to prevent unauthorized local or remote access unless a security password is entered.

VI. Remote Operation Features

A. Status Report

The system shall allow the user to call into the unit at any time using any standard telephone to obtain a full status report of all monitored channels. The status report shall be articulated using the resident voice-synthesized English vocabulary, in combination with digitized user-recorded voice messages.

B. Acknowledgment

An alarm on any monitored channel may be acknowledged remotely by pressing tones on a touch-tone telephone keypad or by calling the system back within a

1 YEAR LIMITED WARRANTY

1. **WARRANTOR:** Dealer, Distributor, Manufacturer
2. **ELEMENTS OF WARRANTY:** This Product is warranted to be free from defects in materials and craftsmanship with only the limitations and exclusions set out below.
3. **WARRANTY AND REMEDY:**

One-Year Warranty — In the event that the Product does not conform to this warranty at any time during the time of one year from original purchase, warrantor will repair the defect and return it to you at no charge

This warranty shall terminate and be of no further effect at the time the Product is (1) damaged by extraneous cause such as fire, water, lightning, etc. or not maintained as reasonable and necessary; (2) modified; (3) improperly installed; (4) repaired by someone other than warrantor; (5) used in a manner or purpose for which the Product was not intended; or (6) sold by original purchaser.

WARRANTORS' OBLIGATION UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT. THIS WARRANTY DOES NOT COVER PAYMENT OR PROVIDE FOR THE REIMBURSEMENT OF PAYMENT OF INCIDENTAL OR CONSEQUENTIAL DAMAGES.

It must be clear that the warrantors are not insuring your premises or guaranteeing that there will not be damage to your person or property if you use this Product. The warrantors shall not be liable under any circumstances for damage to your person or property or some other person or that person's property by reason of the sale of this product or its failure to operate in the manner in which it is designed. The warrantors' liability, if any, shall be limited to the original cost of the Product. The warrantors assume no liability for installation of the Product and/or interruptions of the service due to strikes, riots, floods, fire, and/or any cause beyond Seller's control.

4. **PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY:** In the event that the Product does not conform to this warranty, the Product should be shipped or delivered freight prepaid to a warrantor with evidence of original purchase.
5. **LEGAL REMEDIES:** This warranty gives you specific legal rights, and you may also have other rights which vary from state to state to the extent allowed by law expressly in lieu of any other express or implied warranty, condition, or guarantee.

Effective date 07/01/90

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901 Tryens Road

Aston, PA 19014

(610) 558-2700

Fax (610) 558-0222

Appendix N
System Electrical Component Information



REV 2

CLIENT/SUBJECT RENK - SAUNDERS SUPPLY

TASK DESCRIPTION RELAY PANEL LADDER DIAGRAM

PREPARED BY SKIP BOOZ DEPT 1283 DATE 3/26/98

MATH CHECKED BY _____ DEPT _____ DATE _____

METHOD REV. BY _____ DEPT _____ DATE _____

SHEET 1 of 1

W.O. NO. 03347-142

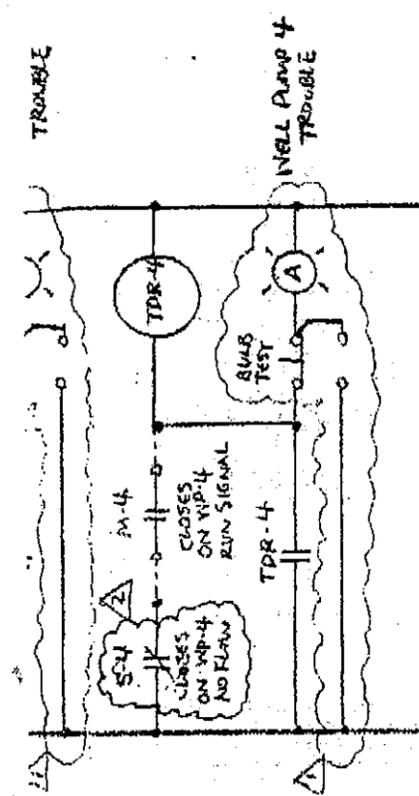
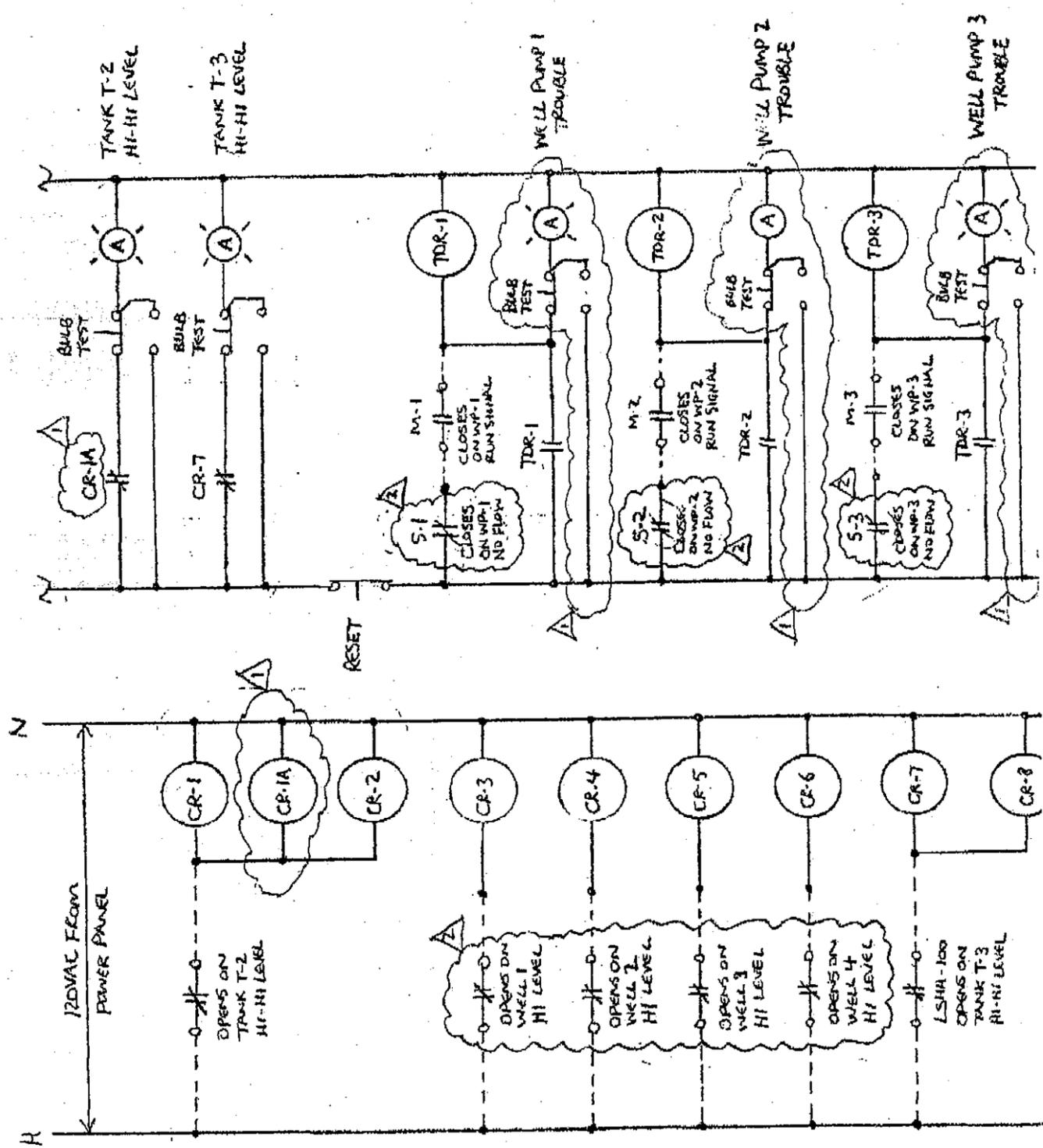
TASK NO. 2305-02

APPROVED BY _____

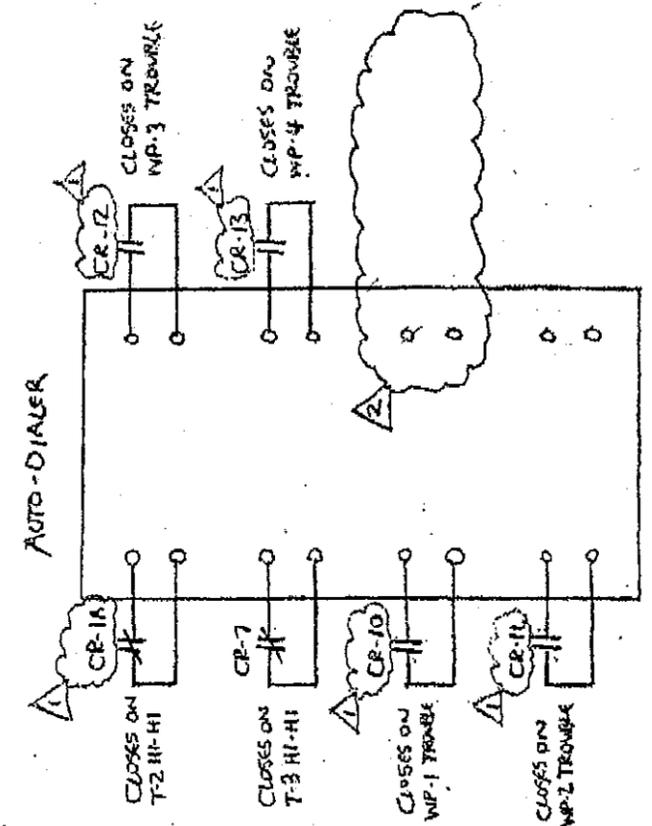
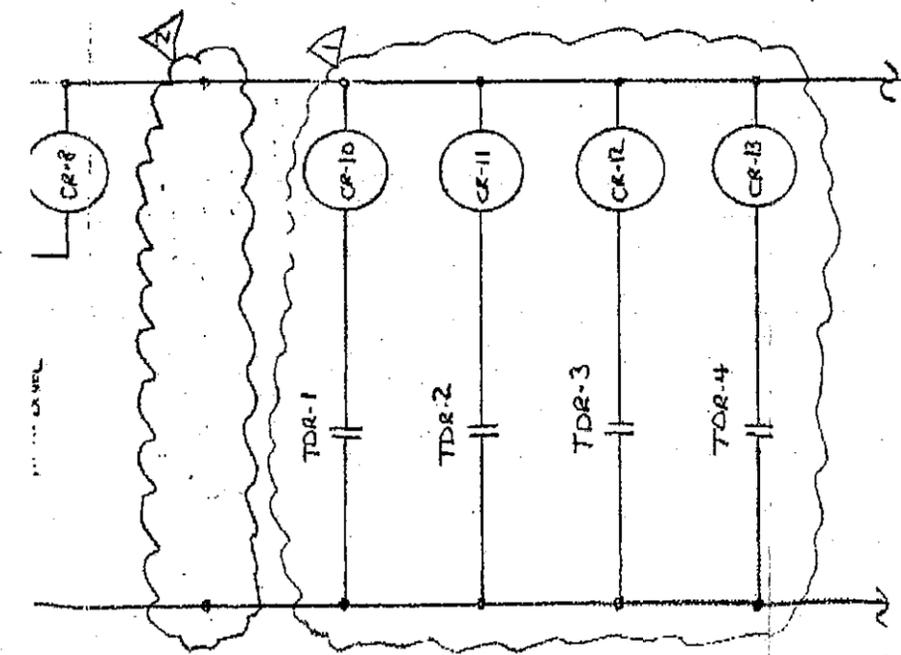
DEPT _____ DATE _____

REV. 1 ADDED CR-1A, 10, 11, 12, 13 SB 3/26/98

REV. 2 AS-BUILT SB 4/29/98



NOTE: WELL PUMP TROUBLE ALARM ON PANEL WILL LIGHT UNTIL FLOW IS ESTABLISHED. THEN IT WILL ONLY LIGHT ON TROUBLE TROUBLE.



Dayton Fractional HP Motors

E
N
G
L
I
S
H

Motor Installation and Maintenance Information

*Please read and save these instructions.
Read carefully before attempting to assemble,
install, operate or maintain the product described.
Protect yourself and others by observing all safety
information. Failure to comply with instructions
could result in personal injury and/or property
damage! Retain instructions for future reference.*

Dayton[®]

Initial Inspection and Handling

- After opening carton, look for concealed damage. If concealed damage is found, immediately file claim with carrier.
- Check the nameplate to verify that data conforms to specifications of motor ordered.

⚠ DANGER

High voltage and moving parts around motors and motor driven equipment can cause serious or fatal injuries. Always disconnect power source before working on a motor or its connected load. Installation must conform to all OSHA requirements, and the National Electrical Code (NEC) in the United States, and all local codes.

Electrical - Motor must be securely and adequately grounded by wiring with a grounded metallic conduit, or other grounding method approved by the NEC and local codes.

Insulate all connections carefully to prevent grounding or short circuits. Reinstall all conduit and terminal box covers. Do not force connections into the conduit box.

Thermal Protection - Use thermally protected motors or a motor starter incorporating thermal overload protection wherever required by safety regulations such as NEC or Underwriters Laboratories (UL) Standards in the United States; or where overloading, jamming or other abnormal operating conditions may occur. Under low temperature conditions, manual reset protectors may reset automatically, causing motor to start unexpectedly. Always disconnect power before working on equipment.

Mechanical - Guard all moving parts. Remove the shaft key before running the motor without a connected load. Be careful when touching the exterior of an operating motor! Motor may be hot enough to be painful or cause injury. This condition is normal for most motors when operated at rated load and voltage. Do not use the motor in a hazardous location as defined by Article 500 of the National Electrical Code (NEC).

Storage - Motor should be stored indoors in a clean, dry location.

Location

- Open, Drip-proof Motor** - Clean dry locations with access to an adequate supply of cooling air.
- Totally Enclosed Motor** - Harsher environments where damp and dirty conditions may exist. Totally enclosed motors are not water-proof.
- Use only UL listed Hazardous Location motors for service in Hazardous Locations as defined in Article 500 of the NEC.**
- Temperature around the motor should not exceed 104°F (40°C). Minimum temperature is -20°F (-29°C).
- If the motor nameplate indicates "Air-Over, Cont. A.O.", etc., the motor must be mounted in the air stream of an air moving device.

⚠ CAUTION Not for fans in unattended areas. Refer to the following for proper thermal protection, and other motor selection information.

UL 507 STANDARD - FANS FOR USE IN UNATTENDED AREAS (PARAGRAPHS 125 & 126)

Any motor used in a fan product, such as bathroom exhaust fans, wall-insert fans, ceiling-insert fans, attic exhaust fans, whole house fans and duct fans, etc., which are built into or within the building structure and which are likely to operate unattended or in situations in which the operator may not detect a locked rotor (stalled motor) condition must have either a manual reset thermal protector or a thermal cut-off (one-shot) device. Rangehoods, circulating fans, pedestal fans and ceiling suspended fans are not included. Agricultural fans are included, if they are built into the building structure and are likely to operate unattended or in situations in which the person operating the fan may not detect a locked rotor (stalled motor) condition.

Power Source

- Voltage, frequency and phase of the power supply must correspond to that shown on the motor nameplate. Low voltage can reduce performance and cause overheating.
- On three-phase power, voltages on all three lines should be balanced within 1%. Unbalanced voltages cause motor overheating and poor performance.

Motor Control Devices

- Use of a suitable motor starting device is advisable and usually required by local electrical codes.
- Power supply must have fuses or circuit breakers to provide short circuit protection for the motor and controller.
- Where a motor starter is used, follow the control manufacturer's recommendations on heater selection or setting. If an existing controller is to be used with a replacement motor, new heaters may be required.
- Any switching device used to control motor must have a horsepower rating equal to or greater than the motor.
- An electronic adjustable speed control must not be used unless the motor has been specifically designed for such applications.

Motor Mounting

Motor must be securely fastened to prevent vibration and minimize noise. For secure mounting use high-quality bolts of the largest possible diameter. Where possible, sleeve bearing motors should be mounted with oil ports up and accessible.

Belt-drive sheaves must be in-line. Use a straight edge to check. Do not overtighten belts.

Direct-coupled installations require a careful check of shaft and coupling alignment. Shim motor base as necessary. Do not depend on a flexible coupling to compensate for misalignment.

Table A - Minimum Wire Sizes for Three-Phase Motors

Motor HP	25 to 50 Feet 230V	50 Feet 115V 230V	100 Feet 115V 230V	150 Feet 230V	200 Feet 230V	250 Feet 230V	450V
1/8	14(18)*	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*
1/6	14(18)*	14(18)*	14(18)*	14(18)*	14	14(16)*	14(18)*
1/4	14(18)*	14(18)*	14(18)*	14(18)*	14	14	14(18)*
1/3	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	14	14(18)*
1/2	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	10	14(18)*
3/4	14(16)*	14(16)*	14(18)*	14(18)*	10	10	14(16)*
1	14	14(16)*	14(18)*	14(18)*	8	8	14
1 1/2	12	14	14(18)*	10	14(18)*	6	14
2	12	12	14(18)*	8	10	6	12
3	10	12	14(18)*	6	8	4	12

NOTE: NEC Article 310.5 Minimum conductor size for General Wiring at 115-440VAC is No. 14AWG.

Connecting Power to Motor

To connect motor for proper voltage and rotation, refer to the connection diagram on the nameplate or inside the terminal/conduit box.

Table B - Minimum Wire Sizes for Single-Phase Motors

Motor HP	25 Feet 115V 230V	50 Feet 115V 230V	100 Feet 115V 230V	150 Feet 230V	200 Feet 115V 230V	250 Feet 115V 230V
1/8	14(18)*	14(18)*	14	14(18)*	10	14(16)*
1/6	14(16)*	14(18)*	12	14(18)*	6	14
1/4	14	14(18)*	10	14(16)*	6	12
1/3	14	14(18)*	10	14(16)*	8	12
1/2	12	14(18)*	8	14	6	12
3/4	10	14(18)*	6	12	4	10
1	10	14(16)*	6	12	4	10
1 1/2	8	14	6	12	4	10
2	8	14	4	10	2	8
3	6	12	3	8	1/0	6

ENGLISH

ENGLISH

NOTE:

- NEC Article 310-5 — Minimum conductor size for general wiring at 115-440VAC is No. 14AWG.
- Above wire sizes based on approximate 5% voltage drop during starting; copper conductors; and 75°C type THHW, THW, THWN, RH, RHW insulation, etc. For aluminum wire, increase two wire size steps minimum. See NEC Article 310 for ampacities of aluminum conductors.
- Type S, SO, SJ, SJO, etc. flexible cable wire sizes. See NEC Article 400 for ampacity.

WARNING

All aspects of the installation must conform to 430 (Motor Circuits and Controllers), and all local codes. Wherever possible, each motor should be powered from a separate circuit of adequate capacity to keep voltage drop to a minimum during starting and running. Increase wire size where motor is located a distance from the power source. Wire size must be adequate to minimize voltage drop during starting and running. Refer to Tables A and B for suggested wire sizes. Distances shown are one-way between source and motor. Portable cords, if used, should be as short as possible to minimize voltage drop. Long or inadequately sized cords, especially on hard starting loads, can cause motor failure. All electrical connections in system must be secure to prevent voltage drop and localized heating.

- Determine direction of rotation before connecting driven equipment to prevent damage.
- To prevent bearing damage, do not strike shafts with hammer or other tool.
- If the motor has been damp or wet, have motor serviced by a qualified motor repair shop before operating.

Starting Motor

Be sure motor is properly grounded.

Connect motor to load and run briefly. Check for unusual noises and vibration (see Troubleshooting). Check motor current; it should be close to nameplate. Visually re-inspect the installation. Make sure that the guards and other protective devices are securely in place. All covers and gaskets must be re-installed to minimize the entry of dirt and moisture.

DANGER Before performing any maintenance, disconnect power and allow motor to come to a complete stop. Discharge capacitors, if any, for safety.

Recommended Maintenance

Remove dirt accumulations in and around vent openings, by vacuuming. Dirt accumulations can cause motor overheating and a fire hazard. Enclosed motors can be cleaned with an air jet; wear eye protection. Periodically inspect the installation. Check for dirt accumulations; unusual noises or vibration; overheating; worn or loose couplings, sheaves and belts; high motor current; poor wiring or overheated connections; loose mounting bolts or guards; and worn motor starter contacts. Exercise caution with solvents: some solvents may attack motor insulation, finish or bearing lubricants; some are highly flammable. If solvents are used, make sure area is well ventilated. Sleeve bearing motors require periodic reoiling. Follow reoiling instructions on the motor (See nameplate or terminal box cover). If instructions are not included, re-oil continuous duty units once a year, intermittent duty units every two years and occasional duty units every five years with 30 to 35 drops of SAE No. 20 non-detergent or electric motor oil. Do not overlubricate. Dayton ball bearing motors are pre-lubricated at the factory and do not require relubrication.

Troubleshooting

This chart suggests common answers to electric motor problems. The information is not all-inclusive and does not necessarily apply in all cases. When unusual operating conditions, repetitive failures, or other problems occur, consult an electric motor service firm for assistance.

Symptoms	Possible Cause(s)	Corrective Action
Motor fails to start	Blown fuses Tight shaft	Replace with time-delay fuses. Check for grounded winding Occasionally during shipment a sleeve bearing motor may be received with a shaft which does not rotate freely. It may be necessary to strike the motor, at the shell/endshield rabbet, with a rawhide or plastic mallet to align the bearings Consult local power company. Increase wire size (refer to Tables A & B). Check for poor connections Check and reset overload relay in starter. Check heater rating against motor nameplate current rating Check motor load. If motor has an automatic or manual reset thermal protector, check if tripped Check connections against diagram supplied with motor Reduce load or increase motor size Repair or replace Consult motor service firm for proper type. Use larger motor
Motor does not come up to speed or takes too long to accelerate	Voltage too low at motor terminals Starting load too high Excess loading; tight belts	Increase wire size (refer to Tables A & B). Check for poor connections. Check for voltage unbalance (3-phase) Check load motor is carrying at start Reduce load; increase motor size. Adjust belts Repair or replace Replace with larger motor
Motor stalls during operation	Overloaded motor Low motor voltage	Reduce load or increase motor size Verify that nameplate voltage is maintained
Motor vibrates or is excessively noisy	Motor shaft misaligned Three-phase motor running single phase High or unbalanced voltages Worn, damaged, dirty or overloaded bearings Defective winding. Bent or bowed shaft Loose sheave or mis-aligned coupling	Realign Check for open circuit; blown fuses or unbalanced voltages Check wiring connections. Consult local power company Repair or replace motor; check loading and alignment Repair or replace Tighten setscrew(s); realign coupling
Motor stalls during operation	Overloaded motor Low motor voltage	Reduce load or increase motor size Verify that nameplate voltage is maintained
Motor vibrates or is excessively noisy	Motor shaft misaligned Three-phase motor running single phase High or unbalanced voltages Worn, damaged, dirty or overloaded bearings Defective winding. Bent or bowed shaft Loose sheave or mis-aligned coupling	Realign Check for open circuit; blown fuses or unbalanced voltages Check wiring connections. Consult local power company Repair or replace motor; check loading and alignment Repair or replace Tighten setscrew(s); realign coupling

E S P A Ñ O L

Motores de potencia fraccional Dayton

Información para instalación y mantenimiento del motor

Limited Warranty

Dayton One-Year Limited Warranty. Electric motors are warranted by Dayton Electric Manufacturing Company (Dayton) to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Dayton's option. For limited warranty claim procedures, see "PROMPT DISPOSITION" below. This limited warranty gives purchasers specific legal rights which vary from jurisdiction to jurisdiction.

Limitation of Liability. To the extent allowable under law, Dayton's liability for consequential and incidental damages is expressly disclaimed. Dayton's liability in all events is limited to and shall not exceed the purchase price paid.

Warranty Disclaimer. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions.

Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in the "LIMITED WARRANTY" above is made or authorized by Dayton.

Product Suitability. Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Dayton attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; (c) by law, during the period of this limited warranty, any implied warranty of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.

E N G L I S H

Por favor lea y guarde estas instrucciones. Léelas cuidadosamente antes de tratar de montar, instalar, operar o dar mantenimiento al producto aquí descrito. Protéjase usted mismo y a los demás siguiendo toda la información de seguridad. ¡El no cumplir con las instrucciones puede ocasionar daños, tanto personales como en la propiedad! Guarde estas instrucciones para referencia en el futuro.

Manufactured for Dayton Electric Mfg. Co.
5959 West Howard Street
Niles, Illinois 60714 U.S.A.





SQUARE D

Instruction Bulletin | Boletín de instrucciones | Directives d'utilisation



39000-285-01B
Huntington, IN, USA 2/97

Industrial Control Transformer Transformador de control industrial Transformateur de commande industrielle

Class Clase	Type Tipo
9070	T, TF

RECEIVING

Inspect the transformer for damage. If damaged, notify and file a claim with the carrier. Contact the supplier for repair or replacement.

RECIBO

Realice una inspección visual del transformador para ver si encuentra daños. Si ha encontrado daños, notifique a la compañía de transportes y presente una reclamación. Comuníquese con el proveedor para obtener detalles sobre la reparación o sustitución del equipo.

RÉCEPTION

Inspecter le transformateur pour rechercher les dommages. En cas de dommage, prière d'aviser l'entreprise de transport et de faire une déclaration auprès de celle-ci. Contacter le fournisseur pour les réparations ou le remplacement.

PRECAUTIONS

PRECAUCIONES

PRÉCAUTIONS

▲ DANGER	▲ PELIGRO	▲ DANGER
HAZARDOUS VOLTAGE can cause serious personal injury or death. This transformer must be installed and serviced only by qualified electrical personnel in accordance with The National Electric Code (NEC) and any other applicable codes and standards.	TENSION PELIGROSA puede causar lesiones personales serias o la muerte. Sólo el personal de mantenimiento eléctrico especializado deberá instalar y dar servicio a este transformador de acuerdo con las pautas establecidas en el Código Nacional Eléctrico de los EUA (NEC) así como con cualquier otra norma y código correspondiente.	TENSION DANGEREUSE pouvant causer des blessures graves ou la mort. Ce transformateur doit être installé et entretenu uniquement par du personnel électrique qualifié, conformément au Code National de l'Électricité (NEC) et tout autre code et norme applicables.

- On the nameplate, verify that the transformer kVA and voltage are correct for the line and load.
- Install the transformer only in a well ventilated area that is free from explosive or corrosive gases, vapor, or excessive dust, dirt, and moisture.
- Ensure a free flow of air around the transformer. Do not exceed surrounding air temperature of 40°C (104°F).
- Use sufficient mounting hardware to support the weight of the transformer.

- Consulte la placa de identificación y verifique que los kVA y tensión del transformador sean los correctos para la línea y carga.
- Instale el transformador sólo en un área bien ventilada libre de gases explosivos y corrosivos, vapor o demasiado polvo, suciedad y humedad.
- Asegúrese de que circule el aire alrededor del transformador y de que no exceda la temperatura ambiente de 40°C (104°F).
- Utilice suficiente tornillería de montaje para soportar el peso del transformador.

- Sur la plaque signalétique, vérifiez si les kVA et la tension du transformateur sont corrects pour le secteur et la charge.
- Installer le transformateur seulement dans une zone bien ventilée, dépourvue de gaz ou de vapeur explosif ou corrodant, ou de poussière, de saletés et d'humidité excessives.
- Assurer une circulation libre de l'air autour du transformateur. Ne pas dépasser une température ambiante de 40°C (104°F).
- Utiliser une visserie de montage suffisante pour supporter le poids du transformateur.

PROTECTION

- Use fuses or circuit breakers in accordance with Article 450 of the NEC and any other applicable codes and standards.
- For fuse recommendations, use the Square D fax on demand system. Dial 1-800-557-4556. Follow the prompts and request document code 1348.
- For Type TF fusing, use only Class CC non-rejection fuses on the primary.
- If high voltage transients are possible, use appropriate surge suppression.

PROTECCION

- Utilice los fusibles o interruptores automáticos necesarios para cumplir con los requisitos del artículo 450 del NEC así como con otras normas y códigos correspondientes.
- Para las recomendaciones de fusibles, utilice el sistema de "fax en demanda" de Square D. Marque el 1-800-557-4556. Introduzca la información que se le pide y solicite el código de documento 1348.
- Para los fusibles tipo TF, utilice sólo fusibles sin rechazo clase CC en el primario.
- Utilice supresores de transitorios apropiados si existe la posibilidad de sobretensiones transitorias.

PROTECTION

- Utiliser les fusibles ou les disjoncteurs conformément à l'article 450 du NEC et à tout autre code ou norme applicable.
- Pour les recommandations de fusible, utiliser le système «fax sur demande» de Square D. Composer le 1-800-557-4556. Suivre les invites et demander le code du document 1348.
- Pour les fusibles de type TF, utiliser seulement les fusibles sans reject de classe CC sur le primaire.
- Si des tensions transitoires élevées sont possibles, utiliser une suppression de surtension appropriée.

ACCESSORIES

- To meet European Normalized (EN) Standards, use terminal covers (not included). Contact Square D at 414-426-8040 for accessory information.

ACCESORIOS

- Para cumplir con las normas europeas (EN), utilice las cubiertas de terminales (no provistas). Comuníquese a las oficinas de Square D al 414-426-8040 para obtener información sobre los accesorios.

ACCESSOIRES

- Pour satisfaire aux normes européennes (NE), utiliser des couvercles de bornes (non fournis). Contacter Square D au 414-426-8048 pour obtenir des informations concernant les accessoires.

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SQUARE D

TRANQUELL® Secondary Surge Arresters and Protective Capacitor

120-650 Volt AC

Assures Service Continuity

The GE TRANQUELL secondary arrester is specifically designed to protect utility, agricultural, and industrial installations and equipment in the 120-650 volt range from overvoltages caused by lightning discharges. It is available for both single- and three-phase application.

Among applications which provide ideal installations for this arrester are:

- Exposed secondary circuits
- Watthour meters
- Service entrances
- Station auxiliary equipment and circuits

TRANQUELL Secondary Arresters — Indoor or Outdoor Mounting

Circuit Voltage Rating RMS	Max. Permissible Line-to-Ground Voltage RMS	No. of Poles	Model No.	List Price Each \$0-24 0	Net Weight		Figure Number
					Lbs	Kg	

For Knockout or Bracket Mounting

120	175	2	9L15FCB001 Ⓞ	\$35.00	1.0	0.4	1
650	650	1	9L15ECC001 Ⓞ	\$8.00	1.0	0.4	1
		2	9L15ECB001 Ⓞ	\$1.80	1.0	0.4	1
		3	9L15ECC001 Ⓞ	\$2.85	1.0	0.4	1

Secondary Arrester Protective Characteristics

IR Discharge Voltage kV Crest (8 x 20 Microsecond Current Wave)				Discharge Capability 8 x 20 (microsecond)	Energy Handling Capability
At 1500 Amp	At 6000 Amp	At 10,000 Amp	At 20,000 Amp		
2.2	2.6	2.9	3.6	20,000 Amp	600 Joules per pole

(Non-PCB) Secondary Protective Capacitors — Indoor or Outdoor Mounting

650	650	3	9L16BBB001	\$88.00	4.00	1.9	2
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- Ⓞ Quantity break pricing applies; consult factory or your GE sales representative.
- Ⓞ These units have Underwriters Laboratories, Inc. listing and Canadian Standards Association certification.

Dimensions

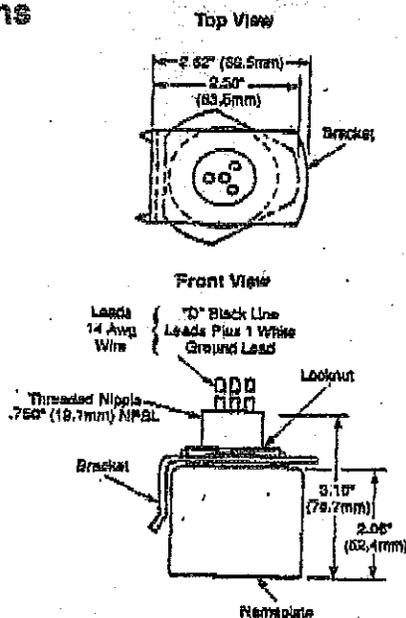


Fig. 1. TRANQUELL Arrester

- Motors and control circuits
- Distribution transformer secondaries

Fusing

To minimize the possibility of violent rupture in the unlikely event of electrical failure of the arrester, current limiting fuses are recommended for all applications above 120 volts. A fuse must be installed in series with each pole of the arrester (i.e. each black wire). See Fuse Selection table below. The GEH-4982C instruction book shipped with each arrester also includes fusing guidelines.

Fuse Selection—For 9L15E Series (above 120V)

Arrester Location	Maximum Lightning Impulse See Notes Ⓞ & Ⓞ	Fuse Rating See Note Ⓞ
A Long Branch Circuit: more than 20 m from Service Entrance with wires # 14-10	200A	30 A; 600 V U.L. Class T 200,000 A Interrupt
B Major Feeders and Short Branch Circuits less than 20 m from Service Entrance	3 kA 8x20 μs	30 A; 600 V U.L. Class T 200,000 A Interrupt
C Outside and Service Entrance	10 kA 4x10 μs	30 A; 600 V U.L. Class T 200,000 A Interrupt

Notes:

- Ⓞ Maximum impulse expected as described in ANSI/IEEE C62.41-1980 for systems with medium exposure to surges. Arresters have been design tested to impulses as high as 20 kA, 8x20 μs.
- Ⓞ Design tests for secondary arresters as required by ANSI/IEEE C62.11-1987 are limited to a maximum of 10 kA, 4x10 μs impulses.
- Ⓞ U.L. Class CC (Midget) 30 A fuses are also satisfactory for locations A & B.

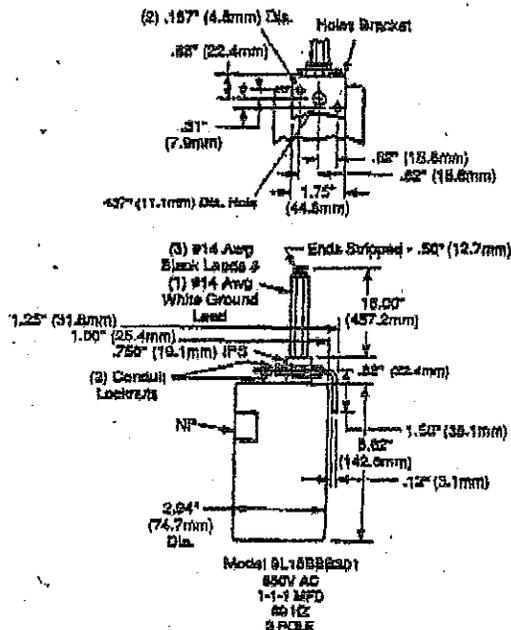


Fig. 2. Protective Capacitor

Note: Secondary capacitor is a 3-pole device that can be applied with 1- and 3-pole arresters by connecting the corresponding black leads and tying off the unused leads.

Dennis



Commercial/Industrial Hardwired Surge Devices

Applications/Features

- Designed for installation on main and sub-pencils up to 1000 amp capacity
- For application associated with Category "B" locations
- Provides protection between line-line, line-neutral, line-ground and neutral-ground
- Fail short design ensures unit will disconnect from electrical source
- Install on a 30 or 40 amp circuit breaker
- LED indicator for each phase provides surge protection status
- Housed in a metal NEMA 12 enclosure
- 30" color coded 10 gauge wire leads
- Bracket included for foot mounting
- 5 year product warranty
- \$15,000 connected equipment warranty



IG2083LYH



IG4803LYH

From Down VCES

IG1201LH

- 120V single phase
- 2 wire plus ground
- NEMA 12 enclosure

IG2403LDH

- 120/240V 3 phase
- High Leg Delta
- 4 wire plus ground
- Foot mounted NEMA 12 enclosure

IG2401LH

- 120/240V single phase
- 3 wire plus ground
- Foot mounted NEMA 12 enclosure

IG4803LYH

- 277/480V 3 phase WYE
- 4 wire plus ground
- Foot mounted NEMA 12 enclosure

IG2083LYH

- 120/208V 3 phase WYE
- 4 wire plus ground
- Foot mounted NEMA 12 enclosure

IG4803LDH

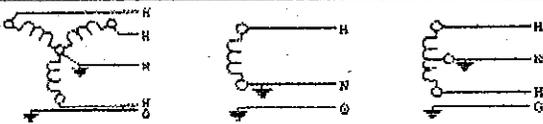
- 480V 3 phase Delta
- 3 wire plus ground
- Foot mounted NEMA 12 enclosure

IG1FMP-H

- Flushmount plate for all models

See page 14 for IEEE Location Categories

Wiring Diagrams



120/208 V
4 wire plus
Ground 208
Wye 3 Phase

120 V plus
Ground 120 V
Single Phase

120/240 V
3 wire plus
Ground

Model	Service Voltage	Maximum Continuous Operating Voltage	Phases	Number of 30" Leads	Wire Configuration	Protection Modes	Maximum Inlet Rating (per Phase / Total System)	Maximum Surge Current (per Phase / Total System)	Volt/Minute Limiting Voltage (200 V)	UL 1449	UL 1449
IG1201LH	120	150	1	3	L, N, G	3	960 / 960	39,000 / 39,000	415	Yes	Yes
IG2401LH	120 / 240	150 / 275	1	4	L1, L2, N, G	6	1,520 / 2,160	52,000 / 78,000	394	Yes	Yes
IG2083LYH	120 / 208	150 / 250	3	5	L1, L2, L3, N, G	10	2,000 / 3,000	65,000 / 130,000	414	Yes	Yes
IG2403LDH	120 / 240	150 / 275	3	5	L1, L2, L3, N, G	10	2,080 / 4,320	65,000 / 130,000	414	Yes	Yes
IG4803LYH	277 / 480	320 / 550	3	5	L1, L2, L3, N, G	10	3,200 / 6,560	65,000 / 130,000	798	Yes	Yes
IG4803LDH	480	550	3	4	L1, L2, L3, G	6	3,200 / 7,200	52,000 / 117,000	1233*	Yes	Yes

25-99

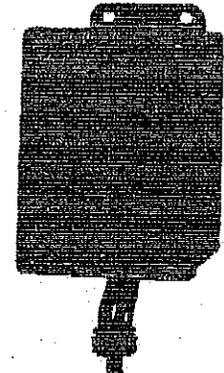
*L-G

Surge Protection Devices

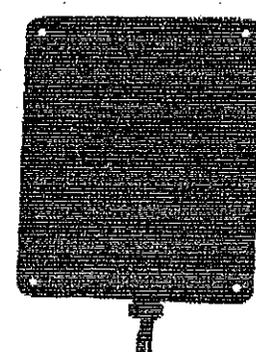
Enhanced Commercial Industrial Hardwired Surge Devices

Applications/Features

- Designed for installation on disconnect switches, main and sub-panels up to 2000 amp capacity
- For applications associated with Category "B" and "C" locations
- Dual components provide twice the protection of a comparable "LH" model listed previously
- Internal fuse(s) eliminate circuit breaker requirement for installation
- Install downstream from a 400 amp maximum breaker or fuses
- 100,000 amp interrupting capacity fuse for each phase
- Provides protection between line-line, line-neutral, line-ground and neutral-ground
- LED indicator for each phase provides surge protection status
- 30" color coded 10 gauge wire leads
- Housed in a metal NEMA 12 enclosure with brackets for mounting
- 5 year product warranty
- \$20,000 connected equipment warranty



IG2403DEH



An easy-to-use adapter plate is available for flush mounting of all "LH" and "EH" Series Protectors. Order part number IG1FMP-H

IG1201EH

- 120V single phase, 2 wire plus ground
- NEMA 12 enclosure

IG2403DEH

- 120/240 V 3 phase High Leg Delta, 4 wire plus ground
- Foot-mounted NEMA 12 enclosure

IG2401EH

- 120/240V single phase, 3 wire plus ground
- Foot-mounted NEMA 12 enclosure

IG4803YEH

- 277/480V 3 phase WYE, 4 wire plus ground
- Foot mounted NEMA 12 enclosure

IG2083YEH

- 120/208V 3 phase WYE, 4 wire plus ground
- Foot-mounted NEMA 12 enclosure

IG4803DEH

- 480V 3 phase Delta, 3 wire plus ground
- Foot-mounted NEMA 12 enclosure

IG1FMP-H

- Flushmount plate for all Commercial/Industrial models

See page 14 for IEEE Location Categories

Wiring Diagrams

120/240 V 4 wire w/N plus Ground
240 Delta 3 Phase

277/480 V 4 wire plus Ground
480 Wye 3 Phase

480 V 3 wire plus Ground
480 Delta 3 Phase

Model	Service Voltage	Maximum Continuous Operating Voltage	Phase	Number of Poles	Wire Configuration	Protection Modes	Maximum Bolt Rating per Phase / Bolt System	Maximum Surge Current per Phase / Bolt System	Approximate Clamping Voltage (1.0s)	UL 1449	UL 1449
IG1201EH	120	150	1	3	L, N, G	3	1,920 / 1,920	78,000 / 78,000	419	Yes	Yes
IG2401EH	120 / 240	150 / 275	1	4	L1, L2, N, G	6	3,040 / 4,320	104,000 / 136,000	375	Yes	Yes
IG2083YEH	120 / 208	150 / 250	3	5	L1, L2, L3, N, G	10	4,000 / 7,600	130,000 / 260,000	392	Yes	Yes
IG2403DEH	120 / 240	150 / 275	3	5	L1, L2, L3, N, G	10	4,160 / 8,640	130,000 / 260,000	386	Yes	Yes
IG4803YEH	277 / 480	320 / 550	3	5	L1, L2, L3, N, G	10	6,400 / 13,120	130,000 / 260,000	791	Yes	Yes
IG4803DEH	480	550	3	4	L1, L2, L3, G	6	6,400 / 14,400	104,000 / 234,000	1194*	Yes	Yes

Class 9001 - Type K, SK and KX, 30mm Contact Blocks

The Class 9001 Type KA contact blocks have been improved. The most noticeable change is that the terminals are FINGERSAFE® contact blocks (meeting VDE 0106 Part 100). They also have one screw mounting and captive backed out plus/minus terminal screws. These contact blocks are double break direct acting contacts. Because of the wiping action of these contacts, they are suitable for use with programmable controllers. All contact blocks listed below will accept up to 2 #12-#24 AWG solid or stranded wires. Recommended tightening torque for screw terminals is 7 inch-lbs.

Standard Contact Blocks

Description	Symbol	Type	Price
(Clear Cover)		KA1	\$19.
(Green Cover)		KA2	9.50
(Red Cover)		KA3	9.50
(Clear Cover)	 N.O. Contact Early Closing	KA4	19.
(Red Cover)	 N.C. Contact Late Opening	KA5	9.50
(Green Cover)	 N.O. Contact Early Closing	KA6	9.50

Symbol	Contact Blocks With Blinder Head Screws (not Fingersafe)		Price	Gold Flashed Contacts With Standard Pressure Wire Terminals	
	Type	Quantity		Type	Price
	KA21	25-Up ▲	\$19.	KA31	\$31.70
	KA22	25-Up ▲	9.50	KA32	15.80
	KA23	25-Up ▲	9.50	KA33	15.80
	KA24	25-Up ▲	19.	KA34	31.70
	KA25	25-Up ▲	9.50	KA35	15.80

▲ Minimum order quantity is 25. The price represents one individual contact block.

Contact Blocks Listed Below Are Not Fingersafe®, But Provide:

- Terminals that accept ring tongue/fork tongue connectors
- Short single circuit contact blocks (.75" deep vs. .97" deep on the Fingersafe)
- Same as old style Series G product available prior to March, 1989.
- Use form Y238 (add to catalog # as suffix - Example: 9001KRU1H13Y238)



Symbol	Type	Price	Symbol	Type	Price
	KA1G	\$19.		KA4G	\$19.
	KA2G	9.50		KA5G	9.50
	KA3G	9.50		KA6G	9.50

Additional Circuit Arrangements Available

Sequencing * N.O. Contact of KA4 closes before N.O. Contact on KA1		Order One Type KA4 and One Type KA1	\$38.
Overlapping * N.O. Contact of KA4 closes before N.C. Contact of KA5 Opens		Order One Type KA4 and One Type KA5	29.50

Contact Blocks Listed Below Are Not Fingersafe®, Have "Quick Connect" Terminals.

Symbol	Type	Price
	KA12	\$15.80
	KA13	15.80

* For push buttons or two position selector switches (Types K or SKS11, K or SKS12, K or SKS25, K or SKS34, K or SK11J, K or SK12J, K or SK25J and K or SK34J) only. For sequencing or overlapping contacts on other operators — consult local Square D Sales Office.

Dimensions

Maximum Current Ratings For Control Circuit Contacts — Types KA1-KA6, KA21-25, KA31-35, KA1G-KA6G

Volts	AC					Relative 75% Power Factor Make, Break and Continuous Amperes	Volts	DC				
	Inductive (NEMA Type A600) 35% Power Factor							Inductive and Resistive (NEMA Type P600)				
	Make		Break		Continuous Carrying Amperes			Make and Break				Continuous Carrying Amperes
Amperes	VA	Amperes	VA	KA1		KA2 KA3	KA4	KA5 KA6				
120	60	7200	6.0	720	10	10	1.1	1.1	1.1	1.1	10	
240	30	7200	3.0	720	10	10	0.55	0.55	—	0.55	10	
480	15	7200	1.5	720	10	10	0.2	0.2	—	0.2	10	
600	12	7200	1.2	720	10	10	—	—	—	—	10	

For additional information, reference: Catalog Number 9001CT9701 or D-Fax™ #1548.

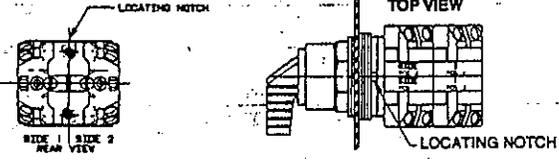
Class 9001 - Type K, SK and KX, 30mm Contact Block "H" Numbers

Suffix No. (Add to Operator Type No.)	Price	Positions					
		1	2	3	4	5	6
H1	\$ 18.	KA1					
H2	38.	KA1	KA1				
H3	57.	KA1	KA1	KA1	KA1		
H4	76.	KA1	KA1				
H5	9.50	KA2					
H6	9.50	KA3					
H7	19.	KA2	KA2				
H8	19.	KA3	KA3				
H9	38.	KA4	KA1				
H10	28.50	KA4	KA5				
H11	57.	KA1	KA1				
H12	38.	KA2	KA3	KA2	KA1	KA3	
H13	19.		KA1				
H14	9.50		KA3				
H15	28.50	KA2	KA3	KA2			
H16	28.50	KA2	KA3		KA3		
H17	47.50	KA1	KA1	KA2	KA3		
H18	47.50	KA3	KA1	KA3		KA3	KA1
H19	95.	KA1	KA1	KA1	KA1		
H21	19.	KA2	KA3				
H23	114.	KA1	KA1	KA1	KA1	KA1	KA1
H24	28.50	KA1	KA2				
H25	19.	KA5	KA3				
H26	57.	KA1	KA1	KA4	KA3		
H27	28.50	KA3	KA3				
H28	28.50	KA1	KA3				
H29	95.	KA1	KA4	KA1	KA5	KA1	KA3
H31	38.	KA2	KA2	KA1			
H32	38.	KA1	KA1				
H33	38.	KA1	KA3	KA3	KA1		
H34	28.50	KA5	KA1				
H36	9.50		KA2				
H37	19.	KA3	KA2				
H38	38.	KA3	KA2	KA3	KA2		
H39	38.	KA5	KA1		KA3	KA3	
H40	57.	KA1	KA1		KA4	KA4	
H41	28.50	KA3	KA2		KA2	KA2	
H42	57.	KA1	KA1	KA2			
H43	28.50	KA2	KA2	KA2			
H44	28.50	KA3	KA2		KA3		
H45	47.50	KA1	KA2	KA3	KA2		
H46	28.50	KA2	KA2		KA2		
H47	57.	KA5	KA3	KA3	KA5	KA3	KA3
H48	76.	KA1	KA1	KA4	KA4		
H50	39.	KA5	KA3	KA3			
H51	39.	KA5	KA3		KA3		
H52	39.	KA3	KA1	KA3	KA3		
H53	28.50	KA4	KA2				
H54	38.	KA4	KA5	KA2			
H55	57.	KA1	KA2	KA2			
H56	39.	KA2	KA2	KA2			
H57	28.50	KA5	KA4		KA2	KA1	
H58	9.50		KA5				
H59	47.50	KA1	KA2	KA1			
H60	57.	KA1	KA2	KA1			
H61	39.	KA2	KA2	KA5			
H62	39.	KA1	KA2	KA3	KA5	KA3	
H63	28.50	KA1	KA3	KA3			
H64	28.50	KA3	KA2	KA2			
H66	57.	KA3	KA1	KA3	KA1		
H71	38.	KA3	KA3	KA3	KA3		
H72	19.	KA3	KA5				
H73	47.50	KA1	KA1	KA3			
H74	47.50	KA1	KA2	KA5	KA5		
H75	57.	KA1	KA3	KA3	KA3	KA3	
H76	57.	KA1	KA2	KA2	KA2	KA2	
H77	39.	KA1		KA1			
H78	39.	KA1	KA2		KA5		
H79	28.50	KA3	KA3		KA5		
H80	57.	KA4	KA4	KA5	KA5		
H81	57.	KA1	KA1	KA2	KA3		
H82	63.	KA12	KA12	KA13	KA13		
H83	31.70	KA35	KA33				
H86	28.50	KA3	KA2	KA3			
H87	47.50	KA3	KA2	KA3	KA2	KA3	
H89	28.50	KA3	KA1				
H90	66.50	KA1	KA1	KA3	KA3	KA3	
H91	57.	KA1	KA2	KA1	KA2	KA3	
H92	57.	KA1	KA2	KA1	KA2	KA3	
H93	57.	KA3	KA2	KA3	KA5	KA3	KA3
H94	85.50	KA1	KA1	KA1	KA3	KA3	KA3
H95	28.50	KA2	KA1				
H97	39.	KA1	KA3		KA2		
H98	76.	KA1	KA1	KA1	KA2		KA2
H99	47.50	KA2	KA2	KA2	KA2		
H100	57.	KA1	KA3	KA1	KA2	KA2	KA2
H101	57.	KA2	KA2	KA2	KA2	KA2	KA2
H102	39.	KA1	KA3		KA3		
H103	57.	KA1	KA1	KA3	KA3		
H104	85.50	KA1	KA1	KA1	KA2	KA2	KA2
H105	31.70	KA31					
H106	83.	KA31	KA31				
H107	29.	KA3	KA2	KA5			
H109	28.	KA3	KA3	KA2	KA3	KA3	KA3
H110	57.	KA3	KA3	KA3	KA4		
H111	86.50	KA4	KA4	KA4	KA5		
H112	31.70	KA33	KA33				
H113	47.50	KA1	KA1	KA5			
H114	19.	KA21					

The design of the Class 9001 Type KA contact blocks allows them to be mounted side by side and/or in tandem.

The system illustrated below has been set up to enable an operator and a particular arrangement of contact blocks to be specified by a single type number. Operators and contact blocks will be shipped completely assembled.

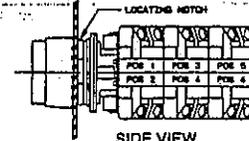
EXAMPLE: A Type KR1B push button with 2 Type KA1 contact blocks would be Class 9001 Type KR1BH2.



For Types K and SK



FRONT VIEW



SIDE VIEW

For Type KX

Suffix No. (Add to Operator Type No.)	Price	Positions					
		1	2	3	4	5	6
H115	\$ 47.50	KA3	KA1	KA5	KA3		
H118	47.50	KA3	KA1	KA3	KA2	KA2	
H117	57.	KA2	KA3	KA1			
H118	28.50	KA1	KA5				
H119	57.	KA1	KA1	KA5	KA3		
H120	38.	KA3	KA4	KA3			
H121	38.	KA3	KA3	KA3			
H122	38.	KA1	KA3				
H124	19.		KA3		KA3		
H125	28.50	KA5	KA5	KA3			
H126	19.	KA42					
H127	19.	KA43					
H128	38.	KA41					
H129	19.	KA2		KA2			
H130	28.50	KA2	KA3		KA2		
H131	28.50	KA2		KA3		KA2	
H132	38.	KA2	KA2	KA3	KA3		
H133	19.	KA3		KA2	KA3		
H134	38.	KA3	KA3	KA2	KA2	KA2	
H135	38.	KA3	KA2	KA2	KA2	KA2	
H136	19.	KA3		KA5			
H137	152.	KA45	KA45	KA4	KA44		
H138	28.50	KA3	KA3		KA2		
H139	19.	KA5	KA5				
H140	38.	KA44					
H141	38.	KA43	KA43				
H142	76.	KA1	KA1				
H143	38.	KA3	KA1	KA41			
H144	38.		KA5	KA5			
H145	63.	KA51			KA4		
H146	69.	KA53	KA52				
H147	44.50	KA53					
H148	126.	KA51	KA51				
H152	38.	KA1	KA2		KA2		
H153	133.	KA53	KA52	KA53			
H154	28.50	KA4	KA5				
H155	47.50	KA42	KA43	KA2			
H156	95.	KA1	KA1	KA1	KA1	KA2	KA2
H157	47.50	KA1	KA1	KA1	KA1	KA2	KA2
H158	47.50	KA1	KA2	KA3	KA3	KA3	KA3
H159	57.	KA1	KA1	KA3	KA2		
H161	44.50	KA52					
H162	19.	KA2		KA5			
H163	38.	KA5		KA4	KA4		
H164	76.	KA5	KA5				
H165	63.	KA55					
H166	19.	KA22					
H167	9.50	KA23	KA22				
H168	9.50	KA22	KA22				
H170	190.	KA54	KA51		KA51		
H171	108.	KA53	KA51				
H172	19.	KA23	KA23				
H173	126.	KA54	KA51				
H174	57.	KA1	KA3	KA1	KA3	KA5	
H175	38.	KA6	KA2	KA5	KA5		
H176	19.	KA4					
H177	28.50	KA3	KA4		KA3		
H178	28.50	KA3					
H179	107.60	KA53	KA55				

*H Numbers not shown in their sequence are no longer used.

For additional information, reference Catalog Number 9001CT9701 or D-Fax™ #1548.

15 PUSH BUTTONS AND OPERATOR INTERFACE

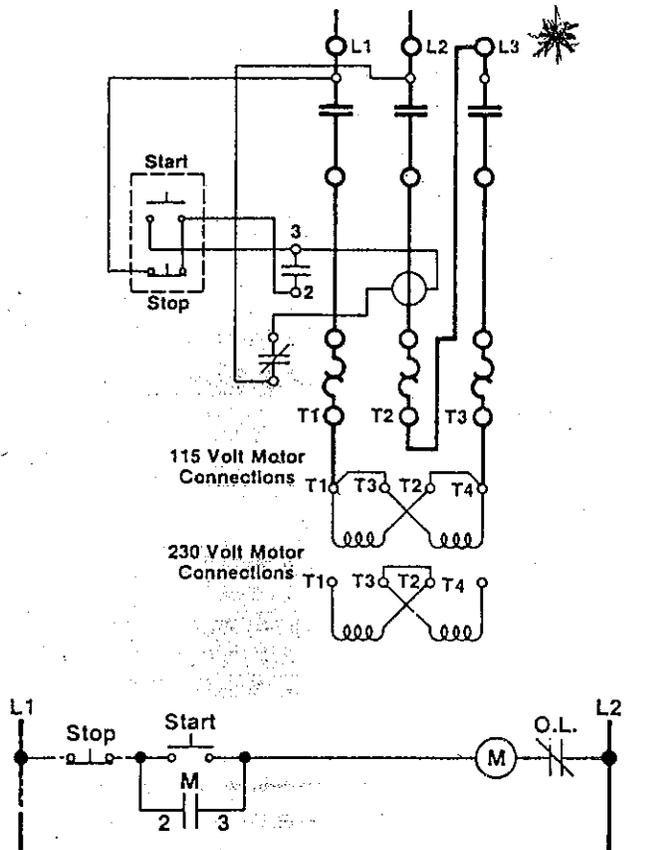




Single Phase Using Standard 3-Phase Starters

Sizes 0, 1, 2, 3, & 4

Standard wiring with START-STOP push button station.



Variations with START-STOP Stations

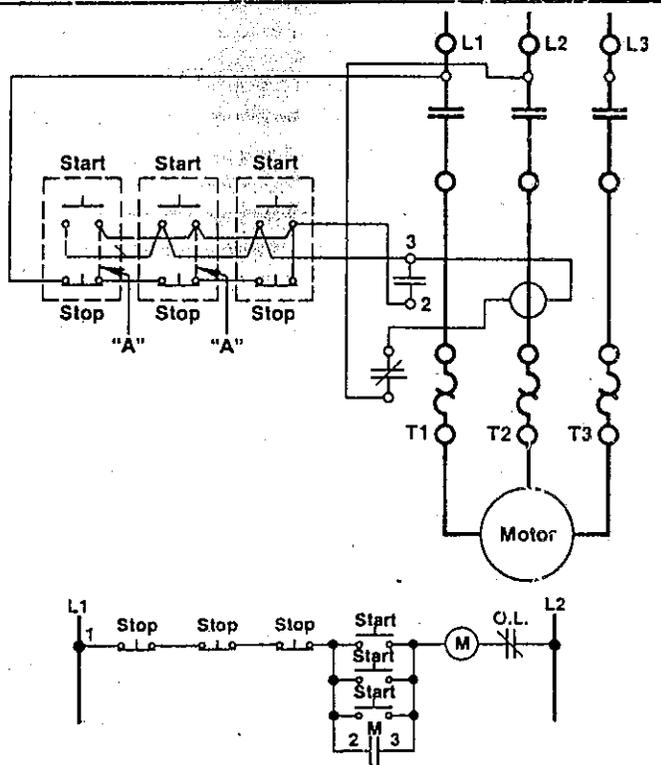
More Than One START-STOP Station Used to Control a Single Starter

This is a useful arrangement when a motor must be started and stopped from any of several widely separated locations.

Notice that it would also be possible to use only one "START-STOP" station and have several "STOP" buttons at different locations to serve as emergency stops.

Standard duty "START-STOP" stations are provided with the connections "A" shown in the adjacent diagram. This connection must be removed from all but one of the "START-STOP" stations used.

Heavy duty and oillight push button stations can also be used but they do not have the wiring connection "A", so it must be added to one of the stations.



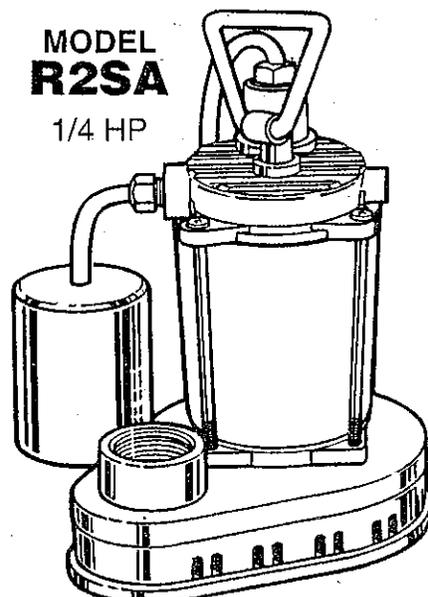
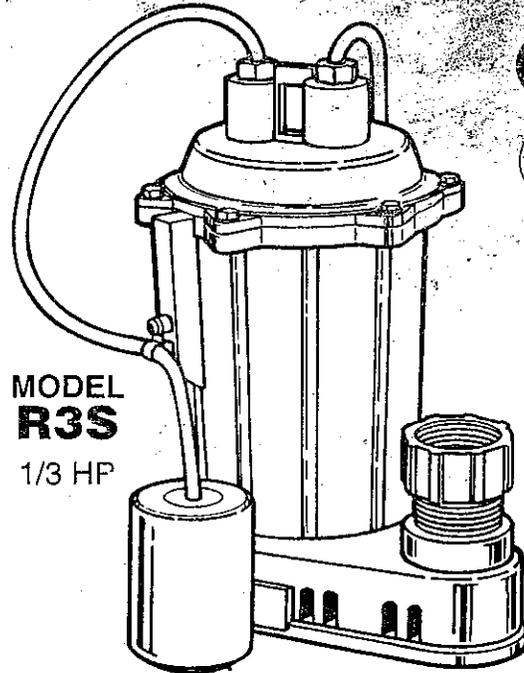
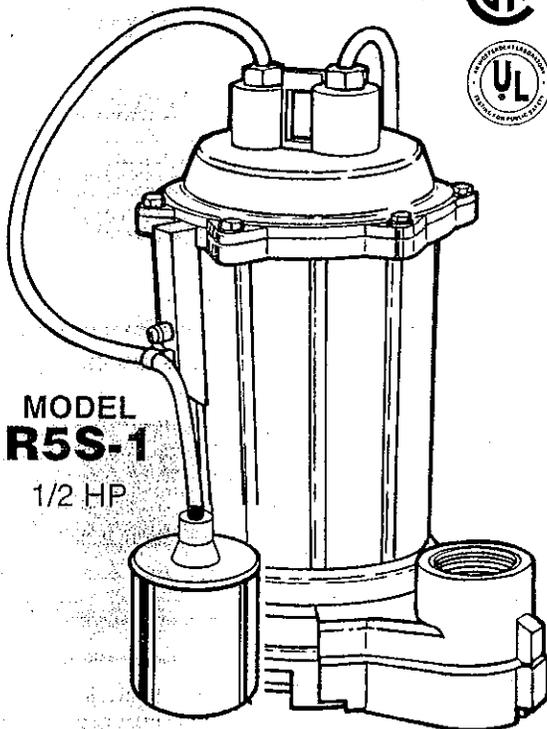
Appendix O
Ancillary Equipment



INSTALLATION MANUAL

SUBMERSIBLE SUMP PUMPS

CONSUMER HOT-LINE: 1-800-942-3343 • MONDAY - FRIDAY • 7 AM to 5 PM EASTERN STANDARD TIME



WARRANTY: PRODUCT DEFECTS COVERED 12 MONTHS FROM DATE OF PURCHASE OR 18 MONTHS FROM DATE OF MANUFACTURE, WHICHEVER COMES FIRST. RECEIPT AND PRODUCT DATE CODE REQUIRED FOR WARRANTY CLAIM.

IMPORTANT INSTRUCTIONS BEFORE INSTALLATION

Failure to follow these instructions may cause serious bodily injury and/or property damage.

WARNING, risk of electric shock – This pump is supplied with a grounding conductor and grounding-type attachment plug. To reduce the risk of electric shock, be certain that it is connected only to a properly grounded, grounding-type receptacle. This pump has not been investigated for use in swimming pool areas. **DO NOT WORK ON PUMP UNTIL POWER IS UNPLUGGED.** DO NOT cut off ground pin or use an adapter fitting. DO NOT use an extension cord. The pump power cord should be connected to a separately fused, grounded 115 volt line with a minimum capacity of 15 amps. **NEVER** touch the pump when it is connected to electrical power.

1. Before installing or servicing your pump, BE CERTAIN pump power source is disconnected.
2. Installation and electrical wiring must adhere to state and local codes and must be complete before priming pump. Check appropriate community agencies, or contact local electrical and pump professionals.
3. **CALL AN ELECTRICIAN WHEN IN DOUBT.** Pump should be connected to a separate 15 amp circuit breaker or 15 amp fuse block. Plugging into existing outlets may cause low voltage at motor, causing blown fuses, tripping of motor overload, or burned out motor.
4. A permanent ground connection from pump to the grounding bar at the service panel is mandatory. Water Ace sump pumps come with a grounding conductor and a grounding-type attachment plug. Do not connect pump to a power supply until permanently grounded. For maximum safety, ground pump to a circuit equipped with a fault interrupter device.

5. Voltage of power supply must match the voltage of the pump. All Water Ace sump pumps are factory preset to 115V, 60 Hz.

6. Before installing pump, clear sump basin of any water, debris, or sediment. **WARNING: Sump basin must be vented in accordance with local plumbing codes.**

Water Ace sump pumps are not designed for and CANNOT be installed in locations classified as hazardous in the National Electric Code, ANSI/NFPA 70.

7. The sump basin should be between 14" and 18" in diameter and made of plastic, fiberglass, or concrete.

8. The following may cause severe damage to pump and will void warranty:

- Using an extension cord.
- Cutting off the ground pin or using an adapter fitting.
- Working on pump or switch while plugged in.
- Removing motor housing, unscrewing impeller, or otherwise removing impeller seal.
- Running the pump continuously.
- Pumping chemicals or corrosive liquids.
- Pumping gasoline or other flammable liquids.

PIPING

Plastic PVC pipe is shown in the illustrations, but drain hose, galvanized steel or copper pipe may be used if desired. All piping must be clean and free of all foreign matter to prevent clogging. Use thread compound on all threaded joints unless specified otherwise.

SUBMERSIBLE SUMP PUMP INSTALLATION

Refer to the installation illustration on the following page for the following instructions. Be certain sump basin is clean and all power to pump is shut off. If pump fails to operate properly after installation, refer to the troubleshooting checklist on page 4 or contact Water Ace. All parts with part numbers are quality Water Ace parts.

General Materials Needed

- One can PVC cement (read instructions carefully)
- One can thread compound (read instructions carefully)
- One male PVC adapter: 1-1/4" for R2SA, 1-1/2" for R3S and R5S-1 (adapter included with R3S).
- Enough rigid PVC pipe and couplings or Drain Hose Kit #RSK to reach from bottom of R3S sump basin to discharge: 1-1/4" for R2SA, 1-1/2" for R5S-1.
- One Check Valve #RCV-12S used with PVC pipe (per drawing on page 3) or use Drain Hose Kit #RSK with Check Valve #RCV-120P (not shown).

Tools Needed for all pump installations

Pipe wrench, slot screwdriver, 24-tooth hacksaw, knife or round file.

STEP 1 Thread male PVC adapter into pump discharge opening (1-1/4" for R2SA, 1-1/2" for R3S and R5S-1).

STEP 2 Cement a 15" piece of PVC pipe to adapter. Use appropriate diameter piping. Drill a 1/8" relief hole in the pipe 5" above pump connection. This hole prevents pump from air-locking.

STEP 3 Clamp Check Valve #RCV-12S to top of 15" PVC pipe with water flow arrow pointing away from pump.

STEP 4 Lower pump into basin. Clamp needed PVC discharge pipe and fittings to open end of Check Valve #RCV-12S.

STEP 5 Fill sump basin with water and plug in pump. Pump should turn on at approximate water levels shown on page 3. Perform several ON-OFF cycles to assure satisfactory operation.

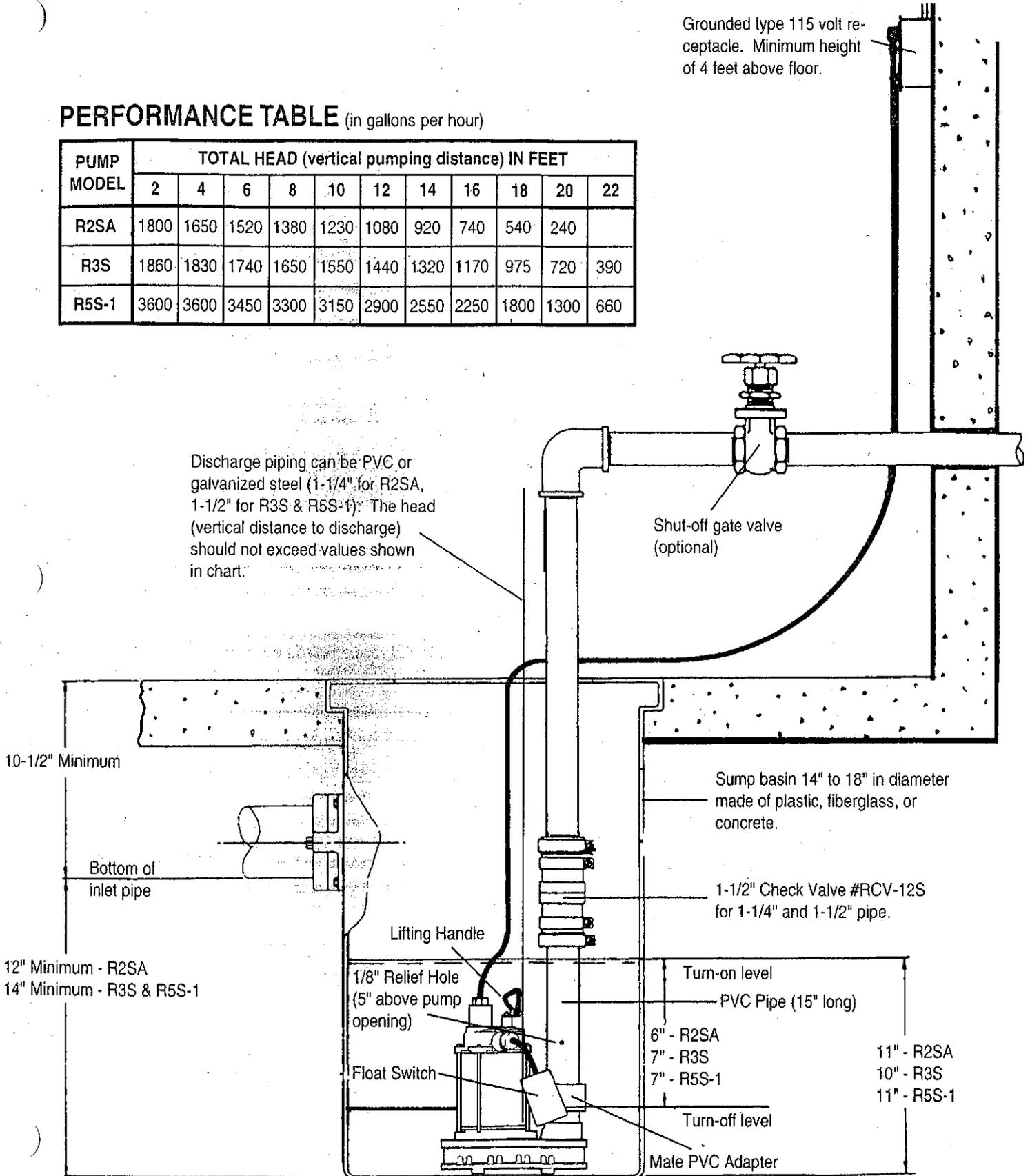
COMPLETE PUMP INSTALLATION

PERFORMANCE TABLE (in gallons per hour)

PUMP MODEL	TOTAL HEAD (vertical pumping distance) IN FEET										
	2	4	6	8	10	12	14	16	18	20	22
R2SA	1800	1650	1520	1380	1230	1080	920	740	540	240	
R3S	1860	1830	1740	1650	1550	1440	1320	1170	975	720	390
R5S-1	3600	3600	3450	3300	3150	2900	2550	2250	1800	1300	660

Grounded type 115 volt receptacle. Minimum height of 4 feet above floor.

Discharge piping can be PVC or galvanized steel (1-1/4" for R2SA, 1-1/2" for R3S & R5S-1). The head (vertical distance to discharge) should not exceed values shown in chart.



LIMITED WARRANTY

WATER ACE PUMP CO. will repair or replace for the original user any portion of a new Water Ace product which proves defective due to materials or workmanship of WATER ACE PUMP CO. WATER ACE PUMP CO. shall possess the sole right to determine whether to repair or replace defective equipment, parts or components. THIS WARRANTY DOES NOT COVER DAMAGE DUE TO LIGHTNING OR OTHER CONDITIONS BEYOND THE CONTROL OF WATER ACE PUMP CO.

PUMPS: Warranted 12 months from date of purchase or 18 months from date of manufacture, whichever occurs first. Receipt and product date code required for warranty claim.

LABOR & COSTS: WATER ACE PUMP CO. shall IN NO EVENT be liable for the cost of field labor or other charges incurred by any customer in removing and/or reaffixing any WATER ACE PUMP product, part or component.

THIS WARRANTY WILL NOT APPLY: (a) to defects or malfunctions resulting from failure to properly install, operate, or maintain the unit in accordance with printed instructions provided; (b) to failures resulting from abuse, accident, or negligence; (c) to normal maintenance services and the parts used in connection with such service; (d) to units which are not installed in accordance with applicable local codes, ordinances, and good trade practices; (e) if the unit is moved from its original installation location; (f) if unit is used for purposes other than for what it was designed and manufactured.

PRODUCT IMPROVEMENTS: WATER ACE PUMP CO. reserves the right to change or improve its products or any component without obligation to provide such a change or improvement for units previously sold and/or shipped.

WARRANTY EXCLUSIONS: After the expiration of this warranty period, THERE WILL BE NO WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE ON ANY SPECIFIC WATER ACE PUMP PRODUCT. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. No warranties or representations at any time made by any representative of WATER ACE PUMP CO. shall vary or expand the provisions hereof.

LIABILITY LIMITATION: IN NO EVENT SHALL WATER ACE PUMP CO. BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES RESULTING FROM OR RELATED IN ANY MANNER TO ANY WATER ACE PUMP PRODUCT OR PARTS. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. This Warranty gives you specific legal rights. You may have other rights which vary from state to state. In the absence of suitable proof of purchase date, the effective date of this warranty will be based upon the date of manufacture plus 180 days.

Direct all notices, etc. to: Product Warranty and Return Dept., WATER ACE PUMP CO., 1101 Myers Parkway, Ashland, Ohio 44805-1969.



Water Ace Pump Co. • 1101 Myers Parkway • Ashland, Ohio 44805-1969

Appendix P
Correspondence, Vendors, Supply Receipts, Contact Information

Appendix Q
MSDS

PAGE 2
C-19
2 of 3

MATERIAL SAFETY DATA SHEET ACTIVATED CHARCOAL

SECTION 06 HEALTH HAZARD DATA

EFFECTS OF EXPOSURE...

ACTIVATED CARBON IS A NUISANCE PARTICULATE, AND THERE IS NO KNOWN HEALTH EFFECTS FROM EXPOSURE.

TLV...10 MG/M TOTAL DUST 5 MG/M RESPIRABLE NUISANCE PARTICULATE

SECTION 07 FIRST AID PROCEDURES AND PHYSICIAN NOTES

EXPOSURE...WASH WITH WATER TO REMOVE CARBON FROM SKIN.
EMERGENCY TREATMENT...WASH THE ACTIVATED CARBON FROM THE EYES AND SKIN.

SECTION 08 SPECIAL HANDLING INFORMATION

PROTECTIVE EQUIPMENT TYPES...
EYES...GOGGLES WITH SIDE SHEILDS HELPFUL IN DUSTY AREAS.
RESPIRATORY...PARTICULATE MASK HELPFUL IN EXTREMELY DUSTY AREAS.
GLOVES...NOT REQUIRED
OTHER...NONE
VENTILATION...
GENERAL MECHANICAL...NOT REQUIRED
LOCAL EXHAUST...HELPFUL TO MINIMIZE DUST CONDITIONS.

SECTION 09 SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

REGULATED IDENTIFICATION...
IT PROPER SHIPPING NAME...CARBON, ACTIVATED
SHIPPING ID NUMBER UN...1362 EXEMPTED FROM IMDG CODE 'P 4082-1'
DOT HAZARD CLASS...NOT REGULATED AS A HAZARDOUS MATERIAL BY DOT 'FR VOL. 48, NO. 22J'
EPA HAZARD WASTE CLASS...ONLY THOSE ACTIVATED CARBONS USED FOR THE TREATMENT OF EXPLOSIVE WASTE 'K045' OR VETERINARY PHARMACEUTICALS ARE SPECIFICALLY LISTED.
HEALTH...0
FLAMMABILITY...1
REACTIVITY...0
HANDLING AND STORAGE...
AVOID CONTACT WITH STRONG OXIDIZING MATERIALS AND HYDROCARBONS.
OTHER...
NEVER ENTER CONFINED SPACES CONTAINING WET, ACTIVATED CARBONS SINCE WET CARBONS WILL ADSORB OXYGEN AND ASPHYXIATION MAY RESULT.
KNOWN HAZARDS UNDER 29 CFR 1910.1200...
COMBUSTIBLE LIQUID...NO
FLAMMABLE MATERIAL...NO
PYROPHORIC MATERIAL...NO
EXPLOSIVE MATERIAL...NO
UNSTABLE MATERIAL...NO
WATER REACTIVE MATERIAL...NO
OXIDIZER...NO
ORGANIC PEROXIDE...NO
CORROSIVE MATERIAL...NO
COMPRESSED GAS...NO
IRITANT...NO
SKIN HAZARD...NO
EYE HAZARD...NO
TOXIC AGENT...NO
HIGHLY TOXIC AGENT...NO

TEXTILE CHEMICAL COMPANY POTTSVILLE PIKE & HULLER LANE READING, PA. 19603
TC PHONE#... 215-926-4151 TC MSDS#... 222 9/08/88 PAGE 3

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MATERIAL SAFETY DATA SHEET ACTIVATED CHARCOAL

SECTION 09 SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

SENSITIZER...NO
CARCINOGEN...NO
REPRODUCTIVE TOXIN...NO
BLOOD TOXIN...NO
NERVOUS SYSTEM TOXIN...NO
LUNG TOXIN...NO
LIVER TOXIN...NO
KIDNEY TOXIN...NO

SECTION 10 HAZARDOUS INGREDIENTS

HAZARDOUS INGREDIENTS...NONE

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MATERIAL SAFETY DATA SHEET ACTIVATED CHARCOAL

SECTION 01 IDENTIFICATION

FURNISHED BY..... WESTVACO CHEMICAL DIVISION
ADDRESS..... CARBON DEPARTMENT COVINGTON, VIRGINIA, VA. 24426
DATE EFFECTIVE..... NOVEMBER 1, 1985
CHEMICAL NAME/SYNONYMS... ACTIVATED CHARCOAL
CHEMICAL FAMILY..... CARBON, GROUP
EMERGENCY PHONE #..... 703-962-1121
PRODUCT OR TRADE NAME... ACTIVATED CARBON
CAS #..... 7440-44-0
CHEMICAL FORMULA..... C

SECTION 02 PHYSICAL DATA

BOILING POINT..... 8721 DEG F
% VOLATILE BY VOLUME..... N/A
VAPOR PRESSURE..... N/A
VAPOR DENSITY/AIR IS 1... N/A
SOLUBILITY IN WATER..... INSOLUBLE
APPEARANCE & COLOR..... BLACK GRANULAR OR POWDERED PRODUCT, ODDORLESS
EVAPORATION RATE..... N/A
PH OF WATER EXTRACT...4-8
WILL DISSOLVE IN...INSOLUBLE
VOLATILE COMPONENTS...N/A
IGNITION POINT IS...550-600 DEG F.

SECTION 03 FIRE AND EXPLOSION HAZARD DATA

FLASH POINT..... N/A *
IGNITION POINT...550-600 DEG F ASTM D 3466-76
FLAMMABILITY
LFL...N/A
UFL...N/A
EXTINGUISHING MEDIA...WATER FOG, FOAM, DRY CHEMICAL
SPECIAL PROCEDURES...REMOVE CARBON FROM BUILDING
UNUSUAL HAZARDS...CARBON MONOXIDE CAN RESULT FROM INCOMPLETE COMBUSTION.

SECTION 04 REACTIVITY DATA

STABILITY...STABLE.
CONDITIONS TO AVOID...AVOID CONTACT WITH STRONG OXIDIZING CHEMICALS SUCH AS PERMANGANATE, PERCHLORIC ACID, SODIUM CHLORITE AND HYDROCARBONS.
INCOMPATIBILITY 'MATERIALS TO AVOID'...STRONG OXIDIZING CHEMICALS AND HYDROCARBONS
HAZARDOUS DECOMPOSITION PRODUCTS...NONE
HAZARDOUS POLYMERIZATION...WILL NOT OCCUR
'MATERIALS TO AVOID'...STRONG OXIDIZING CHEMICALS AND HYDROCARBONS

SECTION 05 SPILL, LEAK AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN...WASH AREA WITH WATER HOSE AFTER REMOVING BULK MATERIAL BY NORMAL CLEANING PROCEDURES.
BEST DISPOSAL METHOD...LANDFILL OR INCINERATE.
.....N/A

SECTION 06 HEALTH HAZARD DATA



MATERIAL SAFETY DATA SHEET

MSDS No. 00719000
ENGLISH

1.0 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**PRODUCT NAME:** AMERICAN® INDUSTRIAL OIL NO. 68**MANUFACTURER/SUPPLIER:**Amoco Oil Company
200 East Randolph Drive
Chicago, Illinois 60601 U.S.A.**EMERGENCY HEALTH INFORMATION:**

1 (800) 447-8735

EMERGENCY SPILL INFORMATION:

1 (800) 424-9300 CHEMTREC (USA)

OTHER PRODUCT SAFETY INFORMATION:

(312) 856-3907

2.0 COMPOSITION/INFORMATION ON INGREDIENTS

<u>Component</u>	<u>CAS#</u>	<u>Range % by Wt.</u>
Hydrotreated heavy paraffinic distillate	64742-54-7	60-100

(See Section 8.0, "Exposure Controls/Personal Protection", for exposure guidelines)

3.0 HAZARDS IDENTIFICATION**EMERGENCY OVERVIEW:** This product has been evaluated and does not require any hazard warning on the label under OSHA criteria.**POTENTIAL HEALTH EFFECTS:****EYE CONTACT:** No significant health hazards identified.**SKIN CONTACT:** Prolonged or repeated contact may produce some skin irritation. High-pressure equipment can inject this product through the skin and cause severe damage.**INHALATION:** No significant health hazards identified.**INGESTION:** No significant health hazards identified.**HMIS CODE:** (Health:0) (Flammability:1) (Reactivity:0)**NFPA CODE:** (Health:0) (Flammability:1) (Reactivity:0)

4.0 FIRST AID MEASURES**EYE:** Flush eyes with plenty of water.**SKIN:** Wash exposed skin with soap and water. Get medical attention if irritation develops. Get immediate medical attention following injection injuries.**INHALATION:** If adverse effects occur, remove to uncontaminated area. Get medical attention.**INGESTION:** If a large amount is swallowed, get medical attention.

5.0 FIRE FIGHTING MEASURES

FLASHPOINT: 421°F(216°C) (minimum) (Cleveland open cup)

UEL: Not determined.

LEL: Not determined.

AUTOIGNITION TEMPERATURE: Not determined.

FLAMMABILITY CLASSIFICATION: Not Flammable.

EXTINGUISHING MEDIA: Agents approved for Class B hazards (e.g., dry chemical, carbon dioxide, foam, steam) or water fog.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None identified.

FIRE-FIGHTING EQUIPMENT: Firefighters should wear full bunker gear, including a positive pressure self-contained breathing apparatus.

HAZARDOUS COMBUSTION PRODUCTS: Incomplete burning can produce carbon monoxide and/or carbon dioxide and other harmful products.

6.0 ACCIDENTAL RELEASE MEASURES

Remove mechanically or contain on an absorbent material such as dry sand or earth. Keep out of sewers and waterways.

7.0 HANDLING AND STORAGE

HANDLING: No special requirements.

STORAGE: No special requirements.

8.0 EXPOSURE CONTROLS / PERSONAL PROTECTION

EYE: None required; however, use of eye protection is good industrial practice.

SKIN: Wear protective gloves if prolonged or repeated contact is likely.

INHALATION: None required; however, use of adequate ventilation is good industrial practice.

ENGINEERING CONTROLS: Control airborne concentrations below the exposure guidelines.

EXPOSURE GUIDELINES:

<u>Component</u>	<u>CAS#</u>	<u>Exposure Limits</u>
Hydrotreated heavy paraffinic distillate	64742-54-7	OSHA PEL: 5 mg/m ³ (oil mist) (1000)(1071) ACGIH TLV-TWA: 5 mg/m ³ (oil mist) ACGIH TLV-STEL: 10 mg/m ³ (oil mist)

9.0 CHEMICAL AND PHYSICAL PROPERTIES

APPEARANCE AND ODOR:	Oily liquid. Pale-yellow.
pH:	Not determined.
VAPOR PRESSURE:	Not determined.
VAPOR DENSITY:	Not determined.
BOILING POINT:	Not determined.
MELTING POINT:	Not determined.
SOLUBILITY IN WATER:	Negligible, below 0.1%.
SPECIFIC GRAVITY (WATER = 1):	0.88
VISCOSITY:	61.2-74.5cSt at 40°C ASTM D445
POUR POINT:	-15°F (-26°C) (maximum)
VISCOSITY INDEX:	90 Minimum.

10.0 STABILITY AND REACTIVITY

STABILITY: Stable.

CONDITIONS TO AVOID: None identified.

MATERIALS TO AVOID: Avoid chlorine, fluorine, and other strong oxidizers.

HAZARDOUS DECOMPOSITION: None identified.

HAZARDOUS POLYMERIZATION: Will not occur.

11.0 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY DATA:

EYE IRRITATION: Testing not conducted. See Other Toxicity Data.

SKIN IRRITATION: Testing not conducted. See Other Toxicity Data.

DERMAL LD50: Testing not conducted. See Other Toxicity Data.

ORAL LD50: Testing not conducted. See Other Toxicity Data.

INHALATION LC50: Testing not conducted. See Other Toxicity Data.

OTHER TOXICITY DATA:

Specific toxicity tests have not been conducted on this product. Our hazard evaluation is based on information from similar products, the ingredients, technical literature, and/or professional experience.

A similar product produced a primary eye irritation score (PEIS) of less than 10/110.0 (rabbits).

A similar product produced a dermal LD50 score greater than 2000 mg/kg (rabbits).

A similar product produced an oral LD50 score greater than 5000g/kg (rats).

No component of this product at levels greater than 0.1% is identified as a carcinogen by ACGIH or the International Agency for Research on Cancer (IARC). No component of this product present at levels

greater than 0.1% is identified as a carcinogen by the U.S. National Toxicology Program (NTP) or the U.S. Occupational Safety and Health Act (OSHA).

12.0 ECOLOGICAL INFORMATION

Ecological testing has not been conducted on this product.

13.0 DISPOSAL INFORMATION

Disposal must be in accordance with applicable federal, state, or local regulations. Enclosed-controlled incineration is recommended unless directed otherwise by applicable ordinances. This material may be amenable to recycling.

Since the emptied containers retain product residue, follow label warnings even after container is emptied.

14.0 TRANSPORTATION INFORMATION

U.S. DEPT OF TRANSPORTATION

Shipping Name : Not Regulated

INTERNATIONAL INFORMATION:

Sea (IMO/IMDG)

Shipping Name : Not determined.

Air (ICAO/IATA)

Shipping Name : Not determined.

European Road/Rail (ADR/RID)

Shipping Name : Not determined.

Canadian Transportation of Dangerous Goods

Shipping Name : Not Regulated

15.0 REGULATORY INFORMATION

CERCLA SECTIONS 102A/103 HAZARDOUS SUBSTANCES (40 CFR PART 302.4): This product is not reportable under 40 CFR Part 302.4.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR PART 355): This product is not regulated under Section 302 of SARA and 40 CFR Part 355.

SARA TITLE III SECTIONS 311/312 HAZARDOUS CATEGORIZATION (40 CFR PART 370): This product is not regulated under SARA Title III Section 311/312.

SARA TITLE III SECTION 313 (40 CFR PART 372): This product is not regulated under Section 313 of SARA and 40 CFR Part 372.

U.S. INVENTORY (TSCA): Listed on inventory.

OSHA HAZARD COMMUNICATION STANDARD: Contains a component listed by OSHA. Contains a component listed by ACGIH.

WHMIS CONTROLLED PRODUCT CLASSIFICATION: Not a Controlled Product under Canada's Workplace Hazardous Material Information System.

EC INVENTORY (EINECS/ELINCS): Not determined.

JAPAN INVENTORY (MITI): Not determined.

AUSTRALIA INVENTORY (AICS): Not determined.

KOREA INVENTORY (ECL): Not determined.

CANADA INVENTORY (DSL): One or more of the components of this product is not listed on the DSL.

PHILIPPINE INVENTORY (PICCS): Not determined.

FOOD CONTACT STATUS

USDA: H2 Status: This product is acceptable to the USDA for use as a lubricant in official meat and poultry establishments provided there is no possibility of the lubricant or lubricated part contacting edible products.

16.0 OTHER INFORMATION

BY:



Donald M. Barker, Director
Product Stewardship & Toxicology

Issued: March 06, 1995
Supersedes: March 06, 1995

This material Safety Data Sheet conforms to the requirements of ANSI Z400.1.

This material safety data sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in this data sheet which we received from sources outside our company. We believe that information to be correct but cannot guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. No statement made in this data sheet shall be construed as a permission or recommendation for the use of any product in a manner that might infringe existing patents. No warranty is made, either express or implied.

MATERIAL SAFETY DATA SHEET

C. ADDRESS:

I. I.D. NO.

II. SPECIFIC GENERIC INGREDIENTS

III. GENERAL REQUIREMENTS

IV. PHYSICAL PROPERTIES

V. FIRE AND EXPLOSION DATA

VI. REACTIVITY DATA

VII. SPILL OR LEAK

A. Product Name **Quartz Gravel, Filter or Blast Sand**
 B. Manufacturer **The Parry Company**
 E. Chemical Name(s) & Molecular Formula(s).
 Give Specific IUPAC Name(s).
**Silicon Dioxide (Silica) SiO₂
 (Crystalline Silica) Quartz**

F. Synonyms
Quartz; Coesite; Cristobalite; Tridymite

A. MATERIALS OR COMPONENTS		B. % w/w	C. CAS#	D. HAZARD DATA (TLV, LD50, LC50, etc.)
Include all carcinogens at levels >0.1% and all other ingredients at levels >1.0%.	N/A	N/A	N/A	N/A

A. Use **Post area where sand is used warning of possible lung injury from repeated inhalation of respirable silica dust. Follow OSHA standards for free silica.**
 B. Handling **Wear approved OSHA respirator/dust mask. Dampen sand to minimize dust.**
 C. Storage **Same as A.**

A. Boiling Point/Range **2230 °C 4046 °F**
 B. Melting Point **1600 °C 2912 °F**
 C. Freezing Point **N/A °C °F**
 D. Molecular Weight (Calculated) **60.1**
 E. Specific Gravity (H₂O=1) **2.65 @ 22 °C 72 °F**
 F. Vapor Pressure (mm Hg) **N/A @ °C °F**
 G. Vapor Density (Air=1) **essentially 0**
 H. pH **6-8**
 I. Solubility in H₂O **Insoluble**
 J. % Volatiles by Volume **N/A**
 K. Evaporation Rate **N/A** Ether = 1 Water = 1 Butylacetate = 1
 L. Appearance and Odor **Tan-Brown-Buff Granular - Odorless Solid**
 M. Other **N/A**

A. Flash Point **Not Combustible** Test Method **Lower** B. Flammable Limits **N/A** Upper **N/A** C. Autoignition Temperature/Fire Point **N/A °C °F**
 D. EXTINGUISHING MEDIA Water spray Water fog Water stream CO₂ Dry chemical Alcohol foam Foam Earth or sand **N/A**
 E. SPECIAL FIRE FIGHTING PROCEDURES Do not enter building Allow fire to burn Water may cause frothing Do not use water None
 F. UNUSUAL FIRE AND EXPLOSION HAZARDS Dust explosion hazard Sensitive to shock Contamination Temperature None Other (specify)

A. STABILITY Stable Unstable B. CONDITIONS CONTRIBUTING TO INSTABILITY Thermal decomposition Photo degradation Polymerization Contamination None
 C. INCOMPATIBILITY - Avoid contact with Strong acids Strong alkalis Strong oxidizers Reducers Water None Other (specify):
 D. HAZARDOUS DECOMPOSITION PRODUCTS - THERMAL AND OTHER (list)
None
 E. CONDITIONS TO AVOID **Crystalline Silica attacked by hydrogen fluoride, (hydrofluoric acid)**
 Heat Open flames Sparks Ignition sources None Other (specify):

A. STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED Flush with water Absorb with sand or inert material Neutralize moisten, Sweep or scoop up and remove Keep upwind. Evacuate enclosed spaces. Prevent spread or spill
 Dispose of immediately Other (specify): **Persons not wearing protective equipment should be restricted from area. Use approved dustless methods (water/vacuum).**
 B. WASTE DISPOSAL METHOD (specific)
**Any secured sanitary landfill. Dampen waste to reduce airborne dust. If dust is generated during handling, use OSHA approved respirator.
 SiO₂ not a hazardous waste under 40 CFR Part 261 EPA Regulations.**

CONTINUED ON REVERSE SIDE

NA - Not Applicable

A. PRIMARY ROUTE(S) OF ENTRY:

Skin absorption Inhalation Ingestion

B. EXPOSURE LIMITS (Specify if TLV/TWA, Ceiling (c), PEL, etc.)
 For Respirable Dust: 10 milligrams silica per cubic meter of air divided by percent SiO₂ averaged over 8 hr. work shift. Total Dust: Same except 30m
 ACGIH 19 _____ OSHA 19 10-100 Table Z-3 Other _____

III. HEALTH HAZARD INFORMATION

Effects of Exposure

C. INGESTION
 Acute: None - But recommend seeking medical advise
 Chronic: None - But recommend seeking medical advise

D. DERMAL:
 Acute: Irritant Corrosive Sensitizer Defatter None Other
 Chronic: Irritant Corrosive Sensitizer Defatter None Other
 Gloves - Optional
 Gloves - Optional

E. EYE:
 Acute: Severe Irritant Mild Irritant Corrosive None Other
 Chronic: Severe Irritant Mild Irritant Corrosive None Other
 Recommend Full Eye Protection
 Same as Above

F. INHALATION:
 Acute: Irritant Allergen Asphyxiant Sensitizer Edema None
 Narcotic effect Cyanosis Other: See B&H this section
 Chronic: Irritant Allergen Sensitizer Carcinogen None Other See B&H this section

G. SYSTEMIC:
 Acute: Specific effect(s)
 Chronic: Specific effect(s) Cough and shortness of breath. Pulmonary distress.

H. OTHER TOXIC EFFECTS (include Aquatic Toxicity and no effect level):
 Repeated inhalation of crystalline silica or quartz dust may cause silicosis a form of disabling, progressive and sometimes fatal pulmonary fibrosis characterized by the presence of typical nodulations in the lungs. Good industrial hygiene ventilation practices should be used to reduce environmental concentrations to the permissible exposure level or OSHA approved respiratory protection should be used to avoid inhaling dust.

IX. EMERGENCY FIRST AID

A. INGESTION
 Induce vomiting Do NOT induce vomiting Give plenty of water Get medical attention No ill effects Other (specify): Seek Medical Advice

B. SKIN CONTACT
 No Res. or Injury expected Wash area, remove contaminated clothing immediately Wash area, remove garment within reasonable time. Flush area remove clothing immediately. Report to Medical Dept.

C. EYE CONTACT
 Flush with plenty of water for at least 15 minutes Get medical attention No ill effects Other (specify): See Attached Addendum

D. INHALATION
 Remove to fresh air If not breathing, provide appropriate life support Give oxygen Get medical attention No ill effects Other (specify):

X. SPECIAL PROTECTION INFORMATION

A. VENTILATION REQUIREMENTS - Always maintain exposure below permissible exposure limits
 Consult an industrial hygienist or environmental health specialist Local exhaust Use with adequate ventilation Check for air contaminant and oxygen deficiency (Abrasive Blasting ANSI Z9.2-1960, OSHA 1910.94(e))
 Store in well ventilated area None required Other (specify):

B. EYE
 Safety glasses Face shield Goggles

C. HAND (GLOVE TYPE)
 Polyvinyl chloride Neoprene Butyl rubber Natural rubber Polyvinyl alcohol Poly-ethylene Cloth Leather
 Other (specify): Gloves - Optional

D. RESPIRATOR TYPE - Use only NIOSH/MSHA approved equipment
 Self-contained Supplied air Can or cartridge gas or vapor Filter - dust, fume, mist Other (specify): See Attached Addendum

E. OTHER PROTECTIVE EQUIPMENT
 Rubber boots Apron Other (specify): See attached U.S. Dept. of Health and Human Services "Occupational Health Guideline for Crystalline Silica"

XI. SPECIAL PRECAUTIONS

A. PRECAUTIONS
 Wash thoroughly after handling Do not get in eyes, on skin or clothing Do not breathe dust! Keep container closed Keep away from heat, sparks and open flames Store in tightly closed containers
 Do not store near combustibles Keep from contact with clothing and other combustible materials Empty container may contain hazardous residues Use explosion proof equipment Other (specify): See Attached Addendum

B. TRANSPORTATION & OTHER PRECAUTIONS
 Advise and post warning to employees where product is used, handled or stored. Follow existing OSHA standards or hereafter amended, modified or adopted.

Prepared by _____ Date _____ Address _____ Phone _____
 Updates: _____

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard,
29 CFR 1910.1200. Standard must be
consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072



IDENTITY (As Used on Label and List)
"CARBONITE", ANTHRACITE FILTER MEDIA

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name
CARBONITE FILTER CORPORATION

Emergency Telephone Number
(717) 467-3350

Address (Number, Street, City, State, and ZIP Code)
P.O. BOX No. 1

Telephone Number for Information
(717) 467-3350

DELANO, PENNSYLVANIA 18220-0001

Date Prepared
MAY 18, 1990

Signature of Preparer (optional)

Section II -- Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
NONE!				

Section III -- Physical/Chemical Characteristics

Boiling Point	N/A	Specific Gravity (H ₂ O = 1)	1.60 AVERAGE
Vapor Pressure (mm Hg.)	N/A	Melting Point	N/A
Vapor Density (AIR = 1)	N/A	Evaporation Rate (Butyl Acetate = 1)	N/A

Solubility in Water
NONE!

Appearance and Odor
BLACK, SOLID, ODORLESS.

Section IV -- Fire and Explosion Hazard Data

Flash Point (Method Used) IGNITION AT 840 °C (1,710 °F)	Flammable Limits	LEL	UEL
--	------------------	-----	-----

Extinguishing Media
WATER (CO₂) OR ANY TYPE OF EXTINGUISHING MEDIA AVAILABLE.

Special Fire Fighting Procedures
NONE!

Unusual Fire and Explosion Hazards
NONE!

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid TEMPERATURE ABOVE 900 ^o F
	Stable	X	

Incompatibility (Materials to Avoid) NONE!

Hazardous Decomposition or Byproducts NONE!

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur	X	

Section VI — Health Hazard Data

Route(s) of Entry: N/A Inhalation? Skin? Ingestion?

Health Hazards (Acute and Chronic) N/A

Carcinogenicity: N/A NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure N/A

Medical Conditions Generally Aggravated by Exposure N/A

Emergency and First Aid Procedures N/A

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled
NONE! IF SPILLAGE OCCURS, MEDIA CAN THEN BE PICKED UP BY USING A BROOM AND SHOVEL, IF MEDIA IS NOT CONTAMINATED, SPILLED MEDIA CAN THEN BE REBAGGED.

Waste Disposal Method
PRIMARILY A LANDFILL.

Precautions to Be Taken in Handling and Storing
AVOID BREAKING BAGS OR SPILLING MEDIA SO AS TO AVOID POSSIBLY CREATING RESIDUAL DUST.

Other Precautions
USE ADEQUATE VENTILATION AND DUST COLLECTION. USE GOOD HOUSEKEEPING SENSE AND AVOID ACCUMULATING DUST.

Section VIII — Control Measures

Respiratory Protection (Specify Type)
N/A

Ventilation	Local Exhaust	N/A	Special
	Mechanical (General)		Other

Protective Gloves NONE! Eye Protection SAFETY GLASSES.

Other Protective Clothing or Equipment NONE!

Work/Hygenic Practices N/A

MATERIAL SAFETY DATA SHEET

 **Texasgulf** Inc.

SODA ASH, DENSE

Glenwood at Glen Eden

P.O. Box 30321

CAUTION: MAY IRRITATE SKIN AND EYES

Raleigh, North Carolina 27622-0321 (919) 881-2700

TRANSPORTATION EMERGENCIES. CALL (800) 424-9300 (CHEMTREC)
HEALTH EMERGENCIES. CONTACT YOUR LOCAL POISON CENTER

PRODUCT INFORMATION

CHEMICAL NAME AND SYNONYMS
Sodium Carbonate, Anhydrous

TRADE NAME AND SYNONYMS
Soda Ash

CHEMICAL FAMILY
Sodium Salts

FORMULA
 Na_2CO_3

CAS NUMBER
497-19-8

LISTED IN: _____ OSHA SUBPART Z _____ ACGIH TLV LISTS: _____ NTP LIST:

_____ IARC MONOGRAPH: X NONE OF THE ABOVE

TYPICAL COMPOSITION Sodium Carbonate 99.7 %

PHYSICAL DATA

BOILING POINT (*F) Decomposes @1800

MELTING POINT (*F) 1,564

VAPOR PRESSURE (mm Hg.) N/A

SPECIFIC GRAVITY (H₂O=1) 2.533

VAPOR DENSITY (AIR=1) N/A

PERCENT VOLATILE BY VOLUME (X) N/A

SOLUBILITY IN WATER 18 wt. @ 70°F

EVAPORATION RATE (_____ *1) N/A

APPEARANCE AND ODDR White odorless crystal

pH 11.7 for 15% by wt. solution @73.4°F

OTHER Size 90% -20 to +100 mesh (Tyler)

FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT (Method Used) N/A

FLAMMABLE LIMITS LEL N/A UEL N/A

EXTINGUISHING MEDIA N/A

SPECIAL FIRE FIGHTING PROCEDURES N/A

UNUSUAL FIRE AND EXPLOSION HAZARDS N/A

HEALTH INFORMATION

THRESHOLD LIMIT VALUE OSHA nuisance dust limit of 15/mg/m³ or ACGIH nuisance dust limit of 10/mg/m³ for the eight hour time weighted average.

EFFECTS OF OVEREXPOSURE EYE-Irritant. SKIN-slightly irritating. INGESTION-Ingestion of large amounts (LD₅₀, rat @4000mg/kg) may produce corrosion of G.I. tract, vomiting, diarrhea, circulatory collapse, death. INHALATION-Irritation and drying of mucous membranes and respiratory tract.

12/28/88

(N/A - Not Applicable)

EMERGENCY AND FIRST AID PROCEDURES

EYE-Flush with large amounts of water.

SKIN-Wash with soap and water.

INGESTION-If patient is conscious, give large amounts of water. DO NOT INDUCE VOMITING.
Seek medical help.

INHALATION-Remove patient to fresh air. Seek medical attention if discomfort persists.

REACTIVITY DATA

STABILITY

UNSTABLE

CONDITIONS TO AVOID Confined contacts with acid.

STABLE

INCOMPATIBILITY (Materials to avoid) Acids

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS MAY OCCUR

CONDITIONS TO AVOID N/A

POLYMERIZATION

WILL NOT OCCUR

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Keep dry and contain as a solid. Soda ash solutions may be neutralized to pH 7 with hydrochloric acid. Prevent large quantities from contact with waterways or vegetation.

WASTE DISPOSAL METHOD If uncontaminated, recover and reuse product. Consult State or Federal environmental regulatory agencies for acceptable disposal procedures and locations.

PERSONAL PROTECTION INFORMATION

EYE-Tight fitting goggles should be worn in dusty areas.

SKIN-If irritation occurs, long sleeves and impervious gloves should be worn.

Stress personal hygiene.

RESPIRATORY- A NIOSH-approved dust respirator should be used when exposure exceeds the OSHA standard of 15/mg/m³.

SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Keep product dry.

OTHER PRECAUTIONS None

Although the information contained herein is offered in good faith, SUCH INFORMATION IS EXPRESSLY GIVEN WITHOUT ANY WARRANTY (EXPRESS OR IMPLIED) OR ANY GUARANTEE OF ITS ACCURACY OR SUFFICIENCY and is taken at the user's sole risk. User is solely responsible for determining the suitability of use in each particular situation. Texasgulf specifically DISCLAIMS ANY LIABILITY WHATSOEVER FOR THE USE OF SUCH INFORMATION, including without limitation any recommendations which user may construe and attempt to apply which may infringe or violate valid patents, licenses and/or copyright.