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OPERATIONS AND MAINTENANCE MANUAL FOR PUMP AND TREATMENT SYSTEM AT SITE 45 FORMER DRY CLEANING FACILITY SPILL AREA MCRD PARRIS ISLAND SC

8/1/2000

BECHTEL

145-000179

OPERATIONS AND MAINTENANCE MANUAL

PUMP AND TREATMENT SYSTEM

SITE 45/SWMU45
FORMER DRY CLEANERS FACILITY
BUILDING 193
EPA I.D. No. SC6 170 022 762

MARINE CORPS RECRUITING DEPOT
PARRIS ISLAND, SOUTH CAROLINA

Prepared for
DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
Under Contract No. N62467-93-D-0936

Prepared by
BECHTEL ENVIRONMENTAL, INC.
OAK RIDGE, TENNESSEE

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CONTENTS

Page

1.0 INTRODUCTION **1**

1.1 FORMER DRY CLEANERS FACILITY SITE DESCRIPTION AND HISTORY 1
1.2 GROUNDWATER PUMP AND TREATMENT SYSTEM DESCRIPTION 1
1.2.1 Recovery Wells *2*
1.2.2 Submersible Well Pumps and Pressure Transducers *2*
1.2.3 Equipment Building/Air Stripper Unit with Blower and Transfer Pump *2*
1.2.4 Automated Control System *3*
1.2.5 Piping *3*

2.0 TREATMENT SYSTEM OPERATION, MAINTENANCE AND MONITORING **3**

2.1 TREATMENT SYSTEM OPERATION 4
2.2 BUILDING AND EQUIPMENT INSPECTIONS AND MAINTENANCE 4
2.3 O&M SAMPLING 5
2.4 WASTE DISPOSAL 5
2.5 O&M REPORTING 6

3.0 SPARE PARTS SOURCES **6**

4.0 POINTS OF CONTACT **6**

Attachments

Attachment 1. - Drawings
Attachment 2. - Well Completion Reports
Attachment 3. - Equipment/Material List and Manual
Attachment 4. - OPTO-22 Program Logic
Attachment 5. - Treatment System Operating Instruction
Section 1 System Startup and Shutdown
Section 2 System Control and Monitoring
Section 3 Recovery Well Pump Servicing
Attachment 6. - Maintenance and Sampling Checklists and Log

1.0 INTRODUCTION

The purpose of this manual is to provide the necessary information for the Operation and Maintenance (O&M) of the pump and treatment system at the Marine Corps Recruit Depot (MCRD), former Dry Cleaners Facility, Bldg.193. The manual provides:

- site specific data,
- pump and treatment system operations,
- sampling requirements,
- spare parts and supplier information,
- vendor data, and
- drawings.

1.1 FORMER DRY CLEANERS FACILITY SITE DESCRIPTION AND HISTORY

MCRD Parris Island is located in the southeastern corner of South Carolina's low country within Beaufort County, 70 miles south of Charleston and 45 miles north of Savannah, Georgia. The Depot consists of 8,095 acres and is a maximum of 20 feet above sea level. The former Dry Cleaners Facility (Bldg. 193), located at the intersection of Samoa and Panama Streets, was abandoned in 1997. This site has been designated as Site 45/Solid Waste Management Unit 45 (SWMU 45). This facility maintained four above ground storage tanks in a concrete secondary containment basin. These tanks were installed in 1988 and were used to store the dry cleaning solvent tetrachloroethylene (PCE). The above ground system was constructed to replace an underground storage tank system which contained a petroleum based solvent used prior to the facility's conversion to the use of PCE.

In March of 1994, a reportable release of PCE occurred when one of the storage tanks was inadvertently overfilled spilling PCE into the concrete containment basin. The PCE was subsequently released to the soils when the containment basin was drained following heavy rains. Parris Island personnel excavated and disposed of the PCE-contaminated soil outside the containment basin. In June, 1994 the facility contracted with S&ME to conducted a PCE-contamination assessment determining the extent of contaminated groundwater and to develop a conceptual remediation plan.

In the summer of 1996, Bechtel was contracted to conducted a site groundwater investigation and define the current extent of contamination. Results indicated a plume of PCE; TCE; 1,2 DCE; and vinyl chloride contaminated groundwater existed with concentrations exceeding the regulatory limits. In December 1996, sixteen monitoring wells were installed to confirm and monitor groundwater contamination levels. Soil samples were also collected to determine lithology and geological stratigraphy, and to establish baseline soil contamination levels. In March, 1998 an Engineering Evaluation and Interim Removal Remedial Work Plan/Interim Measure Work Plan was approved by the Southern Division, Naval Facilities Engineering Command, wherein the interim removal action (IRA) was identified as the installation and operation of a groundwater pump and treatment system. The groundwater pump and treatment system installation was completed in April 1998.

1.2 GROUNDWATER PUMP AND TREATMENT SYSTEM DESCRIPTION

The pump and treatment system installed at the former Dry Cleaners Facility consists of three recovery wells with submersible well pumps and pressure transducers, an equipment building housing an air stripper with blower and transfer pump, instrumentation and controls, and piping. Treated groundwater is

discharged to the Federal Owned Treatment Works (FOTW). Project as-built drawings are included in Attachment 1.

1.2.1 Recovery Wells

Three 6-inch diameter, PVC recovery wells were installed in March, 1998 for recovery of contaminated groundwater which is processed through the treatment system. Well locations and elevations are shown on project drawing 22567-145-DD000-002, included in Attachment 1. Well construction details are provided in the Well Completion Reports and can be found in Attachment 2. Fiberglass enclosures cover each well and are secured with a padlock.

1.2.2 Submersible Well Pumps and Pressure Transducers

A submersible pump and pressure transducer are installed in each recovery well. The project drawing 22567-145-DD000-002, included in Attachment 1, provides the elevations where well pumps and pressure transducers have been set. The pressure transducer has been installed below the submersible pump to measure the water level in the well and signal the OPTO-22 controller located in the equipment building to operate the well pump. The well pumps are regulated to shut off when the well water level lowers to within 1 foot of the pump intake and restarts after the water level raises 5 feet. Manufactures' details and operation and maintenance manuals on the pumps and transducers are included in Attachment 3.

The flow rate from submersible pumps in recovery wells 1 and 2 is controlled manually by adjusting the flow regulating valves on each pump discharge line. The flow rate for the pump in recovery well 3 is controlled using a microprocessor based frequency inverter to control the motor speed. This allows more exact adjustment of the discharge from this well at the lower end of the flow range. Attachment 3 provides operating instruction for the Siemens "Micromaster" frequency inverter.

1.2.3 Equipment Building/Air Stripper Unit with Blower and Transfer Pump

An equipment building located south of Building 193 houses the air stripper unit, system controls, and is equipped with an emergency light, exhaust fan, intake louvers and unit heater. The air stripper unit is a Shallow Tray, low flow, pressurized system which removes the dissolved volatile organic compounds (VOC) from the contaminated groundwater. The air stripper unit has a treatment capacity of 15 gallon per minute incoming water flow rate while maintaining 150 cubic feet per minute of air flow at 18 inches of water column. The air stripper unit is equipped with a blower and transfer pump. The blower delivers the air through the shallow trays to strip the volatile organic compounds from the water and the transfer pump discharges the treated water to a FOTW sanitary sewer manhole. The air stripper operation is controlled by float and pressure switches wired to the OPTO-22 controller. The OPTO-22 regulates the air stripper operation depending on water levels in the recovery wells, air stripper unit, and the equipment building sump. Flow indicating transmitters are installed on the influent lines and a totalizing flow indicating transmiter is installed on the effluent line which allows the OPTO-22 contoller to monitor flows. In the event of a spill within the building, water would accummulate in the sump and activate a float switch shutting down the entire system. Project drawings 22567-145-D000-007 and 009 provide details on the equipment building and treatment system. Additionally, manufactures details and operation and maintenance manuals for the equipment are provided in Attachment 3.

1.2.4 Automated Control System

The treatment system has an OPTO-22 automated control system. The automated controls system consists of computer based system hardware and software used for monitoring and control of the treatment process. Project drawing 22567-145-D000-010 provides details on the control system. and is included in Attachment 1 and the associated program logic is included in Attachment 4. The system provides local/remote control functions; start/stop, open/close control, monitoring, alarming, notification, trending, and historical logging for treatment system processes. The system also provides local/remote indication of operating parameters such as pressure, flow and temperature etc. The system may be locally supervised with a personal computer directly connected to the controller's communication port or remotely supervised with a personal computer through shared communication with a modem. In addition to the above, the system programming accomplishes the following:

- scan inputs;
- control outputs;
- enables/disables the alarms;
- provides remote and local graphical interface for interaction with personnel to change set points, modes of operation, or monitoring of treatment skid components;
- responds to commands local or remote;
- maintains real time and accepts real time updates from local or remote supervisory computer;
- communicates with local or remote interfaces; and
- performs historical logging functions.

1.2.5 Piping

The system piping includes three piping configurations. The first is a 4-inch PVC secondary containment pipe routed between recovery wells and equipment building. The second is 0.75-inch tubes which are a continuous section of LDPE tubing contained within the 4-inch PVC containment pipe and used to transfer contaminated groundwater from the well pump to the treatment building. The third is the 1-inch PVC process piping within the treatment building. Each piping system has passed pressure testing.

The secondary containment pipe route is shown on project drawing 22567-145-D000-002 included in Attachment 1, and provides details of the below grade pipeline. The ends of the secondary containment pipe have been set at an elevation to prevent extraneous water from entering the pipe and to drain water to the treatment building in the event a leak occurs in the LDPE tubing during the transfer of well water. Inside the treatment building, the pipe stub-up is set at an elevation 1-inch higher than the top of the building curb to prevent any water accumulating inside the building from draining into the pipe. At the Recovery well pad, the pipe stub-up is set at an elevation at least 12-inches above the surrounding grade and 1-inch higher than the stub-up within the building to allow water accumulating inside the secondary containment pipe to overflow into the treatment building.

2.0 TREATMENT SYSTEM OPERATION, MAINTENANCE AND MONITORING

The treatment system will be operated and maintained to meet the following objectives:

- Minimize migration of groundwater containing solvents by providing hydraulic control of the site.
- Reduce elevated concentrations of contaminates in the groundwater in the area of concern.

- Operate the remediation system until equilibrium is reached. Equilibrium is defined as 3 month's recovery well groundwater samples without a significant (10%) decrease of contaminant concentrations in groundwater.
- Allow an orderly transition to any required final remedy at the site.

The operation of the system is automated and can be controlled and monitored remotely. To ensure a safe and uninterrupted system performance, operation and maintenance (O&M) visits will be conducted monthly to inspect the system; perform building/equipment maintenance/repairs; and monitor the groundwater remediation and water discharge by sampling.

2.1 TREATMENT SYSTEM OPERATION

The treatment system is designed to be started, controlled, monitored, and shutdown by the OPTO-22 controls. Manual control switches exist at the MSP-1 panel for the recovery well pumps and the air stripper panel for the blower and discharge pump. These switches can override the OPTO-22 controls, but are recommended for emergency use only. The engineer must be contacted whenever the manual controls have been initiated and before restarting the treatment system. Instructions for treatment system startup and shutdown and the treatment system control and monitoring are provided in Attachment 5, Sections 1 and 2.

Instructions for removal and installation of the recovery well pumps for servicing are provided in Attachment 5, Section 3.

2.2 BUILDING AND EQUIPMENT INSPECTIONS AND MAINTENANCE

The maintenance of the groundwater treatment system shall consist of:

- physical inspections and maintenance of the groundwater recovery pumps, air stripper, transfer pump, blower, exposed piping connections, valves, gauges, meters, and controls. Including cleaning the air stripper trays as required.
- physical inspection of the building, including its exhaust fan, heater, sump pump, lighting, electric panels, phone and electric services, and building doors and locks. This includes repair or replacement of worn or damaged parts.
- physical inspection of the sanitary sewer manhole, recovery well enclosures, and monitoring well surface casings. This includes repair or replacement of worn or damaged parts and maintaining the integrity of the well surface casing seals.

An Equipment Maintenance Schedule that provides a listing of equipment requiring regularly scheduled maintenance is included in Attachment 6. The O&M technician will complete the required maintenance during site visits. The Equipment Maintenance Schedule will be incorporated in an O&M logbook which will be kept in the equipment building.

Maintenance activities shall be performed in accordance with the manufacturer's recommendations. Equipment manufactures manuals are included in Attachment 3 along with a table listing all the material and equipment incorporated in the treatment system. The manuals in attachment 3 have been placed in the same order as they are listed in the table. Equipment venders and contacts are indicated on the table. Equipment cleaning, repairs and/or replacements will be made as warranted to maintain the equipment in a safe and effective operating mode.

Cleaning the air stripper trays requires dismantling the stripping tray column. Instructions are provided in the NEEP Manual located in Attachment 3. Sequence numbers and orientation arrows have been drawn on each of the trays to assist reassembly in the proper order. A scraper or pressure washer is needed to remove the scale deposited on the trays. The scale shall be collected and containerized for disposal. Refer to the Waste Disposal section herein, for disposition of the scale. During reassembly of the stripping column, the weir in each tray needs to be filled with water.

2.3 O&M SAMPLING

Sampling will be performed to monitor the effectiveness of the pump and treat system in reducing groundwater contamination levels and in determining the quantity of VOC's off-gased by the treatment system.

Groundwater samples from the treatment system influent and effluent and the sixteen monitoring wells will be analyzed to measure the effectiveness of the system. The treatment system influent and effluent water will be sampled monthly from sample port valves SP-1. SP-2, SP-3 and SP-5. The sixteen monitoring wells will be sampled quarterly. Sample field test parameters and lab analysis are listed on the sample record sheets included in Attachment 6. Analytical results from the influent and effluent samples will be used to calculate the quantity of VOCs discharged each month by the treatment system.

All sampling will be done in accordance with the latest revision of the EPA Region 4 *Environmental Investigations Standard Operation Procedures and Quality Assurance Manual*. A field duplicate sample shall be taken bimonthly for VOCs. A trip blank shall be provided for each sampling event.

Before collecting influent and effluent water samples from the sampling ports, the sampling port valve shall be opened for one minute to flush the valve, and then the flow rate shall be reduced to 500 mL/min. Monitoring wells shall be purged prior to collecting water samples. Waste water generated from flushing sample ports and purging wells shall be processed through the treatment system.

Sample containers will be furnished by the laboratory. Chain-of-custody forms, labels, and sample identification numbers will be completed at the time of sampling. Samples will be packed in coolers with ice prior to shipment to the laboratory.

The O&M logbook will be used to record the field sampling data.

2.4 WASTE DISPOSAL

Scale and sediment generated from cleaning the air stripper will be containerized, the container labeled as waste material and stored in the building. The waste material will be tested for waste disposal profile after the container has been filled. The waste material will then be disposed according to the results of the waste disposal profile and its waste designation. Waste manifests shall be signed by the MCRD NREAO personnel as generator.

Wastewater generated from cleaning stripper trays, flushing sample ports and purging wells shall be processed through the treatment system.

Debris and trash generated from operation and maintenance activities shall be disposed in the domestic trash container at the Dry Cleaning Facility. Personal Protective Equipment (PPE) shall be free of liquid, bagged and disposed in the domestic trash container.

2.5 O&M REPORTING

An O&M logbook, containing checklist sheets and sample record sheets will be kept onsite in the equipment building. A checklist sheet and sample record sheets will be completed during each O&M visit.

Instrument calibration shall be noted on the logsheet/record where applicable.

3.0 SPARE PARTS SOURCES

A table is provided in Attachment 3, listing the equipment venders and contacts to order replacement parts.

4.0 POINTS OF CONTACT

Points of contact for this system are:

- Art Sanford, NAVFACENGCOM, SouthDiv, Navy Project Manager (1-843-820-7482)
- Tim Harrington, MCRD NREAO , (1-843-525-3423)

MONITORING *	NORTH	EAST	TOP OF RISER
193-1-MW-S	187455.597	2099298.879	7.60 FT
193-1-MW-D	187454.710	2099308.355	7.57 FT
193-2-MW-S	187345.032	2099203.731	7.11 FT
193-2-MW-D	187341.197	2099201.966	7.23 FT
193-3-MW-S	187257.657	2099244.001	7.60 FT
[illegible]-MW-D	187258.713	2099239.820	7.57 FT
[illegible] MW-S	187150.910	2099249.096	6.98 FT
193-4-MW-D	187149.280	2099253.080	6.93 FT
193-5-MW-S	187192.220	2099377.309	8.60 FT
193-5-MW-D	187187.346	2099376.763	8.26 FT
193-6-MW-S	187273.011	2099295.097	7.57 FT*
193-6-MW-D	187277.268	2099296.248	7.52 FT
193-7-MW-S	187326.652	2099295.775	7.68 FT
193-7-MW-D	187328.810	2099293.569	7.72 FT
193-8-MW-S	187387.149	2099318.846	7.60 FT
193-8-MW-D	187391.271	2099319.322	7.53 FT
193-1-RW	187366.755	2099314.999	9.81 FT
193-2-RW	187316.548	2099305.618	9.63 FT
193-3-RW	187263.741	2099295.314	9.35 FT

* CUT TOP OF RISER RESURVEYED 4/14/98

COORDINATES OF BUILDING

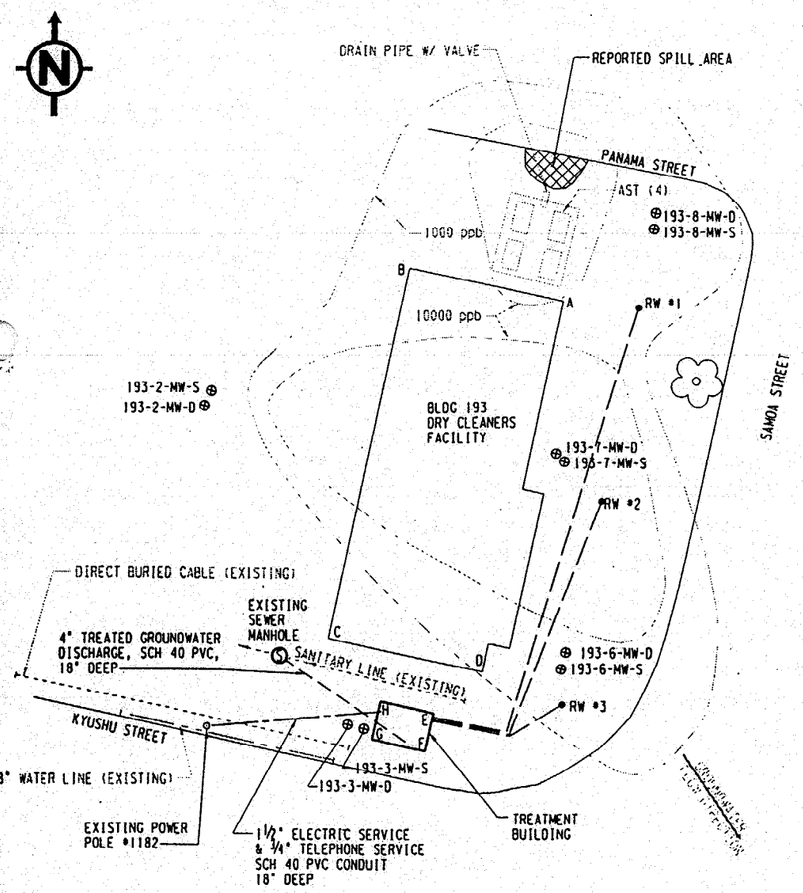
A	N 187368.364	E 2099295.250
B	N 187376.949	E 2099255.312
C	N 187280.942	E 2099234.675
D	N 187272.357	E 2099274.613
E	N 187261.555	E 2099261.948
F	N 187251.804	E 2099259.729
G	N 187254.911	E 2099246.078
H	N 187264.662	E 2099248.297

CONCRETE PAD ELEVATIONS "X" MARKS

TREATMENT BLDG FLOOR	7.81 FT
TREATMENT BLDG TOP OF CURB	8.11 FT
193-1-RW	8.27 FT
193-2-RW	8.07 FT
193-3-RW	7.79 FT

WELL EQUIPMENT ELEVATIONS

WELL NO.	REF	DESCRIPTION	ELEVATION MSL
193-1-RW	I	TOP SCREEN	3.13 FT
193-1-RW	J	PUMP INTAKE	-6.69 FT
193-1-RW	K	BOTTOM TRANSDUCER	-8.82 FT
193-1-RW	L	BOTTOM SCREEN	-8.87 FT
193-2-RW	I	TOP SCREEN	3.89 FT
193-2-RW	J	PUMP INTAKE	-7.17 FT
193-2-RW	K	BOTTOM TRANSDUCER	-9.27 FT
193-2-RW	L	BOTTOM SCREEN	-9.11 FT
193-3-RW	I	TOP SCREEN	3.13 FT
193-3-RW	J	PUMP INTAKE	-6.75 FT
193-3-RW	K	BOTTOM TRANSDUCER	-8.86 FT
193-3-RW	L	BOTTOM SCREEN	-8.87 FT

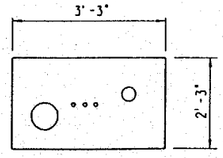


FACILITY PLAN
1"=20'-0"

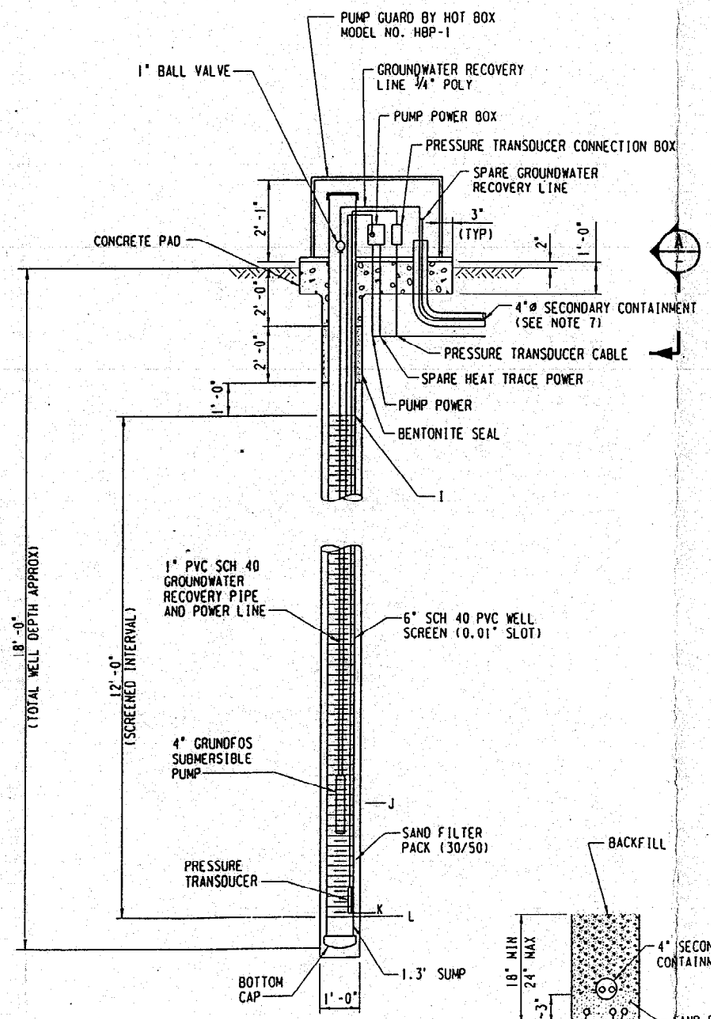
193-1-MW-S 193-1-MW-D

193-5-MW-S
193-5-MW-D

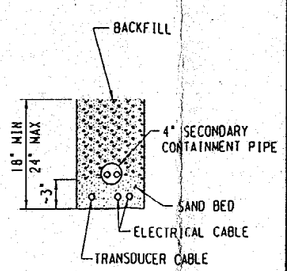
193-4-MW-S 193-4-MW-D



CONCRETE PAD PLAN
NTS (3 REQUIRED)



RECOVERY WELL PROFILE
NTS (3 REQUIRED)



SECTION A
NTS

NOTES

1. DEPTH OF SCREEN IS SET ABOVE EXISTING AQUITARD.
2. COORDINATES ARE SOUTH CAROLINA STATE PLANE.
3. THE EXISTING UNDERGROUND UTILITIES SHOWN ARE PARTIAL AND NOT INTENDED TO BE COMPLETE.
4. SCALE SHOWN ON THIS DRAWING IS BASED ON A DRAWING SIZE OF 22" X 34"; ANY REDUCTION IN DRAWING SIZE WILL REQUIRE AN APPROPRIATE ADJUSTMENT IN THE SCALE.
5. LOCATION SHOWN FOR UNDERGROUND RECOVERY LINES ARE APPROXIMATE.
6. ELECTRIC SERVICE DROP IS FROM POLE #1182.
7. ELEVATION OF SECONDARY CONTAINMENT PIPE ABOVE THE CONCRETE PAD IS MINIMUM OF 2" ABOVE THE TREATMENT PAD TOP OF CURB.
8. TREATED WATER IS BEING DISCHARGED TO FOTW SANITARY SEWER SYSTEM.
9. TREATMENT SYSTEM UTILIZES NCRD PHONE SERVICE.

REFERENCE DRAWINGS

GROUNDWATER TREATMENT SYSTEM P&ID	145-D000-007
GROUNDWATER EQUIPMENT BUILDING	145-D000-008
ELECTRICAL SYSTEM	145-D000-009
CONTROL SYSTEM	145-D000-010

LEGEND

- SANITARY SEWER MANHOLE
- MONITORING WELL
- RECOVERY WELL RW #
- UNDERGROUND GROUNDWATER RECOVERY LINE
- GROUNDWATER CONTAMINATION CONTOUR
- ppb — PARTS PER BILLION
- TREATED GROUNDWATER DISCHARGE LINE
- ELECTRIC & TELEPHONE SERVICE LINES

NO.	DATE	REVISIONS	BY	CHKR	DESIGN SUPV	ENGR	PROJ ENGR	MICRO FILMS
0		AS-BUILT						

SCALE NOTED

22567 145-D000-002

BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

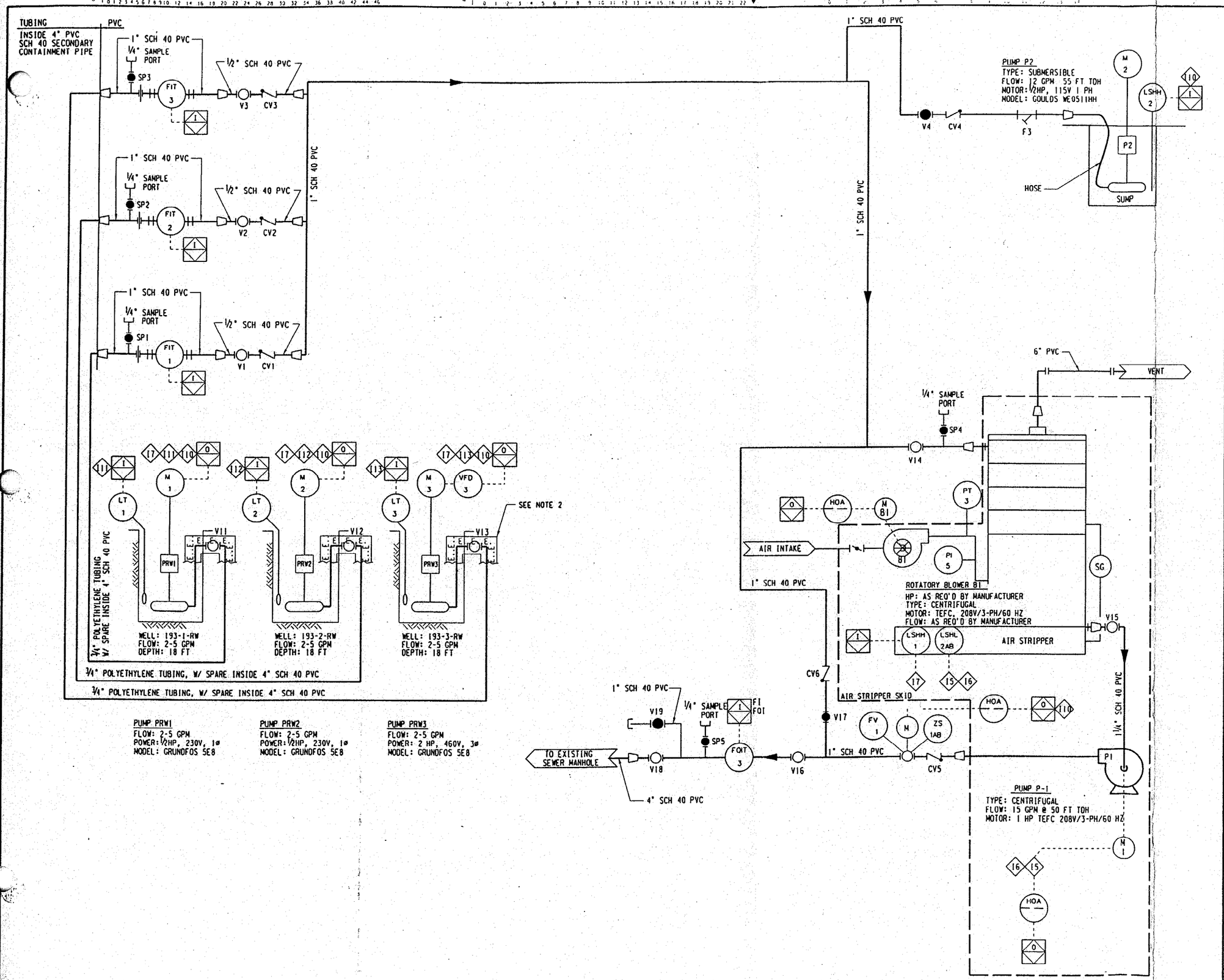
DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, S.C.
SITE 45/SWMU 45, DRY CLEANERS FACILITY
GROUNDWATER TREATMENT SYSTEM

JOB NO.	DRAWING NO.	REV
22567	145-D000-002	0

22567/145/1450002.DGN

230ABIZ



NOTES

1. FIT 1 THROUGH FIT 3 MUST BE INSTALLED IN VERTICAL RUN OF PIPE.
2. POWER FEED WILL BE INSTALLED TO EACH WELL FOR FUTURE HEAT TRACE INSTALLATION (IF NEEDED).
3. MOTOR FOR WELL 193-3-RW USES VARIABLE FREQUENCY DRIVE FOR LOW FLOW CONTROL.

LEGEND

INTERLOCKS

I5 - AIR STRIPPER SUMP LOW
I6 - AIR STRIPPER SUMP HIGH
I7 - AIR STRIPPER SUMP HIGH HIGH
I10 - SUMP HIGH HIGH LEVEL
I11 - WATER LEVEL AT P1
I12 - WATER LEVEL AT P2
I13 - WATER LEVEL AT P3

NO.	DATE	REVISIONS	BY	CHKR	RESIDENT	ENGR	PROJ ENGR	MICRO FLMD
0	6/23/00	AS-BUILT	JTM	JRM	NJA	WIL	JTM	

SCALE NOTED

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BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, S.C.
SITE 45/SWMU 45, DRY CLEANERS FACILITY
GROUNDWATER TREATMENT SYSTEM P & ID

JOB NO.	DRAWING NO.	REV
22567	145-D000-007	0

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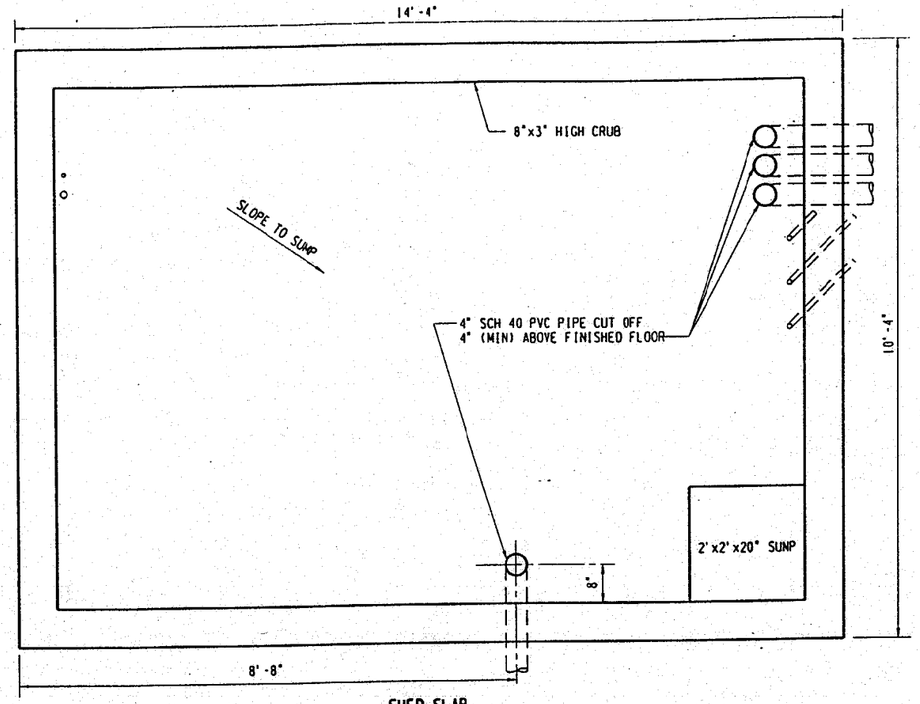
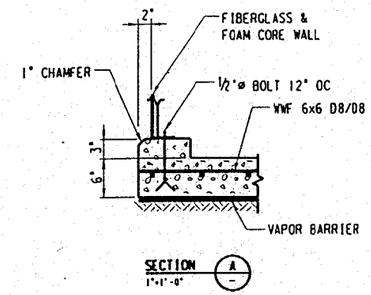
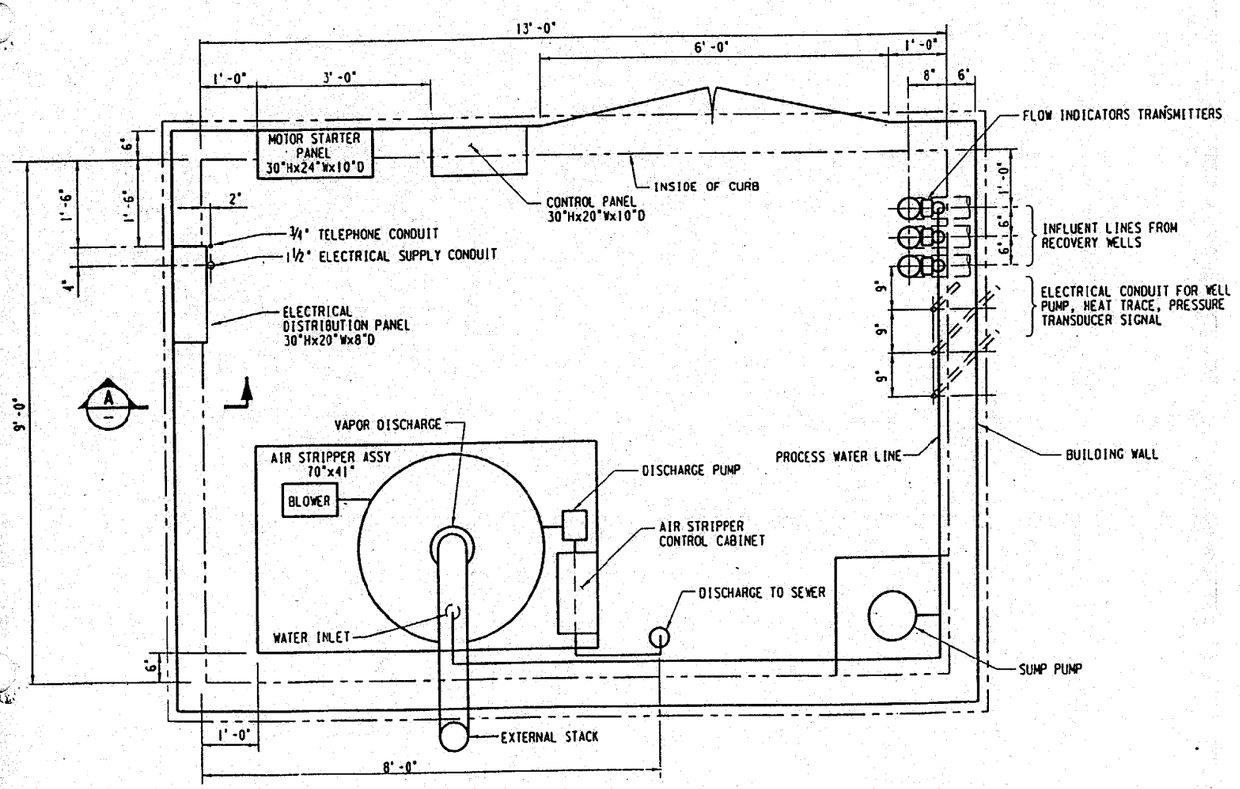


SHED SLAB





EQUIPMENT BUILDING, PLAN VIEW

NOTES

LEGEND

NO.	DATE	REVISIONS	BY	CHKR	DESIGN SUPV	ENGR	PROJ ENGR	MICRO FILMD
0		AS-BUILT						
A	2/5/98	ISSUED FOR REVIEW	RGB	WLU	NJA	WRZ	REH	

SCALE NOTED

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BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, S.C
SITE 45/SWMU 45, DRY CLEANERS FACILITY
GROUNDWATER EQUIPMENT BUILDING

JOB NO.	DRAWING NO.	REV
22567	145-D000-008	A

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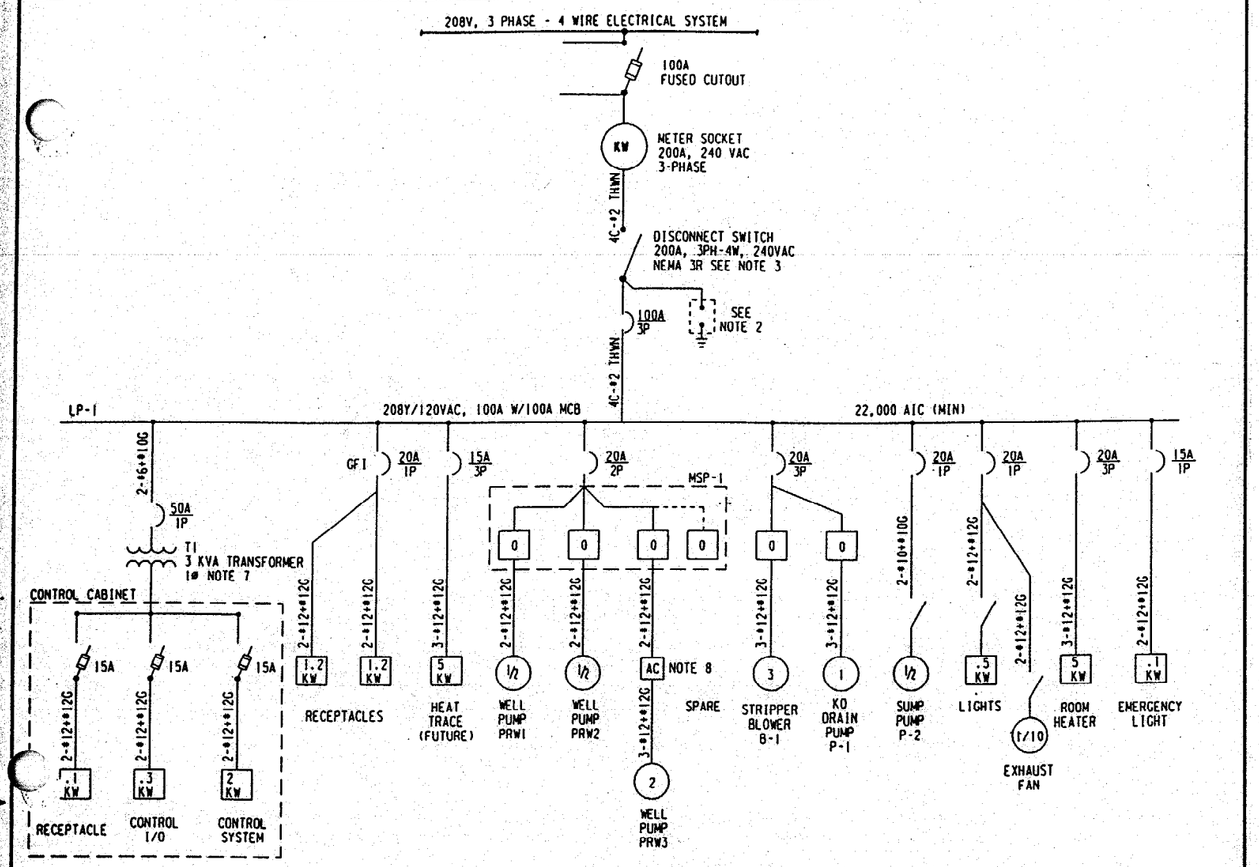
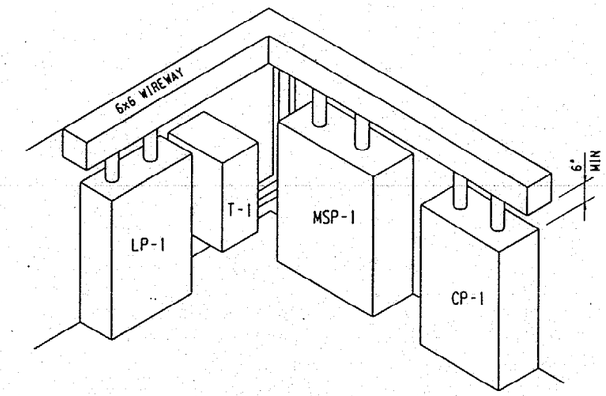
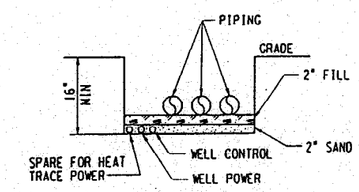




PANEL ARRANGEMENT
NTS



SECTION B
3/4"=1'-0"

NOTES

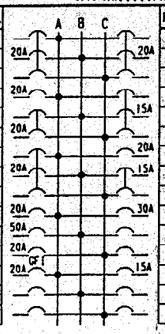
1. ELECTRICAL WORK SHALL BE DONE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NFPA 70).
2. SURGE ARRESTER, WIREMOLD SENTRON HB-120Y.
3. MOUNT DISCONNECT SWITCH ON SERVICE DROP POLE TO PROVIDE EASY ISOLATION POINT.
4. CONDUIT INSIDE BUILDING TO BE E.M.T.
5. CABLING TO WELLS TO BE DIRECT BURIED.
6. FLEXIBLE CONDUIT TO BE USED FOR MOTOR CONNECTION. FLEX LENGTH TO BE APPROXIMATELY 5 FEET.
7. POWER CONDITIONER, SOLA TYPE 63-23-230-8.
8. AC FREQUENCY CONTROLLER, SIEMENS MICROMASTER MODEL NUMBER 6SE9216-8CB40.

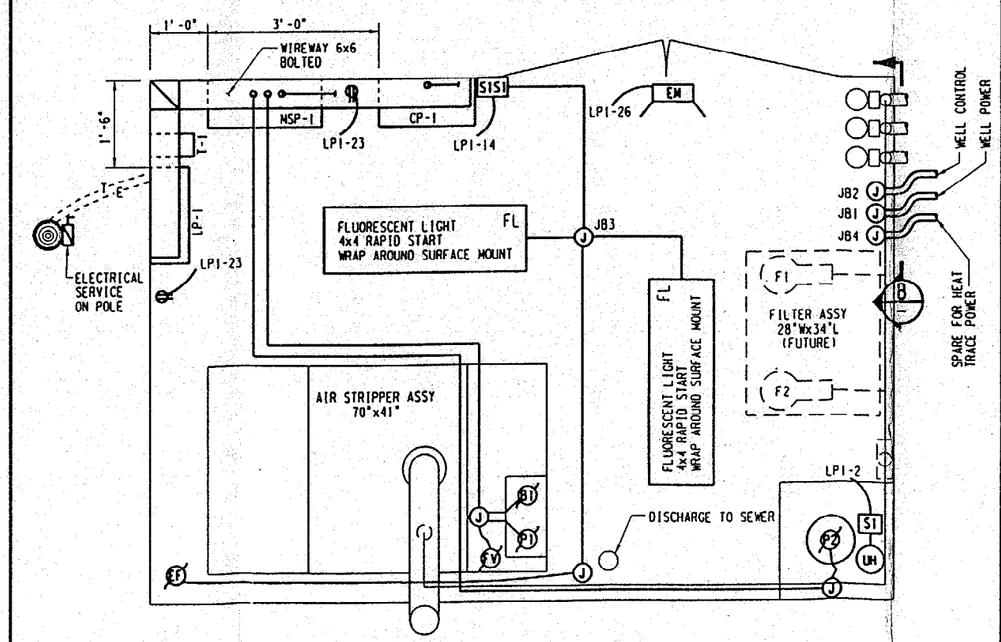
LEGEND

	DUPLEX RECEPTACLE
UH	ELECTRIC HEATER
EF	EXHAUST FAN MOTOR
FL	FLUORESCENT LIGHT FIXTURE
J	JUNCTION/PULL BOX
EM	EMERGENCY LIGHT DUAL-LITE DL-2, 120V
	DISCONNECT SWITCH
--- E ---	UNDERGROUND POWER CONDUIT
--- T ---	UNDERGROUND TELEPHONE CABLE

PANEL NO. LP-1	VOLTAGE: ☒ 120/208V,3 PHASE	GROUND: ☒ LUG ☐ BUS
MOUNTING: ☐ FLUSH ☒ SURFACE	MAINS: ☐ LUGS ONLY AMP. ☒ MAIN BREAKER 100 AMP. ☒ TOP ☐ BOTTOM	NEUTRAL: ☐ 50 % ☒ 100 %
COVER: ☒ WITH DOOR ☐ WITHOUT DOOR ☒ WITH LOCK ☐ WITHOUT LOCK	ALL BRANCH BKRS. 20A.,1 POLE UNLESS NOTED OTHERWISE U/L LISTED BKR. INTERRUPTING RATING 22000 RMS SYM. AMPS.	
CONNECTED LOAD: PHASE A 6.14 KW.....PHASE B 8.18 KW.....PHASE C 7.78 KW.....TOTAL 22.10		

LOCATION	LOAD	NO.	NO.	LOAD	LOCATION
STRIPPER BLOWER B-1	1.19	1	2	1.67	ROOM HEATER
	1.19	3	4	1.67	
	1.19	5	6	1.67	
SUMP PUMP P-2	1.01	7	8	1.67	HEAT TRACE
MOTOR STARTER PANEL	0.75	9	10	1.67	
MOTOR STARTER PANEL	0.75	11	12	1.67	
		13	14	0.50	LIGHTS & EXHAUST FAN
SPARE		15	16		SPARE
		17	18		SPARE
SPARE		19	20		SPARE
T1 TRANSFORMER	2.90	21	22		SPARE
RECEPTACLES	2.40	23	24		SPARE
SPARE		25	26	0.10	EMERGENCY LIGHT
SPACE		27	28		SPACE
		29	30		SPACE





EQUIPMENT BUILDING, PLAN VIEW
3/4"=1'-0"

NO.	DATE	REVISIONS	BY	CHKR	MECH SUPV	ENGR	PROJ ENGR	MICRO FLMD
0	9/20/99	AS-BUILT	JEM	WEH	NJA	WLU	JRM	

SCALE NONE

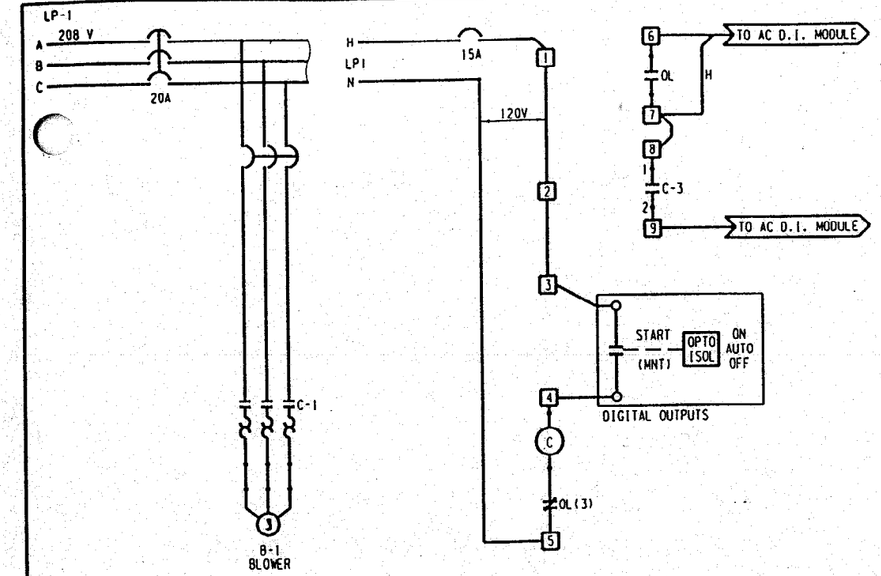
BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

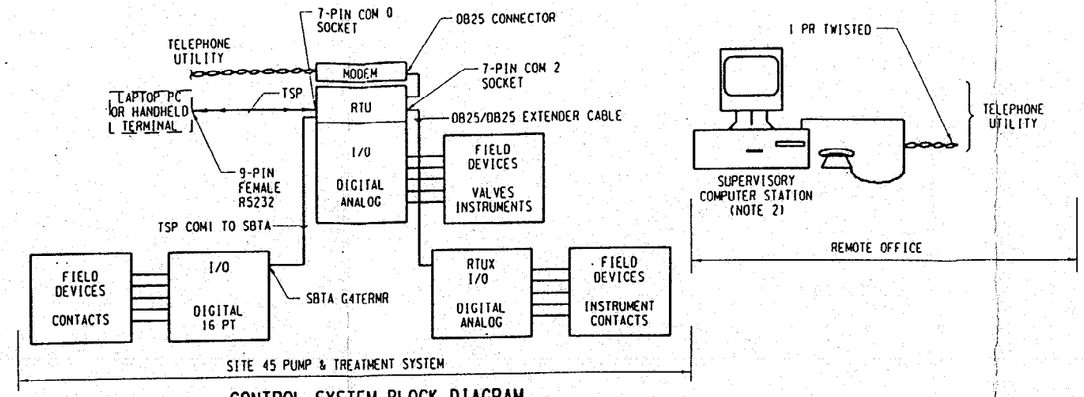
MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, S.C.
SITE 45/SWMU 45, DRY CLEANERS FACILITY
ELECTRICAL SYSTEM

JOB NO.	DRAWING NO.	REV
22567	145-D000-009	0

22567 145 1450009.DGN



208V, 3 PHASE MOTOR CONTROL SCHEMATIC, SINGLE SPEED

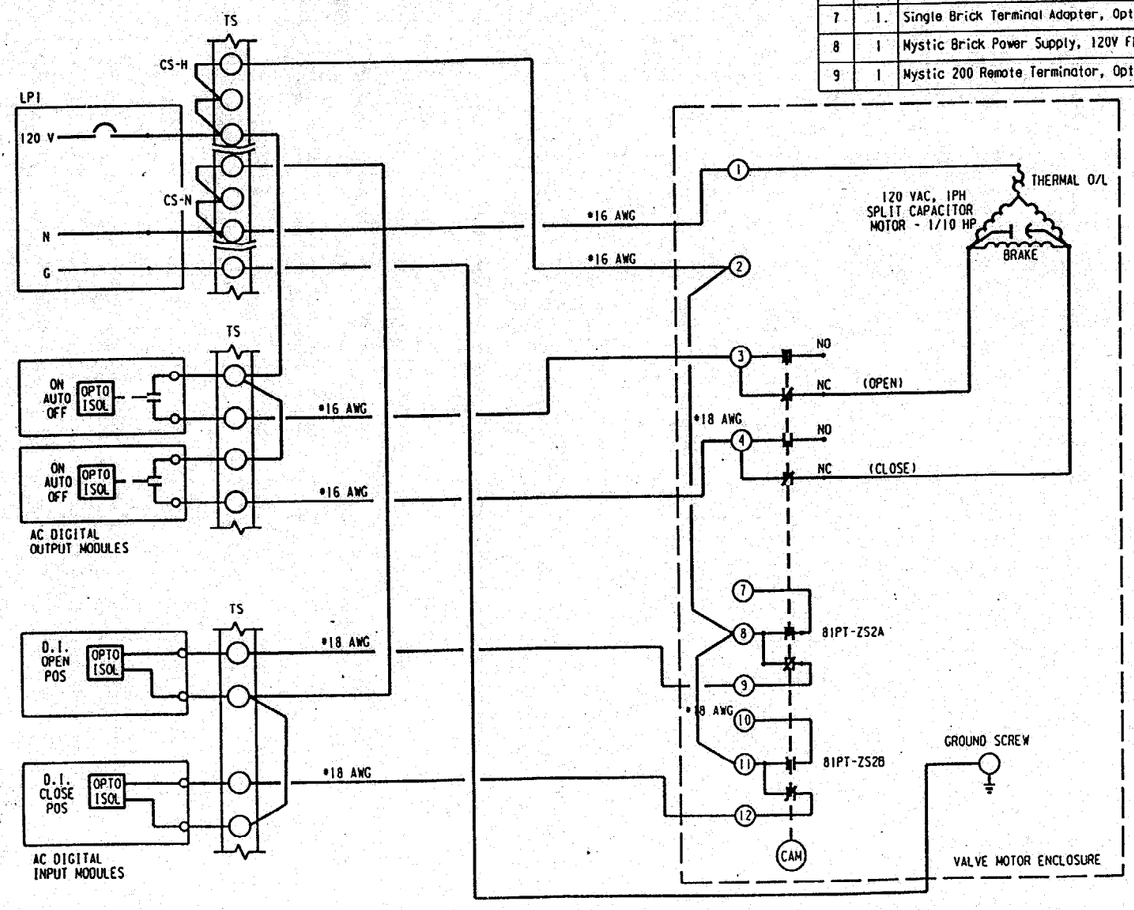


CONTROL SYSTEM BLOCK DIAGRAM

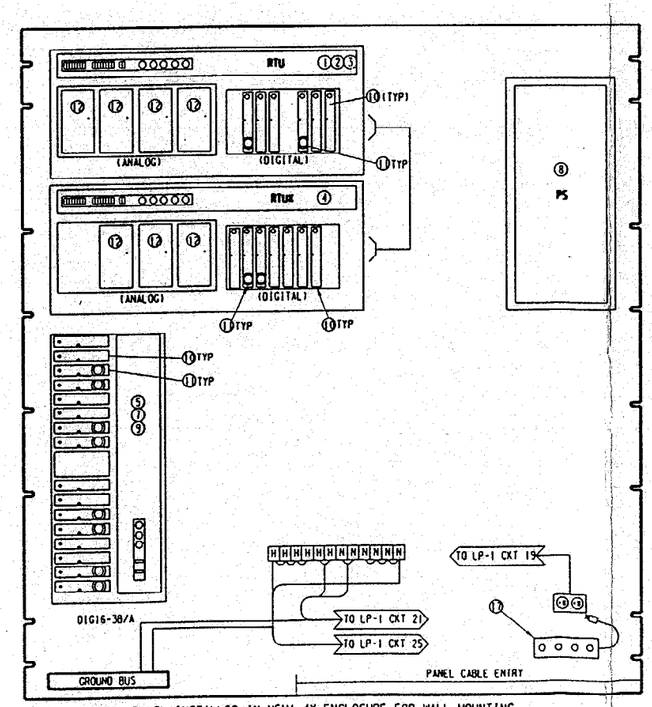
NTS

ITEM	QTY	DESCRIPTION
1	1	Remote Telemetry Unit, Opto 22 P/N M4RTU
2	1	RTU AC Power Supply 90-130V, Opto 22 P/N M4PS120A
3	1	RTU Serial Adapter Card, Opto 22 P/N M4SSER
4	1	Remote Telemetry Unit Extender, Opto 22 P/N M4RTUX
5	1	Mystic 200 Remote Digital Brick 16 I/O Points, Opto 22 P/N G4DI6R
7	1.	Single Brick Terminal Adapter, Opto 22 P/N SBTA
8	1	Mystic Brick Power Supply, 120V FN Opto 22 P/N G4PS24XAFM
9	1	Mystic 200 Remote Terminator, Opto 22 P/N G4TERMR

ITEM	QTY	DESCRIPTION
10	15	Digital AC Input Module, Opto 22 P/N G4IAC5
11	12	Digital AC Output Relays, with mode control toggle switch, Opto 22 P/N G4OAC5MA
12	10	Analog Input Module, 4-20 maDC, Opto 22 P/N G4AD3
14	1	Software, Mystic 200 Processor, lot Opto 22 P/N 'Cyrano 200'
15	1	Software, Mystic 200 Windows MMI, lot Opto 22 P/N 'Mystic MMI'
16	2	4 MEG RAM Expansion, Opto 22 P/N G4RAM4M
17	1	MODEM ZYPCOM Z326-SX
18	1	OPTO 22 P/N G4REG



FV MOTOR CONTROL SCHEMATIC



NOTE: CONTROL PANEL INSTALLED IN NEMA 4X ENCLOSURE FOR WALL MOUNTING.

CONTROL SYSTEM PANEL LAYOUTS

NTS

NOTES

1. FV MOTOR LOCKED-ROTOR CURRENT ESTIMATED TO BE 0.8 AMPERES. TYPICAL CONTROLLER RELAY OUTPUT HAS RATING OF 1 AMPERE. USE OF MOTOR STARTER IS NOT REQUIRED.
2. SUPERVISORY PC USES INTERNAL MODEM SETUP FOR COM PORT 2 COMMUNICATIONS.

LEGEND

GROUNDWATER PUMP AND TREATMENT SYSTEM P&ID	145-D000-010

LEGEND

C	CONTACTOR
DO	DIGITAL OUTPUT
DI	DIGITAL INPUT
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
MNT	MAINTAINED STATE
OL	OVERLOAD

NO.	DATE	REVISIONS	BY	CHKR	DESIGN SUPT	ENGR	PROJ ENGR	MICRO FILMD
0		AS-BUILT						

SCALE NONE

BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, S.C.
SITE 45/SWMU 45, DRY CLEANERS FACILITY
CONTROL SYSTEM

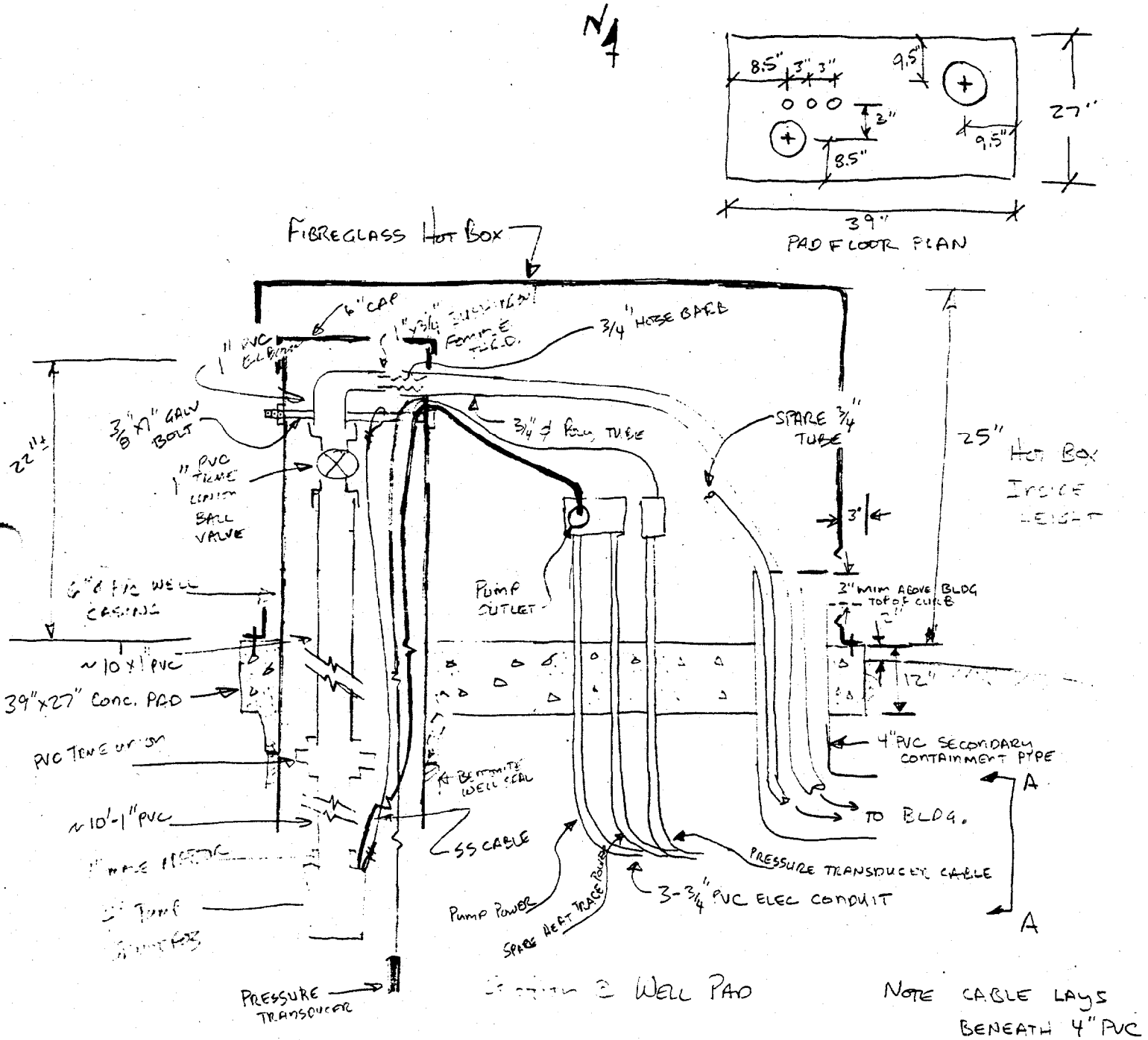
JOB NO.	DRAWING NO.	REV
22567	145-D000-010	0

22567 145 145D010.DGN

Bechtel

Calculation Sheet

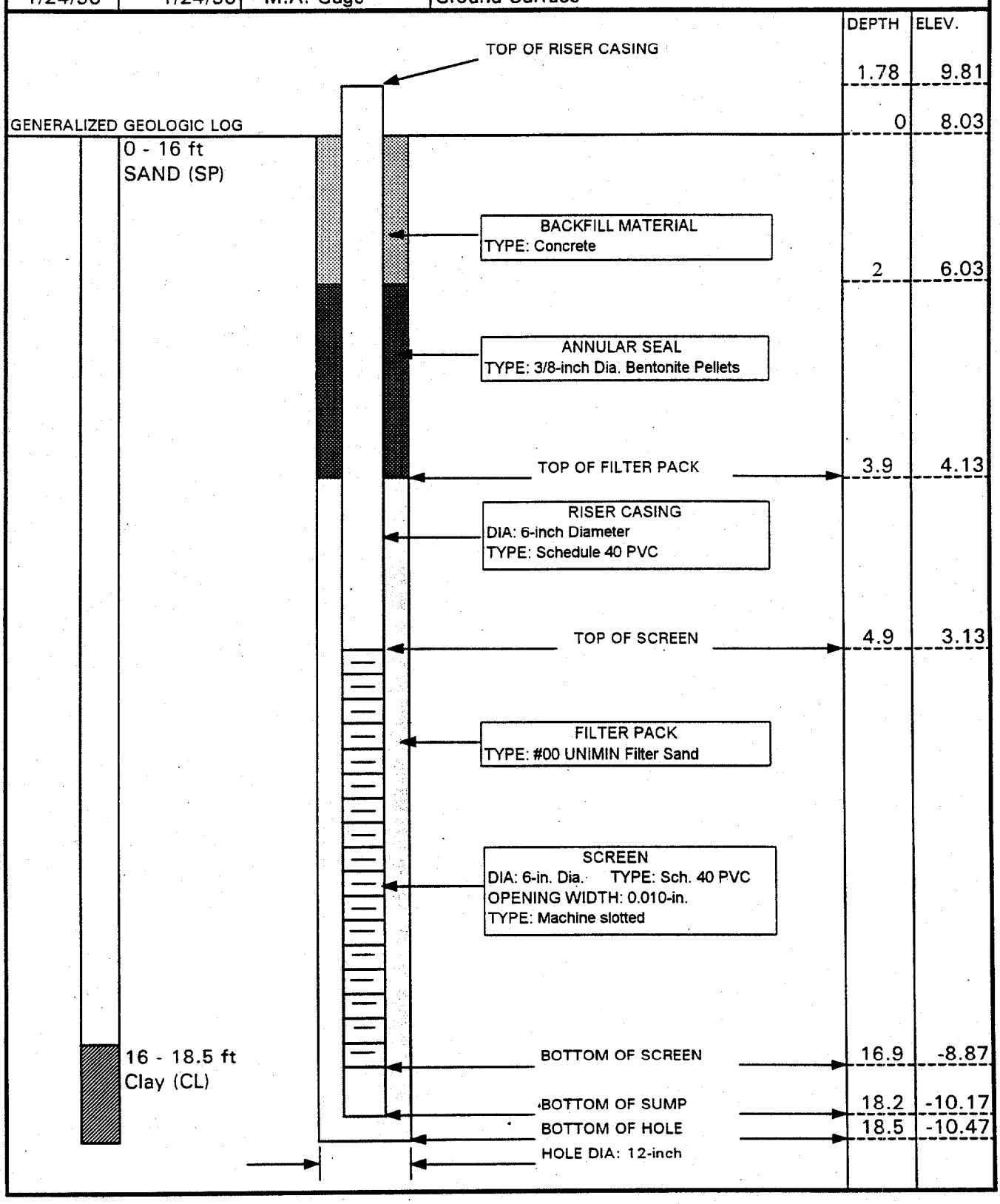
Originator: Bill Hevrdejs Date: April 28 1998 Calc. No. Rev. No.
Project: Navy EFC Job No. 22567-145 Checked Date
Subject: MCRD Parris Island DO 48 Recovery Well Pad As-Built Sheet No.



RECOVERY WELL	PROJECT Bldg 193, MCRD, Parris Island, SC	WELL NO. 193-1-RW

JOB NO.	SITE	COORDINATES
22567-145	45	N 187366.755, E 2099314.999

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
1/24/98	1/24/98	M.A. Gage	Ground Surface



DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: RW-1
Latitude: N 183360.795 Longitude: E 2099314.99
Distance and Direction from Road Intersections:
SEE ATTACHED MAP
Street Address & City of Well Location:
Sketch Map:
SEE ATTACHED MAP
RW #1

2. CUTTING SAMPLES: ☐ Yes ☒ No
Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	Thickness of Stratum	Depth to Bottom of Stratum
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: MARINE CORPS RECRUIT DEPOT
Address: DRY CLEANERS FACILITY
FLORIDA STREET PARRIS ISLAND, SC
Telephone No.:

Engineer: BECHTEL ENVIRONMENTAL
Address: 151 LAFAYETTE DRIVE
OAK RIDGE TN 37830
Telephone No.: (423) 220-2889

5. WELL DEPTH (completed) 18.10 ft. Date Started: 3-24-98 Date Completed: 3-24-98

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☒ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ______ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ~~☐ Monitor Well~~ ☒ Recovery

8. CASING: ☒ Threaded ☐ Welded
Diam.: 6"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
0 in. to 5 ft. depth
______ in. to ______ ft. depth
Height: Above/Below (Above circled) Surface ______ ft.
Weight ______ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: P.V.C. Diam.: 6"
Slot/Gauge: 0.10 Length: 12'
Set Between: 5 ft. and 17 ft. bls NOTE: MULTIPLE SCREENS
______ ft. and ______ ft. USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL 2.5 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface.
9 ft. after ______ hrs. Pumping 2 G.P.M.
Pumping Test: ☐ Yes (please enclose) ☒ No
Yield:

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☒ Yes ☒ No NA
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☐ Yes ☐ No
Installed from 18.10 ft. to 4 ft.
Effective size #30/50 Uniformity Coefficient

14. WELL GROUTED? ☐ Yes ☒ No
☐ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other
Depth: From ______ ft. to ______ ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 15 ft. NW direction
Type well disinfected ☐ Yes Type:
upon completion ☐ No Amount:

16. PUMP: Date installed: 4/7/95 Not installed ☐
Mfr. Name: GRUNDFOS Model No.: 5E8
H.P. 1/2 Volts 230 Length of drop pipe 12 ft. Capacity 5 gpm
TYPE: ☒ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

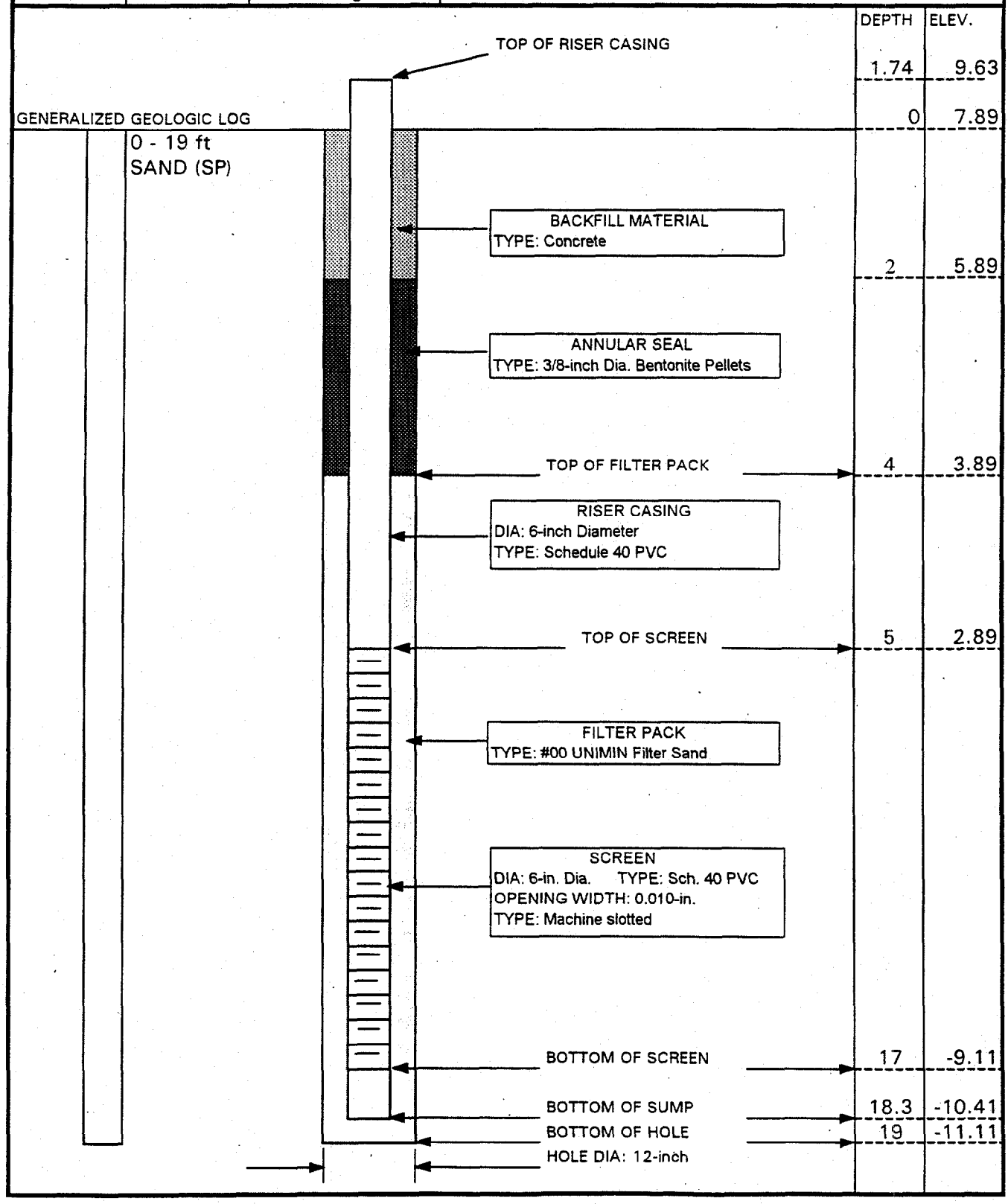
17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Atlantic Drilling Corp Date: 3-24-98
Address: 4247 Spruill Ave N. Charleston, S.C. 29405
Signed: Mark M. Jones Cert. No.: 1294
Authorized Representative

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

RECOVERY WELL	PROJECT Bldg 193, MCRD, Parris Island, SC	WELL NO. 193-2-RW

JOB NO.	SITE	COORDINATES
22567-145	45	N 187316.548, E 2099305.618

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
1/25/98	1/25/98	M.A. Gage	Ground Surface



D H E C

PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:

County: BEAUFORT System Name: RW 2

Latitude: N 32 18 56.48 Longitude: 20 99 305.616

Distance and Direction from Road Intersections:
SEE ATTACHED MAP

Street Address & City of Well Location:

Sketch Map:

SEE ATTACHED MAP

RW #2

2. CUTTING SAMPLES: ☐ Yes ☒ No

Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	Thickness of Stratum	Depth to Bottom of Stratum
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: MARINE CORPS RECRUIT DEPOT
Address: DRY CLEANERS FACILITY
BOUNDARY STREET PARRIS ISLAND SC
Telephone No:

Engineer: BECHTEL ENVIRONMENTAL
Address: 151 LAFAYETTE DRIVE
OAK RIDGE TN 37830
Telephone No: (423) 220-2889

5. WELL DEPTH (completed) 18.4 ft. Date Started: 3-25-98 Date Completed: 3-25-98

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☒ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitor Well ☒ Recovery

8. CASING: ☒ Threaded ☐ Welded
Diam.: 6"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
0 in. to 5 ft. depth
____ in. to ____ ft. depth

Height: (Above)/Below Surface ____ ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 6"
Slot/Gauge: 0.10 Length: 12'
Set Between: 5 ft. and 17 ft. NOTE: MULTIPLE SCREENS
____ ft. and ____ ft. USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL
2.5 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface.
9 ft. after ____ hrs. Pumping 2 G.P.M.
Pumping Test: ☐ Yes (please enclose) ☒ No
Yield:

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☐ Yes ☐ No
Installed from 18.4 ft. to 4. ft.
Effective size 30/50 Uniformity Coefficient ____

14. WELL GROUTED? ☐ Yes ☒ No
☐ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From ____ ft. to ____ ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 40 ft. NW direction
____ Type well disinfected ☐ Yes Type: ____
upon completion ☐ No Amount: ____

16. PUMP: Date installed: 4/7/98 Not installed ☐
Mfr. Name: Grundfos Model No.: 5E8
H.P. 1/2 Volts 230 Length of drop pipe 12 ft. Capacity 15 gpm
TYPE: ☒ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Registered Business Name: Atlantic Drilling Corp Date: 3-25-98

Address: 4247 Spruill Ave N. Charleston, S.C. 29405

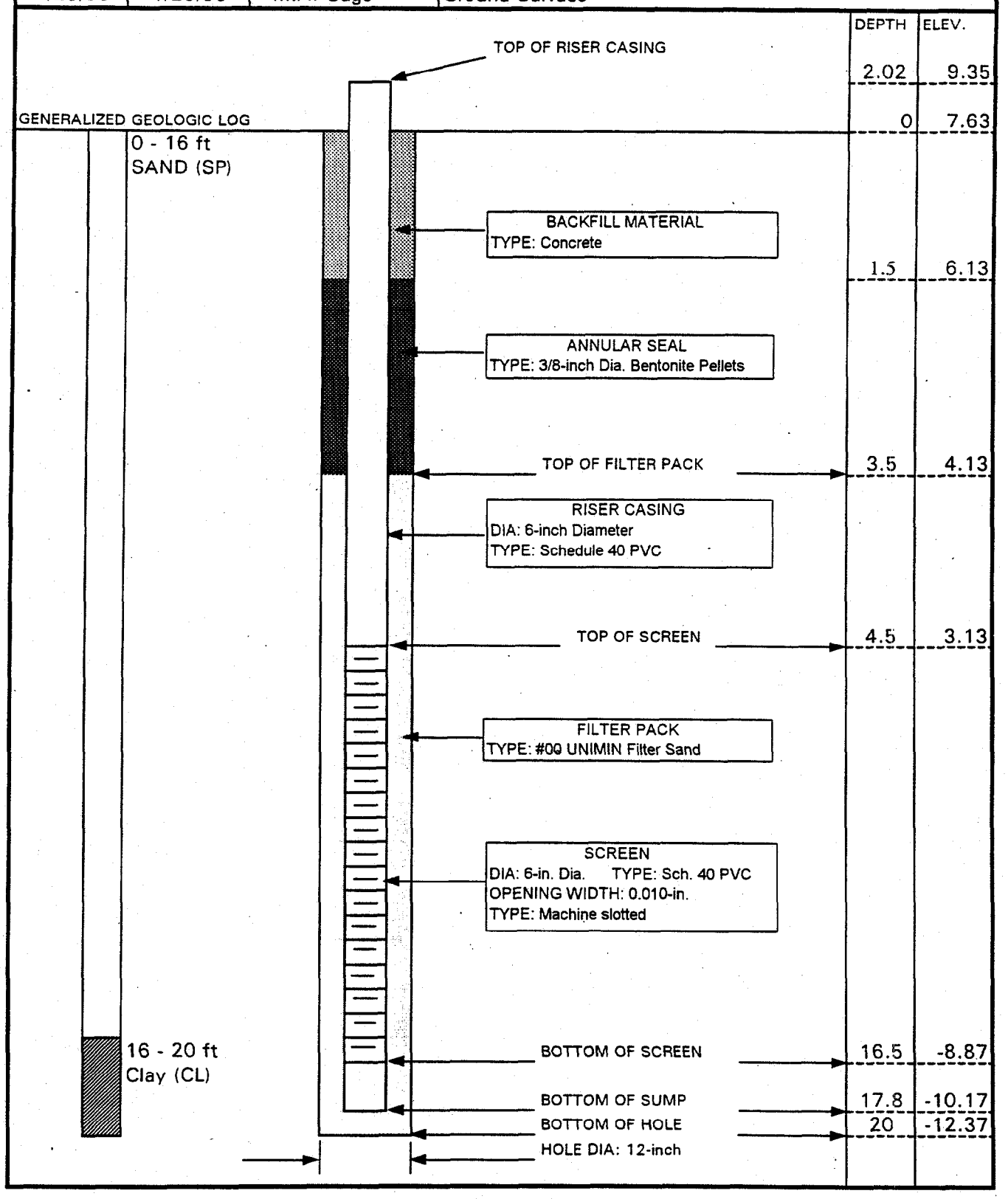
Signed: Nack R. Jones Cert. No.: 1294
Authorized Representative

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

RECOVERY WELL	PROJECT Bldg 193, MCRD, Parris Island, SC	WELL NO. 193-3-RW

JOB NO.	SITE	COORDINATES
22567-145	45	N 187263.741, E 209925.314

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
1/23/98	1/23/98	M.A. Gage	Ground Surface



D H E C

PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

LOCATION OF WELL:

County: Berkeley System Name: RW-3

Latitude: N 1[illegible] Longitude: E 209[illegible]

Distance and Direction from Road Intersections: See Attached Map

Street Address & City of Well Location:

Sketch Map: see Attached Map

RW-3

4. OWNER OF WELL: [illegible]

Address: [illegible]

Telephone No.: [illegible]

Engineer: [illegible]

Address: [illegible]

Telephone No.: [illegible]

5. WELL DEPTH (completed) 18.4 ft. Date Started: 3-23-98 Date Completed: 3-23-98

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☒ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitor Well ☒ Recovery

8. CASING: ☒ Threaded ☐ Welded
Diam.: 6"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
0 in. to 5 ft. depth
____ in. to ____ ft. depth
Height: Above/Below Surface ____ ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: P.V.C Diam.: 6"
Slot/Gauge: 0.10 Length: 12'
Set Between: 5 ft. and 17 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL 2.5 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. 9.1 ft. after ____ hrs. Pumping 2 G.P.M.
Pumping Test: ☐ Yes (please enclose) ☒ No
Yield: ____

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☐ Yes ☐ No
Installed from 18.4 ft. to 4 ft.
Effective size 30/50 Uniformity Coefficient ____

14. WELL GROUTED? ☐ Yes ☒ No
☐ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From ____ ft. to ____ ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 75 ft. NW direction
____ Type well disinfected ☐ Yes Type: ____
upon completion ☐ No Amount: ____

16. PUMP: Date installed: 4/7/98 Not installed ☐
Mfr. Name: Grundfos Model No.: 5 ES
H.P. 1/2 Volts 230 Length of drop pipe 12 ft. Capacity 15 gpm
TYPE: ☒ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

2. CUTTING SAMPLES: ☐ Yes ☒ No
Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	Thickness of Stratum	Depth to Bottom of Stratum

*Indicate Water Bearing Zones

(use a 2nd sheet if needed)

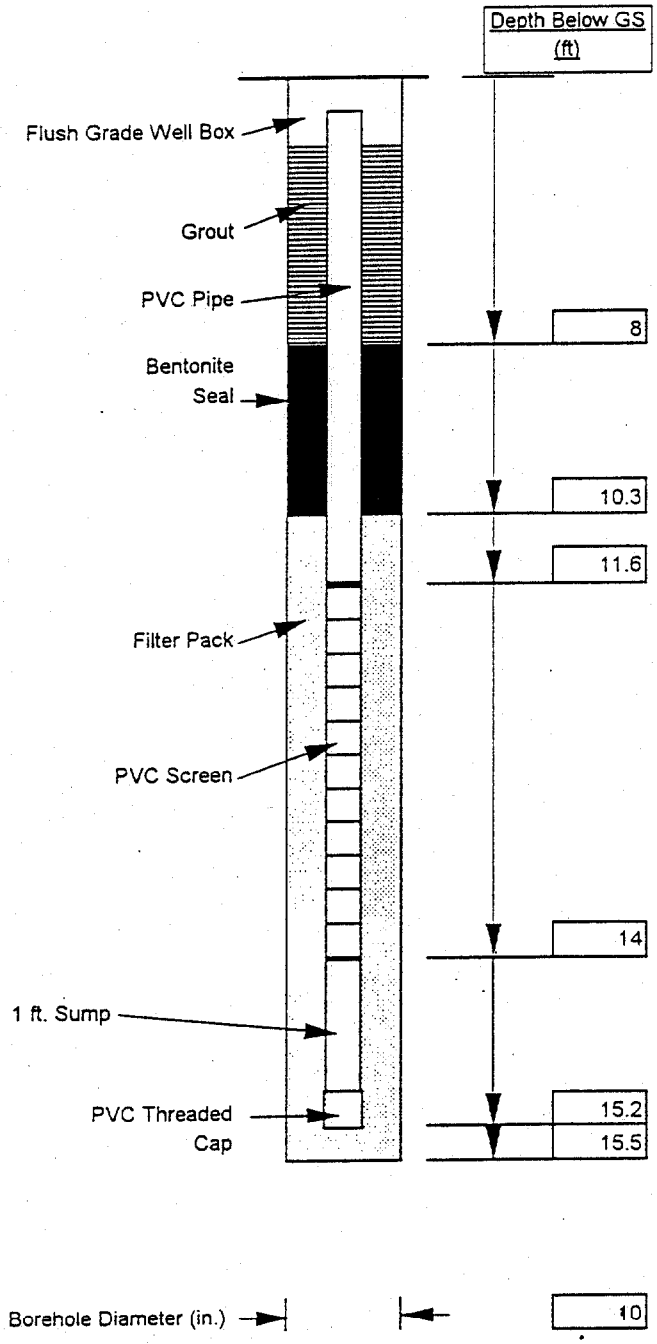
3. REMARKS:

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Atlantic Drilling Co. Date:
Address: 4247 Spruill Ave N. Charleston S.C. 29405
Signed: [illegible] Cert. No. 1294
Authorized Representative

HEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-1-MW-D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/11/96	Coordinates:	N 187454.710
Drilling Equipment:	Mobile B-57	Date Completed:	12/11/96		E 2099308.355
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.57 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	12.3

Backfill

Type	Grout Seal
Length (ft)	8
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2.3
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.2
Placement	Pour
Amount Placed	162.5 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	2.4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

N 187454.710 E 2099508.355

Latitude: Longitude:

Distance And Direction from Road Intersections

SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-1-MW) AND		
WELL CONSTRUCTION LOG		
(193-1-MW-D)		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL

Address MCRD DRYCLEANER FACILITY, MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer

Address AS ABOVE

Telephone No:

5. WELL DEPTH (Completed) 15.5 ft. Date Started: 12/11/96 Date Completed: 12/11/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to ~~15.2~~ 11.6 ft. depth

in. to ft. depth

Height: ~~Above~~/Below

Surface 0.4 ft.

Weight N/A lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 2.4

Set Between 11.6 ft. and 14 ft.

ft. and ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after hrs. pumping G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 10.3 ft. to 15.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐

Depth From 1 ft. to 8 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 100 Feet S/W Direction

Type Well disinfected upon completion ☐ Yes ☒ No Type Amount

16. PUMP: Date Installed not installed ☒

Mfr. name model no.

H.P. volts length of drop pipe ft. capacity gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME E.N.V. DRILLING, INC. ADDRESS

CERT. NO. 1299

Signed Date

AUTHORIZED REPRESENTATIVE

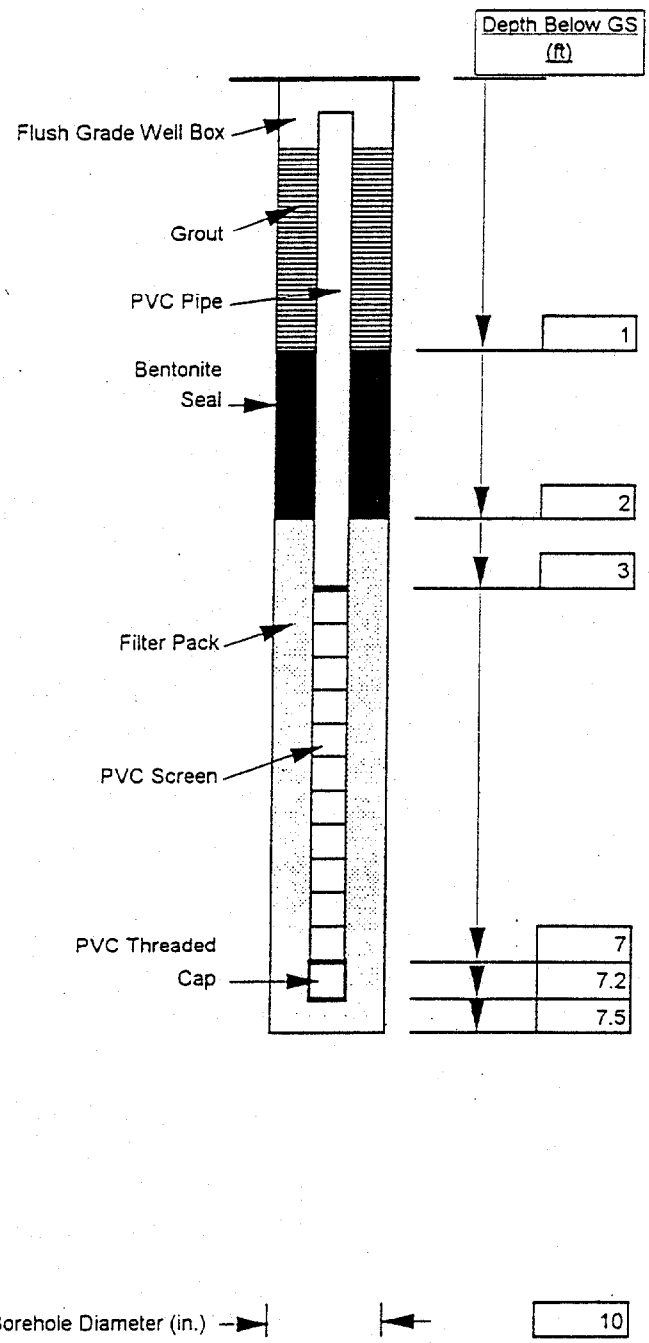
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-1-MW
Project Number: 22567-145	Elevation: 7.81 ft msl	
Location: Bld 193, Dry Cleaners	Date Started: 12/11/96	Date Completed: 12/11/96
Driller: Brian Cornell	Total Depth (ft): 20.0	
Equipment: Mobile B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 10	
Drilling Fluid: None	Depth to Water (ft): 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole to 4ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-5ft: SAND: *(SP)*, gry blk (N2) to lt brn gry (5YR6/1) to gry org (10YR7/4) to dk yel org (10YR6/6), fine, unconsld, mod well sort, subang to subrd, moist to v moist w/depth.	1	SS	80		2/3/3/5
		2	SS	70		5/6/5/4
5	5-6ft: CLAYEY SAND: *(SC)*, med lt gry (N6) v fine to fine, mod sort, unconsld, subang to subrd, v moist.	3	SS	90		3/2/2/4
	6-8ft: SAND: *(SP)*, lt gry (N7) to gry org (10YR7/4) to dk yel org (10YR6/6) to lt brn (5YR5/6) to med lt gry (N6), fine, mod well sort, unconsld, subang to subrd, wet at 7.5ft.	4	SS	100		5/6/3/2
		5	SS	100		2/2/1/2
10	8ft: SANDY CLAY: *(CL)*, med gry (N5), v fine to fine, unconsld, mod well sort, subang to subrd, v moist to wet.	6	SS	100		6/11/5/3
	8-10ft: CLAYEY SAND: *(SC)*, dk yel org (10YR6/6) to pale yel brn (10YR6/2) to med lt gry (N6), v fine to fine, unconsld, mod poor sort, subang to subrd, v moist to wet, @ 8.5-9ft fine sand lense.	7	SS	100		2/1/2/1
15		8	SS	100		2/2/1/1
	10-15.5ft: SAND: *(SP)*, dk yel org (10YR6/6) to gry org (10YR 7/4) to lt gry (N7) to v lt gry (N8), fine, unconsld, mod well sort, subang to subrd, wet @ 11.5ft, minor silt frac 10%.	9	SS	100		2/1/1/2
	15.5-17.7ft: SILTY SAND: *(SM)*, med dk gry (N4) to v pale org (10YR8/2) to gry org (10YR7/4) to med dk gry (N4), v fine to fine, unconsld, mod sort, subang to subrd, v moist.	10	SS	100		3/2/4/2
20						
	17.7-18ft: SANDY SILTY CLAY: *(CL)*					
	18-19ft: SILTY CLAY: *(CL)*, pale yel org (10YR6/2), v fine to fine, mod sort, unconsld, subang to subrd, v moist.					
25	19-19.3ft: CLAYEY SILTY SAND: *(SM/SC)*					
	19.3-19.7ft: SAND: *(SP)*, pink gry (5 YR8/1) to v lt gry (N8)					
	19.7-20ft: SANDY SILTY CLAY: *(CL)*, med dk gry (N4)					
	20ft: PEAT: *(Pt)*, dusky yel brn (10YR2/2) to brn blk (5YR2/1)					
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-1-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/11/96	Coordinates:	N 187455.597
Drilling Equipment:	Mobile B-57	Date Completed:	12/11/96		E 2099298.879
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.6 ft.msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	4

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	325 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

Latitude: N 187955.597 Longitude: E 2099288.879

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back) SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED Borehole		
log (193-1-MW) AND		
Well Construction		
log (193-1-MW-S)		
* Indicate water bearing zones (use a 2nd sheet if needed)		

3. REMARKS

4. OWNER OF WELL

Address: MCRD DRY CLEANER FACILITY, MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer Address: AS ABOVE

Telephone No:

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/11/96 Date Completed: 12/11/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING. ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 3 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~/Below Surface 0.4 ft.

Weight ____ lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 4

Set Between 3 ft. and 7 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield ____

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☐ Yes ☐ No

Installed from 2 ft. to 7.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ~~☒ Yes~~ ☒ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐ ____

Depth From ____ ft. to ____ ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 100 Feet SW Direction

PCE Type Well disinfected upon completion ☐ Yes ☒ No Type ____ Amount ____

16. PUMP: Date Installed ____ not installed ☒

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS

CERT. NO. 1279

Signed ____ Date ____

AUTHORIZED REPRESENTATIVE

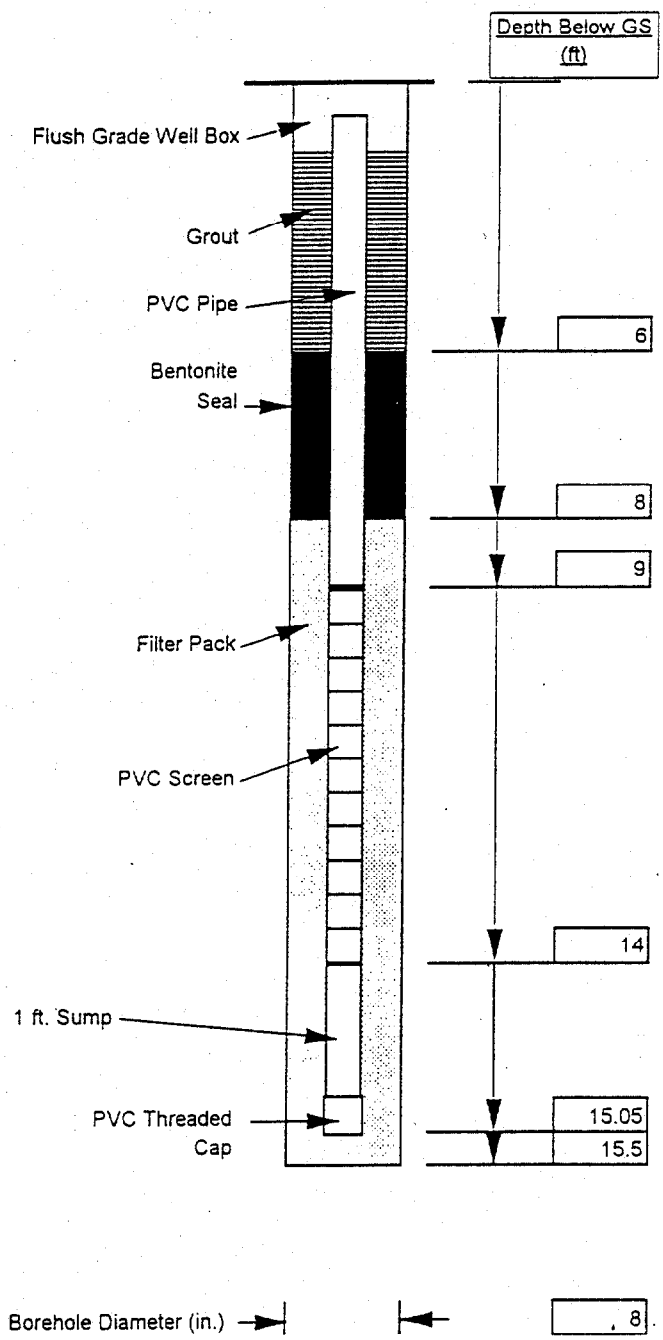
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-1-MW
Project Number: 22567-145	Elevation: 7.81 ft msl	
Location: Bld 193, Dry Cleaners	Date Started: 12/11/96	Date Completed: 12/11/96
Driller: Brian Cornell	Total Depth (ft): 20.0	
Equipment: Mobile B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 10	
Drilling Fluid: None	Depth to Water (ft): 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole to 4ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-5ft: SAND: *(SP)*, gry blk (N2) to lt brn gry (5YR6/1) to gry org (10YR7/4) to dk yel org (10YR6/6), fine, unconsld, mod well sort, subang to subrd, moist to v moist w/depth.	1	SS	80		2/3/3/5
		2	SS	70		5/6/5/4
5	5-6ft: CLAYEY SAND: *(SC)*, med lt gry (N6) v fine to fine, mod sort, unconsld, subang to subrd, v moist.	3	SS	90		3/2/2/4
	6-8ft: SAND: *(SP)*, lt gry (N7) to gry org (10YR7/4) to dk yel org (10YR6/6) to lt brn (5YR5/6) to med lt gry (N6), fine, mod well sort, unconsld, subang to subrd, wet at 7.5ft.	4	SS	100		5/6/3/2
		5	SS	100		2/2/1/2
10	8ft: SANDY CLAY: *(CL)*, med gry (N5), v fine to fine, unconsld, mod well sort, subang to subrd, v moist to wet.	6	SS	100		6/11/5/3
	8-10ft: CLAYEY SAND: *(SC)*, dk yel org (10YR6/6) to pale yel brn (10YR6/2) to med lt gry (N6), v fine to fine, unconsld, mod poor sort, subang to subrd, v moist to wet, @ 8.5-9ft fine sand lense.	7	SS	100		2/1/2/1
15		8	SS	100		2/2/1/1
	10-15.5ft: SAND: *(SP)*, dk yel org (10YR6/6) to gry org (10YR 7/4) to lt gry (N7) to v lt gry (N8), fine, unconsld, mod well sort, subang to subrd, wet @ 11.5ft, minor silt frac 10%.	9	SS	100		2/1/1/2
	15.5-17.7ft: SILTY SAND: *(SM)*, med dk gry (N4) to v pale org (10YR8/2) to gry org (10YR7/4) to med dk gry (N4), v fine to fine, unconsld, mod sort, subang to subrd, v moist.	10	SS	100		3/2/4/2
20	17.7-18ft: SANDY SILTY CLAY: *(CL)*					
	18-19ft: SILTY CLAY: *(CL)*, pale yel org (10YR6/2), v fine to fine, mod sort, unconsld, subang to subrd, v moist.					
25	19-19.3ft: CLAYEY SILTY SAND: *(SM/SC)*					
	19.3-19.7ft: SAND: *(SP)*, pink gry (5 YR8/1) to v lt gry (N8)					
	19.7-20ft: SANDY SILTY CLAY: *(CL)*, med dk gry (N4)					
	20ft: PEAT: *(Pt)*, dusky yel brn (10YR2/2) to brn blk (5YR2/1)					
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-2-MW-D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/14/96	Coordinates:	N 187341.197
Drilling Equipment:	Mobile B-57	Date Completed:	12/14/96		E 2099201.966
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.23 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	10

Backfill

Type	Grout Seal
Length (ft)	6
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	7.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	5
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

N 185734.197 E 2099201.966

Latitude: Longitude:

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
log (193-2-MW) AND		
WELL Construction log		
(193-2-MW-D)		

Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL:

Address MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer

Address AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 15.5 ft. Date Started: 12/14/96 Date Completed: 12/14/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 9 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~ Below Surface 0.4 ft.

Weight ____ lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 5

Set Between 9 ft. and 14 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield ____

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 8 ft. to 15.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐ ____

Depth From 1 ft. to 6 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 130 Feet NE Direction

PCE Type Well disinfected upon completion ☐ Yes Type ____ ☒ No Amount ____

16. PUMP: Date Installed ____ not installed ☒

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS ____

CERT. NO. 1299

Signed ____ Date ____

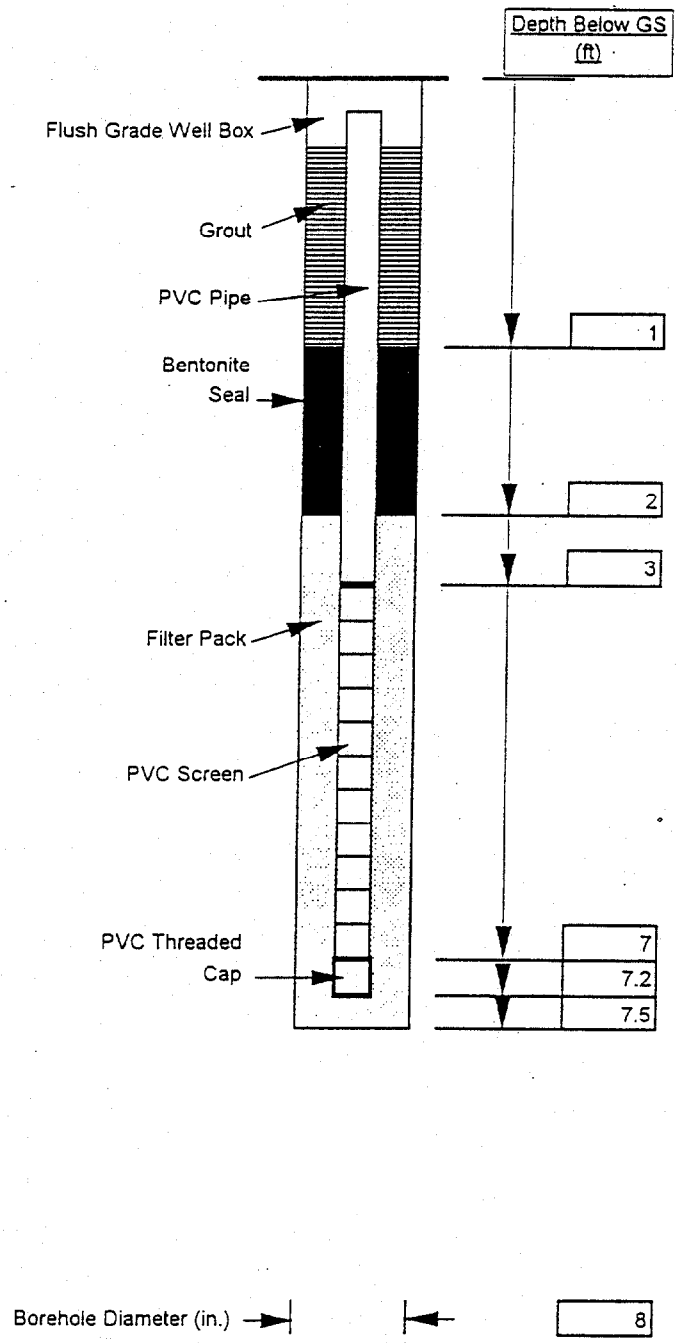
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-2-MW*
Project Number: 22567-145	*Elevation:* 7.45 ft msl	
Location: Bldg 193, Dry Cleaners	*Date Started:* 12/12/96	*Date Completed: 12/12/96*
Driller: Brian Cornell	*Total Depth (ft):* 18.0	
Equipment: Mobile B-57	*Depth to Bedrock (ft):* None	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in):* 8	
Drilling Fluid: None	*Depth to Water (ft):* 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By:* P. Linley	*Posthole to 4ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-7ft: SAND: *(SP)*, pale yel brn (10YR6/2) to dk gry (N3) to brn gry (5YR4/1) to lt brn gry (5YR6/1) to dk yel org (10YR6/6) fine, unconsld, mod well sort, subang to subrd, moist to v moist, wet at 6ft.	1	SS	40		3/4
5		2	SS	90		9/8/6/7
	7-7.8ft: CLAYEY SAND: *(SC)*, lt gry (N7), v fine to fine, mod sort, subang to subrd, unconsld, wet.	3	SS	100		4/3/3/3
	7.8-15.3ft: SAND: *(SP)*, dk yel org (10YR6/6) to med lt gry (N6) to v lt gry (N8) to pale brn (5YR5/2) to med dk gry (N4) to dk gry (N3), fine, mod sort, subang to subrd, unconsld, wet to saturated, minor silt frac	4	SS	100		2/3/6/4
10		5	SS	100		4/3/3/2
		6	SS	100		3/3/3/2
15		7	SS	100		2/2/2/1
	15.3-18ft: SILTY SAND: *(SM)*, med dk gry (N4) to dk gry (N3) to pale brn (5YR5/2) to pale yel brn (10YR6/2) @ 17ft lt gry (N7) at 17.6ft med dk gry (N4) to dk gry (N3) - clay frac increased to 20%, saturated, note organic matter (wood & roots) at	8	SS	100		1/2/3/3
20	17.8ft: PEAT: *(Pt)*, dusky yel brn (10YR2/2) to brn blk (5YR2/1)					
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-2-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/14/96	Coordinates:	N 187345.032
Drilling Equipment:	Mobile B-57	Date Completed:	12/14/96		E 2099203.731
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.11 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	5

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

N 187345.032 E 2099203.731

Latitude: Longitude:

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-2-MW) AND		
WELL CONSTRUCTION LOG		
(193-2-MW-S)		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL

Address: MCRD DRY CLEANER FACILITY, MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer

Address: AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/14/96 Date Completed: 12/14/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ MONITORING WELL

8. CASING. ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 3 ft. depth

in. to ft. depth

Height: ~~Above~~/Below Surface 0.4 ft.

Weight lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 4

Set Between 3 ft. and 7 ft.

ft. and ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after hrs. pumping G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 2 ft. to 7.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☐ Yes ☒ No

Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☐

Depth From ft. to ft. 130

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 80 Feet NE Direction

DCE Type Well disinfected upon completion ☐ Yes ☒ No Type Amount

16. PUMP: Date Installed not installed ☒

Mfr. name model no.

H.P. volts length of drop pipe ft. capacity gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: ENV. DRILLING, INC. ADDRESS

CERT. NO. 1299

Signed Date

AUTHORIZED REPRESENTATIVE

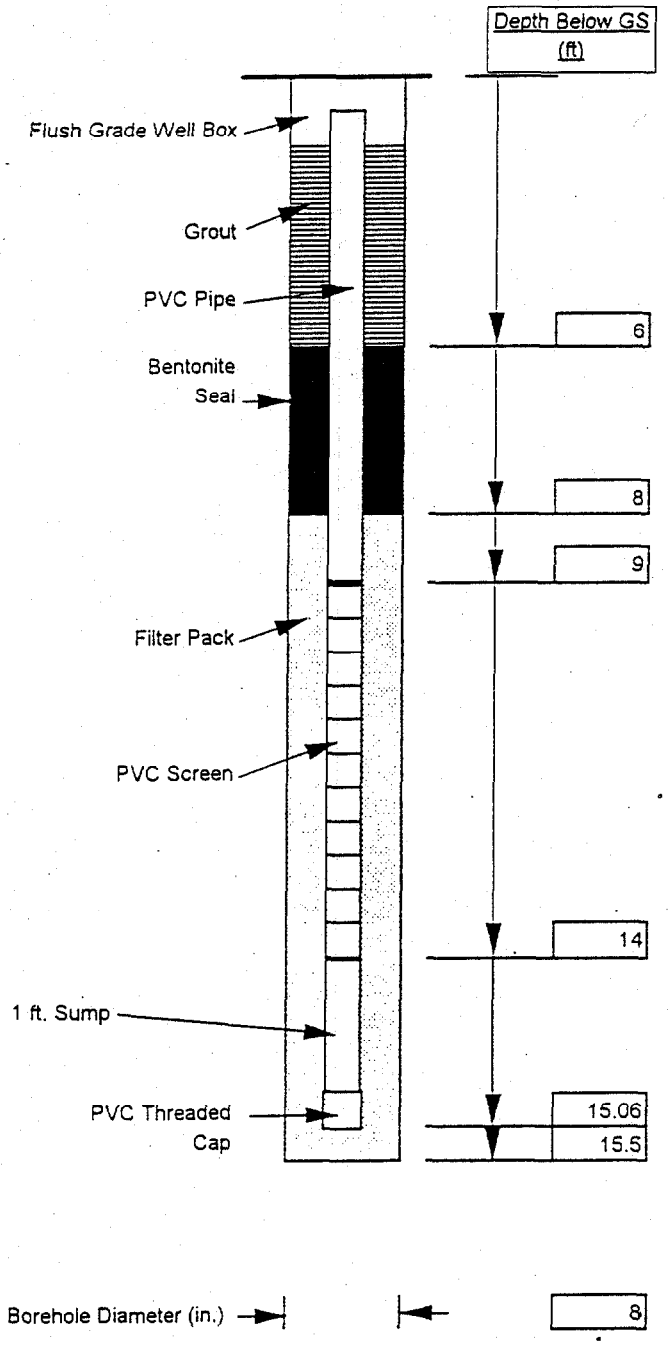
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-2-MW*
Project Number: 22567-145	*Elevation:* 7.45 ft msl	
Location: Bldg 193, Dry Cleaners	*Date Started:* 12/12/96	*Date Completed: 12/12/96*
Driller: Brian Cornell	*Total Depth (ft):* 18.0	
Equipment: Mobile B-57	*Depth to Bedrock (ft):* None	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in):* 8	
Drilling Fluid: None	*Depth to Water (ft):* 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By:* P. Linley	*Posthole to 4ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-7ft: SAND: *(SP)*, pale yel brn (10YR6/2) to dk gry (N3) to brn gry (5YR4/1) to lt brn gry (5YR6/1) to dk yel org (10YR6/6) fine, unconsld, mod well sort, subang to subrd, moist to v moist, wet at 6ft.	1	SS	40		3/4
5		2	SS	90		9/8/6/7
	7-7.8ft: CLAYEY SAND: *(SC)*, lt gry (N7), v fine to fine, mod sort, subang to subrd, unconsld, wet.	3	SS	100		4/3/3/3
	7.8-15.3ft: SAND: *(SP)*, dk yel org (10YR6/6) to med lt gry (N6) to v lt gry (N8) to pale brn (5YR5/2) to med dk gry (N4) to dk gry (N3), fine, mod sort, subang to subrd, unconsld, wet to saturated, minor silt frac	4	SS	100		2/3/6/4
10		5	SS	100		4/3/3/2
		6	SS	100		3/3/3/2
15		7	SS	100		2/2/2/1
	15.3-18ft: SILTY SAND: *(SM)*, med dk gry (N4) to dk gry (N3) to pale brn (5YR5/2) to pale yel brn (10YR6/2) @ 17ft lt gry (N7) at 17.6ft med dk gry (N4) to dk gry (N3) - clay frac increased to 20%, saturated, note organic matter (wood & roots) at	8	SS	100		1/2/3/3
20	17.8ft: PEAT: *(Pt)*, dusky yel brn (10YR2/2) to brn blk (5YR2/1)					
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-3-MW-D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/13/96	Coordinates:	N 187258.713
Drilling Equipment:	Mobile B-57	Date Completed:	12/13/96		E 2099239.820
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.57 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	10

Backfill

Type	Grout Seal
Length (ft)	6
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	7.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	5
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

Latitude: N 1572583.713 Longitude: E 2099239.820

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back) SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-3-MW)		
AND WELL CONSTRUCTION		
LOG (193-3-MW-D)		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL:

Address: MCRD. DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer Address: AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 15.5 ft. Date Started: 12/13/96 Date Completed: 12/13/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply-Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 9 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~/Below Surface 0.4 ft.

Weight ____ lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam. 2-IN

Slot/Gauze 0.010 Length 5

Set Between 9 ft. and 14 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield ____

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 8 ft. to 15.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐ ____

Depth From 1 ft. to 6 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 210 Feet N Direction

PCE Type

Well disinfected upon completion ☐ Yes ☒ No Type ____ Amount ____

16. PUMP: Date Installed ____ not installed ☒

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: ENV. DRILLING, INC. ADDRESS

CERT. NO. 1799

Signed ____ Date ____

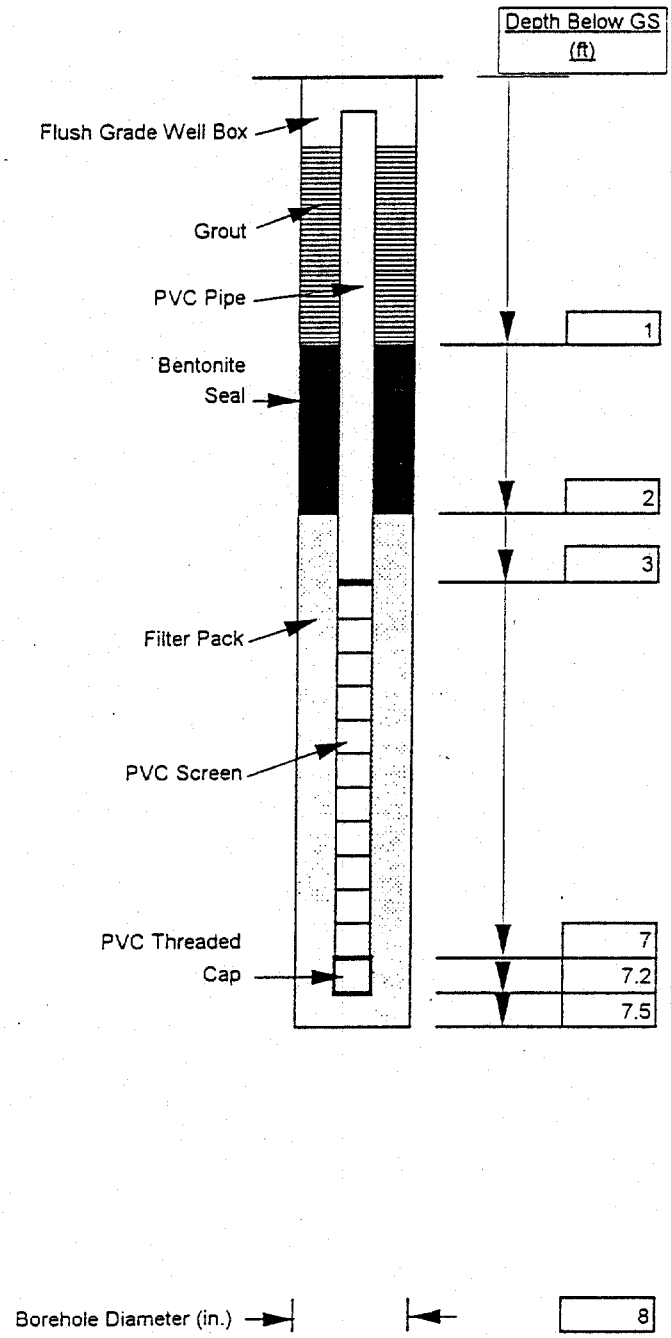
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-3-MW
Project Number: 22567-145	Elevation: 7.78 ft msl	
Location: Bldg 193, Dry Cleaners	Date Started: 12/12/96	Date Completed: 12/12/96
Driller: Brian Cornell	Total Depth (ft): 18.0	
Equipment: Moblie B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 8	
Drilling Fluid: None	Depth to Water (ft): 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole to 4ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-7.3ft: SAND: *(SP)*, gry blk (N2) to brn gry (5YR4/1) to med lt gry (N6) to med dk gry (N4), fine, unconsld, mod well sort, subang to subrd, v lt gry (N8), wet at 3ft, minor silt frac 10%	1	SS	25		1/5
		2	SS	75		4/4/4/5
5		3	SS	100		2/1/0/1
	7.3-8ft: SILTY CLAY: *(CL)*, med gry (N5), v fine, unconsld, mod well sort, subang to subrd, wet.	4	SS	100		1/0/2/7
	8-10ft: SILTY CLAY/SAND: *(SM)*, lt gry (N6), v fine, unconsld, mod sort, subang to subrd, wet.	5	SS	100		5/14/23/25
10	10-17.8ft: SAND: *(SP)*, pale yel brn (10YR6/2) to mod yel brn (10YR5/4) to pale brn (5YR5/2) to lt gry (N7) to v lt gry (N8) to lt olive gry (5Y5/2) to dk yel org (10YR6/6) to lt brn (5YR5/6) to white (N9) to med dk gry (N4) to dk gry (N3), fine, unconsld, mod well sort, subang to subrd, wet, silt frac 10%.	6	SS	100		10/4/5/5
		7	SS	100		3/3/2/2
15	10.6-10.7ft SILTY CLAY: lt gry (N7) lense.	8	SS	100		2/1/3/7
	17.8-18ft: SILTY CLAY: *(CL)*:, dk gry (N3) note ogranic matter (peat) w/in sample, v fine, semiconsld, mod sort, wet.					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-3-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/13/96	Coordinates:	N 187257.657
Drilling Equipment:	Mobile B-57	Date Completed:	12/13/96		E 2099244.001
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.6 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	4.7

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 **Water Well Record**

LOCATION OF WELL
County: BEAUFORT System Name: N/A
N187257.657 E2059244.001
Latitude: Longitude:

Distance And Direction from Road Intersections
SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)
SEE ATTACHED MAP

CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED		
BOREHOLE LOG		
(193-3-MW) AND		
WELL CONSTRUCTION		
LOG (193-3-MW-5)		

Indicate water bearing zones

(use a 2nd sheet if needed)

REMARKS:

4. OWNER OF WELL: Address MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC
Telephone No. 803/525-2630
Engineer Address AS ABOVE
Telephone No:

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/13/96 Date Completed: 12/13/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply-Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING. ☒ Threaded ☐ Welded
Diam. 2-IN
Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
3 in. to 3 ft. depth
___ in. to ___ ft. depth
Height: ~~Above~~/Below Surface 0.4 ft.
Weight ____ lbs./ft.
Drive Shoe? ☐ Yes ☒ No

9. SCREEN:
Type: PVC Diam. 2-IN
Slot/Gauze 0.010 Length 4
Set Between 3 ft. and 7 ft. **NOTE: MULTIPLE SCREENS USE SECOND SHEET**
___ ft. and ___ ft.
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL 3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
___ ft. after ___ hrs. pumping ___ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☒ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No
Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 2 ft. to 7.5 ft.
Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☐ Yes ☒ No
Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☐
Depth From ___ ft. to ___ ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 210 Feet N Direction
PCE Type Well disinfected upon completion ☐ Yes ☒ No Type ____ Amount ____

16. PUMP: Date Installed ____ not installed ☒
Mfr. name ____ model no. ____
H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS:
CERT. NO. 1299
Signed
Date

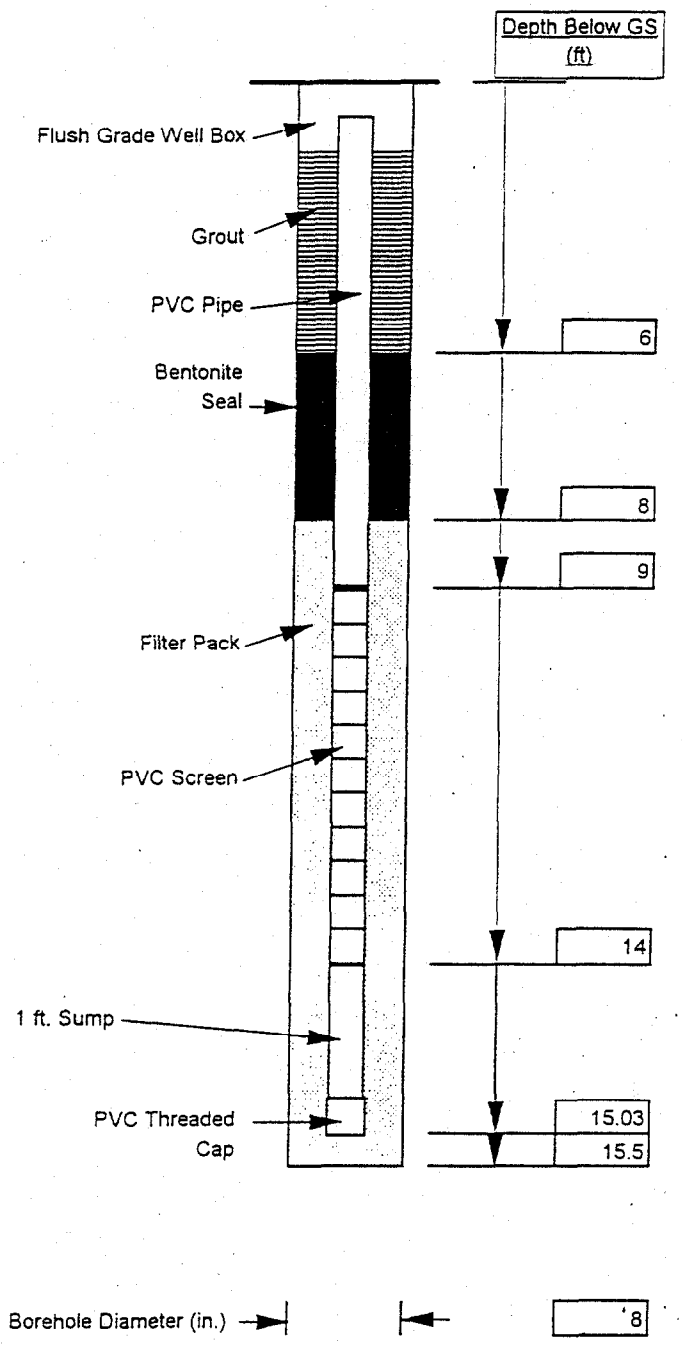
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-3-MW*
Project Number: 22567-145	*Elevation: 7.78 ft msl*	
Location: Bldg 193, Dry Cleaners	*Date Started: 12/12/96*	*Date Completed: 12/12/96*
Driller: Brian Cornell	*Total Depth (ft): 18.0*	
Equipment: Moblie B-57	*Depth to Bedrock (ft): None*	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in): 8*	
Drilling Fluid: None	*Depth to Water (ft): 3.0*	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By: P. Linley*	*Posthole to 4ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-7.3ft: SAND: *(SP)*, gry blk (N2) to brn gry (5YR4/1) to med lt gry (N6) to med dk gry (N4), fine, unconsld, mod well sort, subang to subrd, v lt gry (N8), wet at 3ft, minor silt frac 10%	1	SS	25		1/5
		2	SS	75		4/4/4/5
5		3	SS	100		2/1/0/1
	7.3-8ft: SILTY CLAY: *(CL)*, med gry (N5), v fine, unconsld, mod well sort, subang to subrd, wet.	4	SS	100		1/0/2/7
10	8-10ft: SILTY CLAY/SAND: *(SM)*, lt gry (N6), v fine, unconsld, mod sort, subang to subrd, wet.	5	SS	100		5/14/23/25
	10-17.8ft: SAND: *(SP)*, pale yel brn (10YR6/2) to mod yel brn (10YR5/4) to pale brn (5YR5/2) to lt gry (N7) to v lt gry (N8) to lt olive gry (5Y5/2) to dk yel org (10YR6/6) to lt brn (5YR5/6) to white (N9) to med dk gry (N4) to dk gry (N3), fine, unconsld, mod well sort, subang to subrd, wet, silt frac 10%.	6	SS	100		10/4/5/5
		7	SS	100		3/3/2/2
15	10.6-10.7ft SILTY CLAY: lt gry (N7) lense.	8	SS	100		2/1/3/7
	17.8-18ft: SILTY CLAY: *(CL)*:, dk gry (N3) note ogranic matter (peat) w/in sample, v fine, semiconsld, mod sort, wet.					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-MW-4D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/12/96	Coordinates:	N 187149.280
Drilling Equipment:	Mobile B-57	Date Completed:	12/12/96		E 2099253.080
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	6.93 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	10

Backfill

Type	Grout Seal
Length (ft)	6
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	7.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	5
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: DE AUTOMET System Name: N/A

N187149.250 E2099253.050

Latitude: Longitude:

Distance And Direction from Road Intersections

SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-4-MW) AND		
WELL CONSTRUCTION LOG		
(193-4-MW-D)		

Note water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL:

Address MCRD DRY CLEANER FACILITY
MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SC

Telephone No. 803 / 525-2630

Engineer

Address AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 15.5 ft. Date Started: 12/12/96 Date Completed: 12/12/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 9 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~/Below Surface 0.4 ft.

Weight ____ lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 5

Set Between 9 ft. and 14 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield ____

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 8 ft. to 15.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐ ____

Depth From 1 ft. to 6 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 360 Feet N Direction

PCE Type

Well disinfected upon completion ☐ Yes Type ____ ☒ No Amount ____

16. PUMP: Date Installed ____ not installed ☒

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS ____

CERT. NO. 1299

Signed ____ Date ____

AUTHORIZED REPRESENTATIVE

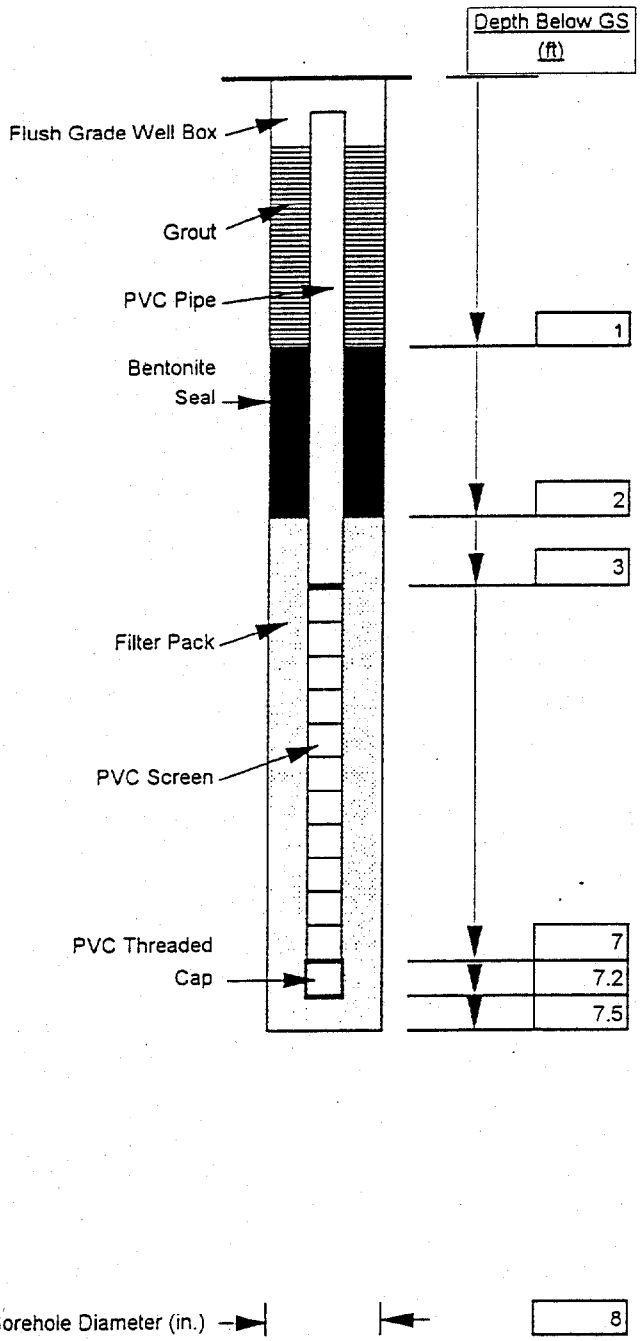
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-4-MW*
Project Number: 22567-145	*Elevation:* 7.14 ft msl	
Location: Bldg 193, Dry Cleaners	*Date Started: 12/12/96*	*Date Completed: 12/12/96*
Driller: Brian Cornell	*Total Depth (ft): 18.0*	
Equipment: Mobile B-57	*Depth to Bedrock (ft): None*	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in): 8*	
Drilling Fluid: None	*Depth to Water (ft): 3.0*	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By: P. Linley*	*Posthole to 4ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-7.2ft: SAND: *(SP)*, gry blk (N2) to med lt gry (N6) to dk yel org (10YR6/6) to brn gry (5YR4/1) to lt brn (5YR5/6), fine, mod well sort, unconsld, subang to subrd, wet at 3ft, silt frac 15%.					
		1	SS	50		2/5
5		2	SS	70		2/2/3/6
	7.2-7.9ft: SILTY CLAY: *(CL)*, lt gry (N7), v fine to fine, mod sort, unconsld, subang to subrd, wet.	3	SS	70		5/1/1/2
	7.9-17.2ft: SAND: *(SP)*, lt gry (N7) to v lt gry (N8) to white (N9)	4	SS	60		5/7/11/15
10	to med gry (N5) to gry org (10YR7/4) to pale yel brn (10YR6/2) to med dk gry (N4) to dk gry (N3), fine, unconsld, mod well sort, subang to subrd, silt frac 10-15%, wet to saturated	5	SS	75		5/8/7/6
		6	SS	100		1/2/2/3
15		7	SS	100		1/2/1/2
	17.2-18ft: CLAY: *(CL)*, med dk gry (N4) to dk gry (N3), v fine semiconsld, mod well sort, v moist to wet.	8	SS	100		1/3/4/6
	17.4ft: PEAT: *(Pt)*, dusky yel brn (10YR2/2) to brn blk (5YR2/1)					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-4-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/12/96	Coordinates:	N 187150.910
Drilling Equipment:	Mobile B-57	Date Completed:	12/12/96		E 2099249.096
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	6.98 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	4.7

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	162.5 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

Latitude: N 187150.910 Longitude: E 2099249.096

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-4-MW)		
AND WELL CONSTRUCTION		
LOG (193-4-MW-S)		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL

Address: MCRD DRY CLEANER FACILITY, MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer

Address: AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/12/96 Date Completed: 12/12/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 3 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~/Below Surface 0.4 ft.

Weight ____ lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam. 2-IN

Slot/Gauze 0.010 Length 4

Set Between 3 ft. and 7 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield ____

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 2 ft. to 7.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☐ Yes ☒ No

Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☐ ____

Depth From ____ ft. to ____ ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 360 Feet N Direction

PCE Type Well disinfected upon completion ☐ Yes Type ____ ☒ No Amount ____

16. PUMP: Date Installed ____ not installed ☒

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME ENVIDRILLING INC. ADDRESS ____

CERT. NO. 1299

Signed ____ Date ____

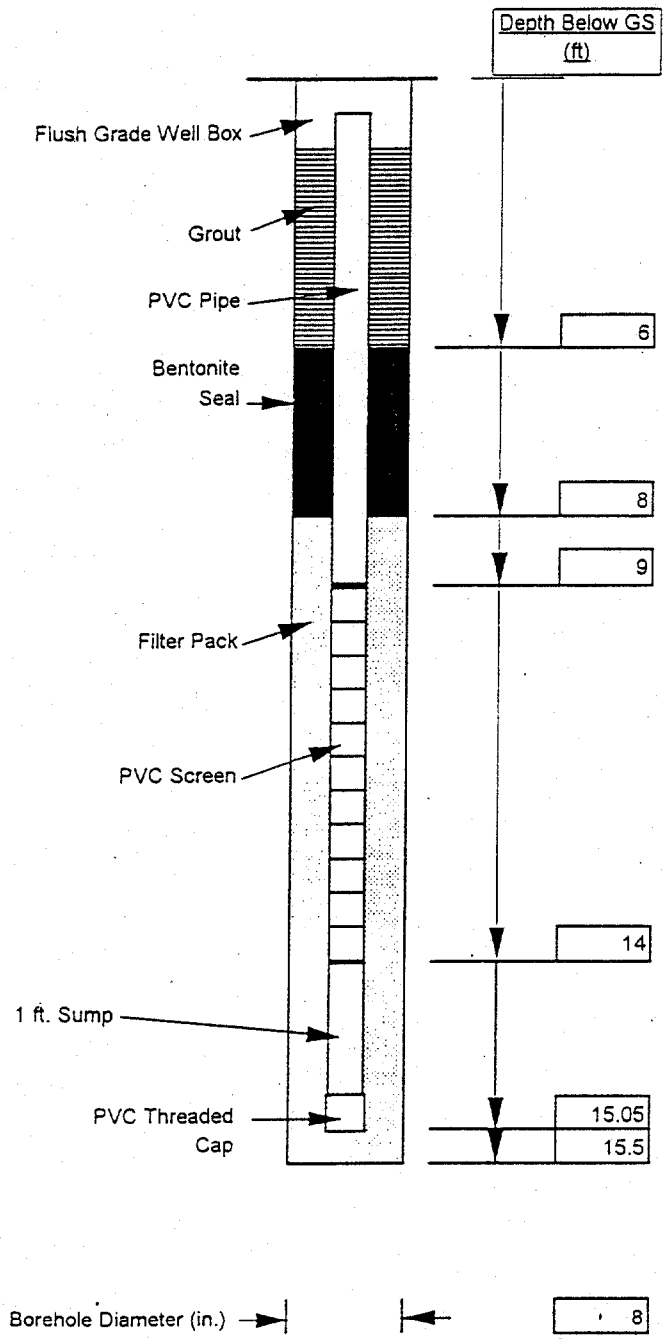
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-4-MW*
Project Number: 22567-145	*Elevation:* 7.14 ft msl	
Location: Bldg 193, Dry Cleaners	*Date Started:* 12/12/96	*Date Completed: 12/12/96*
Driller: Brian Cornell	*Total Depth (ft):* 18.0	
Equipment: Mobile B-57	*Depth to Bedrock (ft):* None	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in):* 8	
Drilling Fluid: None	*Depth to Water (ft):* 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By:* P. Linley	*Posthole to 4ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-7.2ft: SAND: *(SP)*, gry blk (N2) to med lt gry (N6) to dk yel org (10YR6/6) to brn gry (5YR4/1) to lt brn (5YR5/6), fine, mod well sort, unconsld, subang to subrd, wet at 3ft, silt frac 15%.					
		1	SS	50		2/5
5		2	SS	70		2/2/3/6
	7.2-7.9ft: SILTY CLAY: *(CL)*, lt gry (N7), v fine to fine, mod sort, unconsld, subang to subrd, wet.	3	SS	70		5/1/1/2
	7.9-17.2ft: SAND: *(SP)*, lt gry (N7) to v lt gry (N8) to white (N9) to med gry (N5) to gry org (10YR7/4) to pale yel brn (10YR6/2) to med dk gry (N4) to dk gry (N3), fine, unconsld, mod well sort, subang to subrd, silt frac 10-15%, wet to saturated	4	SS	60		5/7/11/15
10		5	SS	75		5/8/7/6
		6	SS	100		1/2/2/3
15		7	SS	100		1/2/1/2
	17.2-18ft: CLAY: *(CL)*, med dk gry (N4) to dk gry (N3), v fine semiconsld, mod well sort, v moist to wet.	8	SS	100		1/3/4/6
	17.4ft: PEAT: *(Pt)*, dusky yel brn (10YR2/2) to brn blk (5YR2/1)					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-5-MW-D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/13/96	Coordinates:	N 187187.346
Drilling Equipment:	Mobile B-57	Date Completed:	12/13/96		E 2099376.763
Drilling Method:	HSA	Depth to Water:	4ft bgl		
Drilling Fluid:	None	Elevation:	8.26 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	10

Backfill

Type	Grout Seal
Length (ft)	6
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	7.5
Placement	Pour
Amount Placed	200 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	5
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

LOCATION OF WELL

County: BEAUFORT System Name: N/A

N787187.346 E2099376.763

Latitude: Longitude:

Distance And Direction from Road Intersections

SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-5-MW) AND		
WELL CONSTRUCTION LOG		
(193-5-MW-D)		

Indicate water bearing zones

(use a 2nd sheet if needed)

REMARKS:

4. OWNER OF WELL:
Address MCRD DRY CLEANER FACILITY
MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SC
Telephone No. 803/525-2630

Engineer
Address AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 15.5 ft. Date Started: 12/13/96 Date Completed: 12/13/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply-Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING. ☒ Threaded ☐ Welded
Diam. 2-IN
Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
3 in. to 9 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 0.4 ft.
Weight ____ lbs./ft.
Drive Shoe? ☐ Yes ☒ No

9. SCREEN:
Type: PVC Diam. 2-IN
Slot/Gauze 0.010 Length 5
Set Between 9 ft. and 14 ft. **NOTE: MULTIPLE SCREENS USE SECOND SHEET**
____ ft. and ____ ft.
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL
3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
____ ft. after ____ hrs. pumping ____ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☒ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No
Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 8 ft. to 15.5 ft.
Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No
Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐
Depth From 1 ft. to 6 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 330 Feet NW Direction
PCE Type Well disinfected upon completion ☐ Yes ☒ No Type ____ Amount ____

16. PUMP: Date Installed ____ not installed ☒
Mfr. name ____ model no. ____
H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS
CERT. NO. 1299
Signed ____ Date ____
AUTHORIZED REPRESENTATIVE

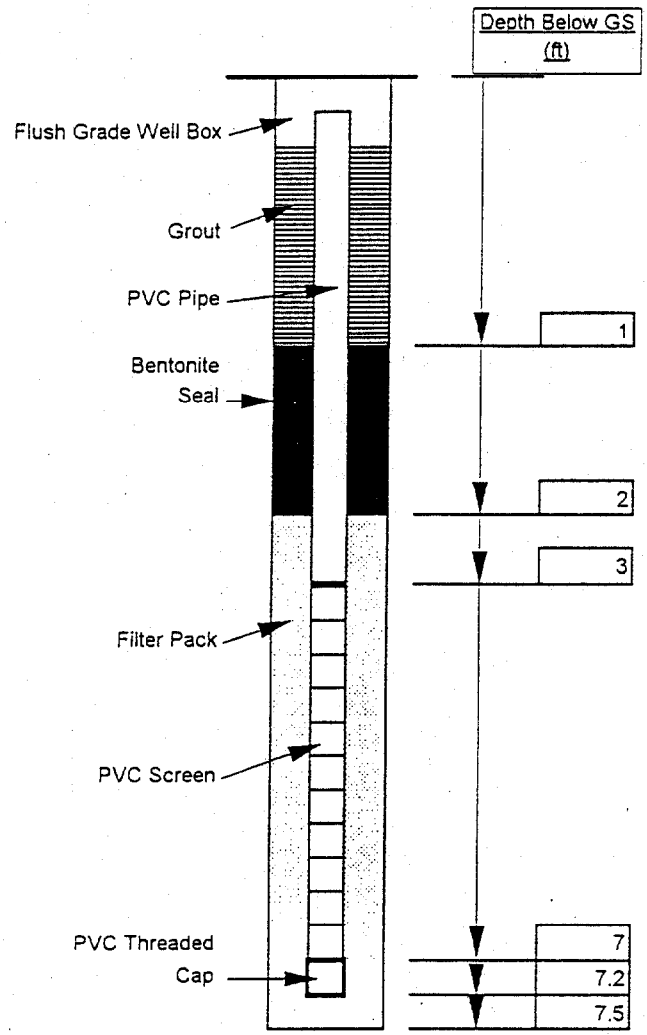
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-5-MW
Project Number: 22567-145	Elevation: 8.64 ft msl	
Location: Bldg 193, Dry Cleaners	Date Started: 12/13/96	Date Completed: 12/13/96
Driller: Brian Cornell	Total Depth (ft): 18.0	
Equipment: Mobile B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 8	
Drilling Fluid: None	Depth to Water (ft): 4.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole to 4ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-12ft: SAND: *(SP)*, pale brn (5YR5/2) to gry blk (N2) to lt brn gry (5YR6/1) to v lt gry (N8) to lt gry (N7) to med lt gry (N6), fine, unconsld, mod well sort, subang to subrd, wet at 3ft, silt frac 10-15%.	1	SS	60		2/1/4/5
5		2	SS	80		5/5/7/9
		3	SS	95		8/8/4/3
10		4	SS	100		1/2/1/1
	12ft: CLAYEY SILT: *(ML)*, dk gry (N3), v fine, unconsld, mod sort, subang to subrd, wet.	5	SS	100		2/2/4/4
	12-17.8ft: SAND: *(SP)*, lt brn gry (5YR6/1) to v lt gry (N8), fine unconsld, mod sort, subang to subrd, wet, silt and clay frac	6	SS	100		2/2/2/2
15	increasing w/depth, 13.5-14ft dk gry (N3).	7	SS	100		2/2/2/4
	17.8-18ft: PEAT: *(Pt)*, dusky brn (5YR2/2)					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-5-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/13/96	Coordinates:	N 187192.220
Drilling Equipment:	Mobile B-57	Date Completed:	12/13/96		E 2099377.309
Drilling Method:	HSA	Depth to Water:	4ft bgl		
Drilling Fluid:	None	Elevation:	8.6 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	4.7

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

Borehole Diameter (in.) 8

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

LOCATION OF WELL

County: BEAUFORT System Name: N/A

N167192.220 E2097377.309

Latitude: Longitude:

Distance And Direction from Road Intersections

SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BORE HOLE		
LOG (193-5-MW) AND		
WELL CONSTRUCTION LOG		
(193-5-MW-5)		

Indicate water bearing zones

(use a 2nd sheet if needed)

REMARKS

4. OWNER OF WELL:
Address MCRD DRY CLEANER FACILITY, MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC
Telephone No. 803/525-2630

Engineer
Address AS ABOVE
Telephone No.

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/13/96 Date Completed: 12/13/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply-Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded
Diam. 2-IN
Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
3 in. to 3 ft. depth
in. to ft. depth
Height: ~~Above~~/Below
Surface 0.4 ft.
Weight lbs./ft.
Drive Shoe? ☐ Yes ☒ No

9. SCREEN:
Type: PVC Diam 2-IN
Slot/Gauze 0.010 Length 4
Set Between 3 ft. and 7 ft.
ft. and ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL
3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
ft. after hrs. pumping G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☒ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No
Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 2 ft. to 7.5 ft.
Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☐ Yes ☒ No
Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☐
Depth From ft. to ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 330 Feet NW Direction
Type Well disinfected upon completion ☐ Yes ☒ No Type Amount

16. PUMP: Date Installed not installed ☒
Mfr. name model no.
H.P. volts length of drop pipe ft. capacity gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS
CERT. NO. 1299
Signed Date

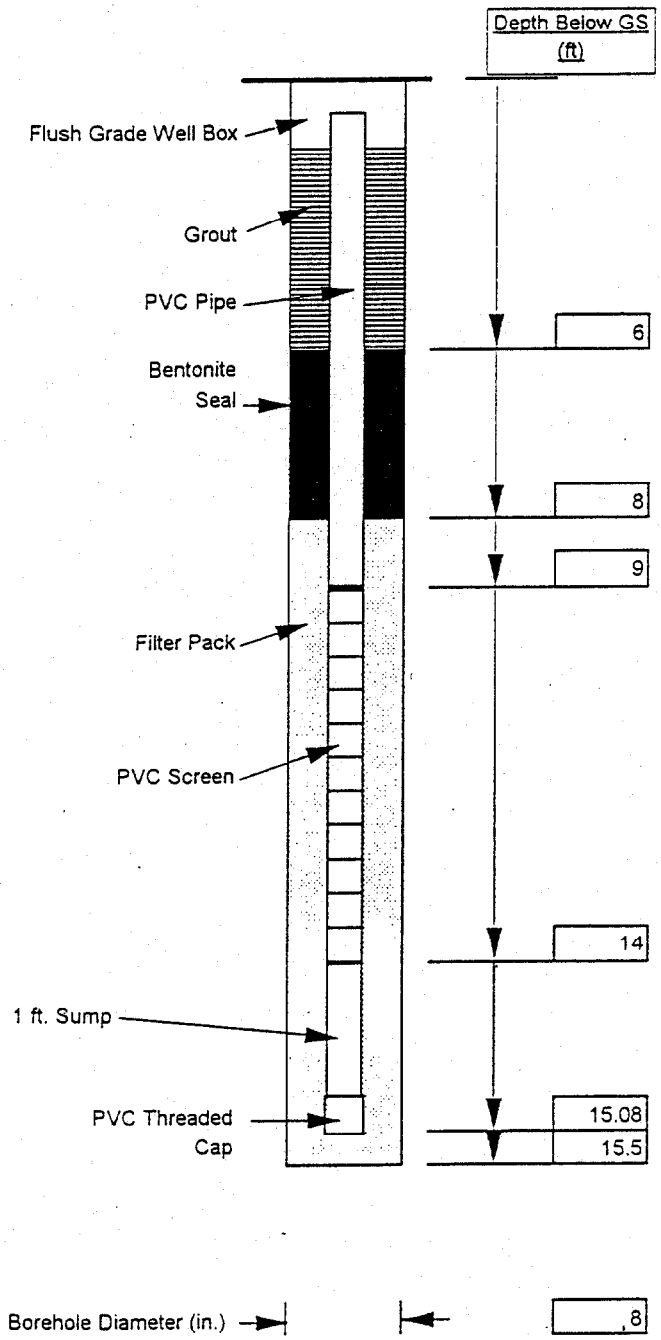
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-5-MW
Project Number: 22567-145	Elevation: 8.64 ft msl	
Location: Bldg 193, Dry Cleaners	Date Started: 12/13/96	Date Completed: 12/13/96
Driller: Brian Cornell	Total Depth (ft): 18.0	
Equipment: Mobile B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 8	
Drilling Fluid: None	Depth to Water (ft): 4.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole to 4ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-12ft: SAND: *(SP)*, pale brn (5YR5/2) to gry blk (N2) to lt brn gry (5YR6/1) to v lt gry (N8) to lt gry (N7) to med lt gry (N6), fine, unconsld, mod well sort, subang to subrd, wet at 3ft, silt frac 10-15%.	1	SS	60		2/1/4/5
5		2	SS	80		5/5/7/9
		3	SS	95		8/8/4/3
10		4	SS	100		1/2/1/1
	12ft: CLAYEY SILT: *(ML)*, dk gry (N3), v fine, unconsld, mod sort, subang to subrd, wet.	5	SS	100		2/2/4/4
	12-17.8ft: SAND: *(SP)*, lt brn gry (5YR6/1) to v lt gry (N8), fine unconsld, mod sort, subang to subrd, wet, silt and clay frac	6	SS	100		2/2/2/2
15	increasing w/depth, 13.5-14ft dk gry (N3).	7	SS	100		2/2/2/4
	17.8-18ft: PEAT: *(Pt)*, dusky brn (5YR2/2)					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-6-MW-D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/16/96	Coordinates:	N 187277.268
Drilling Equipment:	Mobile B-57	Date Completed:	12/16/96		E 2099296.248
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.52 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	10

Backfill

Type	Grout Seal
Length (ft)	6
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	7.5
Placement	Pour
Amount Placed	125 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	5
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

LOCATION OF WELL

County: BEAUFORT System Name: N/A

N187277.268 E 2099296.248

Latitude: Longitude:

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location:

Sketch Map: (See example on back) SEE ATTACHED MAP

CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE BOREHOLE LOG		
(193-6-MW) AND		
Well Completion Log		
(193-6-MW-D)		

Indicate water bearing zones

(use a 2nd sheet if needed)

REMARKS

4. OWNER OF WELL

Address MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer

Address AS ABOVE

Telephone No:

5. WELL DEPTH (Completed) 15.5 ft. Date Started: 12/16/96 Date Completed: 12/16/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING. ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 9 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~/Below Surface 0.4 ft.

Weight ____ lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 5

Set Between 9 ft. and 14 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield ____

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 8 ft. to 15.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐ ____

Depth From 1 ft. to 6 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 175 Feet NW Direction

PCE Type Well disinfected upon completion ☐ Yes Type ____ ☒ No Amount ____

16. PUMP: Date Installed ____ not installed ☒

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME ENVI DRILLING, INC. ADDRESS

CERT. NO. 1299

Signed ____ Date ____

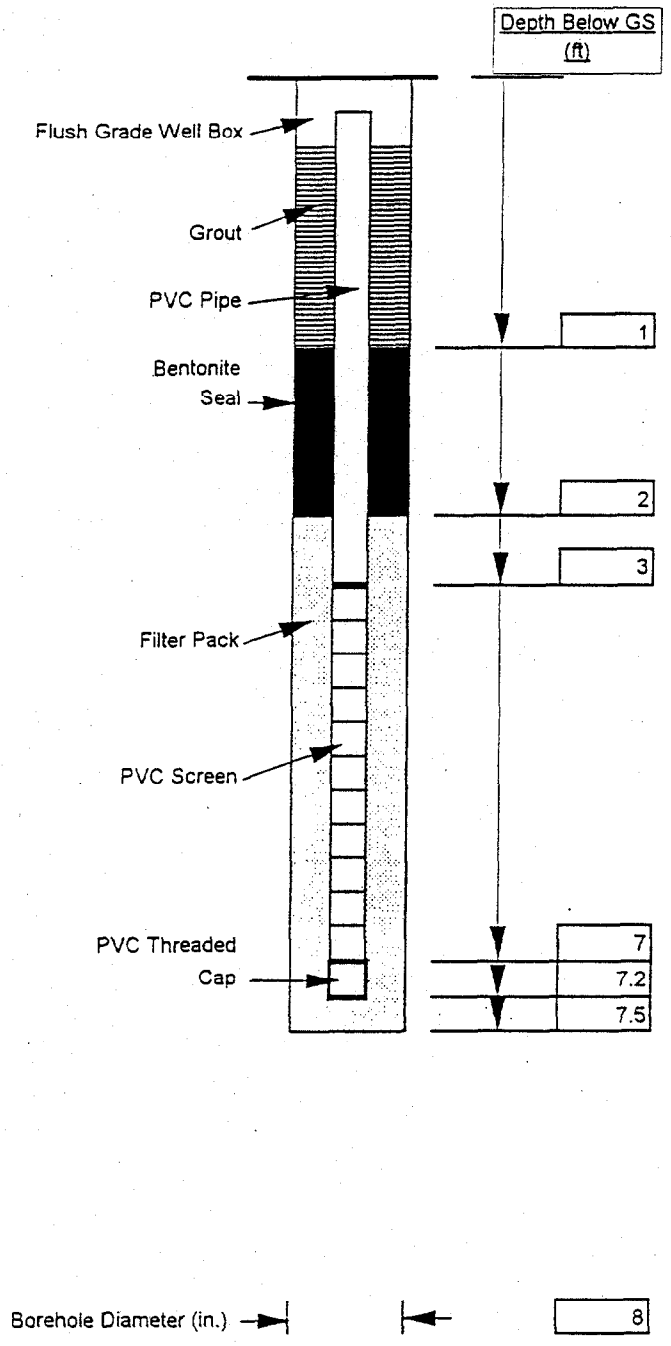
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-6-MW*
Project Number: 22567-145	*Elevation:* 7.76 ft msl	
Location: Bldg 193, Dry Cleaners	*Date Started: 12/16/96*	*Date Completed: 12/16/96*
Driller: Brian Cornell	*Total Depth (ft): 15.5*	
Equipment: Mobile B-57	*Depth to Bedrock (ft): None*	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in): 8*	
Drilling Fluid: None	*Depth to Water (ft): 3.0*	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By: P. Linley*	*Posthole 1ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-4.2ft **SAND**: *(SP)*, Fill/slag/cinders; dusky yel brn (10YR2/2) to pale yel brn (10YR6/2) to olive gry (5Y4/1), fine, unconsld, mod well sort, subang to subrd, wet at 3ft.	1	SS	75		Split spoon from 1-7ft analytical sample (1-3ft bgl)
	4.2-5ft: **CLAYEY SAND**: *(SC)*, med gry (N5), v fine to fine, mod sort, unconsld, subang to subrd, saturated, silt frac 15%.	2	SS	100		N/A
5	5-15.5ft: **SAND**: *(SP)*, grn gry (5G6/1) to dk yel brn (10YR6/6) to med lt gry (N6), to lt gry (N7), fine, unconsld, mod sort, sub-ang to subrd, saturated, silt frac 10-15%; 8ft lt olive gry (5Y5/2) 12ft cuttings soupy; 15ft lt olive gry (5Y6/1) to med gry (N5).	3	SS	65		8/8/8/6 analytical sample (5-7ft bgl)
10						
15						
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-6-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/16/96	Coordinates:	N 187273.011
Drilling Equipment:	Mobile B-57	Date Completed:	12/16/96		E 2099295.097
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.61 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	5

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

LOCATION OF WELL

County: BEAUFORT System Name: N/A

N 189273.011 E 2099295.097

Latitude: Longitude:

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-6-MW) AND		
WELL Completion Log		
(193-6-MW-S)		

Indicate water bearing zones

(use a 2nd sheet if needed)

REMARKS

4. OWNER OF WELL

Address MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer Address AS ABOVE

Telephone No:

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/16/96 Date Completed: 12/16/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply-Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 3 ft. depth

in. to ft. depth

Height: ~~Above~~/Below Surface 0.4 ft.

Weight lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 4

Set Between 3 ft. and 7 ft.

ft. and ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL 3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after hrs. pumping G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 2 ft. to 7.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☐ Yes ☒ No

Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☐

Depth From ft. to ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 175 Feet NW Direction

PCE Type Well disinfected upon completion ☐ Yes ☒ No Type Amount

16. PUMP: Date Installed not installed ☒

Mfr. name model no.

H.P. volts length of drop pipe ft. capacity gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS

CERT. NO. 1099

Signed Date

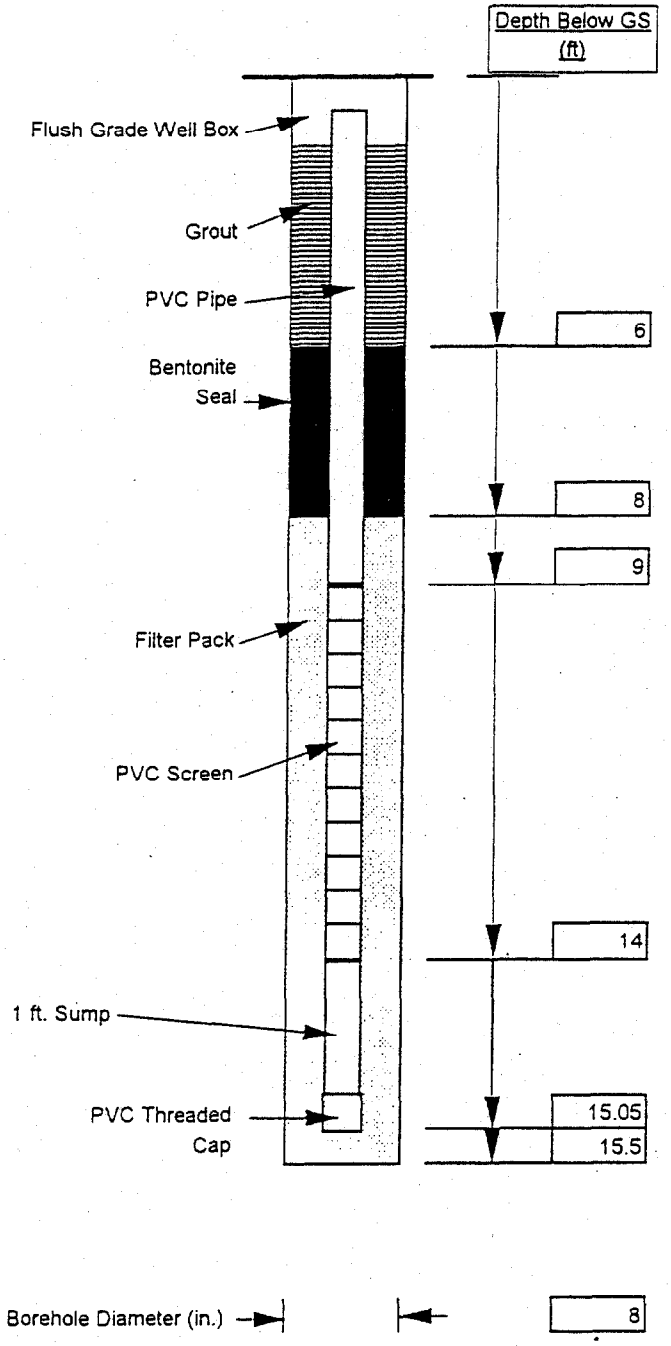
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-6-MW
Project Number: 22567-145	Elevation: 7.76 ft msl	
Location: Bldg 193, Dry Cleaners	Date Started: 12/16/96	Date Completed: 12/16/96
Driller: Brian Cornell	Total Depth (ft): 15.5	
Equipment: Mobile B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 8	
Drilling Fluid: None	Depth to Water (ft): 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole 1ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-4.2ft SAND: *(SP)*, Fill/slag/cinders; dusky yel brn (10YR2/2) to pale yel brn (10YR6/2) to olive gry (5Y4/1), fine, unconsld, mod well sort, subang to subrd, wet at 3ft.	1	SS	75		Split spoon from 1-7ft analytical sample (1-3ft bgl)
	4.2-5ft: CLAYEY SAND: *(SC)*, med gry (N5), v fine to fine, mod sort, unconsld, subang to subrd, saturated, silt frac 15%.	2	SS	100		N/A
5	5-15.5ft: SAND: *(SP)*, grn gry (5G6/1) to dk yel brn (10YR6/6) to med lt gry (N6), to lt gry (N7), fine, unconsld, mod sort, sub-ang to subrd, saturated, silt frac 10-15%; 8ft lt olive gry (5Y5/2) 12ft cuttings soupy; 15ft lt olive gry (5Y6/1) to med gry (N5).	3	SS	65		8/8/8/6 analytical sample (5-7ft bgl)
10						
15						
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-7-MW-D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/16/96	Coordinates:	N 187328.810
Drilling Equipment:	Mobile B-57	Date Completed:	12/16/96		E 2099293.569
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.72 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	10

Backfill

Type	Grout Seal
Length (ft)	6
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	7.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	5
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

LOCATION OF WELL

County: BEAUFORT System Name: N/A

Latitude: D187328-510 Longitude: E2099293-569

Distance And Direction from Road Intersections

SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-7-MW) AND		
WELL CONSTRUCTION LOG		
(193-7-MW-D)		

Indicate water bearing zones

(use a 2nd sheet if needed)

REMARKS:

4. OWNER OF WELL:
Address MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC
Telephone No. 803/525-2630
Engineer
Address AS ABOVE
Telephone No.

5. WELL DEPTH (Completed) 15.5 ft. Date Started: Date Completed:

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded
Diam. 2-IN
Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
3 in. to 9 ft. depth
in. to ft. depth
Height: ~~Above~~/Below Surface 0.4 ft.
Weight lbs./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN:
Type: PVC Diam 2-IN
Slot/Gauze 0.010 Length 5
Set Between 9 ft. and 14 ft.
ft. and ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL
3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
ft. after hrs. pumping G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☒ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No
Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 8 ft. to 15.5 ft.
Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No
Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐
Depth From 1 ft. to 6 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 125 Feet NW Direction
PCE Type Well disinfected upon completion ☐ Yes ☒ No Type Amount

16. PUMP: Date Installed not installed ☒
Mfr. name model no.
H.P. volts length of drop pipe ft. capacity gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS
CERT. NO. 1259
Signed Date

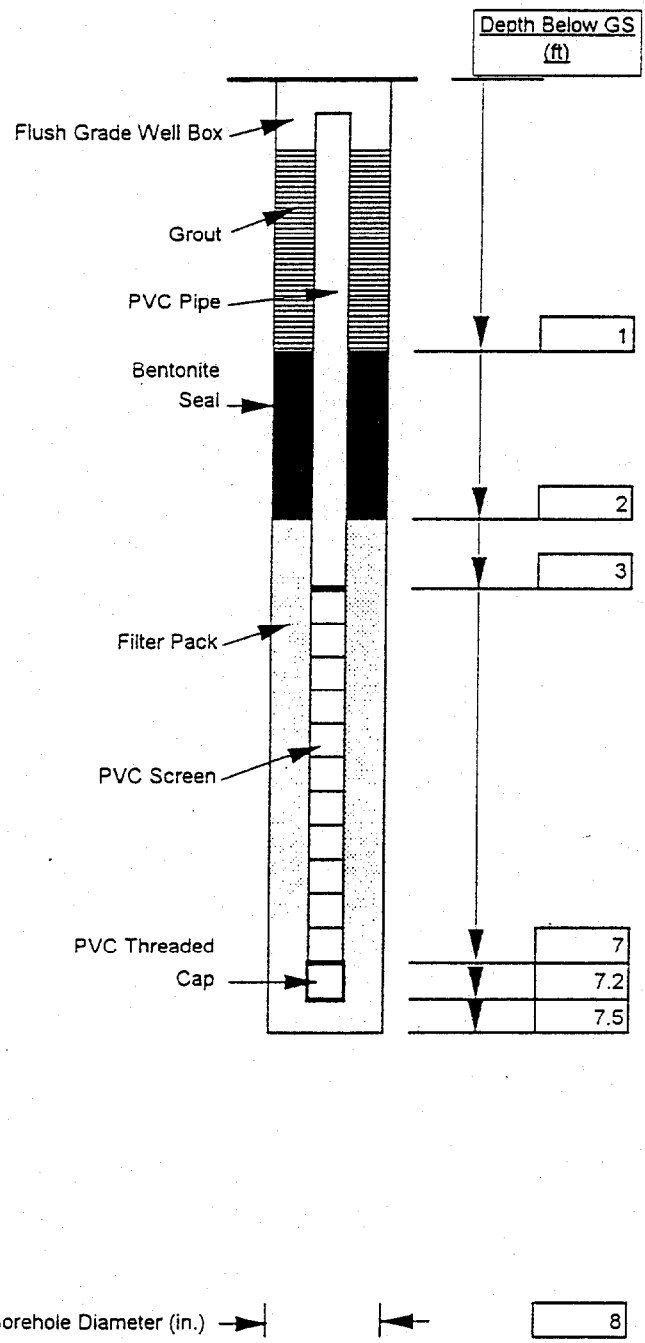
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-7-MW
Project Number: 22567-145	Elevation: 7.95 ft msl	
Location: Bldg 193, Dry Cleaners	Date Started: 12/16/96	Date Completed:12/16/96
Driller: Brian Cornell	Total Depth (ft): 19.0	
Equipment: Mobile B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 8	
Drilling Fluid: None	Depth to Water (ft): 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole to 1ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-8.8ft: SAND: *(SP)*, gry brn (5YR3/2) to dusky brn (5YR2/2) to lt olive brn (5Y5/6) to lt gry (N7) to brn blk (5YR2/1) to dk yel org (10YR6/6) to pale yel org (10YR8/6), fine, unconsld, mod well sort, subang to subrd, wet at 3ft, silt frac to 15%.	1	SS	75		N/A analytical sample
		2	SS	60		2/4/2/2
5		3	SS	70		6/7/8/7 analytical sample
		4	SS	80		7/2/2/1
	8.8-9ft: SILTY CLAY: *(CL)*, med lt gry (N6) v fine, unconsld, mod sort, subang to subrd, wet.	5	SS	100		10/20/20/20
10	9-18.5ft: SAND: *(SP)*, brn gry (5YR4/1) to dk yel org (10YR6/6) to v lt gry (N8) to pale yel org (10YR8/6) to gry org (10YR7/4) to pink gry (5YR8/1) to med gry (N5) to white (N9) to med lt gry (N6), fine, mod well sort, unconsld, subang to subrd, wet to saturated, silt frac 10-15%.	6	SS	100		10/3/3/4
		7	SS	100		2/2/1/2
15		8	SS	100		2/2/3/4
		9	SS	100		2/2/1/4 analytical sample (TOC)
	18.5-19ft: CLAYEY SAND: *(SC)*, med gry (N5) wet, organic layer at 18.8ft brn blk (5YR2/1) to dusky brn (5YR2/2), moist.					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-7-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/16/96	Coordinates:	N 187326.652
Drilling Equipment:	Mobile B-57	Date Completed:	12/16/96		E 2099295.775
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.68 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	5

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

Latitude: N 187326.652 Longitude: E 2099295.775

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back) SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED BOREHOLE		
LOG (193-7-MW) AND		
WELL Construction Log		
(193-7-MW-5)		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL

Address: MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer Address: AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/16/96 Date Completed: 12/16/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING. ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 3 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~/Below

Surface 0.4 ft.

Weight ____ lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 4

Set Between 3 ft. and 7 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield ____

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 2 ft. to 7.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☐ Yes ☒ No

Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☐ ____

Depth From ____ ft. to ____ ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 125 Feet NW Direction

PCE Type Well disinfected upon completion ☐ Yes ☒ No Type ____ Amount ____

16. PUMP: Date Installed ____ not installed ☒

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME ENV. DRILLING, INC. ADDRESS ____

CERT. NO. 1299

Signed ____ Date ____

AUTHORIZED REPRESENTATIVE

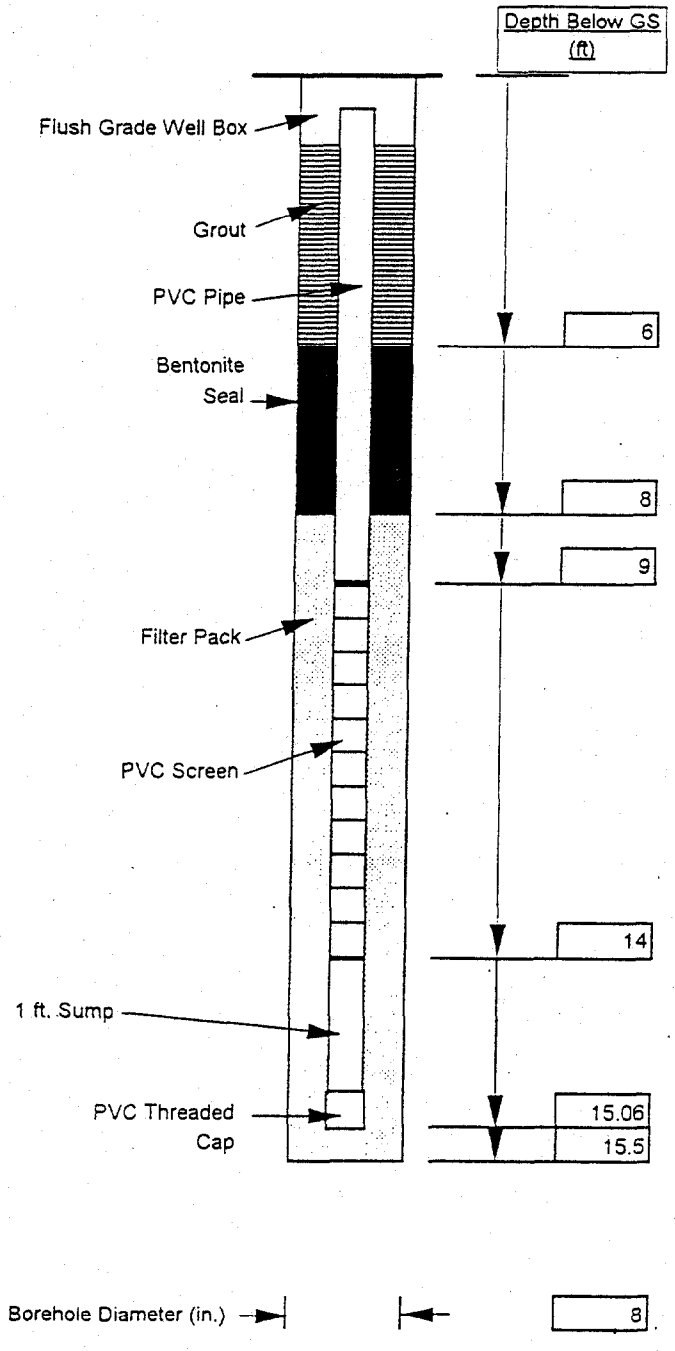
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		Borehole No.: 193-7-MW
Project Number: 22567-145	Elevation: 7.95 ft msl	
Location: Bldg 193, Dry Cleaners	Date Started: 12/16/96	Date Completed: 12/16/96
Driller: Brian Cornell	Total Depth (ft): 19.0	
Equipment: Mobile B-57	Depth to Bedrock (ft): None	
Drilling Method: Hollow Stem Auger	Hole Diameter (in): 8	
Drilling Fluid: None	Depth to Water (ft): 3.0	
Completion: Completed as Monitoring Well See Well Construction Logs for details	Logged By: P. Linley	Posthole to 1ft BGL

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-8.8ft: SAND: *(SP)*, gry brn (5YR3/2) to dusky brn (5YR2/2) to lt olive brn (5Y5/6) to lt gry (N7) to brn blk (5YR2/1) to dk yel org (10YR6/6) to pale yel org (10YR8/6), fine, unconsld, mod well sort, subang to subrd, wet at 3ft, silt frac to 15%.	1	SS	75		N/A analytical sample
		2	SS	60		2/4/2/2
5		3	SS	70		6/7/8/7 analytical sample
		4	SS	80		7/2/2/1
	8.8-9ft: SILTY CLAY: *(CL)*, med lt gry (N6) v fine, unconsld, mod sort, subang to subrd, wet.	5	SS	100		10/20/20/20
10	9-18.5ft: SAND: *(SP)*, brn gry (5YR4/1) to dk yel org (10YR6/6) to v lt gry (N8) to pale yel org (10YR8/6) to gry org (10YR7/4) to pink gry (5YR8/1) to med gry (N5) to white (N9) to med lt gry (N6), fine, mod well sort, unconsld, subang to subrd, wet to saturated, silt frac 10-15%.	6	SS	100		10/3/3/4
		7	SS	100		2/2/1/2
15		8	SS	100		2/2/3/4
		9	SS	100		2/2/1/4 analytical sample (TOC)
	18.5-19ft: CLAYEY SAND: *(SC)*, med gry (N5) wet, organic layer at 18.8ft brn blk (5YR2/1) to dusky brn (5YR2/2), moist.					
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-MW-8D
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/16/96	Coordinates:	N 187391.271
Drilling Equipment:	Mobile B-57	Date Completed:	12/16/96		E 2099319.322
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.53 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	10

Backfill

Type	Grout Seal
Length (ft)	6
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	2
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	7.5
Placement	Pour
Amount Placed	137.5 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	5
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 **Water Well Record**

1. LOCATION OF WELL

County: BEAUFORT System Name: N/A

N 185391.271 E 2099319.322

Latitude: Longitude:

Distance And Direction from Road Intersections: SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED Borehole log (193-8-MW) AND Well Construction log (193-8-MW-D)		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL

Address: MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SC

Telephone No. 803/525-2630

Engineer

Address: AS ABOVE

Telephone No.

5. WELL DEPTH (Completed) 15.5 ft. Date Started: 12/16/96 Date Completed: 12/16/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 9 ft. depth

in. to ft. depth

Height: ~~Above~~/Below

Surface 0.4 ft.

Weight lbs./ft.

Drive Shoe? ☐ Yes ☒ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 5'

Set Between 9 ft. and 14 ft.

ft. and ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after hrs. pumping G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 8 ft. to 15.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☐

Depth From 1 ft. to 6 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 35 Feet W Direction

PCE Type Well disinfected upon completion ☐ Yes Type ☒ No Amount

16. PUMP: Date Installed not installed ☒

Mfr. name model no.

H.P. volts length of drop pipe ft. capacity gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: ENV. DRILLING, INC. ADDRESS

CERT. NO. 1299

Signed Date

AUTHORIZED REPRESENTATIVE

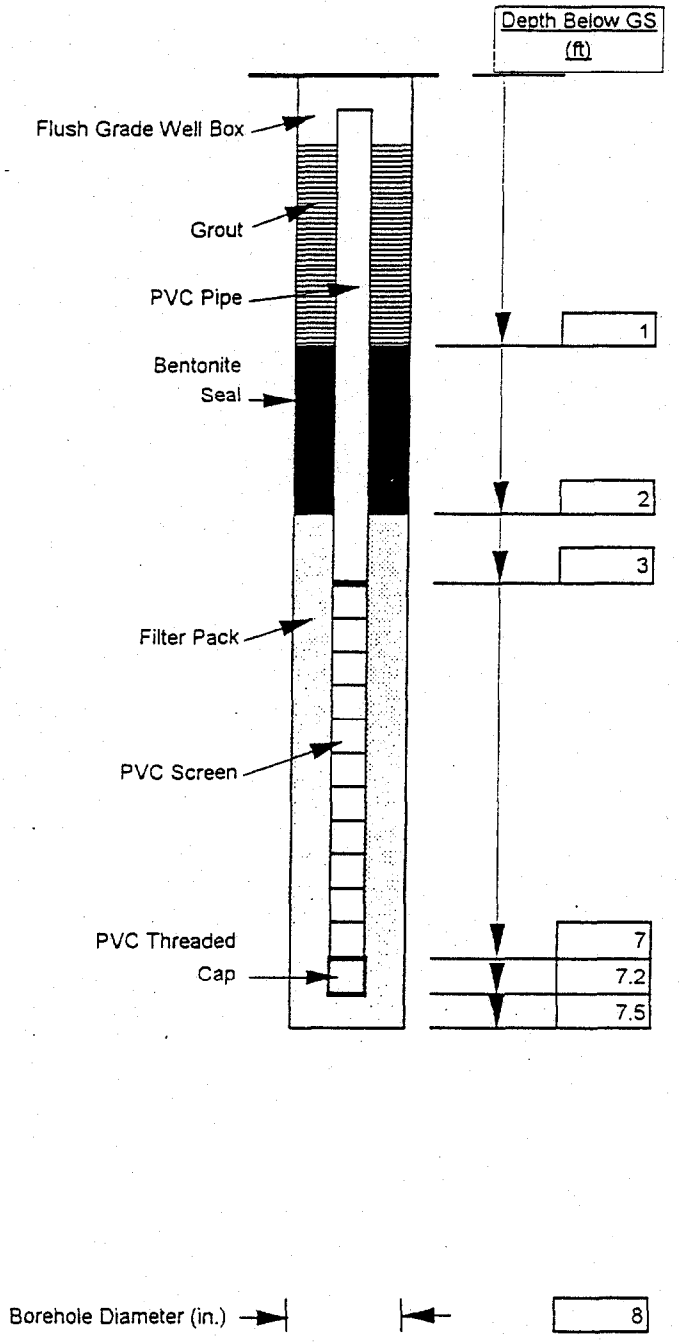
BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-MW-8*
Project Number: 22567-145	*Elevation:* 7.77 ft msl	
Location: Bldg 193, Dry Cleaners	*Date Started: 12/16/96*	*Date Completed: 12/16/96*
Driller: Brian Cornell	*Total Depth (ft): 15.5*	
Equipment: Mobile B-57	*Depth to Bedrock (ft): None*	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in): 8*	
Drilling Fluid: None	*Depth to Water (ft): 3.0*	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By: P. Linley*	*Posthole to 1ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-15.5ft: **SAND**: *(SP)*, dusky yel brn (10YR2/2) to blk (N1) to brn gry (5YR4/1) to dk yel org (10YR6/6) to mod yel brn (10YR 5/4) to pink gry (5YR8/1) to med dk gry (N4) to yel gry (5Y7/2) fine, unconsld, mod sort, subang to subrd, upper 1.5ft gvl frac 25% to 2.5" dia., 1-3ft poorly sorted - fine to coarse grained (slag/cinders layer), 3ft wet to saturated, 15ft silt & clay frac increasing w/depth to 10-15% each.					Split spoon from 1-7ft
		1	SS	80		N/A analytical sample
		2	SS	70		N/A
5		3	SS	90		2/5/7/7 analytical sample
10						
15						
20						
25						
30						

WELL CONSTRUCTION LOG

MCRD Parris Island	Site: Dry Cleaners Bld 193			Well No.:	193-8-MW-S
Drilling Company:	Environmental Drilling Inc.	Project No.:	22567-145	Logged By:	P. Linley
Driller:	Brian Cornell	Date Started:	12/16/96	Coordinates:	N 187387.149
Drilling Equipment:	Mobile B-57	Date Completed:	12/16/96		E 2099318.846
Drilling Method:	HSA	Depth to Water:	3ft bgl		
Drilling Fluid:	None	Elevation:	7.60 ft msl		



MATERIALS

Riser Pipe

Type	Schedule 40 PVC
Diameter (in.)	2
Length (ft)	5

Backfill

Type	Grout Seal
Length (ft)	N/A
Placement	Tremie

Seal

Type	Bentonite Pellets
Length (ft)	1
Placement	Pour

Filter Pack

Type	20/30
Length (ft)	5.5
Placement	Pour
Amount Placed	150 lbs

Screen

Type	Schedule 40 PVC
Length (ft)	4
Diameter (in.)	2
Slot Size (in.)	0.01
Slot Type	Machine Slotted

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

LOCATION OF WELL

County: BEAUFORT System Name: N/A

N187387.149 E2049318.846

Latitude: Longitude:

Distance And Direction from Road Intersections

SEE ATTACHED MAP

Street address & City of Well Location

Sketch Map: (See example on back)

SEE ATTACHED MAP

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☒ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
SEE ATTACHED Borehole log (193-8-MW) AND well construction log (193-8-MW-S)		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL

Address MCRD DRY CLEANER FACILITY MARINE CORPS RECRUIT DEPOT PARRIS ISLAND SC

Telephone No. 803/525-2630

Engineer

Address AS ABOVE

Telephone No:

5. WELL DEPTH (Completed) 7.5 ft. Date Started: 12/16/96 Date Completed: 12/16/96

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply-Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitoring Well

8. CASING: ☒ Threaded ☐ Welded

Diam. 2-IN

Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

3 in. to 3 ft. depth

in. to ft. depth

Height: ~~Above~~/Below

Surface 0.4 ft.

Weight lbs./ft.

Drive Shoe? ☐ Yes ☐ No

9. SCREEN:

Type: PVC Diam 2-IN

Slot/Gauze 0.010 Length 4

Set Between 3 ft. and 7 ft.

ft. and ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL

3 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after hrs. pumping G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☒ No

Yield

12. WATER QUALITY

Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☒ No

Please Enclose Lab Results. See Attached

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 2 ft. to 7.5 ft.

Effective size 20/30 uniformity coefficient N/A

14. WELL GROUTED? ☐ Yes ☒ No

Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☐

Depth From ft. to ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 35 Feet W Direction

PCE Type Well disinfected upon completion ☐ Yes ☒ No Type Amount

16. PUMP: Date Installed not installed ☒

Mfr. name model no.

H.P. volts length of drop pipe ft. capacity gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME B.N. DRILLING, INC. ADDRESS

CERT. NO. 1299

Signed Date

AUTHORIZED REPRESENTATIVE

BOREHOLE LOG

Project Name: Parris Island, SC, MCRD		*Borehole No.: 193-MW-8*
Project Number: 22567-145	*Elevation: 7.77 ft msl*	
Location: Bldg 193, Dry Cleaners	*Date Started: 12/16/96*	*Date Completed:12/16/96*
Driller: Brian Cornell	*Total Depth (ft): 15.5*	
Equipment: Mobile B-57	*Depth to Bedrock (ft): None*	
Drilling Method: Hollow Stem Auger	*Hole Diameter (in): 8*	
Drilling Fluid: None	*Depth to Water (ft): 3.0*	
Completion: Completed as Monitoring Well See Well Construction Logs for details	*Logged By: P. Linley*	*Posthole to 1ft BGL*

Depth (ft)	Description	Sample Number	Sample Type	% Recovery	Blow Count	Comments
	0-15.5ft: SAND: *(SP)*, dusky yel brn (10YR2/2) to blk (N1) to brn gry (5YR4/1) to dk yel org (10YR6/6) to mod yel brn (10YR 5/4) to pink gry (5YR8/1) to med dk gry (N4) to yel gry (5Y7/2) fine, unconsld, mod sort, subang to subrd, upper 1.5ft gvl frac 25% to 2.5" dia., 1-3ft poorly sorted - fine to coarse grained (slag/cinders layer), 3ft wet to saturated, 15ft silt & clay frac increasing w/depth to 10-15% each.					Split spoon from 1-7ft
		1	SS	80		N/A analytical sample
5		2	SS	70		N/A
		3	SS	90		2/5/7/7 analytical sample
10						
15						
20						
25						
30						

PARRIS ISLAND

DO - 48, 22567-145

LISTING OF MATERIAL VENDORS AND PROPERTY IDENTIFICATION

VENDORS	VENDOR ADDRESS	PHONE NUMBER	$ VALUE	PRODUCTS DESCRIPTION	PROPERTY TAG	CONTACT	WARRANTY PERIOD
Drillers Services, Inc	P.O. Box1407, Hickory, NC 28603	800-334-2308	$361.30	gould Sump Pump	N-0881	Charlie Moser	
In-Situ Corporation	210 South Third Street Laramie, WY, 82070	800-446-7488 (7AM - 5:30PM) 307-760-0958 (After Hours & Weekends)	$2,604.19	Pressure Transducers 4-20 mA output - PXD-261 w/ cables - 10 PSI Range	N-0882 N-0883 N-0884	Jim Brodrick	1 Year Parts & Labor
Drillers Services, Inc	P.O. Box1407, Hickory, NC 28603	800-334-2308	$3,033.11	Submersible Pumps, Motors & Cable	N-C-6231 N-C-6232 N-C-6233	Charlie Moser	18 Months
NE Environmental Prod.	17 Technology Drive, W. Lebanon NH, 03784	603-298-7061	$9,158.50	Air Stripper w/ Silencer & Elbow	N-C-6234	Cdon Shearouse	1 Year
OPTO 22	43044 Business Park Dr., Temecula, CA, 92590-3614	909-695-3000	$6,090.57	"Prove-it-to-me Toolbox", Upgrade, Software, Controller & +4 to +20 mA Input	N-C-6235	Jack Parks	2 years
Rockingham Electric	187 River Road, Newington, NH, 03801-2883	603-436-2310	$83.00	Terminal Strip	N-C-6235	N/A	N/A
Zypcom, Inc.	2301 Industrial Parkway West, Haywood, Ca. 94545	510-783-2501	$564.25	Modem	N-C-6235	Scott Porter	
Beaufort Concrete	Beaufort, SC	843-846-2261	$526.03	4000 PSI Concrete	N-C-6236	Jill	N/A
Beaufort Winlectric Co.	21 Broad River Blvd, Beaufort, SC, 29906	843-986-0575	$950.00	Panelboard & Switch	N-C-6236	Casey Getz	
Beaufort Winlectric Co.	21 Broad River Blvd, Beaufort, SC, 29906	843-986-0575	$3,439.34	Misc. Electrical, Cable, Conduit Connections & Unistrut, Emergency Lighting, Wiring, Fuses & Junction Boxes.	N-C-6236	Casey Getz	N/A
Carolina Supplies and Materials	2115 Monrovia Street Charleston, S.C. 29405	843-723-6588	$61.85	Masonry Sand	N-C-6236	N/A	N/A
Farrell Ace Hardware	245 Robert Smalls Parkway, Beaufort, SC 29906	843-521-2030	$194.67	Stl Plugs, Sewer Cap, Pipe Fittings, Anchor Bolts, & Misc. tools	N-C-6236	N/A	N/A

PARRIS ISLAND

DO - 48, 22567-145

LISTING OF MATERIAL VENDORS AND PROPERTY IDENTIFICATION

VENDORS	VENDOR ADDRESS	PHONE NUMBER	$ VALUE	PRODUCTS DESCRIPTION	PROPERTY TAG	CONTACT	WARRANTY PERIOD
Ferguson Enterprises, Inc	3350 Old Meeting Street Rd, Charleston, SC, 29405	843-747-6301	$2,194.50	Hot Box Pump Guard	N-C-6236	Jim Cummings	
Ferguson Enterprises, Inc	1302 South Ribaut Road Port Royal, SC 29935-1110	843-524-5298	$636.69	Misc. Pipe and Fittings	N-C-6236	Tom Walker	N/A
Fluid Flow Of Tennessee	6701 Baum Dr, Suite 245, Knoxville, TN, 37919	423-588-1012	$2,997.79	Flow Indicating Transmitters	N-C-6236	Mike Moore	1 Year
General Engineering Laboratory 22567-145-SC-0801	2040 Savage Road Charleston, S.C. 29414	843-556-8171	$12,900.00	Drilling, Well installation, and Well Development	N-C-6236	Richard Garcia	
General Materials	3366 Business Circle N. Charleston, S.C. 29418	843-552-5853	$345.74	Temporary Safety Fence, Rebar (fence posts), tiewire and welded wire mesh	N-C-6236	N/A	N/A
Grainger	7401 Pepperdam Ave, N. Charleston, SC., 29418-8496	843-552-6504	$486.79	Unit heater, Thermostat, & wire duct	N-C-6236	N/A	1 Year Heater 5 Years Element
Graybar Electric, Inc	80 Pepsi Road, Manchester, NH, 03109	603-624-4341	$903.03	Control Panel & Fuses	N-C-6236	Mike Tansey	
Hilti Corporation	6155 H Jimmy Carter Blvd Norcross, GA 30071	800-879-8000	$664.92	Stainless Steel Bolts & Epoxy	N-C-6236		N/A
Industrial Electric Supply	2812 S. 5tg Ave., Birmingham, AL, 35210	205-951-4601	$229.59	Electric Cable Well Pump Conn. & Plugs	N-C-6236	Anna	N/A

PARRIS ISLAND

DO - 48, 22567-145

LISTING OF MATERIAL VENDORS AND PROPERTY IDENTIFICATION

VENDORS	VENDOR ADDRESS	PHONE NUMBER	$ VALUE	PRODUCTS DESCRIPTION	PROPERTY TAG	CONTACT	WARRANTY PERIOD
McMaster Carr	6100 Fulton Industrial Blvd, Atlanta, GA, 30336	404-346-7000	$1,671.27	Liquid Level Switch, Ashcroft Pressure Transducers (4-20 mA output) - 15 PSIG , Water Flow Totalizer & Siginal Switch, Teflon Tubing, Dowel Pins, Surge Suppressor, SS Rope w/ Clips, Basket Strainer, Shelf Brackets & Heat Shrink Tubing	N-C-6236	N/A	N/A
McNichols Company	P.O. Box 931099, Cleveland, OH, 44193-0376	800-237-3820	$133.33	Aluminum Grating	N-C-6236	Gail	N/A
Metering Sales & Services	1930 Pioneer Road, Huntington Valley, PA, 19006	215-675-5117	$597.62	Electrical Meter & Meter Panel	N-C-6236	Beverly	5 Years
Oak Ridge Loans	110 Randolph Road, Oak Ridge, TN, 37830	423-483-1402	$60.08	Equip Tags	N-C-6236	N/A	N/A
Pelican Building Center	Hwy 78 & Matthews Drive Beaufort, SC 29906	843-681-9600	$315.37	PVC Pipe & Fittings, Patch Compound for Sewer Line, Form Lumber & Cement	N-C-6236	N/A	N/A
Plastic Piping Systems	P.O. Box 350, Philadelphia, PA, 19191-1057	423-546-9422	$987.99	Hayward Motorized & Manual Valves	N-C-6236	Mark Sullivan	2 Years
Quality Controls	2152 Sprint Blvd., Apopka, FL 32703	407-886-6300	$2,636.00	Motor Starter Panel	N-C-6236	John A Evans	
SeaHorse Plastics Corp.	4680 Shoulders Hill Road, Suffolk, VA, 23435	757-488-7653	$9,500.00	Fiberglass Building	N-C-6236	Jerry Lotz	
United Air Products Corp	5920 Weisbrook Lane, Knoxville, TN, 37909	423-558-8090	$829.20	Exh Fan & Louvers	N-C-6236	Michael Simpson	
WalMart	Beaufort, SC	843-522-8221	$95.16	Wed/Dry Vac & Ladder	N-C-6236		

N-0881

PROPERTY RECORD

MCRD PARRIS ISLAND, SC

Contract	Description	Date	Bldg.	Room
N62467-93-D-0936	SUBMERSIBLE EFFLUENT PUMP	4/28/98	SITE 45	BUILDING

Purchase Order	Mfg.
22567-145-CC-0811	GOULD

Requisitioner	Vendor
KENT PARISH	DRILLERS SERVICES, INC

Cost	Model	Serial Number	Acc't.	Org.
$ 361.30	3885	A9842998		

ADDITIONAL DESCRIPTION:

1/2 HP MOTOR - 115 V

Property Number: N-0882

PROPERTY RECORD

Location: MCRD PARRIS ISLAND, SC

Date	Bldg.	Room
4/28/98	WELL 193-3-RW	SITE 45

Contract	Description
22567-145	PRESSURE TRANSDUCER

Purchase Order	Mfg.
22567-145-CC-0805	INSITU CORPORATION

Requisitioner	Vendor
KENT PARISH	SAME AS MFG

Cost	Model	Serial Number	Acc't.	Org.
$ 868.08	PXD-261	05966		

ADDITIONAL DESCRIPTION:

25' OF TEFLON CABLE

BEI/RC N62467-93-D-0936
GOVERNMENT PROPERTY
N-0882

N-0883	PROPERTY RECORD	MCRD PARRIS ISLAND, SC		
		Date	~~Bldg.~~ WELL	Room
Contract 22567-145	Description PRESSURE TRANSDUCER	4/28/98	193-1-RW	SITE 45
Purchase Order 22567-145-CC-0805	Mfg. IN-SITU CORPORATION			
Requisitioner KENT PARISH	Vendor SAM AS MFG			
Cost $ 868.08	Model PDX-261 / Serial Number 05992 / Acc't / Org.			

ADDITIONAL DESCRIPTION:

25' OF TEFLON CABLE

BEI/RC N62467-93-D-0936
GOVERNMENT PROPERTY
N-0883

Property Number N-0884	PROPERTY RECORD	Location MCRD PARRIS ISLAND, SC		
		Date	~~Bldg.~~ WELL	Room
Contract 22567-145	Description PRESSURE TRANSDUCER	4/28/98	193-2-RW	SITE 45
Purchase Order 22567-145-CC-0805	Mfg. IN-SITU CORPORATION			
Requisitioner KENT PARISH	Vendor SAME AS MFG			
Cost $ 868.09	Model PDX-261 / Serial Number 06004 / Acc't / Org.			

ADDITIONAL DESCRIPTION:

25' OF TEFLON CABLE

BEI/RC ~~N62467~~-93-D-0936
GOVERNMENT PROPERTY
N-0884

N-C-6231

Contract	Description	Date	Bldg. WELL	Room
22567-145	STAINLESS STEEL SUBMERSIBLE PUMP	4/28/98	193-1-RW	SITE 45
Purchase Order: 22567-145-CC-0811	Mfg.: GRUNDFUS PUMP CORPORATION			
Requisitioner: KENT PARISH	Vendor: DRILLER SERVICES, INC.			

Cost	Model	Serial Number	Acc't.	Org.
$1011.03	5E8 W/230V	2M9702-3687		

ADDITIONAL DESCRIPTION:

TORQUE ARRESTOR
1/2 HP MOTOR - 230 V
4" PUMP - REDI-FLO 4 5E8
ELECTRIC CORD

BEI/RC N62467-93-D-0936
GOVERNMENT PROPERTY
N-C-6231

BEI/RC N62467-93-D-0936
GOVERNMENT PROPERTY
N-C-6231

Property Number: J-C-6232

PROPERTY RECORD

Location: MCRD PARRIS ISLAND, SC

Contract	Description	Date	Bldg. WELL	Room
22567-145	STAINLESS STEEL SUBMERSIBLE PUMP	4/28/98	193-3-RW	SITE 45
Purchase Order: 22567-145-CC-0811	Mfg.: GRUNDFUS PUMP CORPORATION			
Requisitioner: KENT PARISH	Vendor: DRILLER SERVICES, INC.			

Cost	Model	Serial Number	Acc't.	Org.
$1,011.03	5E8 W/230V	2M9702-3652		

ADDITIONAL DESCRIPTION:

TORQUE ARRESTOR
1/2 HP MOTOR - 230V
4" PUMP REDI FLO 4 5 E8
ELECTRIC CORD

BEI/RC N62467-93-D-0936
GOVERNMENT PROPERTY
N-C-6232

N-C-6233

PROPERTY RECORD

Contract	Description	Date	Bldg. WELL	Room
22567-145	STAINLESS STEEL SUBMERSIBLE PUMP	4/28/98	193-2-RW	SITE 45
Purchase Order: 22567-145-CC-0811	Mfg.: GRUNDFUS PUMP CORPORATION			
Requisitioner: KENT PARISH	Vendor: DRILLER SERVICES, INC.			

Cost	Model	Serial Number	Acc't	Org.
$1,011.04	5E8 W/230V	2K9713-0718		

ADDITIONAL DESCRIPTION:

TORQUE ARRESTOR
1/2 HP MOTOR - 230V.
4" PUMP REDI FLO 4 5E8
ELECTRIC CORD

BEI/RC N62467-93-D-0936
GOVERNMENT PROPERTY
N-C-6233

Property Number: N-C-6234

PROPERTY RECORD

Location: MCRD PARRIS ISLAND, SC.

Contract	Description	Date	Bldg.	Room
22567-145	SHALLOW TRAY AIR STRIPPER	4/28/98	SITE 45	TREATMENT BLDG
Purchase Order: 22567-145-	Mfg.: NORTHEAST ENVIRONMENTAL PRODUCTS, INC			
Requisitioner: BILL ZULLIGER	Vendor: SAME AS MFG			

Cost	Model	Serial Number	Acc't	Org.
$9,158.50	1341-P			

ADDITIONAL DESCRIPTION:

SIGHT GLASS
SUMP LEVEL CONTROL SWITCHES
BLOWER W/ MOTOR
SUMP DISCHARGE PUMP
NEMA 4 SKID MOUNTED CONTROL PANEL
PIPING, ELECTRICAL CONDUIT AND WIRING
8" SILENCER
SKID
VENT PIPE AND BRACKETS

N-C-6236

Contract	Description	Date	Bldg.	Room
22567-145	SITE 45 TREATMENT BUILDING	4/28/98	SITE 45	
Purchase Order	**Mfg.**			
22567-145-PO-0798	SEAHORSE PLASTICS CORPORATION			
Requisitioner	**Vendor**			
BILL ZULLIGER	SAME AS MFG			

Cost	Model	Serial Number	Acc't.	Org.
$43,356.96				

ADDITIONAL DESCRIPTION:

SEE ATTACHED LIST

Property Number	PROPERTY RECORD	Location		
N-C-6235		MCRD PARRIS ISLAND, SC		
Contract	**Description**	**Date**	**Bldg.**	**Room**
22567-145	OPTO 22 CONTROL SYSTEM	4/28/98	SITE 45	TREATMENT BLDG
Purchase Order	**Mfg.**			
CREDIT CARD	OPTO 22			
Requisitioner	**Vendor**			
WAYNE UNDERHILL	SAME AS MFG			

Cost	Model	Serial Number	Acc't.	Org.
$6,737.82				

ADDITIONAL DESCRIPTION:

FACTORY FLOOR SOFTWARE SUITE #980105_002
MODEM
MODULAR CONTROLLER W/(16) DIGITAL INPUTS/OUTPUTS
MODULAR CONTROLLER EXTENDER W/(8) ANALOG INPUTS/ OUTPUTS
M4 SERIAL ADAPTER CARD
CONTROLLER POWER SUPPLY
REMOTE BRICK POWER SUPPLY
DIGITAL BRICK W/(16) DIGITAL INPUT/OUTPUT MODULES
SINGLE BRICK TERMINATOR ADAPTER
END OF LINE TERMINATOR
"PROVE IT TO ME" TOOLBOX AND UPGRADE #971007_001

BEI/RC N62467-93-D-0936
GOVERNMENT PROPERTY
N-C-6235

PARRIS ISLAND

DO - 48, 22567-145

MECHANICAL AND ELECTRICAL EQUIPMENT ASSOCIATED WITH THE FIBERGLASS BUILDING
PROPERTY NUMBER # N-C-6236

S VALUE	PRODUCTS DESCRIPTION
$526.03	4000 PSI Concrete
$950.00	Panelboard & Switch
$3,439.34	Misc. Electrical, Cable, Conduit Connections & Unistrut, Emergency Lighting, Wiring, Fuses & Junction Boxes
$61.85	Masonry Sand
$2,194.50	Hot Box Pump Guard
$636.69	Misc. Pipe and Fittings
$194.67	Stl Plugs, Sewer Cap, Pipe Fittings, Anchor Bolts, & Misc. tools
$2,997.79	Flow Indicating Transmitters
$345.74	Temporary Safety Fence, Rebar (fence posts), tiewire and welded wire mesh
$486.79	Unit heater, Thermostat, & wire duct
$903.03	Control Panel & Fuses
$664.92	SS Bolts & Epoxy
$229.59	Electric Cable Well Pump Conn. & Plugs
$1,671.27	Liquid Level Switch, Ashcroft Pressure Transducers (4-20 mA output) - 15 PSIG , Water Flow Totalizer & Signal Switch, Teflon Tubing, Dowel Pins, Surge Suppressor, SS Rope w/ Clips, Basket Strainer, Shelf Brackets & Heat Shrink Tubing
$133.33	Aluminum Grating
$597.62	Electrical Meter & Meter Panel
$60.08	Equip Tags
$315.37	PVC Pipe & Fittings, Patch Compound for Sewer Line, Form Lumber & Cement
$987.99	Hayward Motorized & Manual Valves
$2,636.00	Motor Starter Panel
$9,500.00	Fiberglass Building
$829.20	Exh Fan & Louvers
$25.16	Wet / Dry Vacuum
$70.00	Ladder
$12,900.00	Drilling, Well Installation and Well development - RECOVERY WELLS/3

$43,356.96

15,800 16 MONITORING WELL, INSTALL & DEVELOP

Property Number	PROPERTY RECORD	Location: OAK RIDGE OFFICE		
N-0003		Date	Bldg.	Room
Contract: N62467-93-D-0936	Description: 2 STAGE REGULATOR	12/17/96	*	
Purchase Order: 22567-145-CC-0702	Mfg.: OXWELD			
Requisitioner: BILL HEVRDEYS	Vendor: SOUTHERN WELDING			
Cost: $211.05	Model: TRIMLINE R-77 / Serial Number: 150-580 / Acc't. / Org.			

ADDITIONAL DESCRIPTION:

FOR HELIUM GAS CYLINDER

* LOCATED IN HEVRDEY'S FILE CABINET

ED: 15-614-5125 Commodity/Cd: QC87

SHADED AREA FOR PROCUREMENT USE ONLY

BECHTEL

Bottled Helium For Parrisisland

REQN. NO.
22567-145-MR-0702
12/4/96

AGREEMENT NUMBER
22567-145-CC-0702

ENTITY
Bechtel Environmental, Inc.

PROMISED DELIVERY DATE
As Required

DIVISION/DEPT./SERVICE

VENDOR
Southern Welding Supply (L)

BUILDING/FLOOR/LOCATION

TELEPHONE

SHIP VIA
Vendor

REQUESTER'S NAME
KIM LEWIS

EMPLOYEE NUMBER

SHIPPING TERMS
FOB: Shipping Point

DATE SUBMITTED
December 2, 1996

DATE REQUIRED
December 16, 1996

ORIGIN
Hilton Head, SC

AUTHORIZATION FOR EXPENDITURE NO. (AFE)

PAGE 1 OF 1

TERMS OF PAYMENT
Credit Card

ITEM	REV	QUANTITY	DESCRIPTION	UNIT PRICE	EXTENSION
	0	3 WSH 3 EA	Industrial Grade Helium, Size K Cylinder 337 CU.FT.	68.50	205.50
	~~0~~	~~3 EA~~	~~Industrial Grade Helium, Size S Cylinder (Smaller than Size K Cylinder.)~~	~~49.50~~	148.50
	0	1 WSH 1 EA	Two Stage Regulator to Fit K Cylinder	197.00	197.00
	~~0~~	~~1 EA~~	~~Two Stage Regulator to Fit S Cylinder~~	~~197.00~~	~~197.00~~
	0	5 dy 12/10/96 THRU 12/17/96 3 cyl. 1 ea. 1 WSH	cylinder rental fee Bill Hevrdeys will call for Delivery. Bill can provide map and phone number when he arrives at Parris Island.	.54	2.70
	0		delivery charge VENDOR: SOUTHERN WELDING SUPPLY INC. 1-800-673-9371 CONTACT R.J., Hilton Head, SC. tax Company only delivers every two weeks to Parris Island. Check to see if delivery schedule can be altered.	1.25	2.25 24.45
			ESTIMATED VALUE: $ 1,000.00 Total Value		431.90

REQUESTING ORGANIZATION			REVIEW AUTHORITY	PROCUREMENT
APPROVAL SIGNATURE (S)		DATE	BUDGET APPROVAL	RECOMMENDED
TYPED APPROVAL NAME		EMPLOYEE NUMBER	DATA PROCESSING SERVICES	APPROVED Cathy Mangum

GEN LEDGER CORE	SUB ACCT.	NAT. CLS.	S/S ACCT	JOB NUMBER	SUB JOB	S/S JOB	ACTIVITY CODE	REQUESTOR'S ORG. CODE	AMOUNT	CTL	LINE ITEM CODE	OVR RN	OVR FC CO
				22567									

William Lundeyn 12/17/96
RECEIVED BY DATE

ORG. ACCT
COPY - P. HOWARD
F. YAZDI
FLD FILE

0060 (REV. 8/92)

INTRA-PROJECT SHIPPING NOTICE

Date: APRIL 28, 1998

WBS: 145

(~~TMA/E~~) Job #: 22567-145

n of Shipment:	Destination:
ITEM #1 & 3 SHIPPED FROM OAK RIDGE, TN ITEM #2 SHIPPED FROM WHITING FLD, FL.	MCRD PARRIS ISLAND, SC. SWMU 45 PUMP & TREAT BLDG. SAMOA STR & K
Ship Via: Fed. Express: ____ UPS STD: ____ UPS/Red: ____ UPS/Blue: ____ Air Freight: ____ Roadway Exp: ____ Yellow Frt: ____ Other: X	Certified Release of Equipment: ____ Health Physic Technician's Signature

Item No.	Quantity	Unit	Description	Action Code	S/N	DOE/BNI Tag Barcode #	
1	1	EA	GRAY METAL UTILITY SHELF UNIT *	5		N0622	
2	1	EA	FIRE EXTINGUISHER *	5	—	—	
3	1	EA	PORTABLE PHONE - LANDLINE *	5		N-S-4313	
		*	SHELF UNIT & FIRE EXTINGUISHER				
			WERE BOLTED TO WALLS IN SIDE				
			TREATMENT BLDG. PHONE IS LOCATED				
			INSIDE CP-1 PANEL.				

Receiving Information:

Received by: William Hendrix

Date: 4/16/98

ion: USED

1, New ____ (2) Good X (3) Fair ____ (4) Broken ____

Action Codes:

(1) Repair (2) Calibrate
(3) Store at Lab (4) Store at Warehouse
(5) Site Transfer (6) Surplused
(7) Other

Packed by: ____

Return date: ____

Packing List

~~PSSRAP~~ C008 (9/93)

Goulds

Submersible Effluent Pump

MODEL

3885

CANADIAN STANDARD ASSOCIATION

SERIAL NO. A 9842998

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Farms
- Trailer courts
- Motels
- Schools
- Hospitals
- Industry
- Effluent systems

SPECIFICATIONS

Pump:

- Solids handling capabilities: ¾" maximum.
- Discharge size: 2" NPT.
- Capacities: up to 128 GPM.
- Total heads: up to 123 feet TDH.
- Mechanical seal: silicon carbide-rotary seat/silicon carbide-stationary seat, 300 series stainless steel metal parts, BUNA-N elastomers.
- Temperature: 104°F (40°C) continuous 140°F (60°C) intermittent.
- Fasteners: 300 series stainless steel.
- Capable of running dry without damage to components.

Motor:

- Single phase: ⅓ HP, 115 or 230 V 60 Hz, 1750 RPM; ½ HP, 115 V, 60 Hz, 3500 RPM; ½ HP – 1½ HP, 230 V, 60 Hz, 3500 RPM. Built-in overload with automatic reset. Class B insulation.
- Three phase: ½ HP – 1½ HP 200/230/460 V, 60 Hz, 3500 RPM. Class B insulation, overload protection must be provided in starter unit.
- Shaft: threaded, 400 series stainless steel.
- Bearings: ball bearings upper and lower.
- Power cord: 20 foot standard length (optional lengths available). Single phase: ⅓ and ½ HP – 16/3 SJTO with three prong plug. ¾-1½ HP – 14/3 STO with bare leads. Three phase: ½-1½ HP – 14/4 STO with bare leads. On CSA listed models – 20 foot length SJTW and STW are standard.

FEATURES

Impeller: Cast iron, semi-open, non-clog with pump-out vanes for mechanical seal protection. Balanced for smooth operation. Silicon bronze impeller available as an option.

Casing: Cast iron volute type for maximum efficiency. 2" NPT discharge adaptable for slide rail systems.

Mechanical Seal: Silicon carbide vs. silicon carbide sealing faces. Stainless steel metal parts, BUNA-N elastomers.

Shaft: Corrosion-resistant stainless steel. Threaded design. Locknut on three phase models to guard against component damage on accidental reverse rotation.

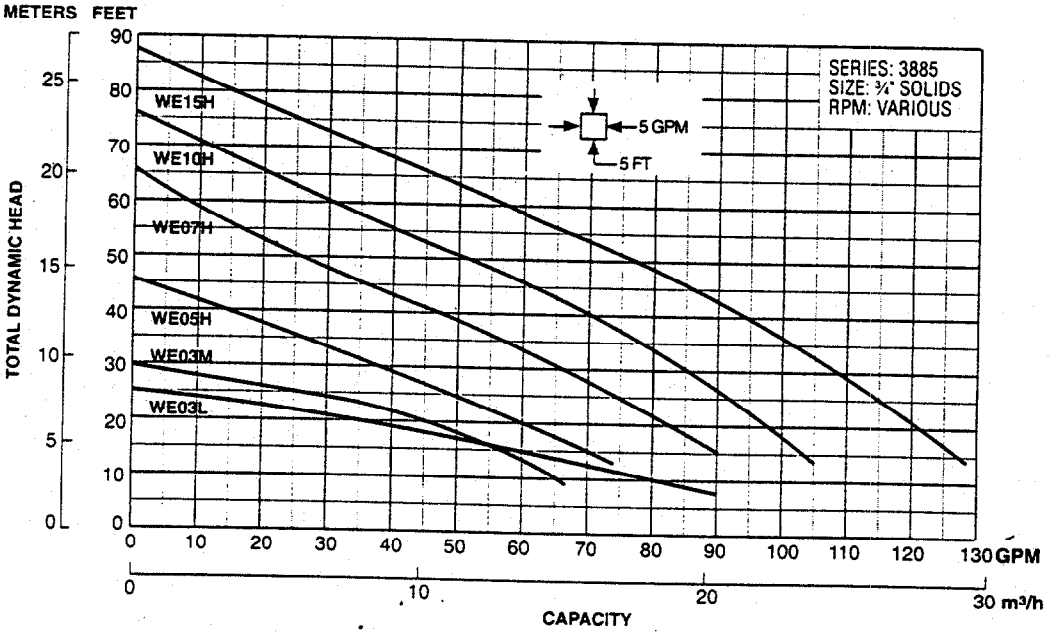
Motor: Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

Designed for Continuous Operation: Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage.

Bearings: Upper and lower heavy duty ball bearing construction.

Power Cable: Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking.

O-ring: Assures positive sealing against contaminants and oil leakage.



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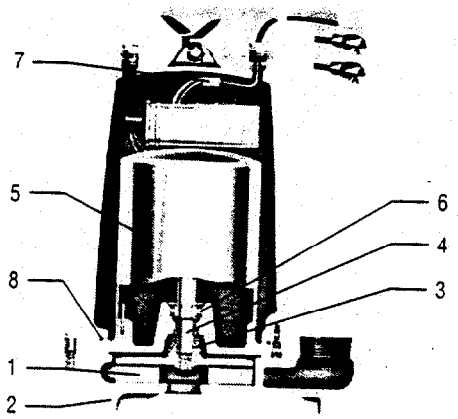
Effective May, 1994
B3885

Item No.	Description
1	Impeller
2	Casing
3	Mechanical seal
4	Shaft
5	Motor
6	Bearings – upper and lower
7	Power cable
8	O-ring



goulds

Submersible Effluent Pump

MODEL

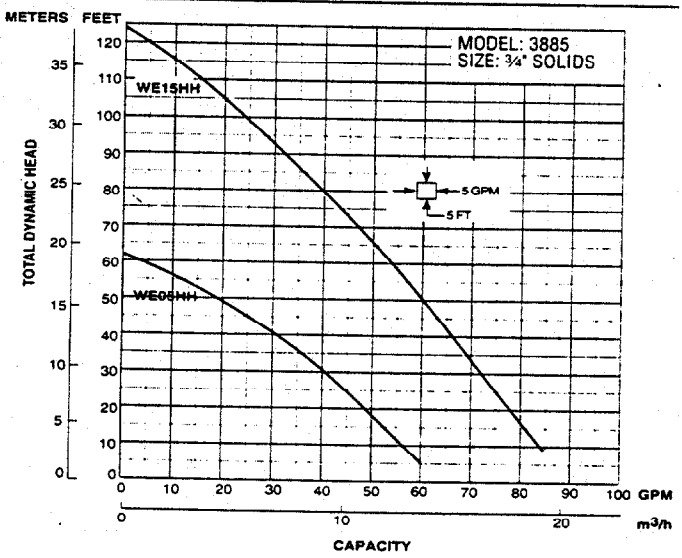
3885

MODELS

Order No.	HP	Volts	Phase	Max. Amp.	RPM	Solids	Wt. (lbs.)
WE0311L	⅓	115	1	9.4	1750		56
WE0312L		230		4.7			
WE0311M		115		9.4			
WE0312M		230		4.7			
WE0511H	½	115	1	13.0			60
WE0512H		230		6.5			
WE0538H		200	3	3.9			
WE0532H		230		3.4			
WE0534H		460		1.7			
WE0511HH		115	1	13.0			
WE0512HH		230		6.5			
WE0538HH		200	3	3.8			
WE0532HH		230		3.3			
WE0534HH		460		1.65			
WE0712H	¾	230	1	10.0	3500	¾"	70
WE0738H		200	3	6.2			
WE0732H		208 – 230		5.4			
WE0734H		460		2.7			
WE1012H	1	230	1	12.5			
WE1038H		200	3	8.1			
WE1032H		208 – 230		7.0			
WE1034H		460		3.5			
WE1512H	1½	230	1	15.0			80
WE1538H		200	3	10.6			
WE1532H		208 – 230		9.2			
WE1534H		460		4.6			
WE1512HH		230	1	15.0			
WE1538HH		200	3	10.6			
WE1532HH		208 – 230		9.2			
WE1534HH		460		4.6			

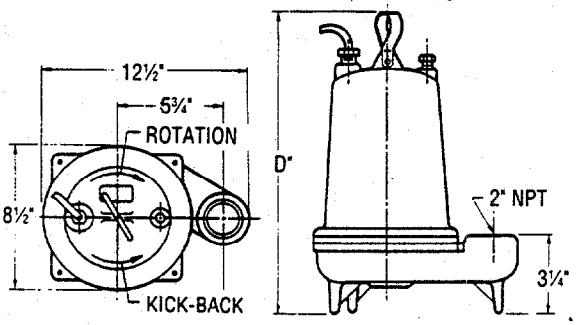
PERFORMANCE RATINGS (gallons per minute)

Order No.	WE0311L WE0312L	WE0311M WE0312M	WE0511H WE0512H WE0538H WE0532H WE0534H	WE0712H WE0738H WE0732H WE0734H	WE1012H WE1038H WE1032H WE1034H	WE1512H WE1538H WE1532H WE1534H	WE0511HH WE0512HH WE0538HH WE0532HH WE0534HH	WE1512HH WE1538HH WE1532HH WE1534HH
HP	⅓	⅓	½	¾	1	1½	½	1½
RPM	1750	1750	3500	3500	3500	3500	3500	3500
Total Head Feet of Water: 5	–	–	–	–	–	–	60	–
10	80	65	–	–	–	–	56	84
15	60	57	69	90	104	128	53	82
20	36	45	60	83	98	122	48	77
25		25	50	76	92	116	45	75
30			38	67	85	109	40	72
35			26	58	78	102	35	70
40			15	47	70	94	30	67
45				36	62	86	25	64
50				25	52	77	18	60
55				17	42	67	12	58
60				8	32	56	3	54
65					21	46		51
70					11	35		47
75						25		43
80						15		40
90								33
100								24
110								15
120								5



DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)
D* ⅓, ½, ¾ and 1 HP = 15"
except for model WE0712H and WE1012H = 18"; 1½ HP = 18"



EFFLUENT EJECTOR SYSTEM

Effluent ejector system offers ease of ordering and installation. A single ordering number specifies a complete system designed for most residential and commercial sump and effluent pump applications.

Package Includes:
Submersible Effluent Pump WE0311L, 12L or WE0311M, 12M, WE0511HH, 12HH
Mercury Level Control Switch A2-5 (115V), A2-6 (230V)
Basin A7-1801S, Basin Cover A8-1822
Check Valve A9-2P
Order No.: SWE0311L, SWE0312L, SWE0311M, SWE0312M, SWE0511HH, SWE0512HH.

Repair Parts

MODEL

3885

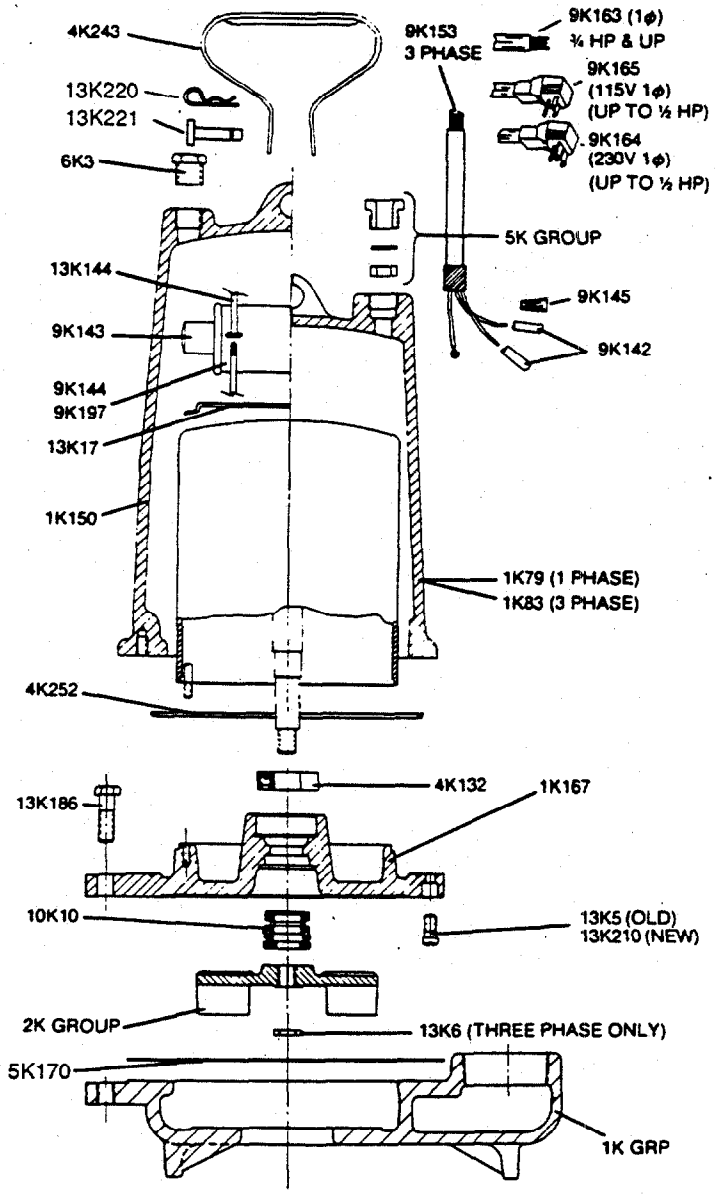
Effective December, 1991

PART NO.	PART NAME	PATTERN NO.
1K170	Casing-All Medium (M), High (H), High-High (HH), Head Models	59114
1K171	Casing-WE0311L, WE0312 Low Head/High Flow Models Only	59115
1K79	Motor Cover-½ HP and ½ HP Single Phase	56887
1K83	Motor Cover-½ HP-1 HP Three Phase	56887
1K150	Motor Cover-¾ HP-1½ HP Single and 1½ HP Three Phase	59055
1K167	Stuffing Box	59113
2K158	Impeller All ½ HP	59049
2K220	Impeller ½ HP WE05(H)	59086
2K219	Impeller ¾ HP WE07(H)	59051
2K218	Impeller 1 HP WE10(H)	59050
2K217	Impeller 1½ HP WE15(H)	59050
2K225	Impeller ½ HP WE05(HH)	59097
2K221	Impeller 1½ HP WE15(HH)	59076
2K271	Impeller All ½ HP	59049
2K272	Impeller ½ HP WE05(H)	59086
2K273	Impeller ¾ HP WE07(H)	59051
2K274	Impeller 1 HP WE10(H)	59050
2K275	Impeller 1½ HP WE15(H)	59050
2K276	Impeller ½ HP WE05(HH)	59097
2K277	Impeller 1½ HP WE15(HH)	59076
4K132	Ball Bearing	
4K243	Lift Handle	
2K245	Insulating Oil (Gal.) ½ & ½ HP 6 Pts. Req.; ¾-1½ HP 8 Pts. Req.	
4K252	O-Ring	
5K111	Strain Relief Assembly-¾-1½ HP 1 Phase & All 3 Phase	
5K113	Strain Relief—½, ½ HP 1 Phase	
5K169	Shim Set (HH Only)	
5K170	Paper Gasket	
6K3	Plug-⅜" NPT	
9K142	Heat Shrink Tubing-1 Phase Models Only	
9K145	Insulating Connector-3 Phase Models Only	
9K153	Cord Set-All 3 Phase (Except CSA)	
9K163	Cord Set-¾-1½ HP 1 Phase (Except CSA)	
9K164	Cord Set-½ & ½ HP 1 Phase 230 Volt (Except CSA)	
9K165	Cord Set-½ & ½ HP 1 Phase 115 Volt (Except CSA)	
9K195	Cord Set-½ & ½ HP 1 Phase 115 Volt-CSA	
9K196	Cord Set-½ & ½ HP 1 Phase 230 Volt-CSA	
9K180	Cord Set-¾-1½ HP 1 Phase-CSA	
9K181	Cord Set-All 3 Phase-CSA	
9K143	Capacitor Cap	
9K197	Capacitor-½, ¾, 1, 1½ Cap. Start	
9K144	Capacitor ¾-1½ HP 1ø Models-PSC Motor used prior to Jan. 90	
10K10	Mechanical Seal Assembly	
13K5	Fillister Head Screw (¼-20)	
13K210	Socket Head Screw (5/16-18)	
13K6	Impeller Locknut-3 Phase Only	
13K17	Capacitor Bracket	
13K144	Strap-Capacitor	
13K186	Hex Cap Screw-St. Box to Casing	
13K220	Hair Pin	
13K221	Handle Pin	
AL27121	Loctite #271	

Cast Iron

Bronze

Note: Impellers on 3ø units are Loctited to motor shaft. Impellers and locknuts must be heated to be removed. When replacing impeller, use Loctite AL27121. See instruction manual.



Repair Motor Numbers				
HP	Phase	Voltage	RPM	Order #
½	1	115	1750	118-12-01
½	1	230	1750	118-12-02
½	1	115	3500	118-12-22
½	1	230	3500	118-12-23
¾	1	230	3500	118-12-32
1	1	230	3500	118-12-33
1½	1	230	3500	118-12-34
½	3	208/230/460	3500	118-13-21
¾	3	208/230/460	3500	118-13-32
1	3	208/230/460	3500	118-13-33
1½	3	208/230/460	3500	118-13-34

GOULDS PUMPS, INC.
SENECA FALLS, NEW YORK 13148

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

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PRINTED IN U.S.A.
R3885

OB0080 1
F1

GOULDS PUMPS, INC.
PICK LIST

PAGE 1
DATE 3/05/98

7308

LL TO : DRILLERS SERVICE INC
1792 HIGHLAND AVE NE
PO BOX 1407
HICKORY NC
28603-1407

SHIP TO : BECHTEL ENV., INC.
ATTN : BILL HEVRDEYS
MCRD BLDG #193
SAMOA STREET
PARRIS ISLAND SC
29905

ORDER NO.	ORDER DATE	SHIP DATE	CUSTOMER PURCHASE ORDER	SHIP VIA	WHS	PICK SLIP
707317	3/05/98	3/06/98	811082	UPS GROUND	F1	54507

SHIP UPS GROUND
TAG: 22567-145-CC-0811
CAROL GRAYDEN - ORLANDO

ORDERED	ALLOC.	PICKED	PRODUCT NO.	DESCRIPTION	LOCATION
1	1	1	WE0511HH	1/2HP 1/60/115 3.87"	E2 - -

END OF PICK LIST ***

GOULDS LIMITED WARRANTY

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

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

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

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;

(b) Reinstallation costs of repaired equipment;

(c) Reinstallation costs of replacement equipment;

(d) Consequential damages of any kind; and,

(e) Reimbursement for loss caused by interruption of service.

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

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds and the dealer in purchases, consignments or contracts for sale of the subject pumps.

(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.

(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

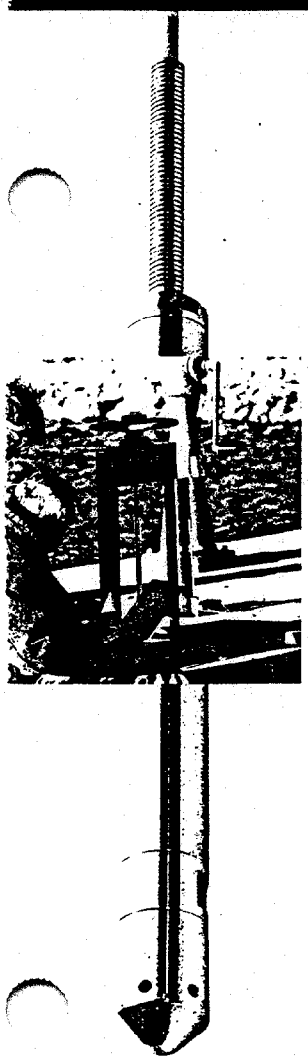
THIS WARRANTY EXTENDS TO THE DEALER ONLY.

GOULDS PUMPS
ITT Industries
SENECA FALLS, NEW YORK 13148

JAN. 1998
FORM NO. GW

Helping monitor the earth's resources

In-Situ Inc.



environmental monitoring systems

data loggers

intelligent probes

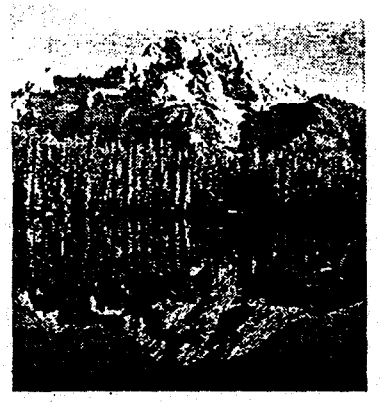
pressure transducers

water quality probes

PXD-261

Pressure Transducer

Operator's Manual



In-Situ Inc.
Helping monitor the earth's resources

PXD-261
Pressure Transducer
Operator's Manual

February 1998

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Laramie, Wyoming 82073-0920	Laramie, Wyoming 82070	*Support Line:*	800 446 7488
USA	USA		*(US & Canada)*

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Contents

1 Introduction 1
- Operating Principle 1
  - PSIA and PSIG 1
- Unpacking and Inspection 2
- Description 2
  - Calibration Documentation 2

2 Installation 3
- Installing the Cable 3
- Connecting to the Logger 4
- Installing in the Water 4
  - Vertical Installation 4
  - Piping Installations 6
- Using the PXD-261 with Other Equipment 7
- Level Mode Application: Slug Tests 8

3 Programming the Data Logger 9
- Definitions of Terms 9
  - Type 9
  - Linearity, Scale, & Offset 9
  - Warmup 10
  - Specific Gravity 10
  - Mode & Reference 10
- HERMIT 1000C 10
- HERMIT 2000 12
- HERMIT 3000 12
- LTM3100 13
- LTM3000 14

4 Transducer Maintenance 15
- Vent Tube 15
- Filter 15
- Nosecone 15
- Quick-Connect Cable 16
- Calibration 16

5 Warranty & Service Information . 17
- Warranty Provisions 17
- To Obtain Repair Service 18
- Serial Number 18

Appendix: Specifications 19

Guidelines and Precautions

- *The PXD-261 will not read past its designated range. If the range is exceeded, the value displayed by the data logger will remain constant.*
- *Never submerge the PXD-261 more than two times its range.*
- *When a slug test is planned, be sure that the transducer's range is sufficient to withstand the pressures it will be subjected to.*
- *Don't let the transducer "free fall" into a well or onto a water surface. Lower it gently.*
- *Be sure connectors are clean and dry before installing them.*
- *Be sure the vented cable is not kinked or blocked.*
- *Allow at least 30 minutes for the PXD-261 to stabilize to the water temperature before collecting data.*
- *When using the PXD-261 to measure water levels with a HERMIT 1000 or 2000 data logger, don't forget to set a Reference. A Reference number left in the data logger from an earlier test will probably be meaningless.* ***Be sure to install the transducer in the water first.***
- *Secure the transducer cable so it doesn't slip during operation.*
- *When the PXD-261 is being used in a pumping well, install it above the pump.*
- *Do not attempt to disassemble the PXD-261 body. Doing so may severely damage the transducer and will void the warranty.*
- *Finally, the PXD-261 pressure transducer is a delicate electronic instrument. Please give it the care it deserves.*

1 Introduction

The PXD-261 is an accurate, stable, fully submersible pressure transducer for monitoring changes in water level. It collects fast, accurate time-drawdown data from pump and slug tests, including the recovery phase. Its small diameter permits access to 1" wells. Its Quick-Connect™ cable is easy to install, and long cable lengths do not compromise accuracy. The PXD-261 is ideal for both short-term testing and long-term monitoring.

The standard PXD-261 is a PSIG type transducer, and its cable is vented to the atmosphere. An "absolute" PSIA version on unvented cable is also available.

Operating Principle

A pressure transducer senses changes in pressure, measured in pounds per square inch (PSI), exerted by a column of water or other fluid above an internal strain gauge. This is translated electronically to a 4-20 mA signal sent to the data logger. Software calibration coefficients unique to each transducer enable the data logger to convert the 4-20 mA output to meaningful results in the desired units.

PSIA and PSIG

PSIA stands for "pounds per square inch absolute," measured with respect to zero pressure. PSIA transducers measure all pressure forces detected by the strain gauge, including atmospheric pressure.

PSIG stands for "pounds per square inch gauge," measured with respect to atmospheric pressure. PSIG transducers thus exlude the atmospheric pressure component.

This difference may be represented by a simple equation:

$$P_{gauge} = P_{abs} - P_{atmos}$$

Unpacking and Inspection

Your PXD-261 was carefully inspected before shipping and is ready to operate right out of the box. Check for any physical damage during shipment. Notify In-Situ and file a claim with the carrier if there is any such damage. If your transducer didn't come as ordered, please contact In-Situ immediately.

The "proof" or over-range pressure is two times (2X) the full-range pressure and should never be exceeded or the transducer may be permanently offset, damaged, or destroyed.

Description

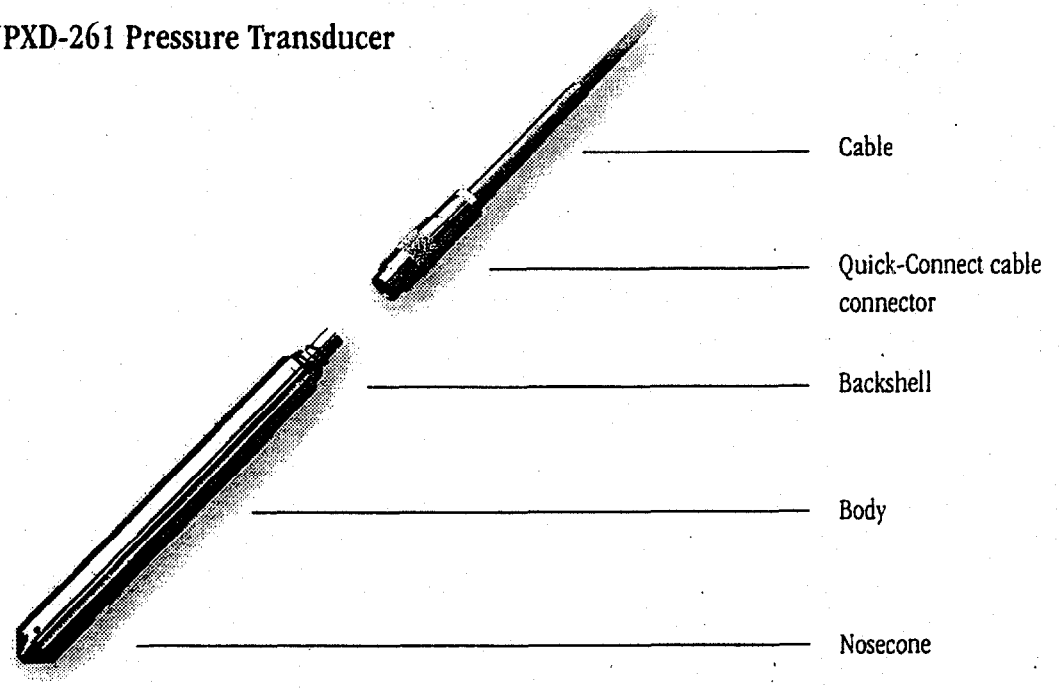
The body of the PXD-261 is 0.86 inch (22 mm) in diameter and constructed of 316 stainless steel. Seals are Viton®. The principal parts are shown in the photo below.

Calibration Documentation

Documents provided with the PXD-261 describe In-Situ's calibration process and contain the transducer's unique calibration coefficients. For convenient reference, the coefficients are printed on the PXD-261 data tag, along with the following information:

- **Serial Number and Calibration Date**
- **Range** of accurate measurement (PSI)
- **Proof**: maximum over-range pressure (PSI)
- **Linearity, Scale, Offset**: calibration coefficients that enable the logger to convert the transducer's 4-20 mA output to meaningful results

PXD-261 Pressure Transducer



2 Installation

The only removable parts of the PXD-261 are the nosecone and cable. Do not take the body apart, as this may severely damage the transducer and will void the warranty.

Installation requires four steps:

- Install the cable.
- Connect the cable to the data logger.
- Install the PXD-261 in the water.
- Program the data logger to identify the PXD-261.

These steps can be performed in any order. You might want to program the data logger in the office, then take it all to the field and set it up, or vice-versa.

Connection and installation in the water are covered in this section. Programming the data logger is summarized in Section 3.

Installing the Cable

Attach the Quick-Connect cable to the PXD-261 as follows:

1. Remove the protective caps from the PXD-261 backshell and the Quick-Connect connector on the cable.

   Don't discard the caps. Set them aside for later use to protect the contacts when the probe and cable are not in use. The backshell cap may display the probe's serial number and calibration coefficients—important numbers you'll need when programming the data logger.

2. Slide back the sleeve of the Quick-Connect connector.
3. Align the tab in the PXD-261 backshell with the slot inside the cable connector.
4. Slide the two parts together and press tightly. They should slip together easily, without forcing.
5. Tighten the locking sleeve hand-tight.

CABLE CONNECTIONS

WHITE = (+)
BLACK = (-)
SHIELDING = (GROUND)

4-20 mA OUTPUT

Proper operation of a transducer depends on a clean, dry connection to the data logger. Make sure the connectors are clean and dry before trying to install them.

Connecting to the Logger

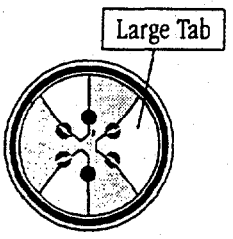
Transducers can be installed at any of the input channels on the connector panel of a HERMIT. If more than one transducer is being used, they should be installed consecutively beginning at channel one.

The Well Sentinel transducer connector is on the bottom of the instrument. Since it is not a weight-bearing connector, strain relief must be provided. Refer to the Well Sentinel *Operator's Manual* for suggestions.

Transducers mounted on reels are supplied with a jumper cable for convenient connection to the instrument. Transducers on cable without a reel connect directly to the instrument without a jumper cable.

To install connectors:

1. Remove the protective caps from the data logger connector and the cable.
2. Orient the connector patterns so that the large tab in the cable connector aligns with the V-shaped notch in the instrument connector.
3. Gently press the connector halves together. Excessive force should not be required.
4. Tighten the connector's lock ring to establish a tight connection and water-resistant seal.



Remove a connector as follows:

1. Loosen the connector's lock ring.
2. Gently pull the connector halves apart.
3. Replace all protective caps. Store the transducer in its original container or where it will be safe from damage to the contacts.

Installing in the Water

Installing a transducer is not difficult, but it should be done with care. Here are some recommendations to bear in mind.

Vertical Installation

DON'T let a transducer "free fall" into a well or onto a water surface because of the likelihood of a pressure wave breaking the strain gauge (the "waterhammer" effect).

DO position the transducer below the lowest anticipated water level, but not so low that the range of the transducer might be exceeded at the highest anticipated level. Maximum depths in feet and meters are shown in the table on the opposite page.

For example: A 10 PSI transducer will measure 23.1 feet of change in water level. If the water level is going to drop, the transducer should be placed not more than 23.1 feet below the static (starting)

Range (PSI)	Max.Usable Depth Feet	Meters
10	23.1 ft	7.03 m
15	34.6 ft	10.5 m
20	46.1 ft	14.1 m
30	69.2 ft	21.1 m
50	115.3 ft	35.2 m
100	230.7 ft	70.3 m
250	576.7 ft	175.8 m

water level. A 10 PSI transducer positioned 18 feet below the surface will measure change from the beginning water level to a drop of 18 feet—at which time it will be out of the water. At the same position it will also measure a rise in water level up to 5.1 feet (23.1 - 18.0) from the starting water level.

Pressure Limitations. The PXD-261 will not read data above full-range pressure (the "Range" number on the data tag). Above this limit the data logger's reading will remain constant. The transducer will not be damaged as long as the pressure is less than two times the full-range pressure (the "Proof" number on the data tag). Never submerge a transducer more than two times the full-range pressure or it will be permanently offset, damaged, or destroyed.

If a transducer is subjected to excess pressure but still appears to function normally, the calibration should be verified by In-Situ. See "To Obtain Repair Service" in Section 5.

To prevent damage to the vent tube, don't allow the cable to kink or bend tightly. The minimum recommended bend radius is one inch. This caution doesn't apply to the PSIA version of the PXD-261, as it has no vent tube.

DON'T block or crimp the vent tube—a small polyethylene tube inside the transducer cable. The vent tube provides for equalization of air pressure on the water surface and inside the transducer. When a change in barometric pressure causes a change in water level (e.g., in confined aquifers), the change will not be distorted by a doubled reading caused by unequal pressure. If the vent tube becomes kinked, the internal components can be damaged without any visible harm to the outside of the cable.

DON'T set a pressure transducer below the level of the pump in a pumping well. The pressure transients generated by the pump will cause false level readings. Large pumps can swallow the transducer and cause permanent damage to both the transducer and the pump.

DO attach the transducer cable securely to the wellhead or other stationary object. If the transducer slips during the test, it will be impossible to tell from the data record whether the water level changed, the transducer moved, or both. A secure transducer placement is critical to accurate measurement.

DO allow at least a half-hour for the transducer to stabilize to the water conditions before starting a test or setting the Reference. Longer stabilization is always desirable, especially in long tests. Even though the

cable is shielded, temperature stabilization and minor stretching can cause apparent changes in the reading. If you expect to monitor water levels to the accuracy of the transducer, it's worth allowing the extra time for the transducer to stabilize to the test environment.

Always remove the cable before screwing the PXD-261 into a pipe.

Check Readings. After the transducer has been installed in the water and the data logger has been programmed, it's a good idea to take a reading of the transducer depth and then move the transducer and take another reading to be sure that the transducer is giving a reasonable reading and showing change. A transducer might not be located where you think it is—for example, it could be wedged against the casing with a loop of cable hanging below it. A transducer in such a position may become dislodged and move during the test, giving a false change in level. The data logger Operator's Manual tells how to take a preliminary reading.

Piping Installations

With the nosecone removed, the PXD-261 can be installed in any 1/4" NPT threaded pipe to monitor flow. Always remove the cable before screwing the transducer body into the NPT.

To install the PXD-261 in a pipe fitting:

1. If the cable is attached, remove it. To do so, unscrew the locking sleeve and gently pull the transducer and cable connector apart.
2. Unscrew the nosecone by hand and remove it.
3. Using a 7/8" open end wrench and the wrench flats on the transducer body, screw the PXD-261 onto any 1/4" NPT threaded nipple, tee, or elbow, depending on plumbing at the wellhead.
   - Apply your wrench to the wrench flats, not to the spanner holes at the back end of the transducer.
   - Thread sealing (compound or tape) may be used if necessary.
4. Reattach the cable.

Accuracy of the electronics may be affected by temperature fluctuations. Therefore, for long-term tests (several weeks), we recommend you insulate the transducer to ensure a thermally stable environment.

Using the PXD-261 with Other Equipment

This information is designed to help you interface the PXD-261 with third-party instrumentation. To make proper use of this information you should be prepared to

- Read and understand a schematic diagram
- Research other equipment manuals for interface details
- Run to an electronics store for parts
- Use a soldering iron and other small tools for electronic assembly

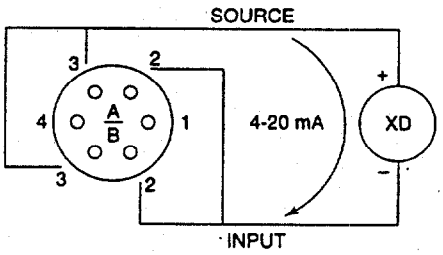
If any of these resources are not available to you, contact In-Situ's customer service personnel for assistance, or quotes on custom cables and interfaces.

In-Situ does not warrant the PXD-261 against damages caused by use with devices not provided by In-Situ.

The PXD-261 provides a linear current output that is proportional to the applied pressure. This output is a 4-20 mA change corresponding to a full-scale change in pressure. The voltage required by the transducer is 12-30 VDC.

Any data logger that provides the necessary voltage and can read the 4-20 mA current output can be used with the PXD-261. To insure accuracy, power should be applied for a minimum of 50 milliseconds prior to any reading.

The wiring of the PXD-261 is shown here. It is a standard 2-wire, 4-20 mA transducer.



Any mating connectors needed must be ordered separately from In-Situ. *Do not use any other type of connector* as this will compromise the integrity of waterproof operation. Also, remember that the vent tube in the cable must remain unobstructed to assure that the transducer is insensitive to barometric pressure changes. See Section 4, Transducer Maintenance, for additional details.

When a slug test is planned, be sure that the transducer can withstand the pressures it will be subjected to.

Level Mode Application: Slug Tests

When conducting a slug test, caution must be used so that the amount of water slugged does not over-pressure the transducer.

For example: You have a 20 PSI transducer down a test hole with 4-inch casing. Say the water surface is 100 ft. from the top of the casing, and the transducer is set 23 ft. below the surface of the water. (This corresponds to a transducer reading of 10 PSI.) If the hole is instantaneously slugged with 20 gallons of water, an additional pressure of 33.2 PSI would be created. Thus, the transducer would be subjected to an instantaneous pressure of 43.2 PSI, which is greater than the 40 PSI (2X) it can withstand without damage.

3 Programming the Data Logger

The process of collecting data from the PXD-261 with In-Situ's data loggers is referred to as "running a test." This has three steps:

- Enter the test conditions into the data logger.
- Enter the transducer characteristics into the data logger.
- When the data logger is programmed and the PXD-261 is in place, the test can be started.

When in doubt about a programming step, please consult the Operator's Manual for your data logger.

How you carry out these steps depends on the data logger you are using. This section briefly highlights some of the differences among data loggers. Depending on the logger, the questions or "prompts" for input may be worded slightly differently. More complete information can be found in the Operator's Manual for the data logger.

Definitions of Terms

Type

also called input type, channel type, probe type, transducer type, XD type, data type, measurement type

This is important because it tells the data logger how to power up, and take a reading from, the transducer connected to an input channel. The type also determines the data reduction equations that are used to convert the 4-20 mA output of the transducer to meaningful results in the desired units.

Linearity, Scale, & Offset

These "calibration coefficients" are unique to each transducer and may be found on a data tag and also in the probe calibration documentation.

The PXD-261 requires 50 mSec warmup time.

Warmup

also called delay, warmup delay

This is the time required for the logger to power and read the transducer. The PXD-261 requires 50 milliseconds (mSec).

Specific Gravity

Pure water has a specific gravity of 1.0. A ten PSI transducer will measure 23.1 feet of change in a fluid that has a specific gravity of 1.0 (10 PSI × 2.30667 ft./PSI).

One PSI—either PSIA or PSIG—is equal to 2.30667 feet of water.

If the working fluid is not water, some situations may require that you determine its specific gravity to obtain accurate test results. Most In-Situ data loggers let you specify the fluid's specific gravity through a simple menu option. When monitoring in water, the specific gravity should usually be set to 1.0.

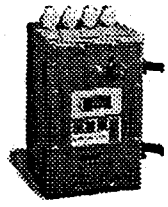
Remember: When you choose surface mode—even if monitoring in a well—when the water level goes up, your numbers will go up; when the water level goes down, the numbers will go down.

Mode & Reference

When measuring water levels, the Mode setting determines whether the displayed values increase or decrease in response to changes in water level. The Reference is a user-specified starting point for all the test measurements. See the box opposite.

The data loger substitutes your Reference for the transducer's raw pressure reading at the moment you enter it (HERMIT 1000, HERMIT 2000, LTM3000) or optionally at the start of the test (HERMIT 3000, LTM3100).

HERMIT 1000C



HERMIT software is integral to the data logger. Each step is performed through its own menu:

1. Set up the test in the Enter Data menu. Refer to Section 4 of the *HERMIT 1000C Operator's Manual* for details.

   Type. Select "Level" for water levels or "Func" for direct pressure readings.

2. Set up the transducer(s) in the Enter XD menu (operator's manual Section 5).

   Scale, Offs(et), Lin(earity). Enter values from the PXD-261 data tag.

   Note: With an older model HERMIT (1000B or earlier), use the "Linear" or "BFSL" coefficients printed in the calibration documentation.

   Delay. Enter 50 (milliseconds).

   For Level types—

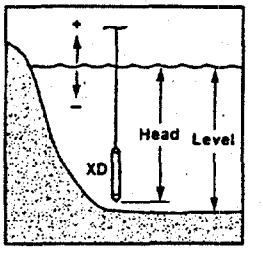
   Ref. Skip the Reference your first time through the menu. Go back and enter it after the transducer is installed.

   Dsp. Combination of Units & Display Mode. Choose from

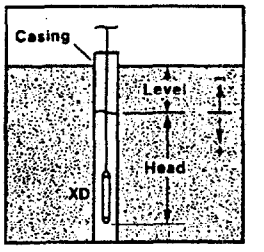
En: toc	Feet, Top of Casing mode
En: Sur	Feet, Surface mode
SI: toc	Meters, Top of Casing mode
SI: Sur	Meters, Surface mode

Mode & Reference

The **Surface Mode** is "positive up." In other words, *increasing* water levels will result in *increasing* readings. *Decreasing* water levels correspond to *decreasing* readings. This mode is often used to monitor surface waters such as streams and lakes, or in wells to use pressure head data directly.



The **TOC (Top of Casing) Mode** is "positive down." That is, *decreasing* water levels correspond to *increasing* readings, because the water level is getting further from the top of the well casing. *Increasing* water levels result in *decreasing* readings. This mode is useful when monitoring drawdown and readings referenced to the top of the well casing are required.



The **Reference** field provides a built-in linear offset for your data. The Reference is used to base the displayed readings on a known, user-specified starting point. (In Win-Situ, the Reference is optional, and can be changed or even removed later, when the data are displayed.) With a careful choice of Reference, you will never have to recalculate your data at the end of a test. However, it is important to understand the effect of different References. The table below shows some examples:

With this Mode...	And this Reference...	The data will be displayed as...
Surface	Present depth (e.g., a lake)	Depths
Surface	Altitude of water surface	Altitudes
Surface	Zero	Changes from the initial water level: When numbers get lower, the level is dropping, when numbers get higher, the level is rising
Surface	Present sensor depth*	Height of the column of water above the sensor
Top of Casing	Distance from TOC to starting water level	Distance from the top of the casing to the present water level
Top of Casing	Zero	Changes from the initial water level: When numbers get higher, the level is dropping, when numbers get lower, the level is rising
Head	*Not applicable*	Height of the column of water above the sensor

* *In Win-Situ, you can read the sensor depth by pressing the **Read** button.*

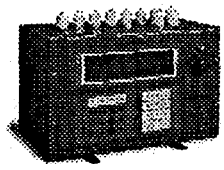
See page 11 or the operator's manual for illustrations of each mode.

3. Install the PXD-261 in the water and let it stabilize (30-40 minutes). Enter the Reference for Level type.

4. Start the test. Details are in Section 7 of the operator's manual.

When measuring water levels with a HERMIT 1000 or 2000, it is crucial to enter a Reference for each level type input, with the transducer connected and set, before starting a test. This is because the data logger calculates the water level as you instructed it to do (up or down from your reference datum) at the moment you enter the Reference and press ENTER.

HERMIT 2000



HERMIT software is integral to the data logger. Each step is performed through its own menu:

1. Set up the test in the Test Setup menu. Refer to Section 4 of the *HERMIT 2000 Operator's Manual* for details.

   Type. Select "Level" type for water level, "Func" type for direct pressure readings, or "Flow" type to measure flow rates.

2. Set up the transducer(s) in the XD menu. See Section 5 of the operator's manual.

   Lin(earity), Scale, Offs(et). Enter the values on the PXD-261 data tag.

   Delay. Enter 50 mSec (milliseconds).

   For Level types—

   Ref. Skip the Reference your first time through the XD menu. Go back and enter it after the transducer is installed and stabilized to the water temperature.

   SG (Specific gravity). Use 1.0 for water.

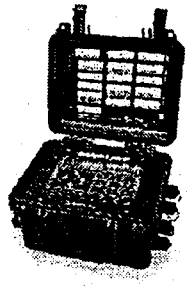
   Units. Select Feet or Meters.

   Mode. Choose Surface or TOC. Refer to page 11 or the *HERMIT 2000 Operator's Manual.*

3. Install the PXD-261 in the water and let it stabilize (30-40 minutes). Enter the Reference for Level type.

4. Start the test. Details are in Section 7 of the operator's manual.

HERMIT 3000



You can set up tests and probes for the eight-channel HERMIT 3000 in two ways—

- use the HERMIT's keypad to access its own internal menus, or
- connect to a PC and use Win-Situ™, In-Situ's data acquisition software for Windows®, as described on page 13 for the LTM3100.

Keypad

1. First, define the probe(s) using the Probe Menu. Refer to Section 3 of the *HERMIT 3000 Operator's Manual* for details.

Probe Type. Select Pressure.

Linearity, Scale, Offset. Enter the coefficients on the PXD-261 data tag.

Warmup seconds. Should be zero.

Warmup millisecs. Enter 50.

Compensation. Select Gauge for PSIG (normal with vented cable) or Absolute for PSIA (non-vented cable). For complete information see Section 3 of the *HERMIT 3000 Operator's Manual.*

HERMIT 3000 users can choose gauge or absolute barometric pressure compensation regardless of whether the PXD-261 cable is vented or non-vented.

Specific Gravity. Use 1.0 for water.

Mode. To measure water levels choose Surface or Top of Casing. See page 11 for descriptions and illustrations of each mode. Choose Head to measure the pressure (or height) of the column of water above the pressure sensor.

Reference. User-specified starting point for Surface or Top of Casing mode. The default reference of 0 is equivalent to "zeroing" the probe.

Manual Read. Displays a head reading to show where the probe is located.

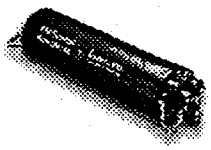
When to Reference. Now: Measurements will be relative to the water level at the time of probe definition. Start of Test: Measurements will be relative to the water level at the time the test starts.

2. After the probe or probes are defined, use the Test Menu to define a test. Refer to Section 4 of the operator's manual.

3. Start the test.

LTM3100

The four-channel Well Sentinel LTM3100 uses Win-Situ™, In-Situ's data acquisition software for Windows®.



1. Use the ***Define*** button in Win-Situ's Probe Facility to set up the "external" probe. See Section 4 of the *Win-Situ User's Guide.*

   Linearity, Scale, Offset. Enter the values on the PXD-261 data tag.

   Warmup. Enter 50 milliseconds.

   Type. Choose Pressure/Level.

   Specific Gravity. Use 1.0 for water.

   Mode. To measure water levels choose Surface or Top of Casing. See page 11 or the *Win-Situ User's Guide* for descriptions and illustrations of each. Choose Head to measure the pressure (or height) of the column of water above the sensor.

   Reference. User-specified starting point for Surface or Top of Casing mode. A reference of 0 is equivalent to "zeroing" the probe.

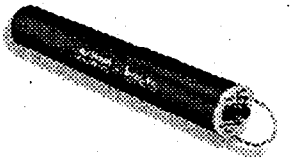
Take reference reading. Now: Measurements will be relative to the water level at the time of probe definition. **Start of test:** Measurements will be relative to the water level at the time the test starts.

2. Use the Test Facility to set up the test. Details are in Section 5 of the *Win-Situ User's Guide.*

3. A Scheduled start test will start by itself; or you can press the Start button to start a Manual test.

With Win-Situ, many of the initial probe setup parameters can be changed later, after the test, when you display, graph, or print the test data:

LTM3000



The one-channel Well Sentinel LTM 3000 uses SituCom, a separate DOS-based program to communicate with a PC. All three steps are performed through one menu option:

1. Select "Program and Activate a Test" from the main menu to enter the test and transducer information, and to start the test. See Section 5 of the *LTM 3000 Operator's Manual* for details.

XD Type. Only the Level type is available.

Units. Toggle between Metric (meters) and English (feet).

SG (Specific gravity). Use 1.0 for water.

Linearity, Scale, Offset. Enter the coefficients from the PXD-261 data tag.

XD Mode. Toggle between Top of Casing and Surface. See page 11 above for details.

Reference. Enter the Reference after the transducer is installed in the water and stabilized (30-40 minutes).

The pressure reading is calculated using the quadratic formula

$$P = LX^2 + SX + O$$

where
- P = Pressure in PSI
- X = Normalized* transducer value (0-1)
- L = Linearity value from probe data tag
- S = Scale value from probe data tag
- O = Offset value from probe data tag

**Transducer reading (in milliAmps) minus 4 divided by 16*

4 Transducer Maintenance

he only removable parts of the PXD-261 are the nosecone and cable. Do not take the body apart, as this may severely damage the transducer and will void the warranty.

Never attempt to dig foreign matter from the cavity under the filter. If you have questions concerning cleaning, please contact Customer Service.

Vent Tube

The pressure sensor of the standard (PSIG) PXD-261 is specifically designed to be insensitive to barometric pressure changes. A vent tube incorporated into the transducer cable assures that atmospheric pressure is the reference pressure to the sensor diaphragm. ***For proper operation the vent tube should not be bent, kinked, or blocked.*** Such obstructions will cause barometric pressure fluctuations to appear in measurements, and may also introduce large, varying errors due to thermal expansion and contraction of air within the vent tube and probe body.

The cable of the PSIA version of the PXD-261 does not have a vent tube.

Filter

A small mesh filter protects the pressure sensor from dirt and other foreign objects. It is held in the end of the NPT threads by a small Teflon sleeve and can be seen when the nosecone is removed. The filter appears opaque when clean. If it becomes clogged with silt, try flushing it gently with a couple of squeezes from a water bottle. If this doesn't do the trick, contact Customer Service as described on page 18.

Nosecone

If the holes in the nosecone become plugged, take the nosecone off and clean the holes with a swab or brush. To replace the nosecone, first put the wavy spring washer over the threads, then screw on the nosecone hand-tight.

Quick-Connect Cable

The PXD-261's Quick-Connect cable connector permits easy cable removal when changing to a different cable, installing the PXD-261 in a pipe fitting, or storing the probe.

For optimum performance, keep the threads on both halves of the cable connector clean.

To attach the cable:

1. Remove the protective caps from the PXD-261 backshell and the Quick-Connect connector on the cable.
2. Slide back the sleeve of the Quick-Connect connector.
3. Align the tab in the PXD-261 backshell with the slot inside the cable connector.
4. Slide the two parts together and press tightly. They should slip together easily, without forcing.
5. Tighten the locking sleeve hand-tight.

If you have questions about cleaning the cable, please contact Customer Service.

To remove the cable:

1. Unscrew the sleeve.
2. Gently pull the transducer and cable connector apart.
2. Replace the protective caps.

The jacket of the standard transducer cable is Teflon®. This material was selected for its toughness, abrasion resistance, and ability to stand up to harsh chemical environments. It is important not to expose the cable to sharp edges common to well casings.

A cable jacket made of polyurethane is also available. It is more flexible at low temperatures than Teflon. The same precaution as to sharp edges should be observed.

All cables are internally sealed to protect the transducer in the event that the cable is cut. Don't attempt to repair, splice, or seal any cuts found without first consulting In-Situ Customer Service personnel, as described in the next section.

Calibration

Your PXD-261 is designed to maintain its accuracy specifications through its useful service life, although annual recalibration will keep it operating at peak efficiency. Accuracy can be adversely affected by improper care and handling, exceeding operating pressure and temperature limits, physical damage or abuse.

Contact In-Situ Customer Service for information on periodic check-ups and recalibration. See page 18.

5 Warranty & Service Information

Warranty Provisions

In-Situ Inc. warrants all products sold, excluding batteries sold with such products, against defects in materials and workmanship under normal operating conditions. Such products include data loggers, probes, and accessories, and are warranted for the following periods: TROLL and Multi-Parameter TROLL data loggers are warranted for five years; HERMIT 3000 data loggers are warranted for two years; probes are warranted for one year; and all other products, including accessories and cable, are warranted for ninety days. The warranty period for all products begins on the day the product is first delivered to the customer.

For an additional price, In-Situ Inc. offers extended warranties for probes at the time of original purchase. When the warranty is extended at the time of purchase, probes are warranted for two years.

During the warranty period, and, if purchased, during the extended warranty period, In-Situ will repair, or, at its option, replace at no charge, components that have proven to be defective during the period of warranty, provided that the warranted product is shipped, prepaid, to In-Situ Inc. In-Situ's Customer Service staff must be contacted for shipping instructions prior to shipment.

These warranties do not apply if the warranted product has been damaged by common negligence, accident or misuse. These warranties do not apply to any product that has been repaired, serviced, or modified by an unauthorized person.

THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH EXTEND BEYOND THE FACE HEREOF. NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE ARE MADE BY IN-SITU INC.

In-Situ Inc.'s obligation and liability under this warranty is expressly limited to repairing and replacing, at In-Situ Inc.'s option, any product found to be defective or otherwise not in conformity with this warranty. The obligation to repair or replace shall terminate when the warranty expires.

In-Situ Inc.'s maximum liability in damages to customer, from whatever source, including any breach of contract, shall be limited to the difference between the delivery price of the product and the market price of such product at Customer's destination at the time

of such breach. IN NO EVENT SHALL IN-SITU INC. BE LIABLE FOR PERSONAL INJURY, PROPERTY DAMAGE, LOSS OF PROFIT, DELAY OR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHETHER ARISING FROM CONTRACT, BREACH OF CONTRACT, TORT, IN-SITU INC.'S NEGLIGENCE, STRICT LIABILITY OR THE BREACH OF ANY EXPRESS OR IMPLIED WARRANTY, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

To Obtain Repair Service

If you suspect that the transducer is malfunctioning and repair is required, you can help assure efficient servicing by following these guidelines:

Please . . . call us before you return equipment, and remember to put the RMA number on the label.

1. Call In-Situ Customer Service toll-free at 1-800-446-7488.
2. Be prepared to describe in detail the exact nature (symptoms) of the problem, including how the transducer was being used and the conditions noted at the time the malfunction occurred.
3. If service is required, obtain an RMA (Return Material Authorization) number from service personnel.
4. Write a description of the symptoms for service personnel, indicating whether the malfunction occurs intermittently or constantly. Save printouts or other materials that illustrate the problem.
5. Clean the probe and cable. Decontaminate thoroughly if the probe has been used in a toxic or hazardous environment.
6. Pack the PXD-261 in its original shipping box if possible. Include your write-up of the symptoms, a statement certifying that the probe has been decontaminated, and any other supporting documentation.
7. Send the package, shipping prepaid, to:

   In-Situ, Inc.
   Customer Service
   ATTN: RMA # (assigned no. here)
   210 South 3rd Street
   Laramie, WY 82070

The warranty does not cover damage during transit. In-Situ recommends the customer insure all shipments. Warranty repairs will be shipped back prepaid.

Serial Number

Each PXD-261 carries an individual serial number engraved on the body. It is recommended that owners keep a separate record of this number. Should your transducer be lost or stolen, the serial number is often necessary for tracing and recovery, as well as any insurance claims. If necessary, In-Situ maintains complete records of original owner's names and serial numbers.

Appendix: Specifications

General

Wetted materials	316 Stainless steel, Viton®
Transduction principle	Integrated silicon strain gauge bridge
Dimensions	0.86" dia., 8.5" long (2.2 x 21.6 cm)
Weight	1 lb. (0.45 kg)
Operating temperature	5° to 30°C (41° to 86°F)
Storage temperature	-40° to 125°C (-40° to 257°F)

Accuracy

At 15°C (59°F)	±0.05%

Electrical

Signal current	4-20 mA (typical throughout pressure range)
Min. warmup time	50 milliseconds

Ranges

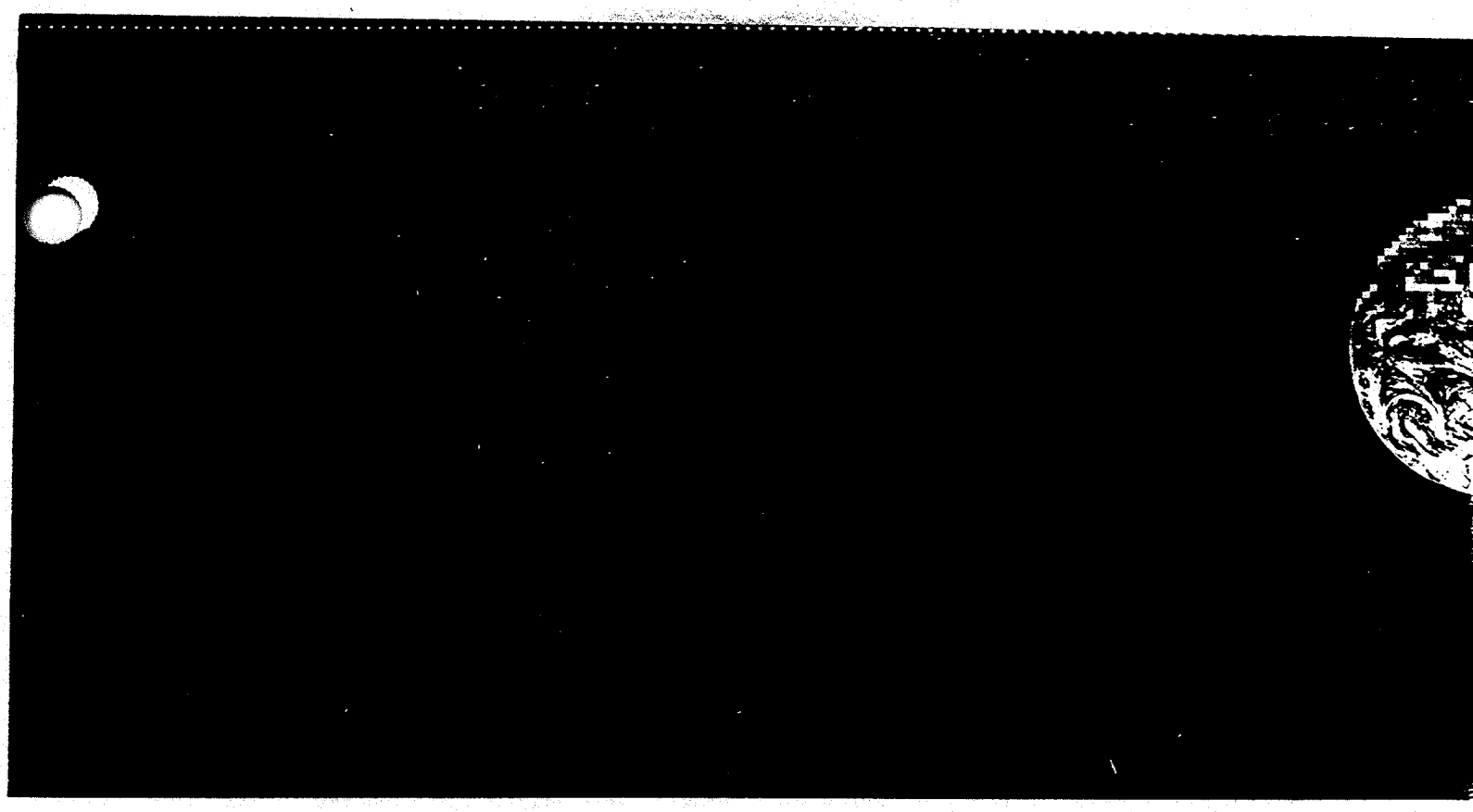
Standard	10 PSI (23 ft. / 7m water)
	15 PSI (35 ft. /11 m water)
	20 PSI (46 ft. /14 m water)
	30 PSI (69 ft. /21 m water)
	50 PSI (115 ft. /35 m water)
	100 PSI (231 ft. /70 m water)
	250 PSI (578 ft. /176 m water)

Overpressure tolerance	2X full range

Cable

Wetted materials	Teflon®, polyurethane
Size	0.26" (6.7 mm) OD nominal
Maximum length	4500 ft (1372 m)
Weight	Polyurethane: 3.3 lb./100 ft. (1.5 kg/30 m) Teflon: 4.4 lb./100 ft. (2.0 kg/30 m)
Reels	ABS Plastic: up to 350 ft. (107 m) capacity (standard) Small Steel: up to 550 ft. (168 m) capacity Large Steel: up to 1500 ft. (457 m) capacity

Due to continuing product development this information is subject to change without notice.



In-Situ Inc.

Helping monitor the earth's resources

210 South Third Street
P.O. Box I
Laramie, Wyoming 82070-0920 USA

Tel: 307 742 8213
800 446 7488
Fax: 307 721 7598
Internet: http://www.in-situ.com

In-Situ Inc.
Helping monitor the earth's resources

210 S. 3rd Street
Laramie, WY 82070

Did you know?

That you can get fast, friendly technical assistance from our Customer Service Department 24-hours a day, 7-days a week!

7:00am-5:30pm Monday-Friday call:
1-800-446-7488

After hours and on weekends call:
1-307-760-0958

Our goal is to ensure your 100% satisfaction with In-Situ and our complete line of Environmental Monitoring Systems. Call us today for answers to your questions!

0003980 2/97

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IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 22 LARAMIE, WYOMING

POSTAGE WILL BE PAID BY ADDRESSEE

In-Situ Inc.

Helping monitor the earth's resources

ATTN CUSTOMER SERVICE
PO BOX I
LARAMIE WY 82073-9900

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Seal here with tape. Please do not use staples.

0004460 2/97

In-Situ Inc.
Helping monitor the earth's resources

Important Calibration Information

The enclosed document provides calibration information for your In-Situ pressure transducer. We want you to know something about our calibration procedures and their effect on the transducers we manufacture and sell. We take our published specifications seriously, and in most cases, the actual product specification exceeds what we publish.

To familiarize you with our calibration procedures we are including a brief explanation of our test procedures and a short description of what the plots show.

THE CALIBRATION PROCEDURE

We run six separate cycles to test the transducer's performance and ability to repeat readings at constant temperatures. For each cycle, the transducer is temperature-stabilized for 2 hours, then pressure readings are taken from 0 to full scale (FS) pressure and back to 0 in 10% FS steps (22 data points).

The transducer is optimized for operation at 15°C, a temperature that characterizes a majority of groundwater applications.

THE PLOTS

"Deviation" refers to the difference between the actual transducer readings and our NIST-traceable (National Institute of Standards and Technology) pressure standard. The percent deviation is plotted against the percent of full scale (FS) pressure. This "deviation" is sometimes referred to as the transducer's "Accuracy."

Temp. Stability Quadratic For the transducer to pass, the deviation over the first four cycles must be within the transducer's accuracy specification.

Repeatability Quadratic For transducers used with most In-Situ data loggers, which provide for entry of 3 quadratic coefficients. The deviation over the last two 15°C cycles must be within the transducer's accuracy specification.

Repeatability Linear For transducers used with the older HERMIT 1000B, which can only accommodate 2 linear (BFSL) coefficients. The deviation is provided for reference.

OVER

The lower right section of the page gives additional information:

Coefficients

Quadratic: The transducer's quadratic coefficients (same as the "**QUAD COEF**" found on the probe's data tag). These are the coefficients to enter into In-Situ's data loggers before running a test. Instructions for programming Linearity, Scale, and Offset may be found in the data logger operator's manuals.

Linear: The transducer's linear coefficients (also called Best Fit Straight Line coefficients; same as the "**BFSL COEF**" found on the probe's data tag). These are the coefficients to use with the older HERMIT 1000B. This model has been discontinued, but if you have one, you can find the instructions for programming Scale and Offset in the HERMIT 1000B Operator's Manual at Section 4, Transducer Parameters.

Quadratic Temperature Stability: The maximum positive and negative deviations plotted over the first four cycles.

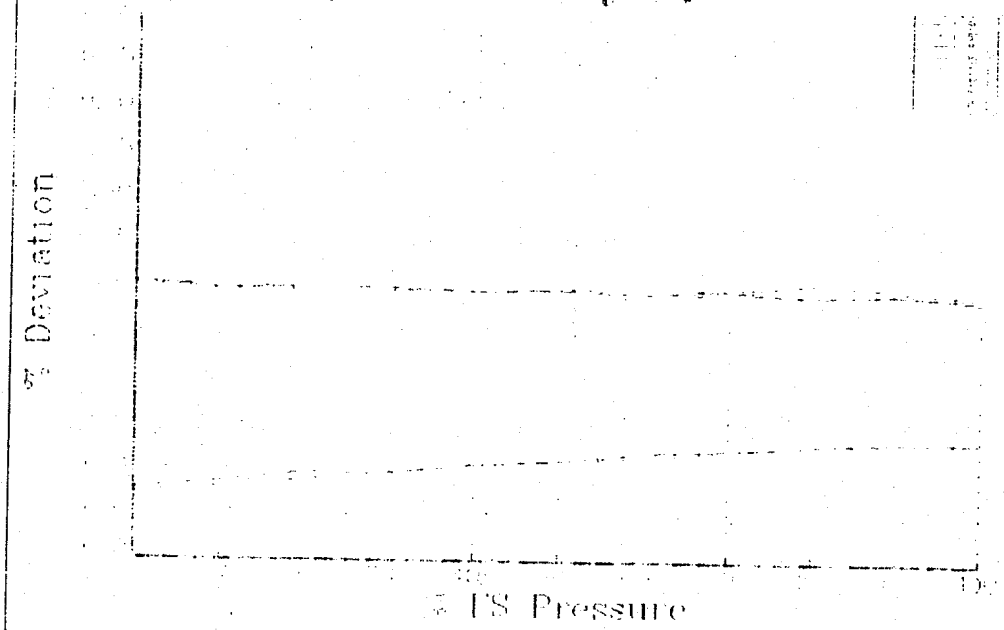
Quadratic Thermal Hysteresis: The deviation between the first two 15°C cycles. Must be within the transducer's accuracy specification.

Repeatability

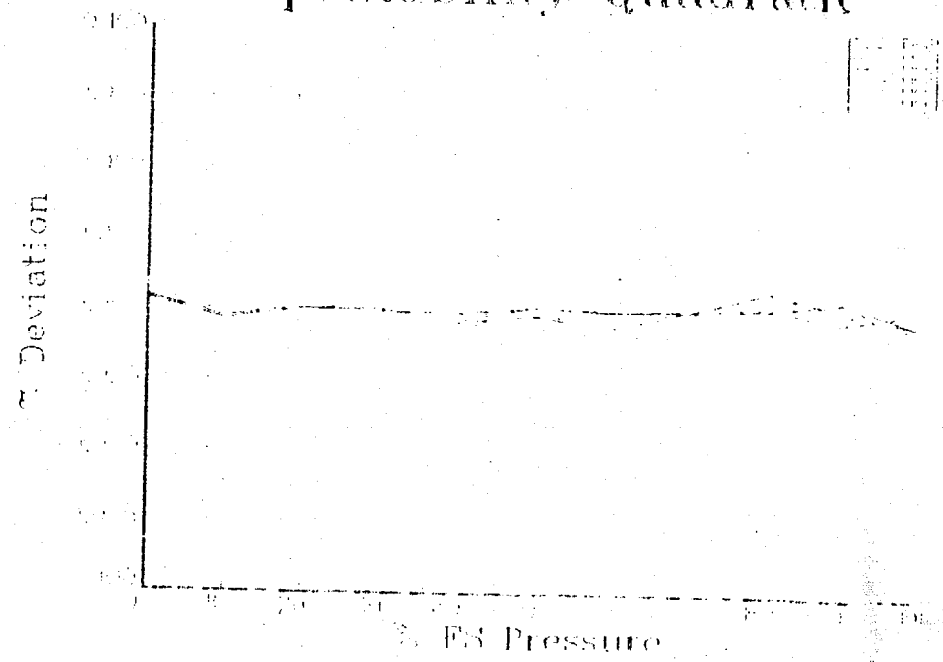
Deviation: The maximum positive and negative deviations plotted over the last 15°C cycles.

Hysteresis: The deviation over the last 15°C cycles. Must be within the transducer's accuracy specification.

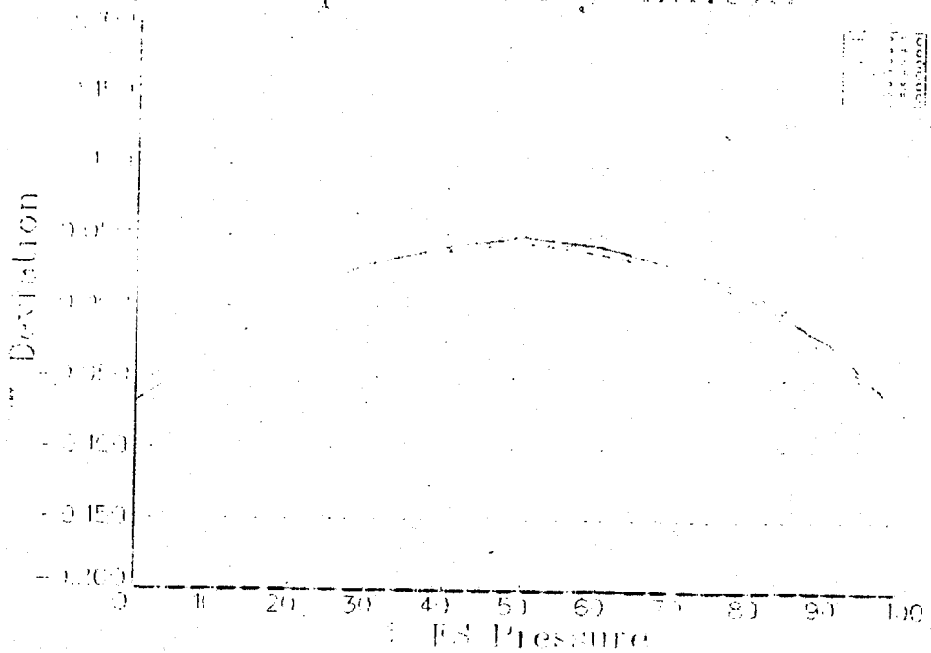
Temp. Stability Quadratic

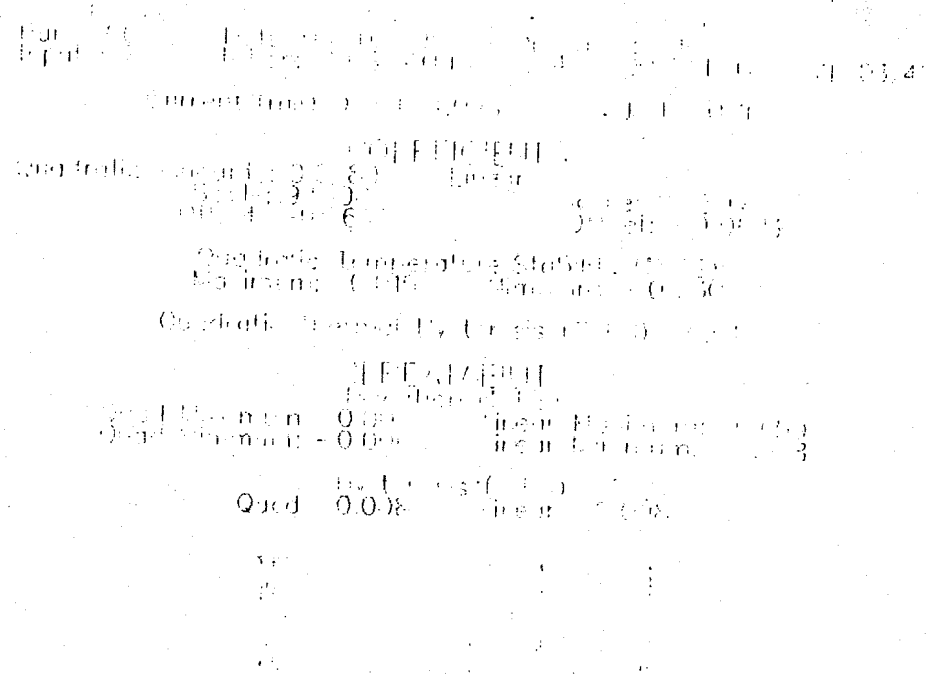


Repeatability Quadratic



Repeatability Linear





In-Situ Inc.
Helping monitor the earth's resources

Quality Inspection Report
PXD-261 Pressure Transducer

Unit Serial Number 5966 10/51G Date Inspected 3/20/98

Area of Inspection	Pass	Fail	N/A	Inspected By
mA output reading within range (3.6 mA – 4.4 mA) 4.11	☒	☐	☐	MMP 3/20/98
Capacitance reading within range (8μF - 20μF) 9.94	☒	☐	☐	
Correct model and serial number engraved on housing	☒	☐	☐	
Correct pressure range ~~and "proof"~~ indicated on dust cap	☒	☐	☐	
Correct quadratic ~~and BFSL~~ coefficients indicated on dust cap	☒	☐	☐	
Correct calibration date indicated on dust cap	☐	☐	☒	
Quick Connect cable head set screws properly installed	☒	☐	☐	
Sensor filter screen properly installed	☒	☐	☐	
Stainless steel front end set screws properly installed	☒	☐	☐	
Wave washer properly installed	☒	☐	☐	
Nose cone properly installed	☒	☐	☐	
"Body" in acceptable condition	☒	☐	☐	
Calibration documentation correct and included	☒	☐	☐	
Production Job Number: 502502				

Thank you for purchasing quality In-Situ products. I have personally certified that this product has been inspected and meets all of the required Quality Inspection Points as prescribed by this document.

Production Technician

PRESSURE TRANSDUCER
DATE OF CALIBRATION 3/3/98

MODEL	PXD-261	S/N	5966
RANGE	10 PSI	PROOF	20 PSI
QUAD COEF.	Linearity		.048
	Scale		9.9108
	Offset		-.0607
BFSL COEF. (1000B ONLY)	Scale		9.9597
	Offset		-.0603

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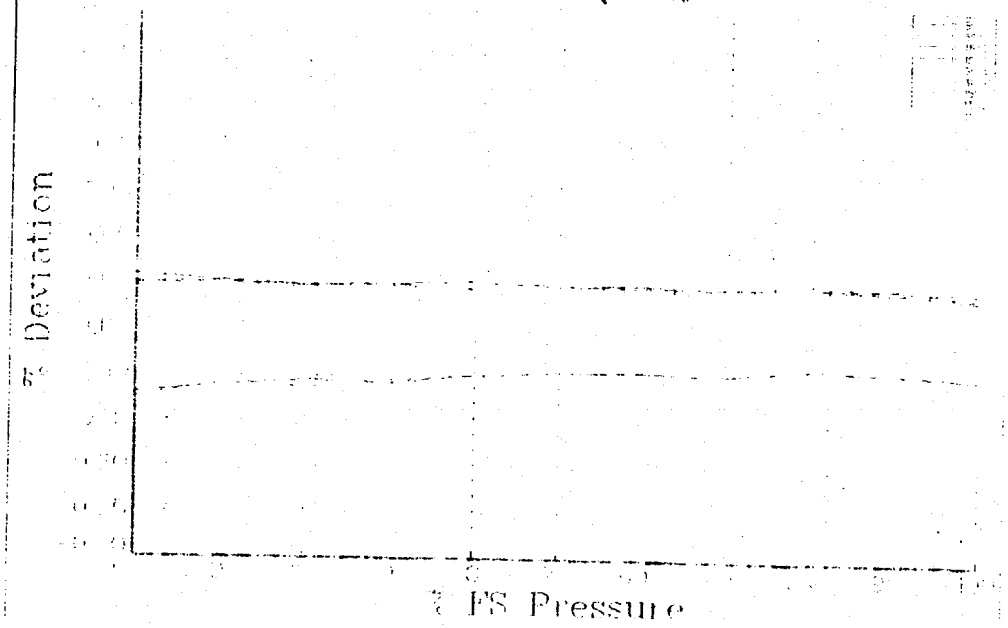
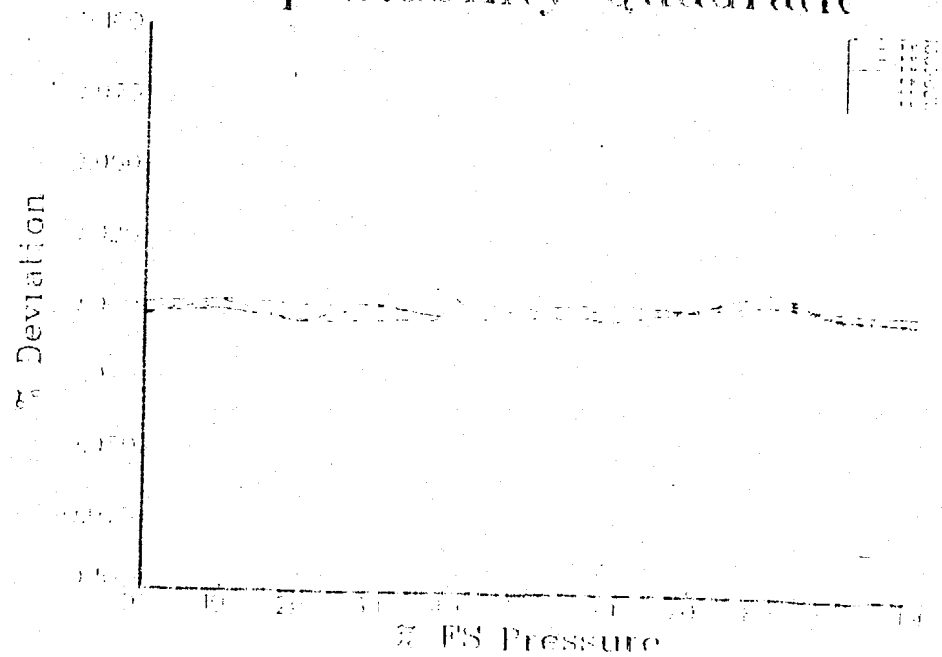
THIS EQUIPMENT IS PROTECTED BY ONE
OR MORE IN-SITU INC. PATENTS

QA Control

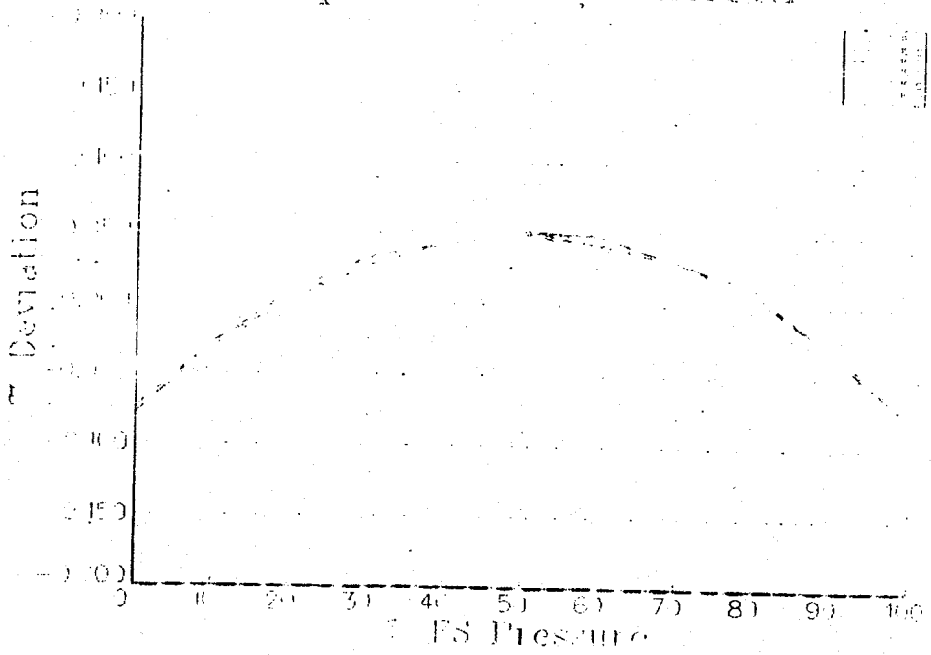
Temp. Stability Quadratic



Repeatability Quadratic



Repeatability Linear



Current (mA)

COEFFICIENTS

Quadratic Linear

Quadratic Temperature Stability

Quadratic Thermal Hysteresis

SPECIFICATIONS

Quadratic: 0.0% Linear Repeatability

Quadratic: -0.0% Linear Hysteresis

Hysteresis (%FS)

Quad 0.0% Linear 0.0%

In-Situ Inc.
Helping monitor the earth's resources

Quality Inspection Report
PXD-261 Pressure Transducer

Unit Serial Number 5992 10 PSIG Date Inspected 3/20/98

Area of Inspection	Pass	Fail	N/A	Inspected By
mA output reading within range (3.6 mA – 4.4 mA) 4.09	☒	☐	☐	MMP 3/20/98
Capacitance reading within range (8μF - 20μF) 9.99	☒	☐	☐	
Correct model and serial number engraved on housing	☒	☐	☐	
Correct pressure range ~~and "proof"~~ indicated on dust cap	☒	☐	☐	
Correct quadratic ~~and BFSL~~ coefficients indicated on dust cap	☒	☐	☐	
Correct calibration date indicated on dust cap	☐	☐	☒	
Quick Connect cable head set screws properly installed	☒	☐	☐	
Sensor filter screen properly installed	☒	☐	☐	
Stainless steel front end set screws properly installed	☒	☐	☐	
Wave washer properly installed	☒	☐	☐	
Nose cone properly installed	☒	☐	☐	
"Body" in acceptable condition	☒	☐	☐	
Calibration documentation correct and included	☒	☐	☐	
Production Job Number: 502502				

Thank you for purchasing quality In-Situ products. I have personally certified that this product has been inspected and meets all of the required Quality Inspection Points as prescribed by this document.

Production Technician

PRESSURE TRANSDUCER
DATE OF CALIBRATION 3/3/98
MODEL PXD-261 S/N 5992
RANGE 10 PSI PROOF 20 PSI

QUAD COEF.	Linearity	.0505
	Scale	9.8944
	Offset	-.0503
BFSL COEF. (1000B ONLY)	Scale	9.9457
	Offset	-.0502

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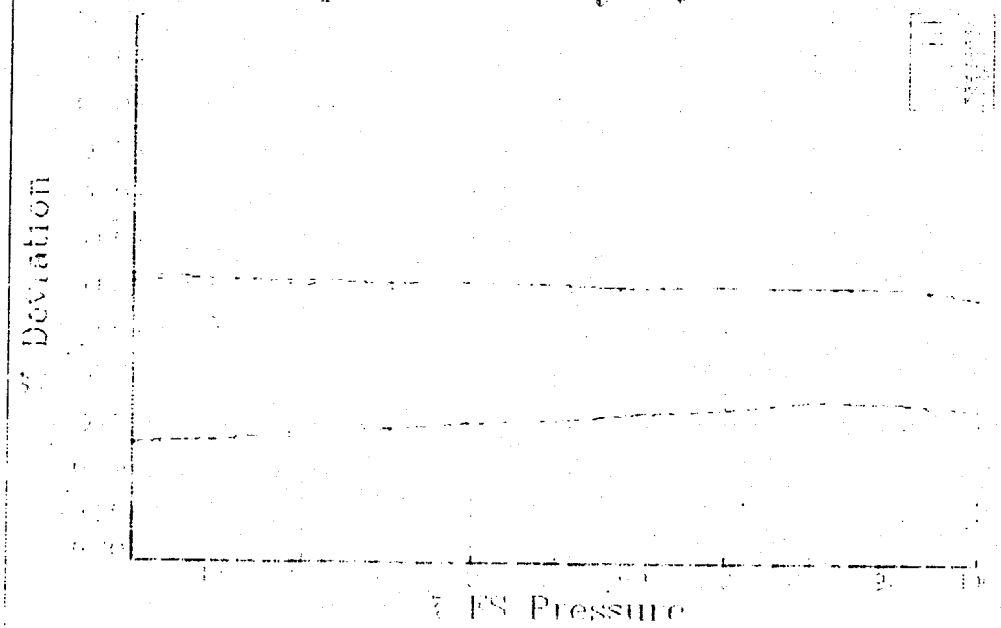
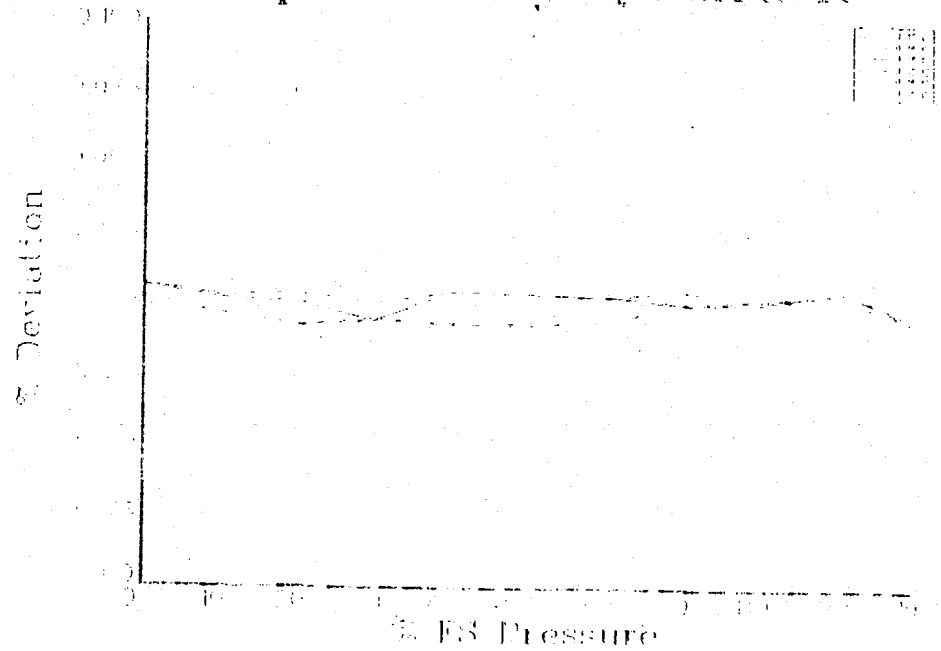
QA Control

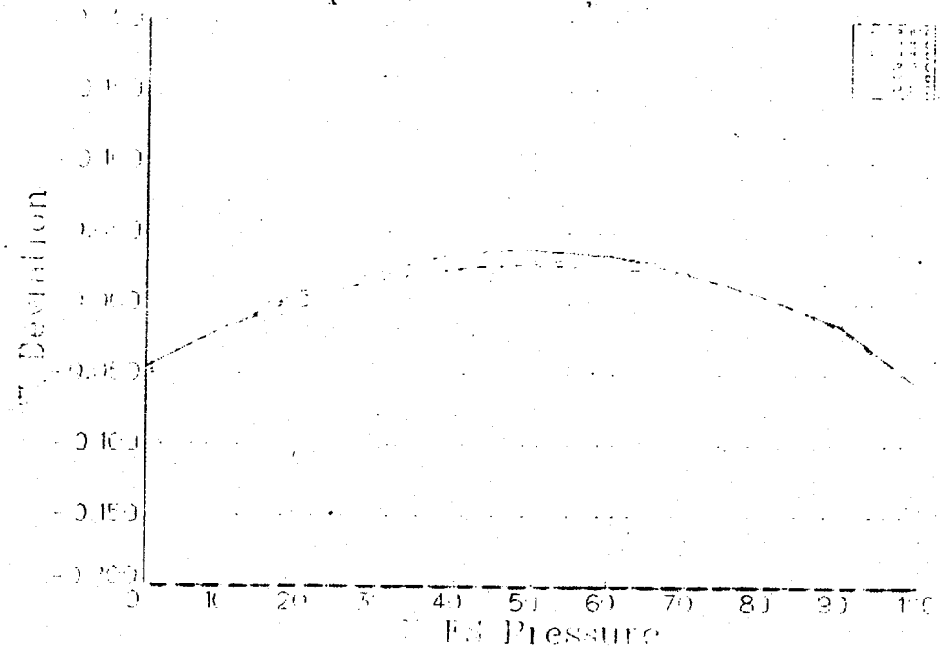
Temp. Stability Quadratic



Repeatability Quadratic



Repeatability Linear



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Quality Inspection Report
PXD-261 Pressure Transducer

Unit Serial Number 6004 10PSIG Date Inspected 3/20/98

Area of Inspection	Pass	Fail	N/A	Inspected By
mA output reading within range (3.6 mA – 4.4 mA) 4.07	☒	☐	☐	MMP 3/20/98
Capacitance reading within range (8μF - 20μF) 9.80	☒	☐	☐	
Correct model and serial number engraved on housing	☒	☐	☐	
Correct pressure range ~~and "proof~~" indicated on dust cap	☒	☐	☐	
Correct quadratic ~~and BFSL~~ coefficients indicated on dust cap	☒	☐	☐	
Correct calibration date indicated on dust cap	☐	☐	☒	
Quick Connect cable head set screws properly installed	☒	☐	☐	
Sensor filter screen properly installed	☒	☐	☐	
Stainless steel front end set screws properly installed	☒	☐	☐	
Wave washer properly installed	☒	☐	☐	
Nose cone properly installed	☒	☐	☐	
"Body" in acceptable condition	☒	☐	☐	
Calibration documentation correct and included	☒	☐	☐	
Production Job Number: 502502				

Thank you for purchasing quality In-Situ products. I have personally certified that this product has been inspected and meets all of the required Quality Inspection Points as prescribed by this document.

Production Technician

PRESSURE TRANSDUCER
DATE OF CALIBRATION 3/3/98
MODEL PXD-261 S/N 6004
RANGE 10 PSI PROOF 20 PSI
QUAD COEF. Linearity .0347
Scale 9.9478
Offset -.0359
BFSL COEF. (1000B ONLY) Scale 9.9829
Offset -.0413

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OR MORE IN-SITU INC. PATENTS

QA Control

In-Situ Inc.
Helping monitor the earth's resources

In-Situ Registration Card

Register today!

Complete and return this card today to help us maintain accurate records of your instrumentation. Additionally, registering now ensures that your receive the latest product information and news from In-Situ.

First name (please print) | Initial | Last name

NAVAL FACILITIES ENG COMMAND

Title/Position

DEPT OF THE NAVY - SOUTHERN DIV.

Company name

2155 EAGLE DRIVE

Street address

P O BOX 190010

Address continued or P.O. Box

N. CHARLESTON | SC | 29419-9101

City | State | ZIP/Postal code

Province | U.S.A. Country

Telephone

N62467-93-D-0936

~~Faxsimile~~ BECHTEL'S DEPT OF THE NAVY CONTRACT NO.

E-mail address

Please list your serial number(s) below:

Product	Serial number
PRESSURE TRANSDUCER	05966
PRESSURE TRANSDUCER	05992
PRESSURE TRANSDUCER	06004

How many people does your company employ?

☐ 1-4 ☐ 5-9 ☐ 10-19 ☐ 20-49 ☐ 50-99 ☒ 100+

Data Acquisition

Primary business of company (check one):

- ☐ Engineering
- ☐ Consulting
- ☐ Industrial
- ☐ Municipality
- ☐ Mining
- ☐ Drilling
- ☐ Military
- ☐ Utilities
- ☐ Education
- ☒ Government
- ☐ Agriculture
- ☐ Other _____

☐ I have an Internet connection

What other types of equipment do you own/rent? ☐ **I prefer to rent**

- ☐ PID/FID/GC
- ☐ Test kits
- ☐ Packers
- ☐ Samplers
- ☐ Pumps
- ☐ Other _____

How would you describe your services?

- ☐ Aquifer characterization
- ☐ Industrial/Wastewater
- ☐ Hydropower
- ☐ Fisheries
- ☐ Surface water
- ☐ Geothermal
- ☐ Aquaculture
- ☐ Groundwater
- ☐ Wetlands
- ☐ Water quality
- ☐ Long-term monitoring
- ☐ Waste management
- ☐ Effluent
- ☐ Remediation
- ☐ Process control
- ☒ Recovery/Extraction
- ☐ Research
- ☐ Other _____

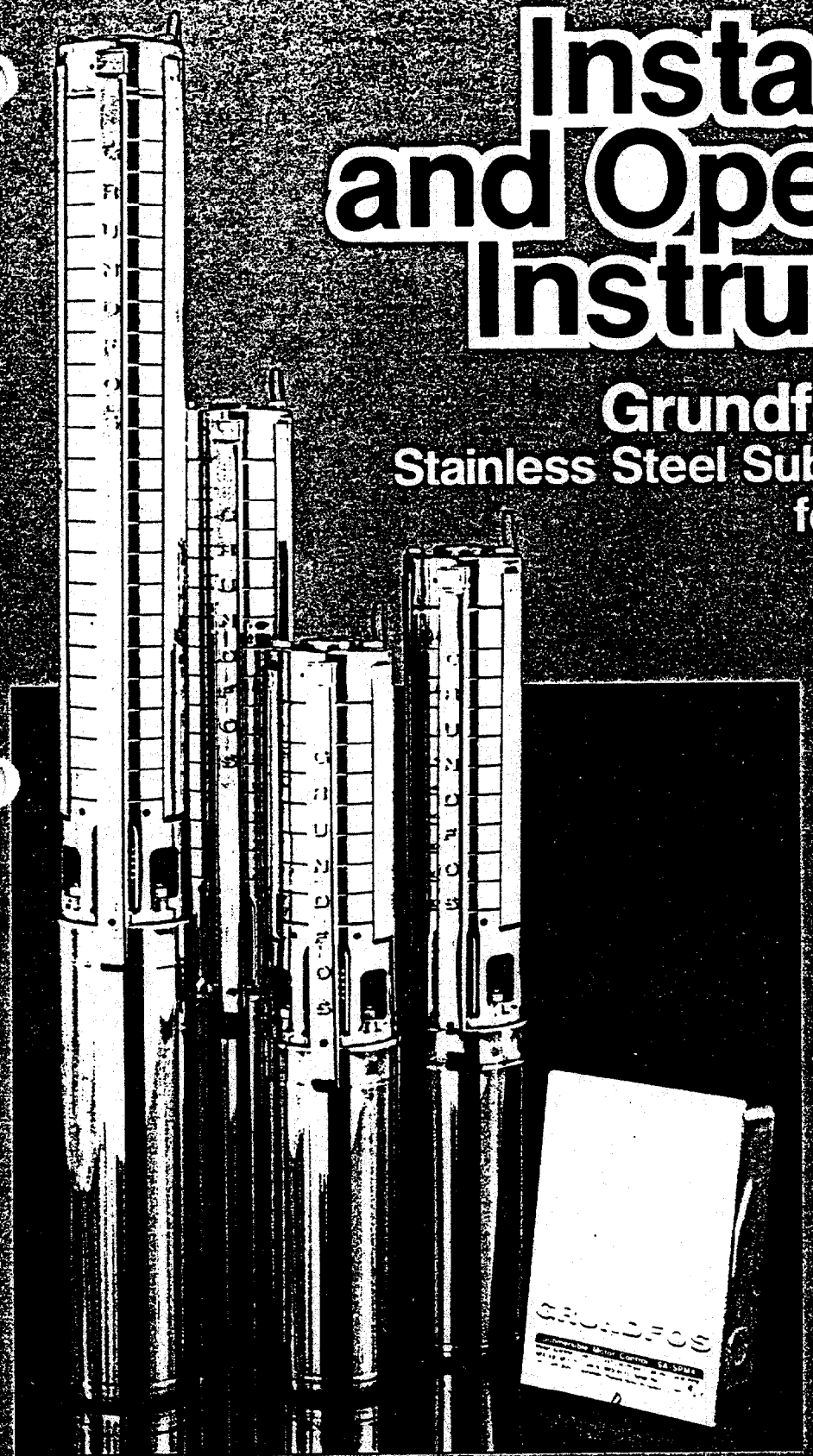
Other comments or suggestions:

BECHTEL NATIONAL INC. WAS THE COMPANY THAT PROCURED THE TRANSDUCERS FOR THE NAVY.

Thank you for taking the time to complete this registration card. Your comments are extremely valuable to us and help us design better products that are suited to your needs. Thank you again.

Installation and Operating Instructions

Grundfos Redi-Flo4
Stainless Steel Submersible Pumps for Environmental Applications



1. Shipment Inspection — Page 1
2. Pre-Installation Checklist — Page 1
3. Wire Cable Type — Page 2
4. Installation — Page 2
5. Electrical — Page 3
6. Start-Up — Page 4
7. Troubleshooting — Page 4

Please leave these instructions with the pump

Installation and Operating Instructions

TABLE OF CONTENTS

SECTION 1
Shipment Inspection . . . . . Page 1

SECTION 2
Pre-Installation Checklist . . . . . Page 1

SECTION 3
Wire Cable Type . . . . . Page 2

SECTION 4
Installation . . . . . Page 2

SECTION 5
Electrical . . . . . Page 3
- Engine Driven Generators 3
- Control Box, Single-Phase Motors 3
- High Voltage Surge Arresters 3
- Control Box and Surge Arrester Grounding 3
- Wiring Checks 3

SECTION 6
Start-Up . . . . . Page 4
Operation . . . . . Page 4

SECTION 7
Troubleshooting . . . . . Page 4
- Preliminary Tests 5
- Troubleshooting Chart 6
- Table A 7
- Table B 7
- Table C 8
- Table D 9

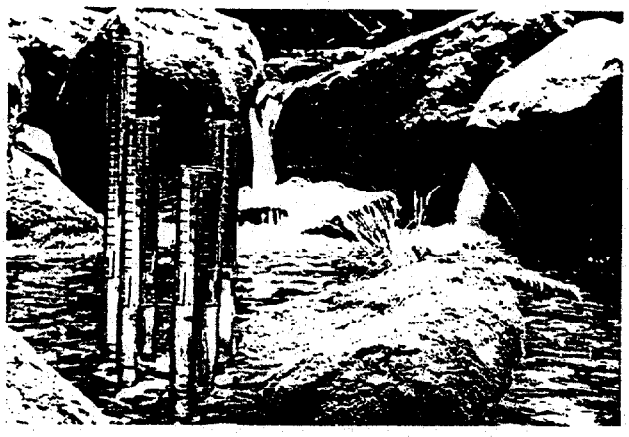
Installation and Operating Instructions

GRUNDFOS

Redi-Flo4

Your Grundfos Redi-Flo4 Environmental Pump is of the utmost quality. Combined with proper installation, your Grundfos pump will give you many years of reliable service.

To ensure the proper installation of the pump, carefully read the complete manual before attempting to install the pump.



SECTION 1.

Shipment Inspection

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

This Grundfos Redi-Flo4 Environmental Pump should remain in its shipping carton until it is ready to be installed. The carton is specially designed to protect it from damage. During unpacking and prior to installation, **make sure that the pump is not contaminated, dropped or mishandled.**

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

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

SECTION 2.

Pre-Installation Checklist

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

☑ A. CONDITION OF THE WELL

If the pump is to be installed in a new well, the well should be fully developed and bailed or blown free of cuttings and sand. Dispose of discharged materials in accordance with the specific job site requirements. The stainless steel construction of the Redi-Flo4 Environmental Pump makes it resistant to abrasion; however, no pump, made of any material, can forever withstand the destructive wear that occurs when constantly pumping sandy groundwater.

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

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

☑ B. CONDITION OF THE WATER

Redi-Flo4 pumps are designed for pumping cold groundwater that is free of air or gases. Decreased pump performance and life expectancy can occur if the groundwater is not cold or contains air or gases.

☑ C. INSTALLATION DEPTH

Pumping sand or well sediment can occur when the pump motor is installed lower than the top of the well screen or within five feet of the well bottom. This can reduce the performance and life expectancy of the pump and should be avoided.

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

☑ D. ELECTRICAL SUPPLY

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

SECTION 3.

Wire Cable Type

The type of wire used between the pump and control box should be approved for submersible pump applications. The conductor insulation should have a continuous Teflon® jacket with no splices and must be suitable for use with submersible pumps.

SECTION 4.

Installation

The riser pipe or hose should be properly sized and selected based on estimated flow rates and friction-loss factors.

A back-up wrench should be used when attaching a riser pipe or metallic nipple to the pump. The pump should only be gripped by the flats on the top of the discharge chamber. **The body of the pump, cable guard or motor should not be gripped under any circumstance.**

If steel riser pipe is used:

An approved pipe thread compound should be used on all joints. Make sure the joints are adequately tightened in order to resist the tendency of the motor to loosen the joints when stopping and starting.

When tightened, the first section of the riser pipe 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.

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

The drop cable should be secured to the riser pipe at frequent intervals using an approved clip or tape to prevent sagging, looping and possible cable damage.

If plastic or flexible riser pipe is used:

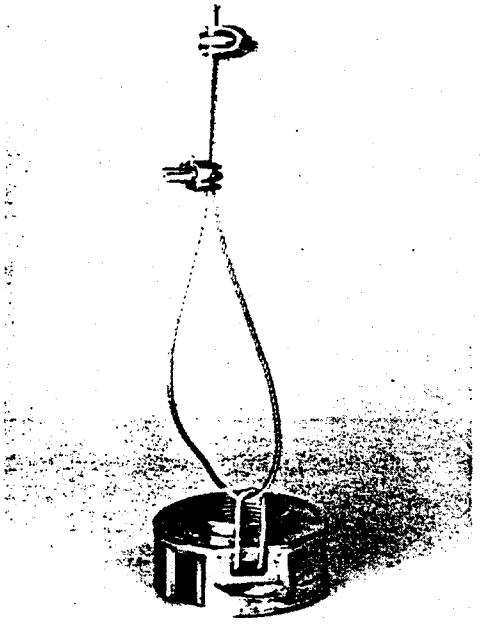
Use the correct compound recommended by the pipe manufacturer or specific job specifications. Besides making sure that joints are securely fastened, the use of a torque arrester is recommended when using these types of pipe.

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

The drop cable should be secured to the riser pipe at frequent intervals using an approved clip or tape to prevent sagging, looping and possible cable damage.

IMPORTANT- Plastic and flexible pipe tend to stretch under load. This stretching must be taken into account when securing the cable to the riser pipe. Leave enough slack between clips or taped points to allow for this stretching. This tendency for plastic and flexible pipe to stretch will also affect the calculation of the pump setting depth. If the depth setting is critical, check with the manufacturer of the pipe to determine how to compensate for pipe stretch.

When these types of pipe are used, it is recommended that a safety cable be attached to the pump to lower and raise it. The discharge piece of Redi-Flo4 submersibles is designed to accommodate this cable. (Figure 4)



Protect the well from contamination:

While installing the pump, proper care should be used not to introduce foreign objects or contaminants into the well. The well should be finished off above grade to protect against surface water from entering the well, causing contamination.

NOTE: Teflon® is a registered trademark of DuPont.

SECTION 5.

Electrical

WARNING: To reduce the 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.

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

Verification of the electrical supply should be made to ensure the voltage, phase and frequency match that of the motor. Motor voltage, phase, frequency and full-load current information can be found on the nameplate attached to the motor. Motor electrical data can be found in Table C.
If voltage variations are larger than ± 10%, do not operate the pump.
Direct on-line starting is used due to the extremely fast run-up time of the motor (0.1 second maximum), and the low moment of inertia of the pump and motor. Direct on-line starting current (locked rotor amp) is between 4 and 6.5 times the full-load current.

Engine-Driven Generators

If the Redi-Flo4 pump is going to be operated using an engine driven generator, we suggest the manufacturer of the generator be contacted to ensure the proper generator is selected and used. See Table B for generator sizing guide.

Control Box, Single-Phase Motors

Single-phase motors must be connected as indicated in the motor control box. A typical single-phase wiring diagram using a Grundfos control box is shown. (Figure 5-A)

High Voltage Surge Arresters

A high voltage surge arrester should be used to protect the motor against lightning and switching surges. The correct voltage-rated surge arrester should be installed on the supply(line) side of the control box.(Figure 5-B) **The arrester must be grounded in accordance with the National Electric Code, local codes and regulations.**

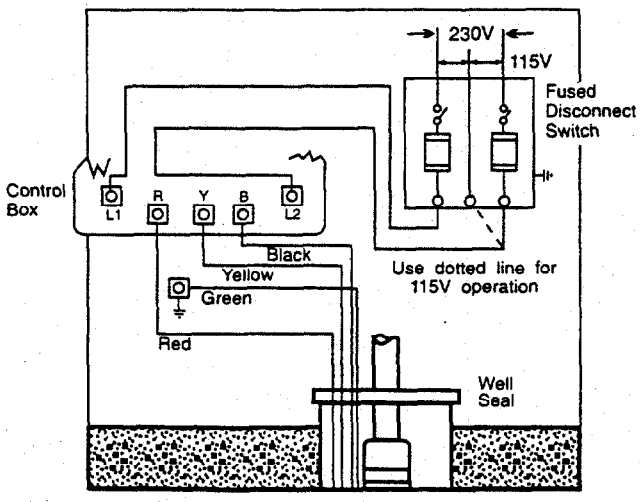
Control Box and Surge Arrester Grounding

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

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

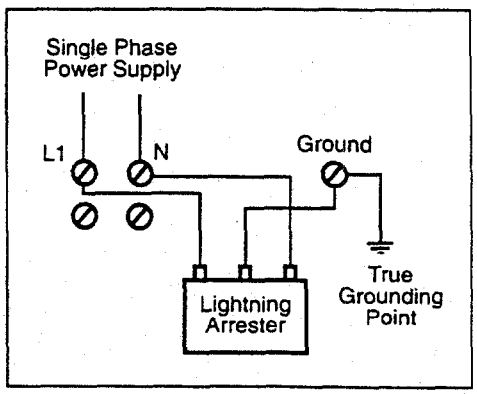
Wiring Checks

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



Single Phase Wiring Diagram for Grundfos Control Boxes

(Figure 5-A)



Single Phase Hookup

(Figure 5-B)

SECTION 6.

Start-Up

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

A. Attach a temporary horizontal length of pipe with installed gate valve to the riser pipe.

B. If required, make provisions to capture discharged fluids for disposal.

C. Adjust the gate valve one-third open.

D. Start the pump and let it operate until the water runs clear of sand and silt.

E. As the water clears, slowly open the gate valve in small increments until the desired flow rate of clear water is reached. The pump should not be operated beyond its maximum flow rating and should not be stopped until the groundwater runs clear.

F. If the groundwater is clean and clear when the pump is first started, the valve should still be opened until the desired flow rate is reached.

G. Disconnect the temporary piping arrangements and complete the final piping connections.

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

I. Start the pump and test the system. Check and record the voltage and current draw on each motor lead.

Operation

A. The pump and system should be periodically checked for water quantity, pressure, drawdown, periods of cycling, and operation of controls. **Under no circumstances should the pump be operated for any prolonged periods of time with the discharge valve closed.** This can result in motor and pump damage due to overheating.

A properly sized relief valve should be installed at the well head to prevent the pump from running against a closed valve.

B. If the pump fails to operate, or there is a loss of performance, refer to Troubleshooting, Section 7.

SECTION 7.

Troubleshooting

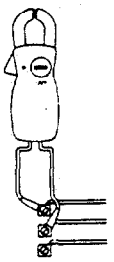
The majority of problems that develop with submersible pumps are electrical, and most of these problems can be corrected without pulling the pump from the well. The following charts cover most of the submersible service work. As with any troubleshooting procedure, start with the simplest solution first;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

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

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

Preliminary Tests

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. On single-phase units, measure between line and neutral.

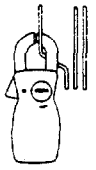
What it Means

When the motor is under load, the voltage should be within ± 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 the Electrical Data, Table C, for motor amp draw information.

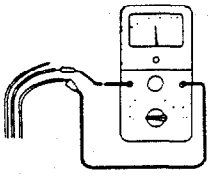
Current should be measured when the pump is operating at a constant discharge pressure with the motor fully loaded.

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 and Rx10 for values over 10 ohms.

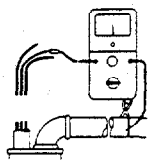
Zero-adjust the meter and measure the resistance between leads. Record the values.

Motor resistance values can be found in the Electrical Data, Table C. Cable resistance values are in Table D.

What it Means

If all the ohm values are normal, and the cable colors correct, the windings are not damaged. If any one ohm value is less than normal, the motor may be shorted. If any one ohm value is greater than normal, there is a poor cable connection or joint. The windings or cable may also be open. If some of the ohm values are greater than normal and some less, the drop cable leads are mixed. To verify lead colors, see resistance values in Electrical Data, Table C.

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 Rx100K and zero-adjust the meter.

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

What it Means

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

OHM VALUE	MEGAOHM VALUE	CONDITION OF MOTOR AND LEADS
		Motor not yet installed:
2,000,000 (or more)	2.0	New Motor
1,000,000 (or more)	1.0	Used motor which can be reinstalled in the well.
		Motor in well (Ohm readings are for drop cable plus motor):
500,000 - 1,000,000	0.5 - 1.0	A motor in reasonably good condition.
20,000 - 50,000	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 Chart

FAULT	POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
A. Pump Does Not Run	1. No power at pump panel.	Check for voltage at panel.	If no voltage at panel, check feeder panel for tripped circuits.
	2. Fuses are blown or circuit breakers are tripped.	Remove fuses and check for continuity with ohmmeter.	Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation and motor must be checked.
	3. Defective controls.	Check all safety and pressure switches for operation. Inspect contact in control devices.	Replace worn or defective parts.
	4. Motor and/or cable are defective.	Turn off power. Disconnect motor leads from control box. Measure the lead to lead resistances with the ohmmeter (Rx1). Measure lead to ground values with ohmmeter (Rx100K). Record measured values.	If open motor winding or ground is found, remove pump and recheck values at the surface. Repair or replace motor or cable.
	5. Defective capacitor.	Turn off the power, then discharge capacitor. Disconnect leads and check with an ohm-meter (Rx100K). When meter is connected, the needle should jump forward and slowly drift back.	If there is no needle movement, replace the capacitor.
B. Pump Runs But Does Not Deliver Water	1. Groundwater level in well is too low or well is collapsed.	Check well drawdown.	Lower pump if possible. If not, throttle discharge valve and install water level control.
	2. Integral pump check valve is blocked.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shut-off. After taking reading, open valve to its previous position. Convert PSI to feet (For water: PSI x 2.31 ft/PSI = _____ ft.), and add to this the total vertical distance from the pressure gauge to the water level in the well while the pump is running. Refer to the specific pump curve for the shut-off head for that pump model. If the measured head is close to the curve, pump is probably OK.	If not close to the pump curve, remove pump and inspect discharge section. Remove blockage, repair valve and valve seat if necessary. Check for other damage. Rinse out pump and reinstall.
	3. Inlet strainer is clogged.	Same as B.2 above.	If not close to the pump curve, remove pump and inspect. Clean strainer, inspect integral check valve for blockage, rinse out pump and reinstall.
	4. Pump is damaged.	Same as B.2 above.	If damaged, repair as necessary. Rinse out pump and reinstall.
C. Pump Runs But at Reduced Capacity	1. Drawdown is larger than anticipated.	Check drawdown during pump operation.	Lower pump if possible. If not, throttle discharge valve and install water level control.
	2. Discharge piping or valve leaking.	Examine system for leaks.	Repair leaks.
	3. Pump strainer or check valve are clogged.	Remove pump and inspect.	Clean, repair, rinse out pump and reinstall.
	4. Pump worn.	Same as B.2 above.	If not close to pump curve, remove pump and inspect.

Troubleshooting (continued)

FAULT	POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
D. Pump Cycles Too Much	1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts.	Re-adjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation.	Re-adjust setting (refer to manufacturer data). Replace if defective.
	3. Plugged snifter valve or bleed orifice.	Examine valve and orifice for dirt or corrosion.	Clean and/or replace if defective.
E. Fuses Blow or Circuit Breakers Trip	1. High or low voltage.	Check voltage at pump panel. If not within ± 10%, check wire size and length of run to pump panel.	If wire size is correct, contact power company. If not, correct and/or replace as necessary.
	2. Control box wiring and components.	Check that control box parts match the parts list. Check to see that wiring matches wiring diagram. Check for loose or broken wires or terminals.	Correct as required.
	3. Defective capacitor.	Turn off power and discharge capacitor. Check using an ohmmeter (Rx100K). When the meter is connected, the needle should jump forward and slowly drift back.	If no meter movement, replace the capacitor.
	4. Starting relay (Franklin single phase motors only).	Check resistance of relay coil with an ohmmeter (Rx1000). Check contacts for wear.	Replace defective relay.

Table A

Minimum Water Flow Requirements for Submersible Pump Motors

MOTOR DIAMETER	CASING OR SLEEVE I.D. IN INCHES	MIN. FLOW PAST THE MOTOR (GPM)
4"	4	1.2
	5	7
	6	13
	7	21
	8	30

NOTES: 1. 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.

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

Table B

Guide for Engine-Driven Generators in Submersible Pump Applications

	MINIMUM KILOWATT RATING OF GENERATOR FOR THREE-WIRE SUBMERSIBLE PUMP MOTORS	
MOTOR HP	EXTERNALLY REGULATED GENERATOR	INTERNALLY REGULATED GENERATOR
0.33 HP	1.5 KW	1.2 KW
0.50	2.0	1.5
0.75	3.0	2.0
1.0	4.0	2.5
1.5	5.0	3.0

NOTES:

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

Table C

Electrical Data - 60 Hz Submersible Pump Motors

GRUNDFOS MOTORS

4 Inch (Two Wire) Motors - Control Box Not Required

60 Hz

HP	Ph	VOLT	Ser. Fact.	Circ. Brk. or Stnd. Fuse	Dual Element Fuse	AMPERAGE Full Load	AMPERAGE Lock Rotor	AMPERAGE S.F. Amps	FULL LOAD Eff.	FULL LOAD Power Factor	Line-to-Line Resistance(Ohms) Blk-Yel	Line-to-Line Resistance(Ohms) Red-Yel	KVA Code **	Maximum Thrust (lbs)	GRUNDFOS PART NO.
											Delta				
SINGLE PHASE															
1/3	1	230	1.75	15	5	3.0	25.5	4.4	47.3	63.0	6.8-8.2		S	750	79.952301
1/2	1	230	1.60	15	7	4.3	34.5	5.9	50.6	64.7	5.2-6.3		R	750	79.952302
3/4	1	230	1.50	20	9	6.6	40.5	8.0	57.0	70.0	3.2-3.8		N	750	79.952303
1	1	230	1.40	25	12	8.0	47.4	9.6	59.8	74.3	2.5-3.1		M	750	79.952304
1 1/2	1	230	1.30	35	15	10.6	60.8	13.1	64.3	77.2	1.9-2.3		L	750	79.952305

4 Inch (Three Wire) Motors

SINGLE PHASE

1/3	1	230	1.75	15	5	3.0	14.0	4.4	47.0	63.0	6.8-8.3	17.3-21.1	L	750	79.453301
1/2	1	230	1.60	15	7	4.3	20.0	5.9	50.7	64.6	4.7-5.7	15.8-19.6	L	750	79.453302
3/4	1	230	1.50	20	9	6.6	30.8	8.0	57.3	70.0	3.2-3.9	14-17.2	L	750	79.453303
1	1	230	1.40	25	12	8.0	36.3	9.6	59.8	74.5	2.6-3.1	10.3-12.5	K	750	79.453304
1 1/2	1	230	1.30	30	15	9.7	44.0	11.5	67.5	84.1	1.9-2.3	7.8-9.6	H	750	79.453305

Franklin Motors

(refer to the Franklin Submersible Motors Application Maintenance Manual)

Table D
Total Resistance of Drop Cable (OHMS)

The values shown in this table are for copper conductors. Values are for the total resistance of drop cable from the **Control box to the motor and back.**

To determine the resistance:

1. Disconnect the drop cable leads from the control box.
2. Record the size and length of drop cable.
3. Determine the cable resistance from the table.
4. Add drop cable resistance to motor resistance. Motor resistances can be found in the Electrical Data Chart, Table C.
5. Measure the resistance between each drop cable lead using an ohmmeter. Meter should be set on Rx1 and zero-balanced for this measurement.
6. The measured values should be approximately equal to the calculated values.

Wire Resistances

Distance From Control Box to Pump Motor (FT.)	12 AWG Wire Resistance (OHMS)	14 AWG Wire Resistance (OHMS)
10	0.03	0.05
20	0.06	0.10
30	0.10	0.15
40	0.13	0.21
50	0.16	0.26
60	0.19	0.31
70	0.23	0.36
80	0.26	0.41
90	0.29	0.46
100	0.32	0.51
110	0.36	0.57
120	0.39	0.62
130	0.42	0.67
140	0.45	0.72
150	0.49	0.77
160	0.52	0.82
170	0.55	0.87
180	0.58	0.93
190	0.62	0.98
200	0.65	1.03

Redi-Flo4

LIMITED WARRANTY

Redi-Flo4 Environmental Pumps manufactured by GRUNDFOS Pumps Corporation (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.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

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TIMCO™

REMEDIATOR™

4" Electric Submersible Remediation Pump

INSTALLATION AND OPERATING INSTRUCTIONS

TIMCO™

This pump may be used as an alternate to the Grundfos Redi-Flo4 series in the groundwater recovery wells

Your Partners in the Field!

Liquid End Model No.: L10T4CH-T
Liquid End Manufacturing Code: 1K98W 427-574
Franklin Electric Motor Model No.: _____
Franklin Electric Motor Serial No.: _____
Hp. Volts / Hz / Ph: _____
Well Number: _____

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INDEX

	PAGE
PRE-INSTALLATION	1
SAFETY INSTRUCTIONS	1
REMEDIATOR™ SUBMERSIBLE PUMP SYSTEM	3
REMEDIATOR™ PUMP ASSEMBLY INSTRUCTIONS	4
CABLE INSTALLATION	5
PUMP INSTALLATION	5
PRE-INSTALLATION CHECK LIST	6
INITIAL PUMP START-UP	7
GROUNDING INFORMATION	8
FRANKLIN ELECTRIC® 4", ½ Hp MOTOR SPECIFICATIONS	9
SYSTEM ELECTRICAL WIRING CONFIGURATIONS	9
REMEDIATOR™ PUMP LIQUID END COMPONENTS	10
REMEDIATOR™ SPECIFICATIONS / PERFORMANCE	11
TROUBLESHOOTING GUIDE	12
WARRANTY	

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12/98

TIMCO™ Remediator™ 4" Electric Submersible Pump

PRE-INSTALLATION:

SHIPMENT AND CLAIMS:

Any and all visible damage claims must be noted to carrier at time of delivery. Claims for concealed damage must be filed with **TIMCO™**: (or carrier) within 10 calendar days after receipt of shipment. Order shortages and/or variances between packing list and actual goods received, must be filed with **TIMCO™** within 10 calendar days after receipt of shipment.

SAFETY INSTRUCTIONS:

Carefully read and follow all safety instructions in this manual, or that are printed on the pump assembly.

1. Under certain conditions, submersible pumps can develop extremely high pressure. Install a pressure relief valve capable of passing entire pump flow at 75 psi (517 kPa).
2. Do not allow pump or any other system component containing water, to freeze. Freezing may damage system leading to injury or flooding. Allowing pump to freeze will void warranty.
3. To avoid dangerous or fatal electric shock hazard, use pump only in a remediation well. Install, ground, and wire pump according to local code and National Electrical Code requirements. Disconnect electrical power supply before installing or servicing pump. Make sure line voltage and frequency of power supply match motor nameplate voltage and frequency.
4. Install pump according to all plumbing, pump and well code requirements.
5. During installation, keep well covered as much as possible to prevent debris from falling into the well; foreign objects in the well can cause mechanical damage to the pump.

WARRANTY WILL BE VOIDED, IF.....

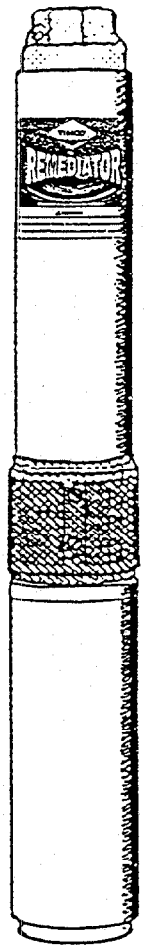
...pump has pumped excessive sand — excessive sand can cause premature wear

...water is corrosive (see pump construction material listing)

...pump has been operated with discharge valve closed—severe internal damage will result

...entrained gas or air are present in the water being pumped—these can reduce flow and cause cavitation which can damage pump

TIMCO™ Remediator™ Submersible Pump System



The liquid end of the **TIMCO™ "Remediator™" Electric Submersible Pump** consists of a series of impellers and diffusers stacked together. The capacity of (gpm/lpm) of the pump is determined by the first impeller. Each successive impeller only serves to increase the pressure. This pump utilizes the **floating stack** design, which enables it to handle effluent with sandy suspensions extremely well. The keys to the design are that the impellers may move axially on the shaft, the multiple wearing surfaces, and the Signa-Seal™ construction which uses a ceramic wear ring to grind sand away.

Typical installation is in a 4″ well. The pump must be submerged for operation. Water moves through the first impeller and is channeled by the diffuser into the eye of the 2nd impeller. This is repeated through each stage until the effluent is discharged.

The motor end of the **Remediator™ Submersible Pump** is powered by the reliable **Franklin Electric™** Pollution Grade submersible motor. It utilizes a water lubricated design. The **Remediator™ Pump System** is powered by a ½ horsepower, 230V, 60Hz, 1 phase TOP (thermal-overload protected) motor. If used in other then a vertical position, these motors perform best if tilted at an angle of 15° and not started more then 10 times per 24 hour period. In the vertical position, this motor is rated to a maximum of 300 starts per day.

The average number of starts per day over a period of months or years influences the motor life. Excessive cycling affects the life of control components such as pressure switches, starters, relays and capacitors, as well as splines and bearings. Rapid cycling can also cause motor overheating and winding failures. Motors should be allowed to run a minimum of one minute each time it is started, to dissipate heat build-up from the starting current.

It is recommended that one or more check valves always be used in submersible pump installations. A line check valve should be installed in the discharge line within 25 feet (7.6M) of the pump and below the drawdown level of the water supply.

Without a check valve in the system, or if there is a check valve and it should fail, as the water flows back down the pipe, it could cause the pump to rotate in reverse direction. Should the motor be started as this is happening, a heavy strain will be put on the system and will most likely cause excessive thrust bearing wear.

During the starting of a submersible pump, the torque developed by the motor must be supported through the pump, delivery pipe, or other supports. Most pumps rotate in the direction which causes unscrewing torque on right hand threaded pipe or pump stages. All threaded joints, pumps, and other parts of the pump support system must be capable of withstanding the maximum torque repeatedly without loosening or breaking. Unscrewing joints will break the electrical cable and may cause loss of the pump-motor unit.

To safely withstand maximum unscrewing torques with a minimum safety factor of 1.5, tightening all threaded joints to at least 10 lb./ft. (4.5kg / 30.5cm) per motor horsepower is recommended.

LEAD FREE PER ANSI/NSF61 STANDARDS

IMPORTANT ELECTRICAL GROUNDING INFORMATION!

WARNING! Hazardous voltage. Can shock, burn, or kill. To reduce the risk of electrical shock during pump operation, ground and bond the pump and motor as follows:

A. To reduce risk of electrical shock from metal parts of the assembly other than the pump, bond together all metal parts accessible at the well head (including metal discharge pipe, metal well casing, and the like). Use a metal bonding conductor at least as large as the power cable conductors running down the well to the pump's motor.

B. Clamp or weld (or both, if necessary) this bonding conductor to the means provided with the pump for grounding, which will be the equipment-grounding terminal, the grounding conductor on the pump housing, or an equipment-grounding lead. The equipment-grounding lead, when provided, will be the conductor having green insulation; it may also have one or more yellow stripes.

C. Ground the pump, motor, and any metallic conduit that carries power cable conductors. Ground these back to the service by connecting a copper conductor from the pump, motor, and conduit to the grounding screw provided within the supply-connection box wiring compartment. This conductor must be at least as large as the circuit conductors supplying the pump.

TIMCO™

REMEDIATOR™ Pump Assembly Instructions

1.) Remove plug from power connection socket on Franklin Electric® Motor.

2.) Insert connector for appropriate power cord into motor electrical socket. (Screw the locking ring securely into place.)

3.) Position Remediator™ Pump Liquid End onto motor shaft and the 4 - mounting bolts on the Franklin Electric® Motor. Align the cut-out area of the liquid end mounting base around the power cord. The brown, soft cover on the motor shaft is to be left in position.

4.) Secure the Remediator™ liquid end with 4 nuts provided (side of nut with Teflon® insert should be up toward the liquid end). Tighten!

5.) Position power leads along side of pump and install the stainless steel lead guard over the wires, fastening the guard by utilizing the two screws and the tapped holes at the top of the liquid end.

6.) Wrap the screen around the intake area of the pump (area between the Franklin Electric® motor and the pump liquid end). The slotted openings must be on the inside and the plain screw holes would be on the outside of the screen. Be sure to position the screen so it fits relatively tightly against the pump head supports; tighten the screws securely.

TIMCO™

TIMCO™ Remediator™ 4" Electric Submersible Pump

CABLE INSTALLATION:

1. To test the Remediator™, momentarily connect it to proper power supply. Power supply and frequency MUST match motor nameplate frequency and voltage to within ± 10%.

2. Fasten cable leads securely to pump discharge section; leave 4-5" (100-127mm) of slack in leads at this point. Securely fasten leads to pipe within 6"(150mm) of the pump discharge section.

3. Connect copper ground wire to motor bracket. Ground wire must be at least as large as wires supplying current to motor. Consult local codes for grounding information.

4. Tefzel® coated submersible electrical cable is recommended. When lowering pump into well, secure cable to the discharge pipe at 10′ (30.5M) intervals. Take care to not damage pump cable.

NOTICE: To avoid dropping the pump down the well or damaging cable or cable splices, <u>NEVER</u> allow pump cable to support weight of pump.

PUMP INSTALLATION:

1. Connect a safety rope strong enough to support pump and drop pipe (minimum 5/16" (8mm) twisted polypropylene or Teflon® coated wire) to eyelet on pump discharge, To prevent losing the pump down the well. Tie off other end of safety rope securely to well seal, well cap, or pitless adapter.

2. Discharge outlet is 1-1/4" NPT (3.175cm) threaded. Check valve for 7-10 GPM (26.5-37.9L) is threaded 1" NPT (2.54cm).

3. For pump installation at depths to 100′ (30.5M), 100 psi (6.9 bar) rated polyethylene plastic pipe, or the necessary chemically resistant tubing may be used; for depths greater then 100′ (30.5M), 160 psi (11 bar) rated pipe (or tubing) is okay.

NOTICE: Pump discharge is left-hand thread into pump shell.

Remediator™ Pump Pre-Installation Check List

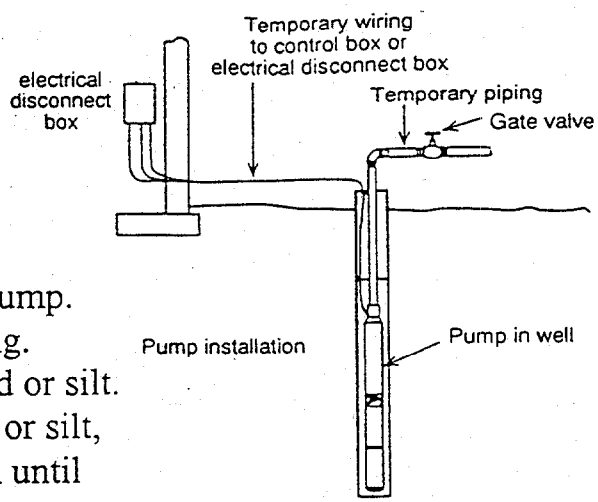
1. **Motor Inspection:**
   - ____ A. Verify that the model, HP or KW, voltage, phase and Hz on the motor nameplate match the installation requirements. Consider any special corrosion resistance requirement.
   - ____ B. Check that the motor lead assembly is tight in the motor and that the motor and lead are not damaged.
   - ____ C. Test insulation resistance using a 500 or 1000 volt DC megohmmeter, from each lead wire to the motor frame. Resistance should be at least 20 megohms, motor only, no cable.
   - ____ D. Keep a record of motor model number, HP or KW, voltage, date code, and serial number.
2. **Pump Inspection:**
   - ____ A. Check that the pump rating matches the motor, and that it is not damaged.
   - ____ B. Verify that the pump shaft turns freely.
3. **Pump/Motor Assembly:**
   - ____ A. If not yet assembled, check that the pump and motor mounting faces are free from dirt.
   - ____ B. Assemble the pump and motor together so their mounting faces are in contact, then tighten assembly bolts or nuts evenly to manufacturer specifications. If it is visible, check that the pump shaft is raised slightly by assembly to the motor, confirming impeller running clearance.
   - ____ C. If accessible, check that the pump shaft turns freely.
   - ____ D. Attach Stainless Steel Screen in space between pump and motor.
   - ____ E. Assemble the pump lead guard over the motor leads. Do not cut or pinch lead wire during assembly or handling of the pump during installation.
4. **Power Supply and Controls:**
   - ____ A. Verify that the power supply voltage, hertz, and KVA capacity match motor requirements.
   - ____ B. Check that the electrical installation and controls meet all safety regulations and match the motor requirements, including fuse or circuit breaker size. Connect all plumbing and electrical enclosures to the power supply ground to prevent shock hazard. Comply with National and local codes.
5. **Lightning and Surge Protection:**
   - ____ A. Use properly rated surge (lightning) arrestors on all submersible pump installations unless the installation is operated directly from an individual generator and/or is not exposed to surges.
   - ____ B. Ground all above ground arrestors with copper wire directly to the motor frame, or to metal drop pipe or casing which reaches below the well pumping level. Connecting to a ground rod does not provide good surge protection.
6. **Electrical Cable:**
   - ____ A. Use cable suitable for use in water, sized to carry the motor current without overheating in water and in air, and complies with local regulations.
7. **Pump/Motor Installation:**
   - ____ A. Support the cable to the delivery pipe every 10 feet (3 M) with straps or tape strong enough to prevent sagging. Use pads between cable and any metal straps.
   - ____ B. A check valve in the delivery pipe is recommended, even though the pump may be reliable without additional valves. More than one check valve may be required, depending on valve rating and pump setting. Install the lowest check valve below the lowest pumping level of the well, to avoid hydraulic shocks which may damage pipes, valve, or motor.
   - ____ C. Assemble all pipe joints as tightly as practical, to prevent unscrewing from motor torque.

INITIAL PUMP START-UP:

NOTICE: *NEVER* operate pump with discharge (pressure relief) valve completely closed. Pump could destroy itself if run with the discharge shut-off ("deadheaded") and warranty will be void!

To avoid sand-locking the pump, follow procedure below when starting pump for the first time. NEVER start a pump with discharge completely open unless you have first completed the following procedures!

1. Connect a pipe elbow, a short length of pipe, and a gate valve to pump discharge at well head.
2. Mount fused disconnect switch (2-wire pump) in a weather-proofed permanent installation. Make sure that the controls will not be subjected to extreme heat or excess moisture.
3. Make sure controls are in "**OFF**" position.
4. Connect motor leads and power supply to motor fused disconnect switch.



DO NOT START PUMP, YET!

5. Set gate valve on discharge 1/3 open; start pump.
6. Keep gate valve at this setting while pumping.
Allow pump to run until effluent is clear of sand or silt.
7. When it appears the effluent is clear of sand or silt, open gate valve to 2/3 open and again let it run until effluent is clear of sand or silt.
8. Finally, open gate valve completely and pump until effluent is clear of sand or silt.
9. Stop pump and remove gate valve from the temporary installation and re-install at its permanent site.
10. Install sanitary well seal for pitless adapter unit, well unit, electrical conduit and surface piping, according to local code requirements.

It is now okay to start the pump.

NOTICE: The **TIMCO™ Remediator™ Electric Submersible Pump** is intended for permanent connection. Provide strain relief for all power supply cords and connections. All control components must be suitable for end use application.

ATTENTION:

IMPORTANT INFORMATION FOR INSTALLERS OF THIS PUMPING SYSTEM!

THIS PUMPING SYSTEM SHOULD BE INSTALLED BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL THIS SYSTEM IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND WITH FRANKLIN ELECTRIC® RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM DISTRIBUTORS AND DIRECTLY FROM FRANKLIN ELECTRIC®. CALL FRANKLIN TOLL FREE AT 800/348-2420 FOR INFORMATION.

WARNING!

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE, TO THE POWER SUPPLY GROUND TERMINAL USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM.

Grounding Control Boxes and Panels:

The National Electrical Code requires that a control box or panel grounding terminal always be connected to circuits which include a grounding conductor. If the circuit has no ground conductor and no metal conduit from the box to supply panel, use a wire at least as large as line conductors and connect as required by the NEC from the grounding terminal to the electrical supply ground.

Grounding Lightning Arrestors:

An above ground lightning arrestor must be grounded, metal to metal, all the way to the water strata for the lightning arrestor to be effective. GROUNDING THE ARRESTOR TO THE SUPPLY GROUND OR TO A DRIVEN GROUND ROD PROVIDES LITTLE OR NO PROTECTION FOR THE MOTOR. In some areas, electrical codes require a ground wire from a submersible motor to the panel and supply ground. This provides maximum protection with above ground arrestors. In locations where this ground wire is not required by code, there are three acceptable ways of grounding above ground lightning arrestors.

1. When metallic well casing extends within at least 20 feet (6.1 M) of the motor, the arrestor should be grounded to the well casing with a No. 12 or larger wire.

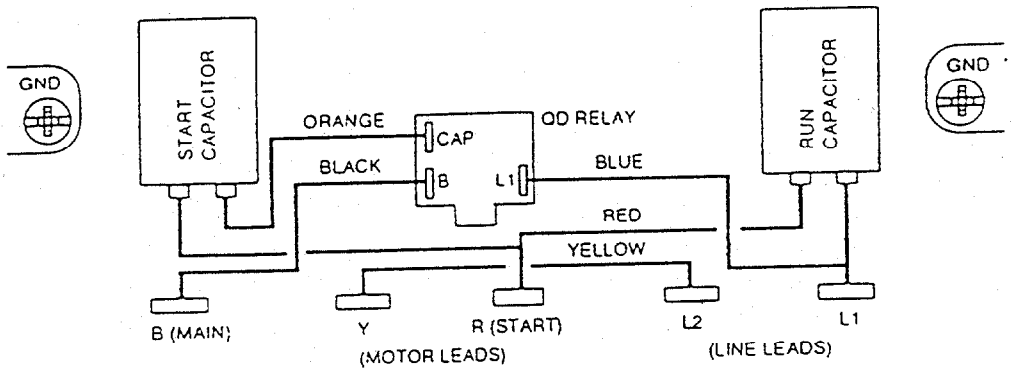
2. If the well casing is plastic or terminates more then 20 feet (6.1 M) above the motor, and metal drop pipe is used, then the best available protection is provided by grounding the arrestor to the metal drop pipe. If the pump is electrically insulated from the motor as it would be with a nonmetallic pump adapter bracket, then a wire should connect the drop pipe to the motor studs.

3. If the well casing is nonmetallic or terminates more then 20 feet above the motor and nonmetallic drop pipe is used, then protection is only provided when the arrestor is grounded to a No. 12 or larger bare copper wire run with the power cable to the motor and connected to a motor stud. This wire should also connect to the top of the well casing, if metallic.

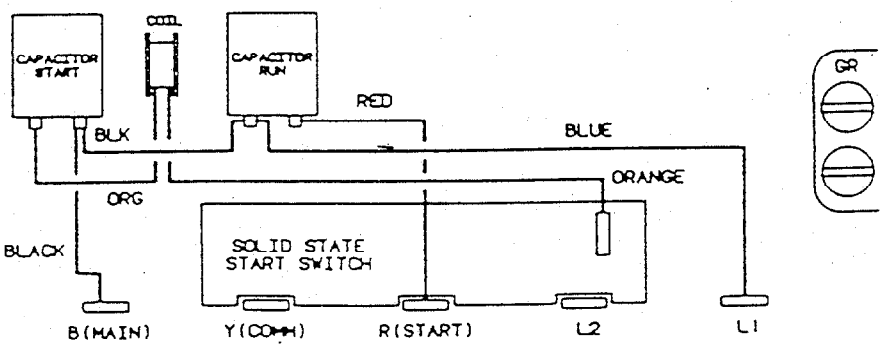
Single Phase Motor Specifications (60Hz) 4" - (2-wire):

				Rated Input (2)		Maximum (2)		Locked Rotor
HP	Volts	Hz	S.F.	Amps	Watts	Amps	Watts	Amps
½	230	60	1.60	10.0	680	12.0	970	64.4

Single Phase Motors

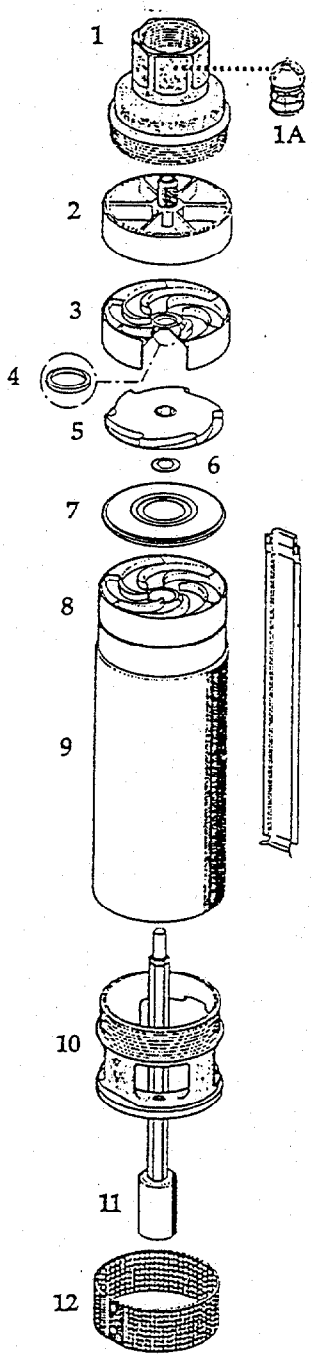


1/2 HP CRC Q D RELAY



1/2 HP CRC

REMEDIATOR™ PUMP LIQUID END COMPONENTS



1.) Discharge—Stainless Steel
Corrosion Resistant 300 series Stainless Steel
High tensile strength
Torque without fear of breakage
Supports weight & thrust of entire pump

1A) Internal Check Valve—Flomatic® premium quality
Anti-spin poppet prevents stem wear
Viton® O-Ring seal provides positive seal
Low head loss

2.) Bearing/Bearing Holder--
Nylatron® GS-71/Isoplast 202®
Self-lubricating—withstands long dry runs
Resilient to abrasives that would wear into metals

3.) Diffuser—Isoplast 202®
Superior abrasive capabilities
Resists breakage
Good tolerance and dimensional stability

4.) Wear Surface—Ceramic
Hard - grinds away sand instead of gouging (as metals do)
Chemically inert

5.) Impeller—Noryl GTX 830®
Self lubricating - improves dry-run endurance
Good abrasive capabilities
Good chemical resistance

6.) Thrust Pad—Proprietary Spec.—Low friction and sand trapping

7.) Suction Cap—Isoplast 202® w/stainless steel insert—Stainless Steel—"wears in" to form a tighter seal

8.) Floating Stack Design—Patented SignaSeal™ Wear System

Improved sand and abrasive handling
Reduces downthrust load on bearings
Replaceable cartridge design—no shims or spacers for ease of service
Dry running capability

9.) Shell—0.65" Stainless Steel

10.) Suction-Stainless Steel

11.) Shaft--Stainless Steel
Hex shape for positive drive

12.) Suction Screen—Stainless Steel
Extremely durable
Securely attached with two screws

13.) Cable Guard—Stainless
Rolled top edge
Attached to discharge fitting --not tapped through steel
Guard tapered at both ends

Noryl® GTX 830 is a registered trade name of General Electric. Isoplast® 202 is a registered trade name of DOW Chemical. Tefzel® and Viton® are registered trade names of Dupont. Nylatron®GS-71 is a registered trade name of DSM Polymers.

TIMCO™ "*REMEDIATOR*™"
ELECTRIC 4" SUBMERSIBLE REMEDIATION PUMP

PUMP ASSEMBLY (LIQUID END):

Impeller/Diffuser (6-stages) *Floating Stack* design
(Axial movement on shaft)
Noryl® GTX830 Impellers
Isoplast® 202 Diffusers and bearing holder
Nylatron® GS-71 bearing
Signa-Seal™ Construction using Ceramic Wear Ring
to grind sand away
Viton® o-ring on pump *Flowmatic*® internal check valve
Stainless Steel Body and Screen
Discharge Port: 1-1/4" (3.175cm)

FRANKLIN ELECTRIC® 4" POLLUTION GUARD MOTOR:

Horsepower: ½
Voltage: 230 V
Cycles: 60 Hz
Motor phase: 1 T.O.P. (thermal overload protection)
Freeze protected with propylene glycol and deionized water

Franklin Electric® motor is rated for maximum load of 6 amps.; locked rotor load of 23 amps.

Overall length: 22-1/4" (8.76cm) (includes pump head and motor)
Weight: 27 lbs. (12.24kg) (includes pump head and motor)

PUMP PERFORMANCE

↓ PSI (Bar)	FEET → (meters)→	20 (6.1)	40 (12.2)	60 (18.3)	80 (24.4)	100 (30.5)	125 (38.1)	150 (45.7)	175 (53.4)	200 (61)
0 (0 bar)	gal/min Liters/Min→	–	–	15.7 (59.4)	15.0 (56.8)	14.2 (53.7)	13.0 (49.2)	11.5 (43.5)	10.0 (37.9)	7.9 (29.9)
20 (1.38 bar)	gal/min Liters/Min→	15.6 (59)	14.8 (56)	14.0 (53)	13.0 (49.2)	11.8 (44.7)	10.2 (38.6)	8.2 (31)	5.7 (21.6)	2.1 (7.9)
30 (2.07 bar)	gal/min Liters/Min→	14.6 (55.3)	13.7 (51.9)	12.8 (48.4)	11.6 (43.9)	10.3 (39)	8.3 (31.4)	6.0 (22.7)	2.5 (9.5)	--
40 (2.76 bar)	gal/min Liters/Min→	13.6 (51.5)	12.6 (47.7)	11.5 (43.5)	10.1 (38.2)	8.6 (32.6)	6.1 (23.1)	2.8 (10.6)	--	--
50 (3.45 bar)	gal/min Liters/Min→	12.5 (47.3)	11.3 (42.8)	9.9 (37.5)	8.2 (31)	6.2 (23.5)	3.0 (11.4)	--	--	--
60 (4.14 bar)	gal/min Liters/Min→	11.0 (41.6)	9.6 (36.3)	8.0 (30.3)	6.0 (22.7)	3.2 (12.1)	--	--	--	--

** Do not run pump at maximum flow; optimum pump performance and longevity will be achieved at the 10 gal/min (38 L/min) flow rate).
Dry running capability

TIMCO™ MFG., INC.
P O Box 8 - 851 15th Street
Prairie du Sac, WI 53578 U.S.A.
800-236-8534 (phone) - 608-643-8534 (phone)
800-228-9552 (fax) - 608-643-4275 (fax)

12/98

Isoplast® is a registered trade name of DOW Chemical. Noryl® is a registered trade name of General Electric. Tefzel® is a registered trade name of Dupont. Nylatron® is a registered trade name of DSM Polymers.

TIMCO™ Remediator™ 4" Electric Submersible Pump

TROUBLESHOOTING GUIDE

PROBLEM	CHECK	CORRECTIVE ACTION
Motor will not start but fuses do not blow	No voltage at fuse box	Replace blown fuses
No voltage	No voltage at pressure switch	Replace faulty pressure switch
	Cable or splices are bad	Consult licensed electrician or serviceman
Fuses blow or overload protector trips when motor starts	Check fuse size	Install correct fuse or time delay fuse
Wrong size fuse or wrong size time delay fuse	Check wire size	Install correct wire size
Wire size too small	Check that line voltage is within ± 10% of nameplate rated voltage while motor is running	If voltage variation is greater than ± 10%, call power company to adjust voltage
Low or high voltage		
Pump or motor stuck or binding	Check for locked rotor in pump	If necessary, pull pump (make all possible checks first!). If pump is locked, replace it. Clean well of sand or lime before reinstalling pump
Fuses Blow or overload protector trips when motor is running	Check that line voltage is within ± 10% of nameplate voltage while motor is running	If voltage variation is more then ± 10%, call power company to adjust voltage
Low or high voltage		
High ambient (atmospheric temperature)	Check temperature of above ground electrical controls	Do not mount electrical controls in direct sunlight
Wire size too small	Check wire size	Install correct wire size
Cable splices or motor leads grounded, shorted, or open	Consult licensed electrician or qualified serviceman	Do not attempt to disassemble pump or motor
Pump starts too frequently Leaks in system	Check all connections with soap suds for air leaks; check plumbing for leaks	System must be air and water tight
Pressure switch	Check for defective switch or switch out of adjustment	Re-adjust or replace pressure switch
Leak in drop pipe	Raise drop pipe one length at a time until water stands in pipe	Replace pipe above that point

TIMCO

LIMITED WARRANTY

TIMCO™ REMEDIATOR™ 4" Electric Submersible Pump

TIMCO™ warrants to the original purchaser of the "Remediator™ 4" Electric Submersible Pump, that it will be free of defects in material and workmanship for the Warranty Period from the date of original manufacture, or installation as noted

Warranty Period:
1 year from date of original installation
or
2 years from date of manufacture

Warranty will not apply to pumps that have been subjected to negligence, misapplication, improper installation or improper maintenance.

Buyer's only remedy and the only duty of TIMCO™ is to repair or replace defective pumps (at discretion of TIMCO™). Buyer agrees to pay all labor and shipping charges associated with this warranty and to request warranty service through the installing dealer as soon as problem is discovered. If warranty service is requested more than 30 days after the Warranty Period has ended, it will not be honored.

TIMCO™ will not be liable for any consequential, incidental, or contingent damages arising from improper installation, improper use, or use in environments not compatible with materials used in the construction of the pump and motor.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND/OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL NOT EXTEND BEYOND THE WARRANTY PERIOD PROVIDED HEREIN.

Certain states do not permit the exclusion of limitation of incidental or consequential damages or the placing of limitations on the duration of an implied warranty. Therefore, the limitations or exclusions herein may not apply. This warranty sets forth specific legal rights and obligations. However, additional rights may exist, which may vary from one state to another.

TIMCO™ MFG., INC.
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800/236-8534
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Fax 608/643-4275
12/98

OPTO 22 IMPORTANT! OptoChannel UPDATE

Form96__-970521

Distribution: All Distribution Partners

Date: May 21, 1997

Subject: Opto 22's Repair Policy

OPTO 22 REPAIR POLICY

In-Warranty Repairs

Opto 22 warrants all of its products against failure for a period of two years from the date of manufacture. Any unit returned within the warranty period will be repaired or replaced free of charge.

Exceptions:
Any unit that has been subjected to obvious mechanical damage due to mishandling or environmental factors is not covered by this warranty.

Out-of-Warranty Repairs

Any unit returned after the warranty period will be repaired at a cost equal to half the current list price. This applies only to those units that can be repaired.

Notes:
1) Solid-state relays and I/O modules are not repairable items.
2) Motion products are not repairable by Opto 22. Please contact nuLogic directly at (617) 444-7680 for motion product repairs.

Repair Returns

Prior to returning any product for repair, please contact Opto 22's Product Support Group at (800) 835-6786 or (909) 695-3080 to request an RMA number. In order to be processed properly, the RMA number must be on the shipping label when the package is received by Opto 22 .

Opto 22 • 43044 Business Park Drive • Temecula, CA 92590 • Phone: (909) 695-3000 • (800) 321-OPTO • Fax: (909) 695-3095 • Internet: http://www.opto22.com

Inside Sales: (800) 452-OPTO • Product Support: (800) TEK-OPTO • (909) 695-3080 • Fax: (909) 695-3017 • E-mail: support@opto22.com

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INSTALLATION AND SETUP

Form 1006-970929

Introduction

The purpose of the OptoDemo is to provide OptoPartners with an easy to use, easy to integrate means of demonstrating the power and functionality of FactoryFloor and OptoConnect. The concepts presented in the OptoDemo are relatively straightforward. Using state-of-the-art hardware products (I/O, brain boards, controllers, etc.) coupled with easy to use and understand software principles, you can build control system solutions that span across several applications. Integration of analog control, digital control, serial communications, and unprecedented data access allows customers to tackle today's business requirements with confidence.

This demo is an enhancement to the original Prove-It-To-Me Toolbox Tutorial. Some enhancements include:

- OptoConnect demo. This includes tracking barcoded information as production runs (months of the year) and downloading new product data.
- Alarming with OptoDisplay R2.0
- Subroutine for displaying data on the QSI terminal
- Many additions to QSI terminal program including more data and backlit display
- Barcode enhancements.
- Demonstration of OptoControl charts calling other charts in a round robin fashion
- Optimized for 640 x 480 256-color display
- New font and colors in OptoControl for better viewing
- Other minor enhancements.

This document describes the installation procedure for the OptoDemo. The installation procedure assumes that you have installed FactoryFloor and OptoConnect. The minimum versions required are listed on the following page. Also included with this demo is an outline to help you present the OptoDemo in a clear, logical way.

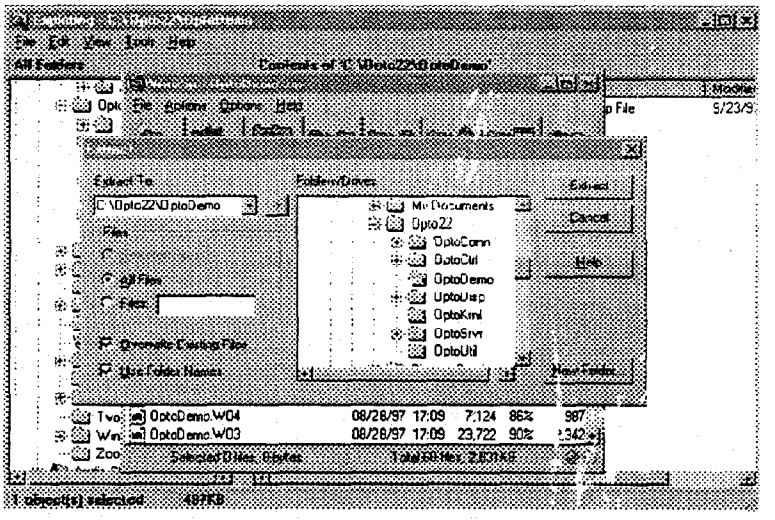
Installation

The correct placement of files is extremely important for the proper operation of the OptoDemo program. Before you start, make sure you have the following files on your demo PC. If any of these files are located in a location which differs from the default locations we have chosen, you will be able to make simple changes to the Demo program to accommodate your configuration. The following are minimum revision levels of the required software:

Software	Revision	Default Location
OptoControl	2.0g	C:\Opto22\OptoCtrl\OptoCtrl.exe
OptoDisplay	2.0e	C:\Opto22\OptoDisp\OptoDispR.exe
OptoConnect	1.0a	C:\Opto22\OptoConnect\OptoConR.exe
OptoKernel	2.0a	C:\Opto22\OptoKrnl\o41rtuR2.0a
Microsoft Access	7.0 for Win95	C:\Program Files\Microsoft Office\Msaccess.exe[1]
Acrobat Reader	3.0	C:\Program Files\Acrobat Reader\AcroRd32.exe[2]
comctl32.dll	08/24/96	C:\Windows\System[3]

1. Required for the OptoConnect portion of the demo. You can, however, demonstrate OptoControl and OptoDisplay without Access.
2. Acrobat Reader can be installed from the OptoInfo CD.
3. This DLL is required for the alarming features in OptoDisplay. This DLL is installed with Internet Explorer 3.0, available on the OptoInfo CD.

1. Copy the file *OptoDemo.zip* to *C:\Opto22\OptoDemo*. Create the *OptoDemo* directory if it does not already exist.
2. Using WinZip, extract the *OptoDemo.zip* file into the *C:\Opto22\OptoDemo* directory.



Installation (continued)

3. Two unique fonts, *Verdana* and *3of9* are used for OptoControl or for printing the barcodes used within the OptoDemo presentation. To verify installation of these fonts, double-click on Fonts in the Control Panel. If these fonts are not installed, select *Install New Font...* from the *File* menu. The source files are in the OptoDemo directory. After the fonts are installed, print out the file *Barcodes.doc*. This Word document contains barcodes for the demo.

4. If it does not already exist, use OptoTerm to configure a controller named "Prove-It-To-Me Toolbox" (no quotes, exact capitalization and spacing). Configure the communication parameters to match the settings on your Prove-It-To-Me Toolbox.

5. Start OptoControl and load *C:\Opto22\OptoDemo\OptoDemo.cdb*. Click the mouse in the Strategy Tree to bring it to the front as the active window, (press CTRL+R). From the *Compile* menu, choose *Compile All*. From the *Mode* menu, choose *Debug* and download the strategy to your Prove It To Me Toolbox. These steps are necessary to ensure a clean download.

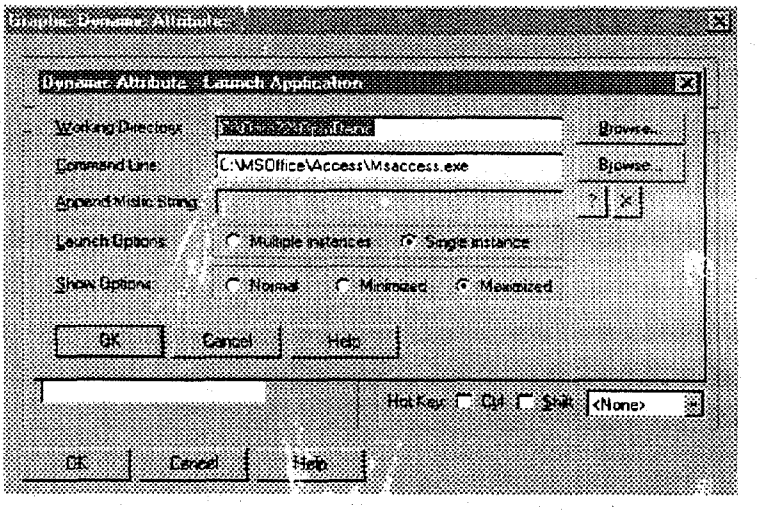
6. Run the strategy, then close OptoControl.

Testing

If some of the files detailed on the first page were not in the default locations, not all of the OptoDisplay functions will work properly. Don't worry, it's easy to fix them.

1. Start OptoDisplay Configurator and load the project *C:\Opto22\OptoDemo\OptoDemo.mmi*. Close OptoDisplay Configurator

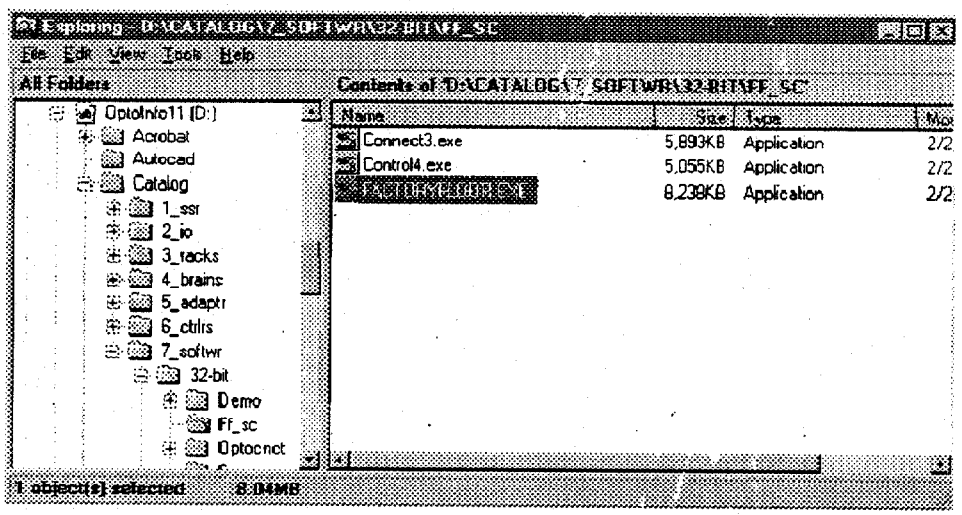
2. **ACCESS**. In OptoDisplay Runtime, if pressing the Start button under the label Microsoft Access (located in the bottom right corner of the OptoDemo window) does not launch Access, perform the following steps:
   A. Go to OptoDisplay Configurator
   B. Double-click on the Start button to open the graphic dynamic attributes window
   C. Highlight Launch Application under the Operator Driven Attributes window and then select Edit
   D. Select the Browse button next to the Command Line data entry box and find the location of Access on your PC; click OK twice to exit.



Testing (cont.)

3. **OptoConnect.** Press the Start button located under OptoConnect Runtime, located in the bottom left corner of the OptoDemo window. If this does not launch OptoConnect (the Runtime icon, , will be in the Taskbar), go to OptoDisplay Configurator and double-click on the Start button to open the Graphic Dynamic Attributes window. Open the Launch Application dialog under Operator Driven Attributes by selecting it and choosing Edit, or double-click on Launch Application. Use the Browse button to the right of the Command Line window to find the location of *OptoConR.exe*, then click OK twice to exit. (If you did launch OptoConnect Runtime, stop the program by right-clicking on the icon in the Taskbar. Choose Close.)

4. Make sure that the FactoryFloor ScreenCam is located in the *C:\Temp* directory on your machine. If not, copy it from the OptoInfo CD. On most PCs, the ScreenCam presentation runs better from the hard disc than it does from the CD ROM drive.



As you have seen during this installation, most of the files involved in the OptoDemo are located in C:\Opto22\OptoDemo. The same procedure we used to redirect the actions of the Microsoft Access and OptoConnect buttons can be applied to other parts of the OptoDemo program, which access external programs. Here is a summary of the required actions:

1. Double-click on the object to open its Graphic Dynamic Attributes window.
2. Double-click on the Launch Application entry in the Operator Driven Attributes window to open that dialog
3. Edit the Command Line entry related to the action you wish to change, then double-click on OK to close.

OptoConnect Setup

The OptoConnect Configurator must be set up to work with the OptoDemo database. The following five steps will ensure that your Configurator works with the database.

1. Move the file *Mfc42.dll* from the OptoDemo directory to *C:\Opto22\OptoConn* directory. This step is not necessary if you have OptoConnect R1.0b or later.

2. Start OptoConnect Configurator. Go to *File, Open JET Master Project Database,* then select *C:\Opto22\OptoDemo\OptoDemo.mdb*. Press *OK* in the *Open Project* window If OptoControl suggests that you run Auto Correct Tags, click ok.

3. From the *Tools* menu, select *Verify/Create Runtime Tables.*

4. Close OptoConnect Configurator and open OptoConnect Monitor. If you get a message, "Unable to connect to OptoConnect Runtime, press OK. This is because OptoConnect Runtime has not been started. From the *File* menu, choose *Open Jet Master Project Database.* Select *C:\Opto22\OptoDemo\OpeoDemo.mdb* and press *Open.* In the *Open Project* dialog, make sure *OptoDemo* is highlighted and press *OK.* From the *Runtime* menu, choose *Set Project.* When started, OptoConnect Runtime will now load this project.

5. Close OptoConnect Monitor.

You are now ready to run the OptoDemo. Refer to the OptoDemo script, located in the OptoDemo directory, for a suggested method of presenting the demo. This script is a reference, and is not designed to be read in front of a customer. It does provide a logical format to present many of FactoryFloor's features and highlights. Run through the demo a few times before you try it in front of a customer. This will ensure that you cover all the important topics and will prevent you from trying things that may not work.

If you have any comments or suggestions on the OptoDemo, please send them to Tom Edwards *tedwards@opto22.com.*

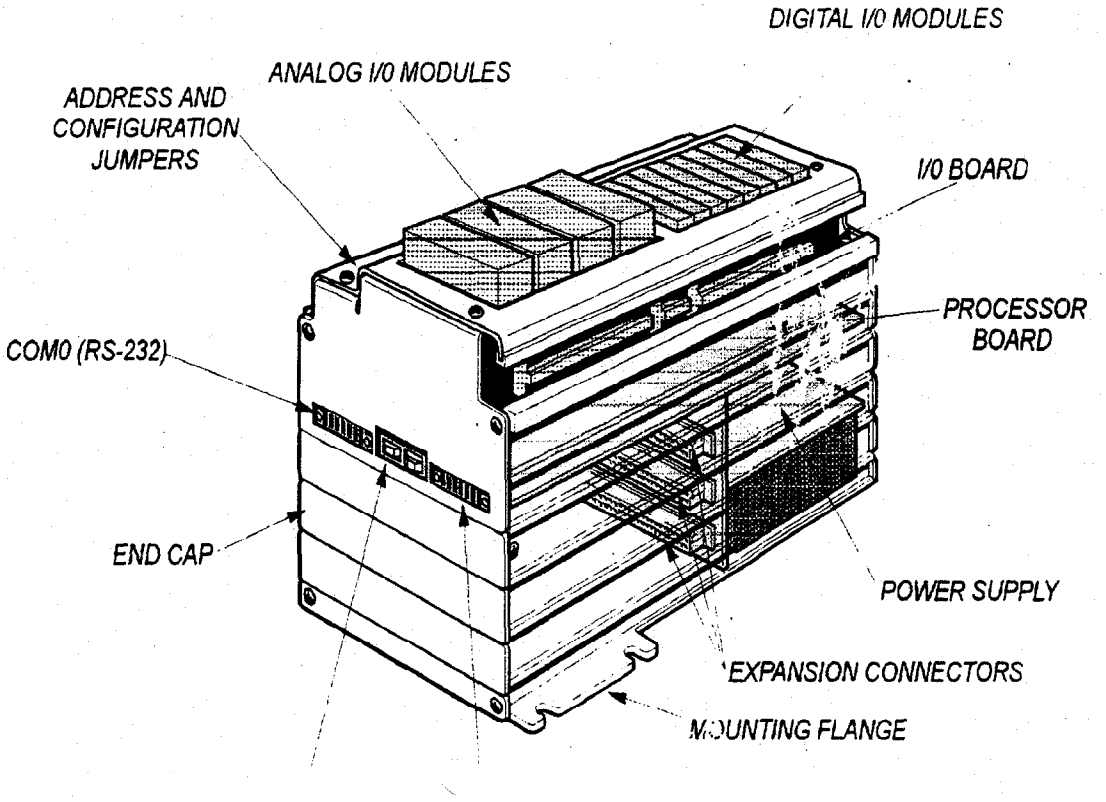
Form 810L-970611

Part Number	Description
M4 I/O	Modular M4 I/O Controller

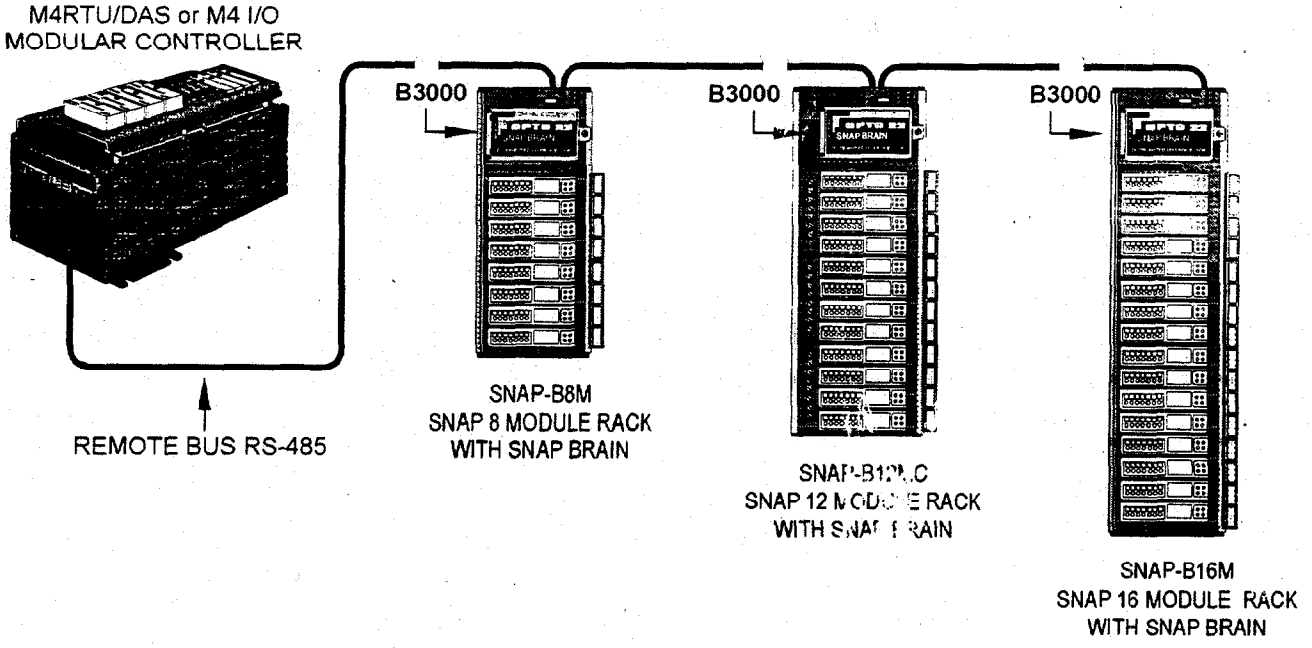
Description

The Modular M4 I/O Controller is part of Opto 22's total control solution and features powerful communications capabilities, built-in diagnostics, and 32-bit processors. Modular controllers are designed to take advantage of the Opto 22 distributed, intelligent I/O architecture and provide a solid hardware foundation for Opto 22's new Windows 32-bit FactoryFloor software suite. The M4 I/O is ideal for remote applications in harsh environments where the M4's unusually broad range of communications options, including radio modems, cellular modems, and even satellite communications capabilities are critical. The M4 I/O was designed specifically for industrial field applications, such as waste water treatment, well monitoring, tank farms, petro-chemical and gas pipelines, remote office/plant management and many others.

The M4 I/O consolidates two powerful processors on a single processor board. Program control and host communications are handled by a powerful 32-bit 68020 microprocessor, while a 16-bit 80C196 processor handles I/O interfacing and control. This dual-processor board is combined with a digital/analog I/O board, a 3-slot vertical expansion bus board (M4BUS), and a modular power supply into a compact aluminum extrusion package that can be mounted horizontally or vertically. For safety and convenience, the M4 I/O has system monitors for temperature, AC operation, and low battery, and includes such features as a real-time clock and watchdog timers. Removable connector technology is integrated throughout the unit for easy maintenance and wiring removal.



Description (CONT.)



Description (CONT.)

SOFTWARE

The M4 I/O is designed to work in combination with FactoryFloor, Opto 22's new suite of Windows 32-bit software, which delivers total control to industrial automation customers. FactoryFloor consists of three integrated components:

- OptoControl, a graphical, flowchart-based development environment for control solutions
- OptoDisplay, a graphical, multimendia operator interface package
- OptoServer, a robust data server that connects the controller network with the PC-based FactoryFloor network.

M4 I/O configuration and development are performed through OptoControl on a PC workstation. OptoControl is an easy to use, self-documenting control environment that uses a plain English command set and a long tagname database that is shared by all FactoryFloor components.

The M4 I/O also works with Opto 22's classic 16-bit software: Cyrano, Mistic MMI and Mistic Data Server (MDS.) Opto 22 is committed to supporting this installed base and to making these products available for those customers who have not moved to the Windows 32-bit platforms. Opto 22 has also provided utilities to assist customers in migrating to FactoryFloor.

COMMUNICATION OPTIONS (STANDARD)

The M4 I/O communication options combined with Opto 22 software support modems (direct, lease, and radio), two-way dial-up capability (host to M4 I/O, M4 I/O to host), and peer-to-peer communications. It also supports remote firmware downloading to Flash memory, remote program downloading and debugging, and remote data uploading and downloading. The M4 I/O base unit has two serial ports:

- 1 RS-232 serial port, 300-115kBd
- 1 full duplex RS-422/485 serial port, 300-115kBd

INTERFACE OPTIONS (ADAPTER CARDS)

The M4BUS has three expansion slots to accommodate a variety of communication interface cards. All modular interface cards for serial communications or network connectivity are supported as standard selections in the FactoryFloor software.

Interface Adapter Card	Function
M4SSER	Two additional serial ports, up to 115 Kbd (configurable as RS-232 or RS-485/422)
M4SARC	High performance ARCNET connection
M4SENETC	Ethernet connection (coaxial)
M4SENETU	Ethernet connection (unshielded twisted pair)
M4SARCF	Fiber Optic ARCNET connection
M4SARCFR	Fiber Optic ARCNET repeater connection
M4RTUX	Eight digital + four analog I/O channels

Description (CONT.)

I/O CONNECTIVITY

A total of eight digital and four analog I/O channels are available on the base unit and may be populated with Opto 22 G4 analog and digital I/O modules. The G4 digital I/O modules provide optical isolation, come in a variety of AC and DC voltages, feature an integral status LED and fused outputs, and offer an optional integral automatic/manual diagnostics switch. The G4 analog I/O modules provide both optical and transformer isolation, eliminating ground loops and channel-to-channel interference.

The M4RTUX I/O Extender Brick, which connects to the base unit using an Opto 22 shielded 25-pin cable, can provide an addition eight digital and four analog channels.

The built-in RS-485/422 COM1 port can be used as a serial link to communicate with remote digital and analog I/O units. Up to 4096 I/O points can be connected. The M4SSER adapter card can provide two additional serial ports.

EXPANSION OPTIONS (RAM AND ROM)

The RAM can be used to store a user's control strategy (program) and data. The flash memory (ROM) stores a kernel (operating system) and can be used to store a control strategy permanently. The use of flash technology allows the user to remotely download new firmware offered by Opto 22.

RAM: Base, 256K
Expansion 1 M.

ROM: Base, 256K
Expansion 1 M.

POWER SUPPLIES

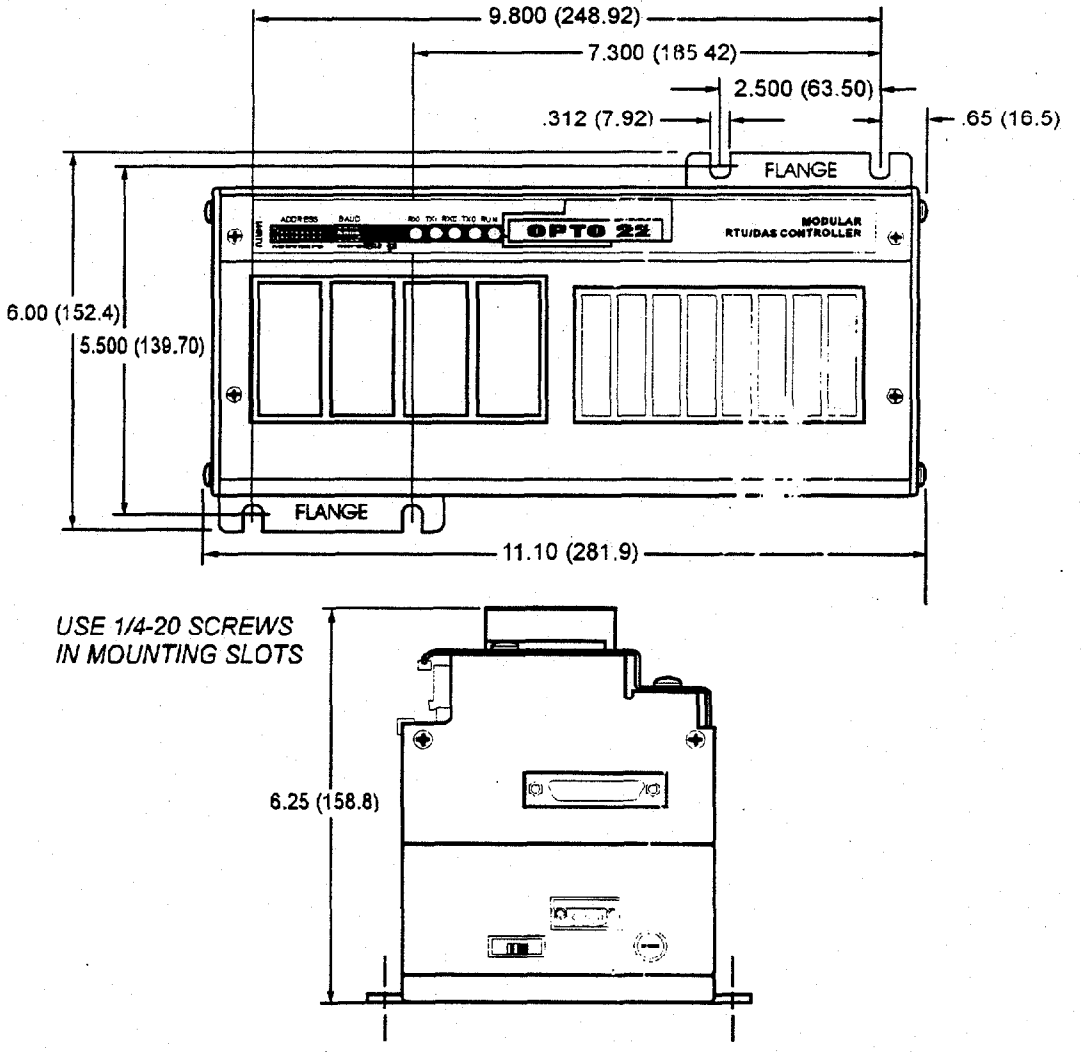
To accommodate a wide variety of applications, seven power supplies are available. These fuse-protected power supplies feature input-to-output isolation protection, a built-in EMI filter, and an on/off switch. They supply enough power to operate the M4 I/O base unit, three M4BUS expansion options, and I/O modules for both the base unit and the M4RTUX I/O extender.

Power Supply Model Number	Voltage
M4PS12D	12 VDC input (9-15 V)
M4PS24D	24 VDC input (18-30 V)
M4PS48D	48 VDC input (36-60 V)
M4PS125D	125 VDC input (94-156 V)
M4PS120A	120 VAC input (95-130 V)
M4PS240A	240 VAC input (190-250 V)
M4PSF	Line Filter• requires 24 VDC and 5 VDC

Specifications

Item	Specification
CPU	32-bit Motorola 68020 processor 16-bit 80C196 I/O processor IEEE floating-point math
CPU clock frequency	16.67 MHz
Memory: RAM Flash EEPROM on controller Flash EEPROM on brain board	 256 KB•1 MB with battery backup (user programs & data) 256 KB•1 MB (firmware and user programs) 128 KB (I/O firmware)
RAM/clock battery	3.6-volt lithium, non-rechargeable
I/O: Base unit Extender unit Expansion	 8 digital, 4 analog, multifunction Adds 8 digital, 4 analog, multifunction Via RS-485 ports, using Opto 22 I/O
Communication: Base unit Expansion Modem support	 1 RS-232 and 1 RS-485/422 port Via daughter cards: configurable serial ports and ARCNET Direct, lease, and radio
Real-time clock	Clock/calendar, Epson 62421A with battery backup
Power requirements	5 VDC at 3.5 A (maximum) 24 VDC at 300 mA (maximum)
Typical operating temperature	-20° C to 70° C
Storage temperature	-40° C to 85° C
Humidity	5% to 95% relative humidity
Software	FactoryFloor (OptoControl, OptoDisplay and Optoserver) Classic Software (Cyrano, Mistic MMI, MDS)
System monitors: Host communications Watchdog timers RAM battery backup low Operating temperature	 Detect communication errors from processor, I/O, etc. Detect main power supply operation Detects program corruption (check sum RAM test) Detects temperature

Dimensions



Dimensions are in: inches (millimeters)

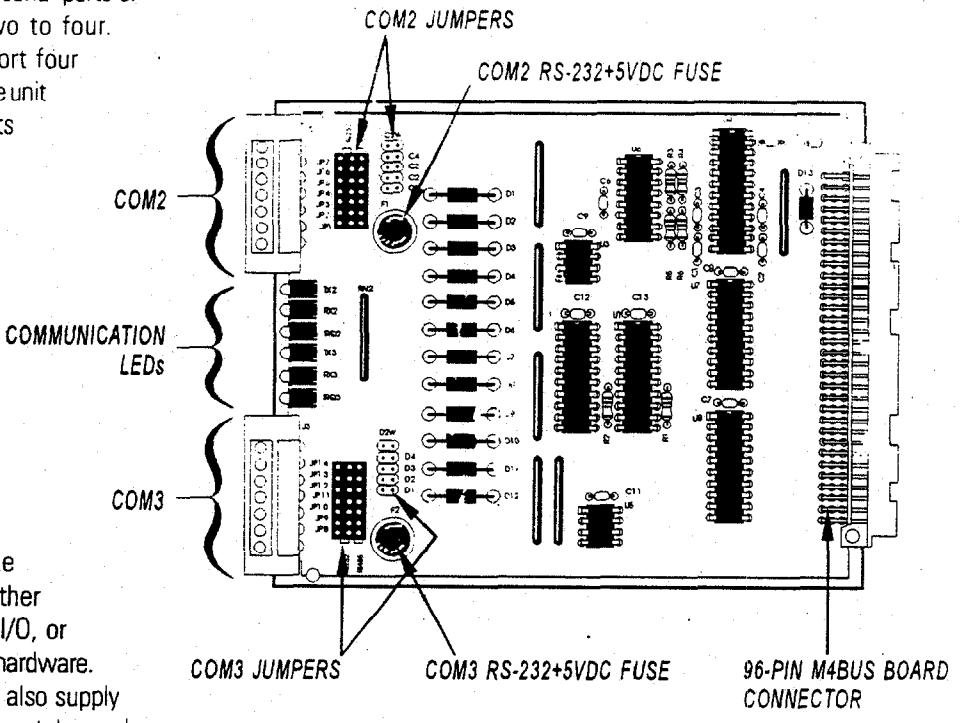
Dimension and specifications are subject to change. All products and/or company names throughout this data sheet are generally trademarks or registered trademarks of their respective companies.

Part Number	Description
M4SSER	M4 Serial Adapter Card

Description M4SSER SERIAL CARD

The M4SSER expands the number of serial ports on the M4 Modular Controllers from two to four. Intrinsically, the M4's UART can support four communication ports. However, the M4 base unit provides connections for only two ports (COM0 and COM1). The M4SSER allows the user to take advantage of the two remaining ports (COM2 and COM3). The M4SSER can be used with any of Opto 22's M4 Modular Controllers.

The two M4SSER ports are configurable as either RS-232 or RS-485/422 ports. They support communication speeds of up to 1,152 KBd, are modem-compatible, and support both ASCII and binary (Mistic) protocols. They may be used to link a host PC to the M4 Modular Controller, provide multiple host ports, network M4s or other Opto 22 controllers, connect additional I/O, or interface to application-specific third-party hardware.



Configured for RS-232, each port can also supply +5 VDC for powering devices with low current demands, such as barcode readers. This allows connection to a variety of application-specific devices requiring RS-232 capability.

Configured for RS-485/422, each port can be used for a remote serial I/O link, expanding the potential M4 base unit I/O from 4096 channels to 12,288 channels. With the help of Opto 22 I/O units and AC38 repeaters, the M4SSER can allow a user to develop a robust distributed control system using M4 Modular Controllers. This configuration also allows connection to a variety of applicationspecific devices requiring RS-485/422 capability — such as a host port network of M4 Modular Controllers, multiple serial I/O links, and intelligent electronic devices. The two M4SSER ports can be configured for either full-duplex (4-wire) or half-duplex (2-wire), terminated, or not terminated operation. Both ports are configurable and addressable through OptoControl or Cyrano.

Specifications

LED Specifications

LED	Indication
TX2 (COM2 transmit)	This indicator illuminates whenever Com2 is transmitting serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
RX2 (COM2 receive)	This indicator illuminates whenever COM2 is receiving serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
IRQ2 (COM2 interrupt)	This indicator illuminates when a hardware interrupt is issued by a connected serial device.
TX3 (COM3 transmit)	This indicator illuminates whenever COM3 is transmitting serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
RX3 (COM3 receive)	This indicator illuminates whenever COM3 is receiving serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
IRQ3 (COM2 interrupt)	This indicator illumates when a hardware interrupt is issued by a connected serial device.

M4SSER General Specifications

Item	Specification
Communication speed	300-115.2 KBd
Maximum connection distance	Up to 3,000 ft. (more with repeater)
Port configuration: COM2, RS-232 or RS-485/422 COM3, RS-232 or RS-485/422	 RS-232: TX, RX, RTS, CTS, DTR (+V), +5V, GND RS485: 2-wire, half-duplex, RS422: 4-wire, half- or full-duplex
Cable specifications for RS-232 or RS-485/422	#24 gauge, 7x32 stranded, 100-ohm nominal impedance, 12.5 p/F/ft.
Connector: Manufacturer	Pluggable, 7-position screw terminal Phoenix Contact, P/N: MC1 5/7-ST-3, 81
Power requirement (at 5 VDC)	220 mA
Typical operating temperature	-20° C to 70° C
Storage temperature	-40° C to 85° C

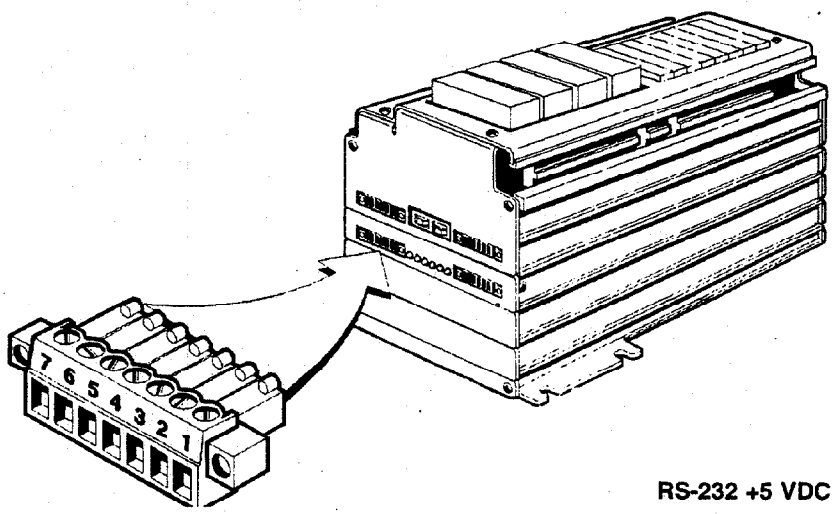
Specifications (CONT.)

Pin Connections for the M4SSER COM2/COM3 Ports

PIN	RS-232	RS-485/422 (2-Wire)	RS-485/422 (4-Wire)
1	Fused +5 VDC (1A)	Transmit/Recieve Plus (TX/RX+)	Transmit Plus (TX+)
2	Transmit (TX)	Transmit/Receive Minus (TX/RX-)	Transmit Minus (TX-)
3	Receive (RX)	Common Ground (GND)	Common Ground (GND)
4	Request-to-Send (RTS)	No Connection (NC)	Receive Plus (RX+)
5	Clear-to-Send (CTS)	No Connection (NC)	Receive Minus (RX-)
6	Passive DTR (pulled up to +9 V)	Interrupt Plus (IRQ+)	Interrupt Plus (IRQ+)
7	Ground (GND)	Interrupt Plus (IRQ-)	Interrupt Plus (IRQ-)

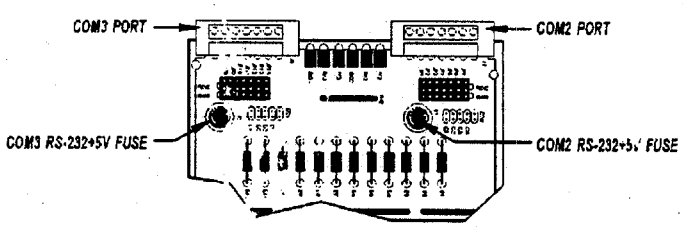
Important: Connectors wired for other Opto 22 controllers may not be compatible with the M4SSERs. Use the connectors provided with the M4SSER and refer to the pin connection label for wiring information

The figure and the table show the location and function of each pin on the 7-position terminal block.



RS-232 +5 VDC Fuse

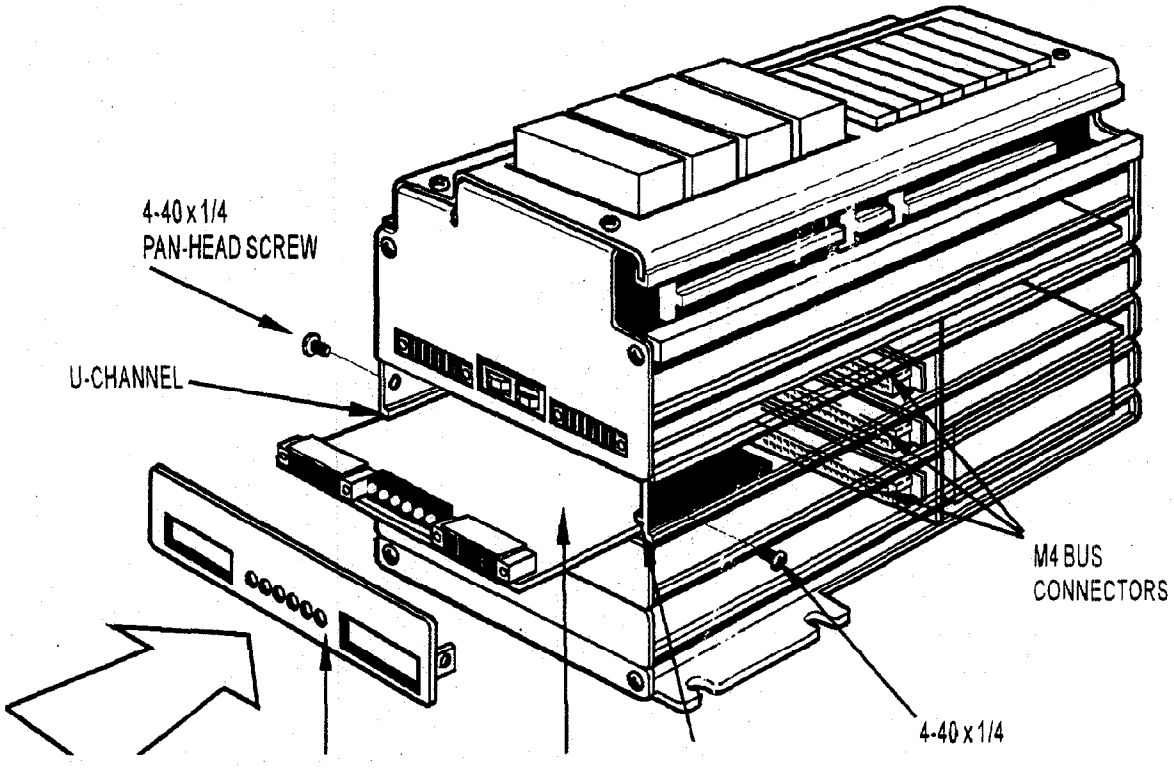
RS-232 +5 VDC Fuse
A +5 VDC fused source is available on Pin 1 from both the COM2 and COM3 ports. A maximum 0.5A load can be drawn through the 1-Amp rated fuse. The replacement part number for this fuse is Opto 22 P/N FUSE01G4 (Wickman P/N 19373A).



Installation

Before installing the M4SSER into the M4 Modular Controller expansion slot, make sure all jumpers have been properly set for RS232 or RS-485/422 communications. Then follow the instructions below:

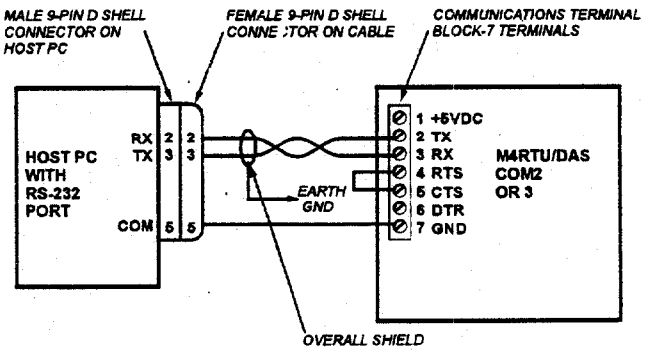
1. Remove all power from the M4 Modular Controller.
2. Remove the blank end cap for any of the three M4BUS expansion slots, located below the serial I/O connectors. Each end cap isheld in place by two screws located on the side panel, adjacent to each end cap. (You may also need to remove one or two additional end caps to achieve proper card alignment.)
3. Align the edges of the M4SSER with the selected expansion slot U-channels located on the sides of the expansion bus cavity. Slide the card all the way in until it seats into the M4BUS connector.
4. Use the original screws to attach the new end cap (included with the M4SSER) to the end of the M4 Modular Controller unit.
5. Only one M4SSER may be added to an M4 controller.



Installation (WIRING)

Wiring to a PC

The figure on the right presents an example of RS-232 wiring between a host PC and the COM2 or COM3 port of an M4SSER installed on an M4. Verify that the pin connections at the host PC are the same as those called out in the diagram.

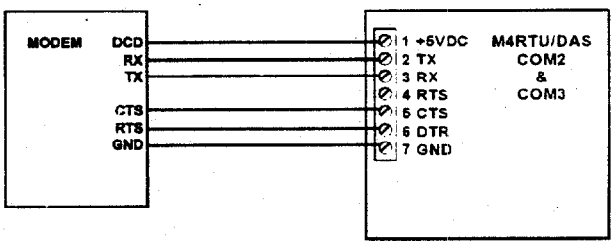


Wiring to a Modem

The figure on the right illustrates a connection from a generic modem to COM2 or COM3 on the M4SSER serial card of an M4 that does not use a carrier detect.

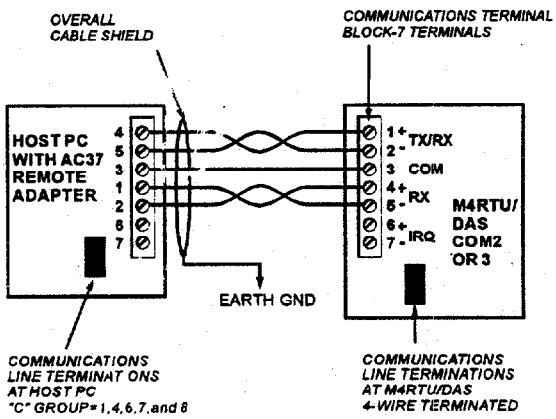
Refer to your modem documentation for detailed wiring information, possible jumper configuration, and initialization setup.

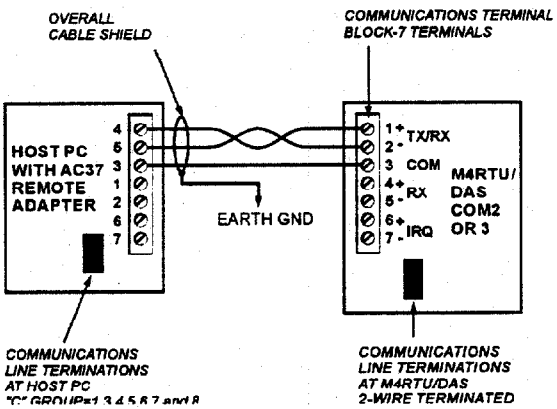
Important: For radio modems, connect RTS from the M4 to RTS on the radio. Do not use DTR on the M4.



Wiring to an AC37

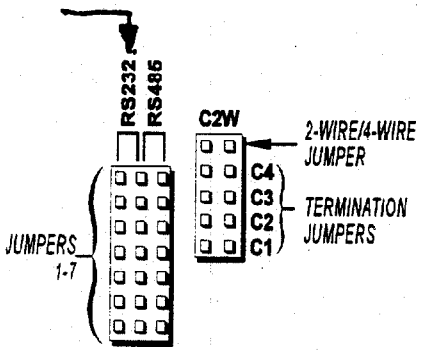
The figures on the right present examples of RS-485/422 wiring between a host PC with an Opto 22 AC37 and the COM2 or COM3 port of an M4SSER.

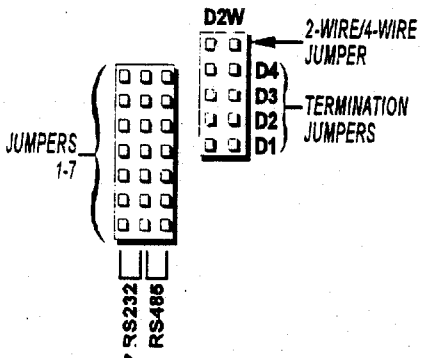




Installation JUMPERS

The two serial ports (COM2 and COM3) of the M4SSER may be configured by setting jumpers for either RS-232 or RS-485/422. Only one serial mode may be used at a time. Each communication port includes a set of 12 jumpers divided into two columns. These jumpers must be set according to the serial mode desired.
The figure below shows the two sets of jumpers as they appear on the M4SSER. Note that the two sets are identical except for the labeling (some jumpers are labeled with C designations for COM2 and D designations for COM3). In this figure, no jumpers have been installed.





Jumper	RS-232 (Jumpers in Left 2 Columns)	2-Wire (Jumper In at C2W/D2W)	4-Wire (Jumper Out at C2W/D2W)
1	+ 5 VDC[1]	TX/RX+	TX +
2	TX	TX/RX-	TX -
3	RX	GND	GND
4	RTS	NC	RX +
5	CTS	NC	RX -
6	DTR	IRQ +	IRQ +
7	GND	IRQ -	IRQ -

[1] The +5 VDC may be used to power devices with light current demands such as barcode readers or hand-held terminals. Leave this jumper out if you do not need this voltage source.

Jumper	Function When Jumper In	Function When Jumper Out
C2W/D2W	2-Wire	4-Wire
C1/D1[1]	Terminated	Not Terminated
C2/D2[1]	Terminated	Not Terminated
C3/D3[1]	Terminated	Not Terminated
C4/D4[1]	Terminated	Not Terminated

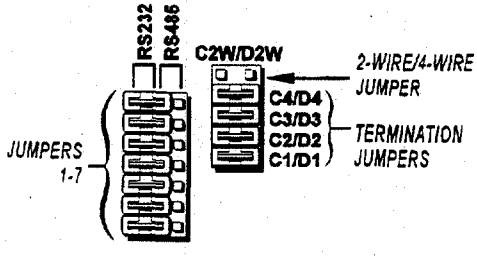
[1] For RS-232 jumpers must be installed on C1 through C4 or D1 through D4. For RS-485/422, this group of jumpers must all be set the same depending on whether the M4RTU/DAS is physically the last unit in the communication link (jumpers in) or not (jumpers out).

Important: When using RS-232, all termination jumpers (C1–C4 or D1–D4) must be installed to ensure reliable communications. In addition, the 2-wire/4-wire jumper (C2W or D2W) must be removed.

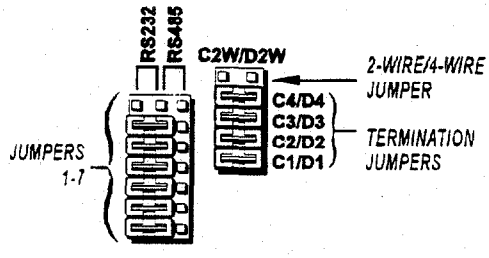
Installation JUMPERS (CONT.)

EXAMPLES OF JUMPER SETTINGS

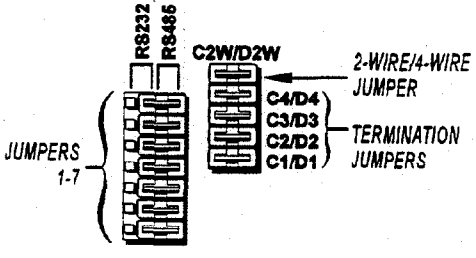
RS-232 with +5 VDC Enable



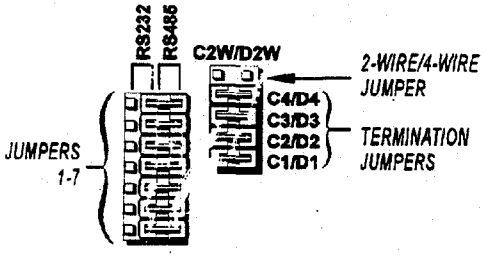
RS-232 with +5 VDC Disabled



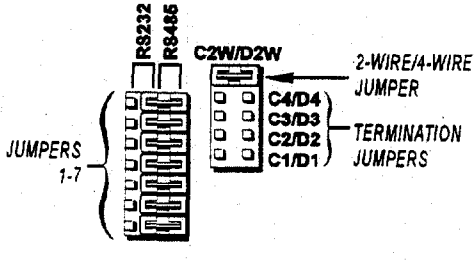
RS-485/422, 2-Wire Terminated



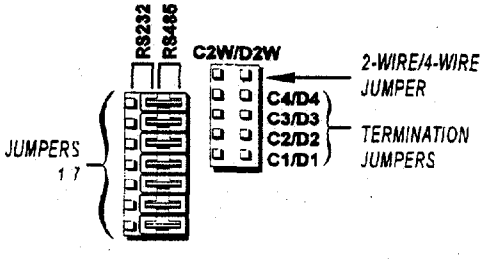
RS-485/422, 4-Wire Terminated



RS-485/422, 2-Wire Non-Terminated



RS-485/422, 4-Wire Non-Terminated



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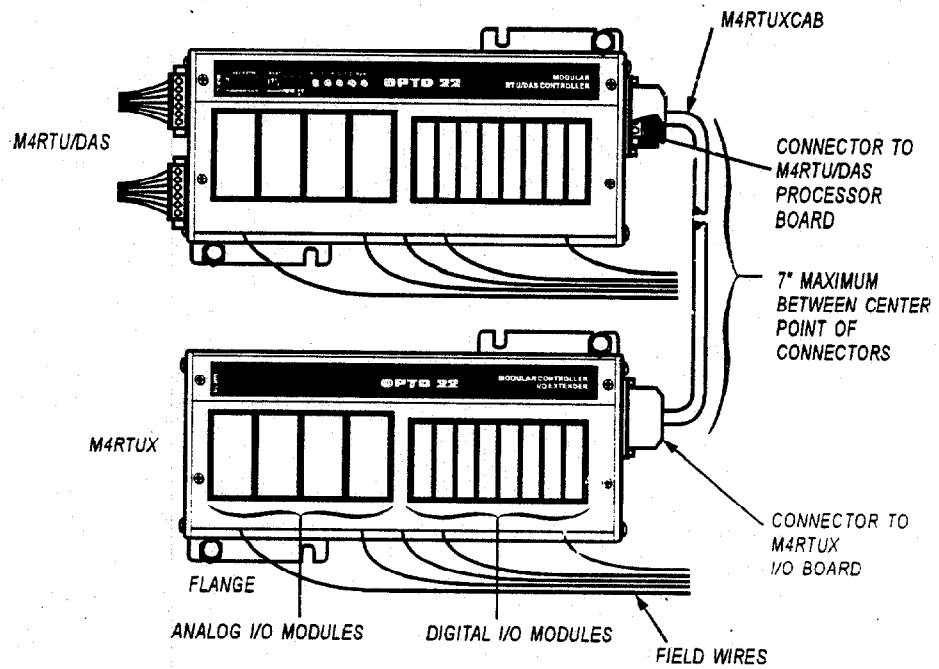
Part Number	Description
M4RTUX	Opto 22 Modular Controller I/O Extender

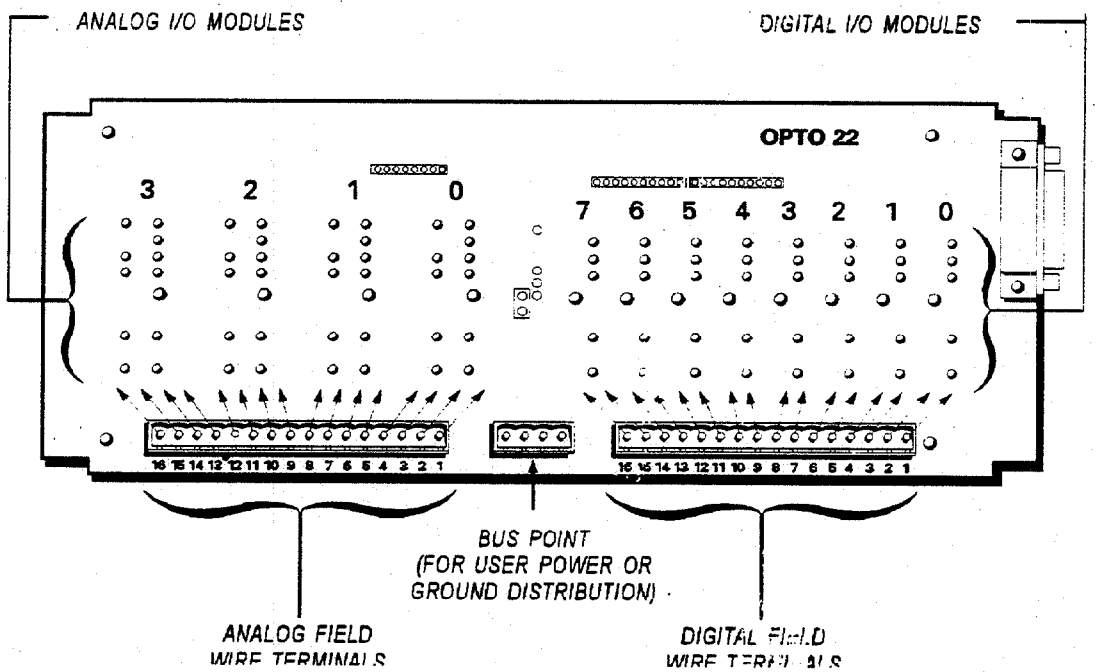
Description

This data sheet provides connection diagrams for the optional M4RTUX I/O Extender. The M4RTUX I/O Extender is an I/O expansion option for the M4RTU/DAS that adds eight G4 digital and four G4 analog I/O channels. Included with the M4RTUX is an M4RTUXCAB cable and connector assembly, used to connect the M4RTUX I/O Extender to the M4RTU/DAS base unit.

Connections



Installation



Connecting Field Wiring
The field wiring terminals are located on the top of the M4RTUX next to the corresponding digital or analog modules. These terminals allow connection of field wires to the selected I/O modules. The diagram above shows the location of the terminals on the unit and the layout of the terminal points as they correspond to each I/O module.

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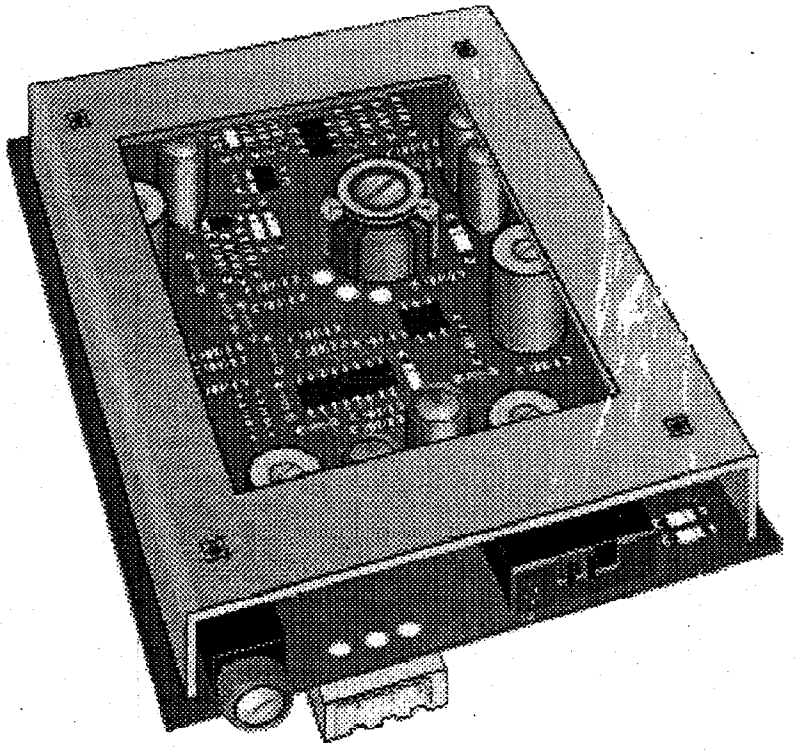
Form 672L-970711

Description

There are six models of input power supplies available for any Modular controller. Each power supply model uses a specific AC or DC voltage input range to accommodate a wide variety of field applications.

A 24 VDC/5 VDC Line Filter is also available if the Modular controller will be connected to an external power supply unit.

Part Numbers	Description
M4PS12D	Modular Controller DC Power Supply 9-15V
M4PS24D	Modular Controller DC Power Supply 18-35V
M4PS48D	Modular Controller DC Power Supply 36-60V
M4PS125D	Modular Controller DC Power Supply 125V
M4PS120A	Modular Controller AC Power Supply 90-130V
M4PS240A	Modular Controller AC Power Supply 180-250V
M4PSF	Modular Controller DC Filter Board



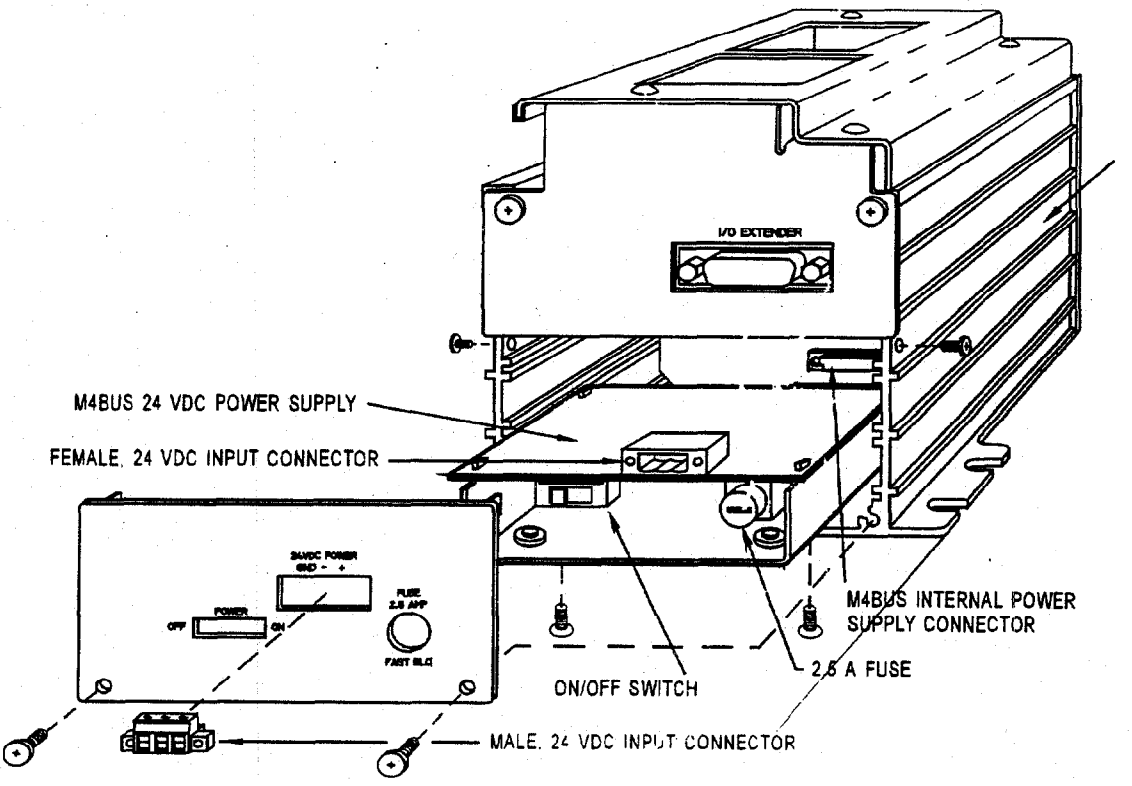
Specifications

General

Typical Operating Temperature	-20° to 70° C
Storage Temperature	-40° to 85° C

Model Specific

Models	Input Voltage Range	Fuse
M4PS12D	9-15 VDC	5.0 A
M4PS24D	18-30 VDC	2.5 A
M4PS48D	36-60 VDC	1.5 A
M4PS125D	94-156 VDC	0.5 A
M4PS120A	95-130 VAC	0.5 A
M4PS240A	190-250 VAC	0.375 A
M4PSF	Line Filter 24 VDC 5 VDC	0.5 A 4.0 A



N/A

Specifications (CONT.)

POWER REQUIREMENTS

M4BUS Power Consumption Worksheet for the M4RTU*			
Hardware	**Watts (W)**	**Quantity (Q)**	**Total (W x Q)**
M4RTU Base Unit	7.5	1.0	7.5
M4RTUX I/O Extender Unit	0		0
Daughter Cards			
	1.6		
M4SARC ARCnet Expansion Card	1.0		
Digital I/O Modules			
G4 Digital AC/DC Input/Output[1]	0.086		
G4ODC5R, G4ODCR5 Dry Contact Output, Single Channel	0.10		
G4IDC5Q Digital Quadrature Input Pair	0.43		
Analog I/O Modules			
G4ADX[2]	1.6		
G4AD3 4-20 mA Input Sourcing, Non-sourcing	2.6, 1.6		
G4DA4 Voltage Output Sourcing, Non-sourcing	2.2, 1.1		
G4DA3, G4DA8 Current Output Sourcing, Non-sourcing	2.6, 1.2		
G4DA9, G4DA10 Time Proportional Output	0.18		
Powered RS-232 devices, i.e., bar code reader			
Total Watts (TW)			W
Your supplied input voltage			V
TW/Your supplied input voltage = Input current requirements			A

1 If the digital module you are using does not appear below, then use the G4 Digital AC/DC Input/Out module wattage.

2 If the analog module you are using does not appear below, then use the G4ADX wattage.

1. In the table above, locate the daughter cards and digital and/or analog modules that you will be using with the M4RTU. Enter a quantity for each item in the "Quantity" column. Also, fill in any RS-232 devices on the line provided.
2. Multiply the value in the "Watts" column by the quantity entered in the "Quantity" column and enter the result in the "Total" column for each component used.

Example: (8) G4 digital modules total 0.688 W. (4) G4ADX analog modules total 6.4 W.

3. Add up the values in the "Total" column, including the value entered for the M4RTU base unit, and enter the number on the "TOTAL WATTS (TW)" line.

Example: 0.688 W (digital modules) + 6.4 W (analog modules) + 7.5 W (base RTU) = 14.588 W.

4. Enter the supplied input voltage for your installation on the "Your supplied input voltage" line

Example: 24 VDC.

5. Divide the total on the "TOTAL WATTS" line by the number entered in step 4 to get total input current requirements. Enter this number on the last line of the table

Example: 14.588 (W) / 24 VDC (supplied input) = 0.6 A required input current for the M4RTU

*For currently available power supplies.

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I/O MODULES
G4
ANALOG INPUT

OPTO 22

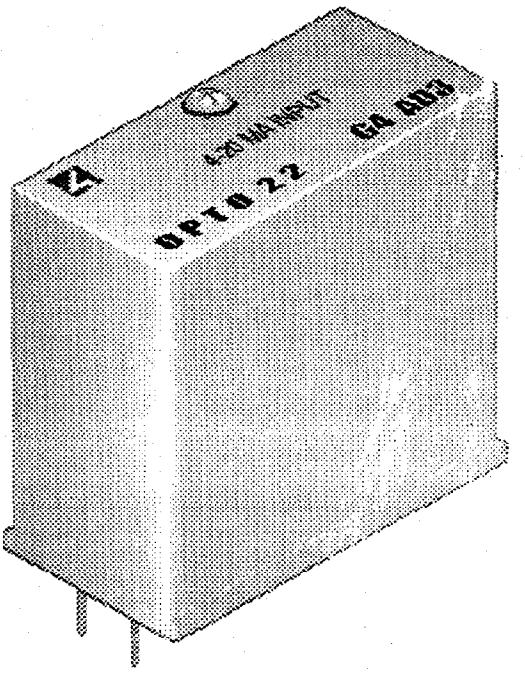
DATA SHEET page 1

Form. 426L-961003

Part Number	Description
G4AD3	4 To 20 mA Input

description

The G4AD3 module provides a single channel of transformer and optically isolated current-to-digital conversion. The nominal input range is 4 to 20 milliamps with an under/over range capability from less than 3 milliamps to greater than 35 milliamps. One of the unique features is that the isolated loop supply can be provided by the G4AD3. This eliminates the need for the user to provide the loop supply (typically 15-48 V) and also saves the associated wiring, barrier strips, etc. The G4AD3 module also includes complete electrical channel-to-channel isolation which eliminates any ground loop problems. Modules plug into an Opto 22 Modular controller or an analog I/O brick and are secured by a captive screw. The field connections are made to the terminal strip located on the Brick base or controller I/O board.



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Inside Sales: (800) 452-OPTO • Product Support: (800) TEK-OPTO • (909) 695-3080 • Fax: (909) 695-3017 • E-mail: support@opto22.com

specifications

G4AD3 Specifications

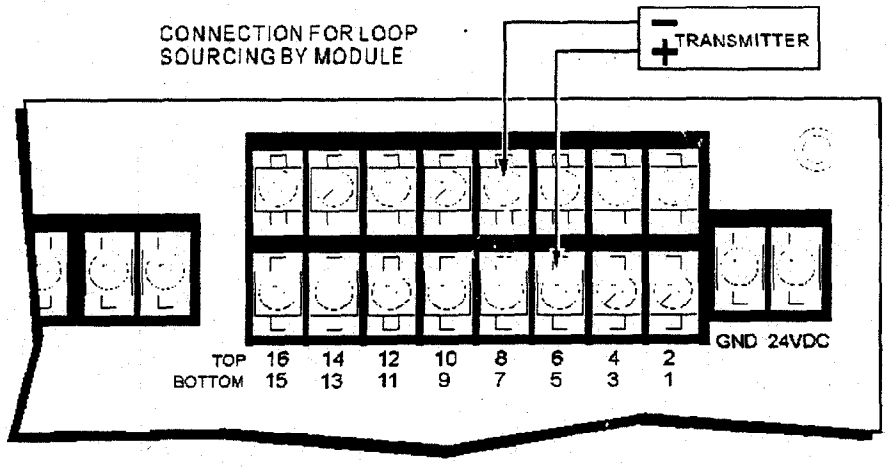
Nominal input range	4 to 20 mA
Input Impedance	249 Ohms
Over/under range	3 to 35 mA
Loop supply	28 VDC nominal
Accuracy*	16 µA
Response time	Full-scale step change in 3 ms
Resolution	12 bits
Isolation (Transient) Input-to-output Input-to-analog supply	 4,000 Vrms 4,000 Vrms
Ambient temperature Operating Storage	 -30° C to 70° C -40° C to 85° C

* Accuracy figure requires use of gain and offset commands.

CONNECTIONS G4AD3

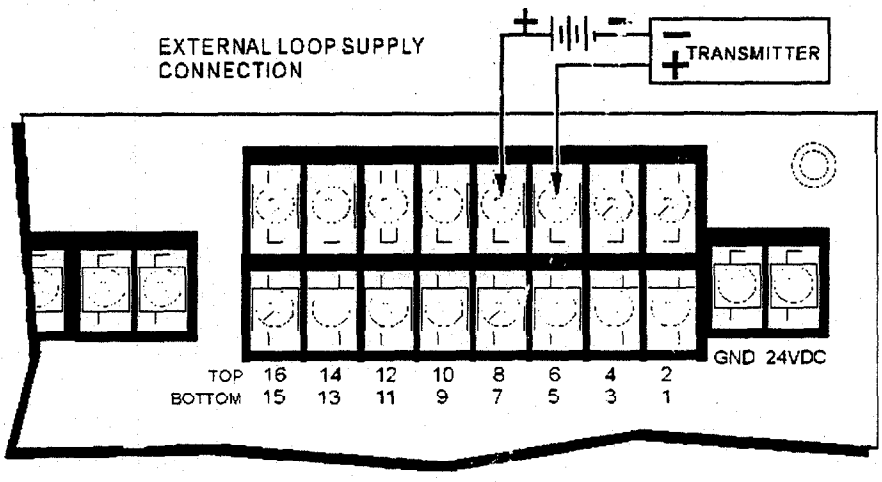
CONNECTION FOR LOOP SOURCING BY MODULE

NOTE: PICTURE SHOWS CONNECTION FOR MODULE IN POSITION 1.



EXTERNAL LOOP SUPPLY CONNECTION

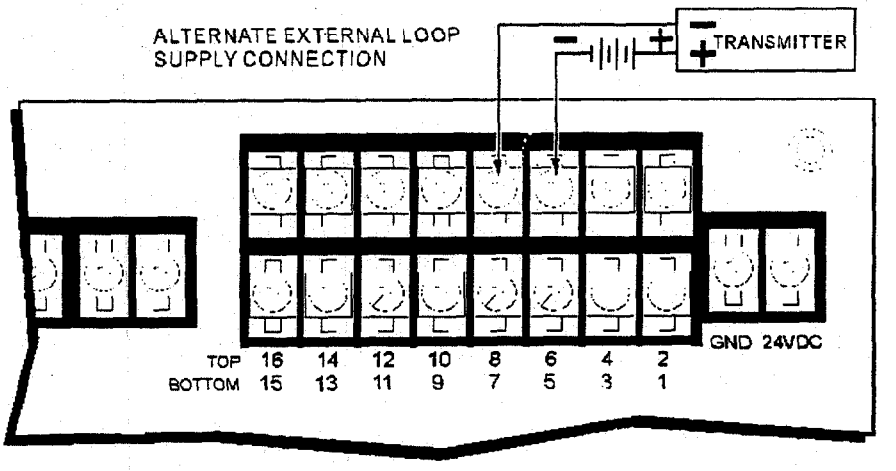
NOTE: PICTURE SHOWS CONNECTION FOR MODULE IN POSITION 1.



CONNECTIONS (CONT.)

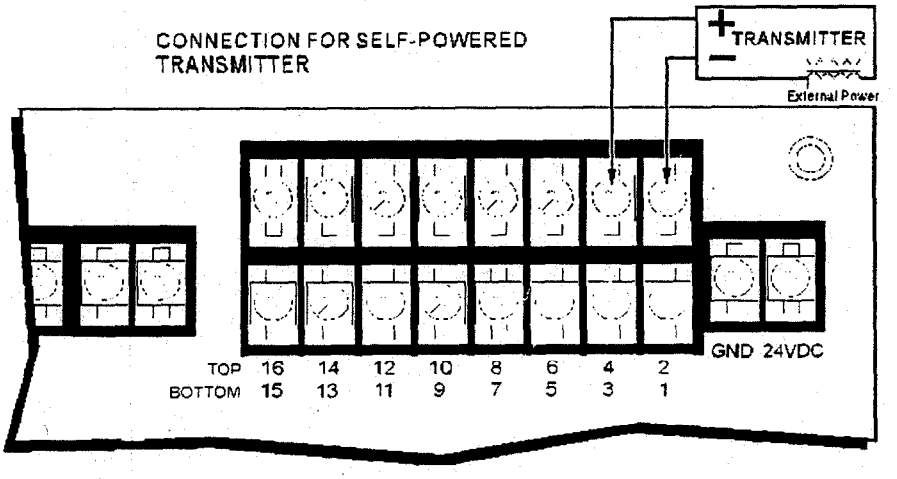
ALTERNATE EXTERNAL LOOP SUPPLY CONNECTION

NOTE: PICTURE SHOWS CONNECTION FOR MODULE IN POSITION 1



CONNECTION FOR SELF-POWERED TRANSMITTER

NOTE: PICTURE SHOWS CONNECTION FOR MODULE IN POSITION 0.



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Form 251L-970609

Part Number	Description
G4IAC5	G4 AC Input 90-140 VAC, 5 VDC Logic
G4IAC5A	G4 AC Input 180-280 VAC, 5 VDC Logic
G4IAC5MA	G4 AC Input 90-140 VAC, 5 VDC Logic W/SW
G4IAC15	G4 AC Input 90-140 VAC, 15 VDC Logic
G4IAC15A	G4 AC Input 180-280 VAC, 15 VDC Logic
G4IAC24	G4 AC Input 90-140 VAC, 24 VDC Logic
G4IAC24A	G4 AC Input 190-280 VAC, 24 VDC Logic

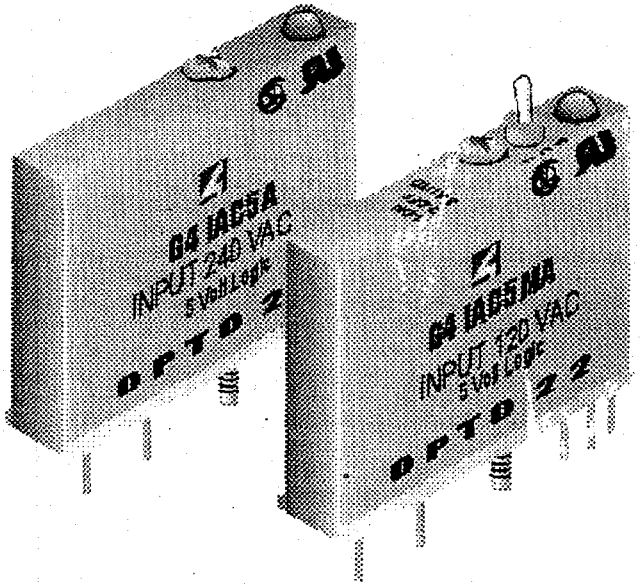
Description

Opto 22's G4 AC input modules are used to detect on/off AC voltage levels. Each module provides up to 4,000 V_{rms} of optical-isolation between field inputs and the logic output of the circuit.

All AC input modules are designed with filtering on the input and a hysteresis amplifier, providing high noise rejection and transient-free "clean" switching.

The G4IAC5MA is a special module featuring a manual-on/manual-off/automatic switch, ideal for diagnostic testing of control applications.

Typical applications for AC input modules include sensing the presence or absence of voltage, and sensing contact closure from sources such as proximity switches, limit switches, float switches, selector switches, push buttons, toggle switches, and thermostats.



Features

- 4,000 V_{rms} optical isolation
- Built-in LED status indicator
- Small footprint design, reducing mounting space by approximately 50 percent
- UL recognized, CSA certified, CE approved
- Passes NEMA Showering Arc Test (ICS 2-230)
- Meets IEEE Surge Withstand Specification (IEEE-472)
- Built-in filtering for transient suppression and noise rejection
- Operating temperature: -30° C to 70° C

Specifications

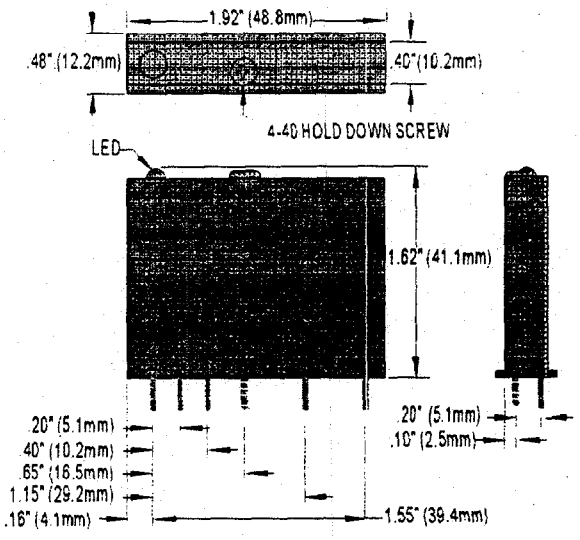
	Units	G4IAC5	G4IAC5A	G4IAC5MA
Input voltage range	VDC or VAC	90-140	180-280	90-140
Key feature	---	---	---	Diagnostic switch
Input current at maximum line	mA	11	5	11
Isolation input-to-output	V_{rms}	4,000	4,000	4,000
Turn-on time	ms	20	2	20
Turn-off time	ms	20	20	20
Input allowed for off-state	mA, V	3, 45	1, 45	3, 45
Nominal output voltage supply	VDC	5	5	5
Output supply voltage range	VDC	4.5-6	4.5-6	4.5-6
Output supply current at nominal logic voltage	mA	12	12	12
Input resistance (R1 in schematic)	W	14K	70K	14K
Control resistance (R_c in schematic)	W	220	220	220
Output voltage drop	V @ 50 mA	.4	.4	.4
Output current (sinking)	mA	50	50	50
Output leakage with no input	µA @ 30 VDC	100	100	100
Transistor	V breakdown	30	30	30
Temperature: Operating Storage	 °C °C	 -30 to +70 -30 to +85	 -30 to +70 -30 to +85	 -30 to +70 -30 to +85

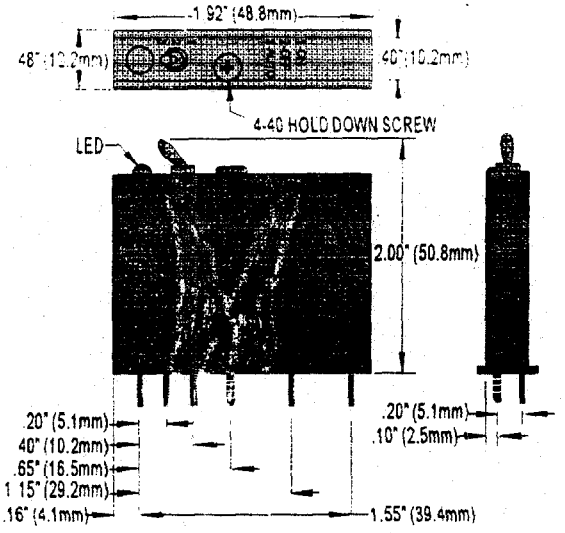
REFERENCE ONLY

Specifications (CONT.)

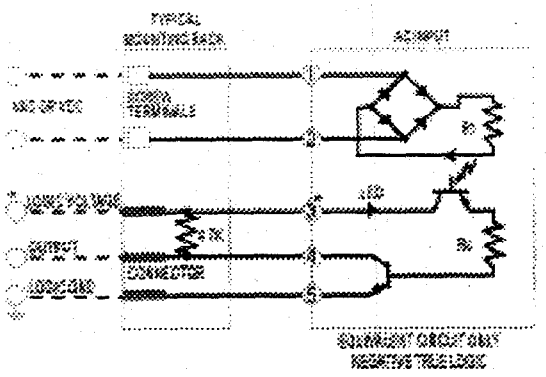
	Units	G4IAC15	G4IAC15A	G4IAC24	G4IAC24A
Input voltage range	VDC or VAC	90-140	180-280	90-140	180-280
Key feature	---	---	---	---	---
Input current at maximum line	mA	11	5	11	5
Isolation input-to-output	V_{rms}	4,000	4,000	4,000	4,000
Turn-on time	ms	20	20	20	20
Turn-off time	ms	20	20	20	20
Input allowed for off-state	mA, V	3, 45	1, 45	3, 45	1, 45
Nominal output supply voltage	VDC	15	15	24	24
Output supply voltage range	VDC	12-18	12-18	20-30	20-30
Output supply current at nominal logic voltage	mA	15	15	15	15
Input resistance (R1 in schematic)	W	14K	70K	14K	70K
Control resistance (R_c in schematic)	W	1K	1K	2.2K	2.2K
Output voltage drop	V @ 50 mA	.4	.4	.4	.4
Output current (sinking)	mA	50	50	50	50
Peak repetitive voltage	VAC	500	500	500	500
Output leakage with no input	µA @ 30 VDC	100	100	100	100
Transistor	V breakdown	30	30	30	30
Temperature: Operating Storage	 °C °C	 -30 to +70 -30 to +85	 -30 to +70 -30 to +85	 -30 to +70 -30 to +85	 -30 to +70 -30 to +85

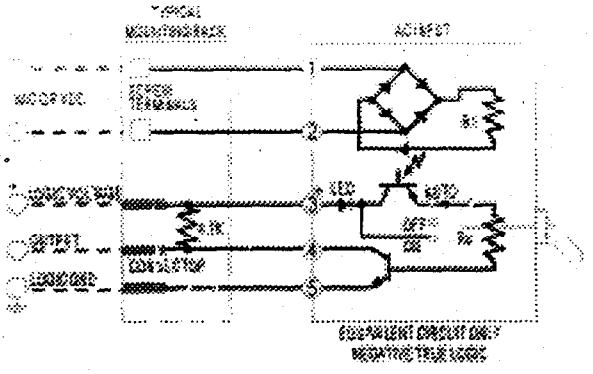
Dimensions





Schematics





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Form 252L-970611

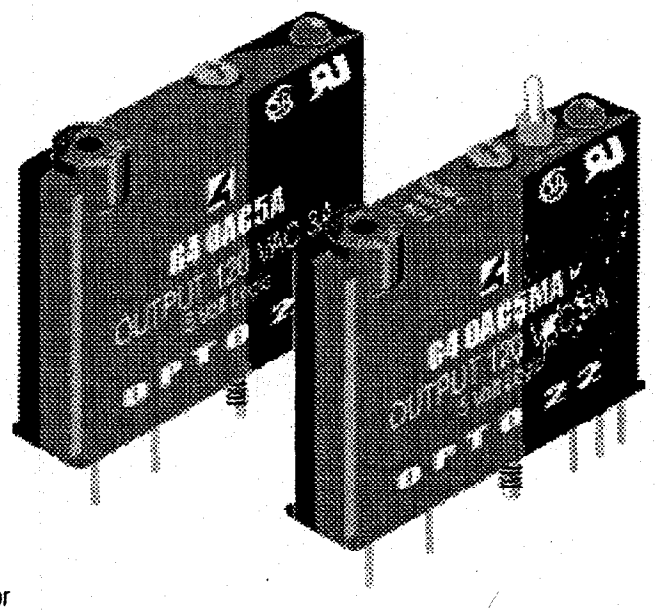
Description

Opto 22's G4 AC output modules are used to control or switch AC loads. Each module provides up to 4,000 V_{rms} of optical-isolation between field outputs and the control side of the circuit, and each features zero voltage turn-on and zero current turn-off. All AC output modules are equivalent to single-pole, single-throw, normally open contacts (Form A, SPST-NO) except the G4OAC5A5, which is equivalent to a single-pole, single-throw, normally closed contact (Form B, SPST-NC).

The G4OAC5MA and the G4OAC5AMA are special modules featuring a manual-on/manual-off/automatic switch, ideal for diagnostic testing of control applications.

Typical applications for AC output modules include switching loads such as AC relays, solenoids, motor starters, heaters, lamps, and indicators.

Part Number	Description
G4OAC5	G4 AC Output 12-140 VAC, 5 VDC Logic
G4OAC5A	G4 AC Output 24-280 VAC, 5 VDC Logic
G4OAC5A5	G4 AC Output 24-280 VAC, 5 VDC Logic NC
G4OAC5MA	G4 AC Output 12-140 VAC, 5 VDC Logic With HOA/SW
G4OAC5AMA	G4 AC Output 24-280 VAC, 5 VDC Logic With HOA/SW
G4OAC15	G4 AC Output 12-140 VAC, 15 VDC Logic
G4OAC15A	G4 AC Output 24-280 VAC, 15 VDC Logic
G4OAC24	G4 AC Output 12-140 VAC, 24 VDC Logic
G4OAC24A	G4 AC Output 24-280 VAC, 24 VDC Logic



Features

- 4,000 V_{rms} optical-isolation
- Built-in LED status indicator
- Logic levels of 5, 15, and 24 VDC
- Removable fuse
- Current rating: 3 amps at 45° C
- Ability to withstand one-cycle surge of 80 amps
- Operating temperature: -30° C to 70° C
- UL recognized, CSA certified, CE approved
- Passes NEMA Showering Arc Test (ICS 2-230)
- Meets IEEE Surge withstand Specification (IEEE-472)

Specifications

	Units	G4OAC5*	G4OAC5A*	G4OAC5A5*	G4OAC5MA*	G4OAC5AMA*
Nominal line voltage	VAC	120	240	120/240	120	240
Output voltage range	VAC	12-140	24-280	24-280	12-140	24-280
Key feature	---	---	Normally	Diagnostic closed	Diagnostic switch	switch
Current rating: At 45° C ambient	A A	3 2	3 2	3 2	3 2	3 2
Isolation input-to-output	V_{rms}	4,000	4,000	4,000	4,000	4,000
Off-state leakage at nom. voltage-60 Hz	mA_{rms}	5	2.5	2.5	5	2.5
Nominal logic voltage	VDC	5	5	5	5	5
Logic voltage range	VDC	4-8	4-8	4-8	4-8	4-8
Logic pickup voltage	VDC	4	4	4	4	4
Logic dropout voltage	VDC	1	1	1	1	1
Logic input current at nominal logic voltage	mA	12	12	12	12	12
Control resistance (Rc in schematic)	W	220	220	220	220	220
One-cycle surge	A peak	80	80	80	80	80
Turn-on time	µs	1/2 cycle max zero volts	1/2 cycle max zero volts	1/2 cycle max zero volts	1/2 cycle max zero volts	1/2 cycle max zero volts
Turn-off time	µs	1/2 cycle max zero amps	1/2 cycle max zero amps	1/2 cycle max zero amps	1/2 cycle max zero amps	1/2 cycle max zero amps
Peak repetitive voltage	VAC	500	500	500	500	500
Minimum load current	mA	20	20	20	20	20
Output voltage drop maximum peak	V	1.6	1.6	1.6	1.6	1.6
Operating frequency	Hz	25-65	25-65	25-65	25-65	25-65
dV/dT-off-state	V/µs	200	200	200	200	200
dV/dT-commutating		snubbed for 0.5 power factor load	snubbed for 0.5 power factor load	snubbed for 0.5 power factor load	snubbed for 0.5 power factor load	snubbed for 0.5 power factor load
Temperature:	°C °C	-30 to +70 -30 to +85	-30 to +70 -30 to +85	-30 to +70 -30 to +85	-30 to +70 -30 to +85	-30 to +70 -30 to +85

* Also available with an FM rating; add FM to the part number (example: G4OAC5FM).

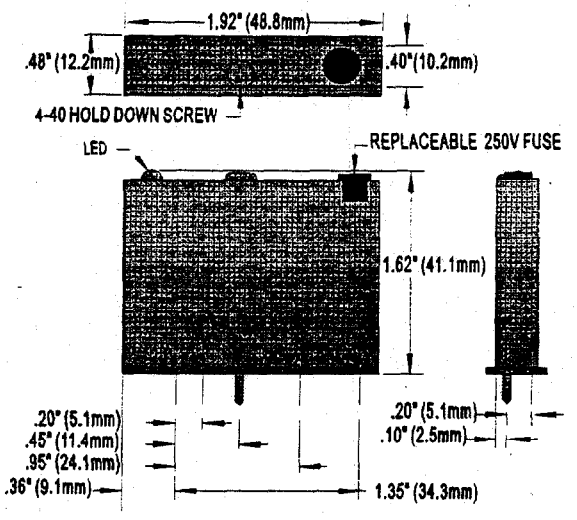
REFERENCE ONLY

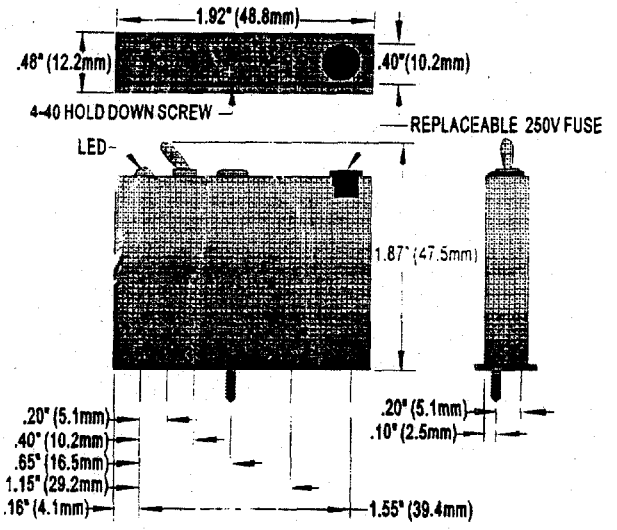
Specifications

	Units	G4OAC15	G4OAC15A	G4OAC24	G4OAC24A
Nominal line voltage	VAC	120	240	120	240
Output voltage range	VAC	12-140	24-280	12-140	24-280
Key feature	---	---	---	---	
Current rating: At 70° C ambient	A A	3 2	3 2	3 2	3 2
Isolation input-to-output	V_{rms}	4,000	4,000	4,000	4,000
Off-state leakage at nom. voltage-60 Hz	mA_{rms}	5	2.5	5	2.5
Nominal logic voltage	VDC	15	15	24	24
Logic voltage range	VDC	10.5-16	10.5-16	19.5-32	19.5-32
Logic pickup voltage	VDC	10.5	10.5	19.5	19.5
Logic dropout voltage	VDC	1	1	1	1
Logic input current at nominal logic voltage	mA	15	15	18	18
Control resistance (Rc in schematic)	W	1K	1K	2.2K	2.2K
One-cycle surge	A peak	80	80	80	80
Turn-on time	µs	1/2 cycle max zero volts	1/2 cycle max zero volts	1/2 cycle max zero volts	1/2 cycle max zero volts
Turn-off time	µs	1/2 cycle max zero amps	1/2 cycle max zero amps	1/2 cycle max zero amps	1/2 cycle max zero amps
Peak repetitive voltage	VAC	500	500	500	500
Minimum load current	mA	20	20	20	20
Output voltage drop maximum peak	V	1.6	1.6	1.6	1.6
Operating frequency	Hz	25-65	25-65	25-65	25-65
dV/dT-off-state	V/µs	200	200	200	200
dV/dT-commutating		snubbed for 0.5 power factor load	snubbed for 0.5 power factor load	snubbed for 0.5 power factor load	snubbed for 0.5 power factor load
Temperature:	°C °C	-30 to +70 -30 to +85	-30 to +70 -30 to +85	-30 to +70 -30 to +85	-30 to +70 -30 to +85

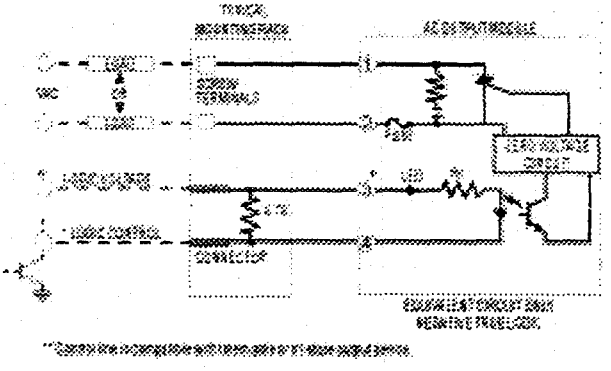
Form 252L-970611

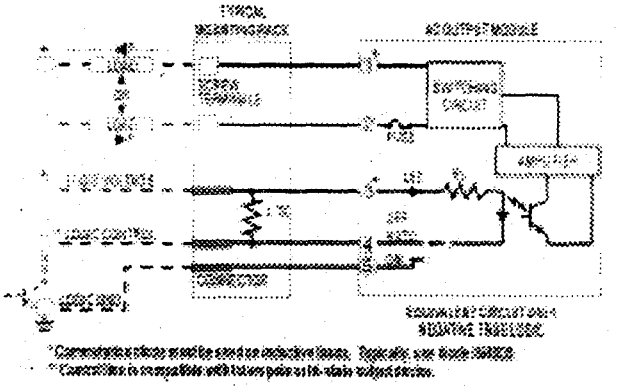
Dimensions





Schematics





Dimension and specifications are subject to change. All products and/or company names throughout this data sheet are generally trademarks or registered trademarks of their respective companies.

SOFTWARE
FACTORYFLOOR

Part Number	Description
FACTORYFLOOR	FactoryFloor Suite
OPTOCONTROL	OptoControl
OPTODISPLAY	OptoDisplay
OPTOSERVER	OptoServer

FactoryFloor® takes you a quantum leap ahead in your search for total control of the manufacturing enterprise. To solve the toughest control automation problems, or build the easiest to use, most informative user interfaces, or to expand your manufacturing systems connectivity, Opto 22 has a total control solution called FactoryFloor, Opto 22's new suite of Windows® 32-bit applications, which is designed to deliver total control to industrial automation customers. FactoryFloor consists of three integrated components:

- OptoControl™, a graphical, flowchart-based development environment for control solutions
- OptoDisplay™, a graphical multimedia operator interface package
- OptoServer™, a robust data server that connects the controller network with the PC-based FactoryFloor network

Opto 22's leadership and innovation in industrial automation hardware and software, combined with Microsoft®'s operating environments and applications, provides a solid foundation for total control. Opto 22's combination of hardware and software expertise, and its belief in the importance of open systems integration, sets them sharply apart from firms that can only deliver pieces of the puzzle.

FactoryFloor takes advantage of the power of Microsoft Windows® 95, Microsoft Windows NT™ and Microsoft Office software products to deliver a complete client/server solution for industrial automation. This reduces training requirements and increases productivity. The power of the Windows programming standards means ease of integration with other applications.

FactoryFloor offers a total control solution from programming and debugging a control system to a networked human/machine interface all from the same vendor who delivers world-class control automation hardware.

Opto 22's history of innovation in control hardware and flowchart-based software, combined with Microsoft Windows 95 and Windows NT, provides a foundation for the world's most powerful graphical development environment for control solutions - OptoControl. OptoControl is the cornerstone of Opto 22's FactoryFloor suite of Windows 32-bit applications and is designed to deliver maximum flexibility and control to the industrial automation customer.

OPTOCONTROL GRAPHICAL CONFIGURATOR

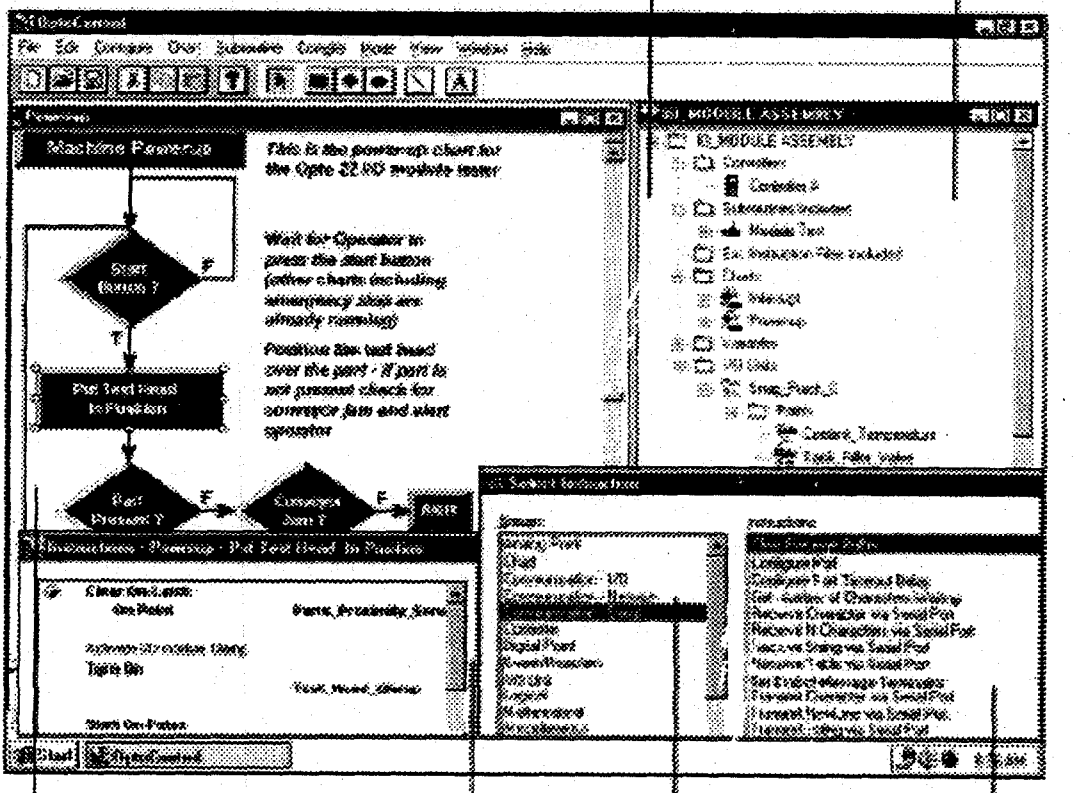
Flowcharts are developed by using 4 simple constructs:

- Action blocks contain a list of things to do;
- Condition blocks contain one or more things to test for.
- Connections indicated the sequence of execution;
- Continue blocks allow you to jump to other areas in the chart.

A control program consists of any number of flowcharts. OptoControl's real-time multi-tasking lets you run up to 30 charts simultaneously.

Powerful subroutine builder allows OptoControl to be easily expanded.

The "Strategy Tree" allows you to point and click to display or edit the configuration of any item in the control strategy.



OptoControl programs are easy to maintain because the flowcharts are self-documenting.

Plain English commands are used to control I/O, perform communications and do math functions. All variables and I/O points are given meaningful names. Standard data types include: Floating point, integer, ASCII strings, and tables of all three types.

Powerful network communications include Ethernet with TCP/IP.

Extensive ASCII string handling and serial communications capabilities offer unprecedented control of serial devices.

OptoControl takes advantage of the graphical Windows 95 interface to make it easy to understand, configure, design and troubleshoot your solution in a distributed client-server environment. Some key features that make OptoControl easy to use are:

- OptoControl's Strategy Tree provides a graphical tree-like view of your control system configuration.
- OptoControl's flowchart programming environment provides a precise, graphical view of your control process.
- OptoControl's animated debugger makes it easy to step through your process and see what's happening at every point in your control program.
- OptoControl's subroutine builder provides extensive code reusability by packaging flow charts for later use.

All these tools can be live and function on your workstation at the same time, thanks to Windows' multitasking.

One of the fundamental advantages of OptoControl is its ease of use. Since it is virtually self-documenting, existing programs can be easily understood which simplifies and streamlines the maintenance process. Every time the program or system configuration is changed, the documentation will reflect the latest changes. This usability is further enhanced by the use of a plain English command set, and a long-tag-name database.

The OptoControl long-tag-name database is shared by all FactoryFloor applications and is open and accessible to third-party applications using the built-in software developers kit (SDK). Eliminating duplicate databases makes the programmer's job easier and reduces the margin for error. OptoControl also uses the communications enabling technologies inherent in Windows to provide open access to the control system database for third party and custom development.

FLOWCHARTING

Because complex processes are easier to understand using graphics and symbols, OptoControl uses a powerful, flowchart-based language which lets programmers write programs visually, making the design phase much less abstract. OptoControl also improves communication between design team members already familiar with flowcharts by providing a consistent programming environment for control program logic and instructions.

PROGRAMMING

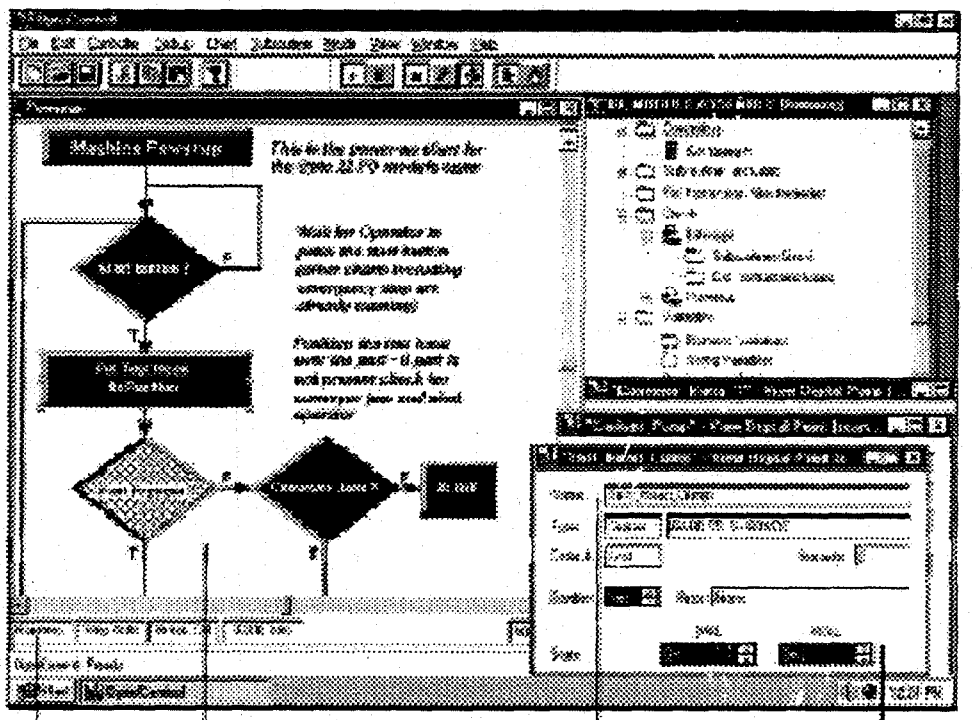
OptoControl is designed to make it easy to program your control process, unlike conventional methods that simply evolved from the old electromechanical wiring layouts for relays. OptoControl is easier to learn, easier to use and is designed to harness all the power of Opto 22's distributed control hardware platform.

Configurator

OptoControl's configurator provides an intuitive user interface that graphically documents the control strategy. The flowcharts are created using a very simple set of drawing tools. Instruction insertion and editing is accomplished through the use of standard pull-downs, dialogs, and controls that are now a familiar part of all Windows-based software packages.

Using simple objects, programmers lay out the logic of the program by creating a flowchart. Action blocks contain a list of things to do, condition blocks contain one or more things to test for, connections show the sequence of operations and continue blocks allow jumps to other areas in the chart. By choosing from menus and assigning long descriptive names to I/O points and variables, programmers can add the appropriate details to each block. Once I/O points and variables are named and defined, they go into the OptoControl database and never have to be referenced by characteristics again, only by name.

OptoControl Animated Debugger



Status bar includes indicators for chart state, step mode, and breakpoints as well as a timer indicating elapsed execution time.

Animated debugger supports automatic, single-step, and breakpoints for testing, verifying and trouble shooting.

OptoControl's open ingredient database is utilized by all Opto 22 FactoryFloor applications and is easily accessible to third party software packages.

Any control object (variables, I/O points, etc.) can be viewed and manipulated in real-time.

Command Set and Subroutines

OptoControl provides programmers with an extensive command set which handles a variety of data types, including integer, floating point, ASCII string, and arrays of each. Sophisticated ASCII string handling also provides unprecedented control over serial ports. The OptoControl Subroutine Configurator lets the programmer create and archive subroutines which can then be called up and executed by multiple programs, as specified by the programmer. Once a subroutine is created it becomes an integral part of the OptoControl command set.

STRATEGY TREE

The entire system configuration is graphically presented in the Strategy Tree. The Strategy Tree is a hierarchical tree-like representation of the Opto 22 control system. Each object configured as part of the OptoControl strategy has an associated icon. Controllers, I/O points, variables and even the logic itself are represented. Using the Strategy Tree, programmers simply point and click to display or edit system configuration items while at the same time looking at the flowchart and logic associated with the object.

DEBUGGER

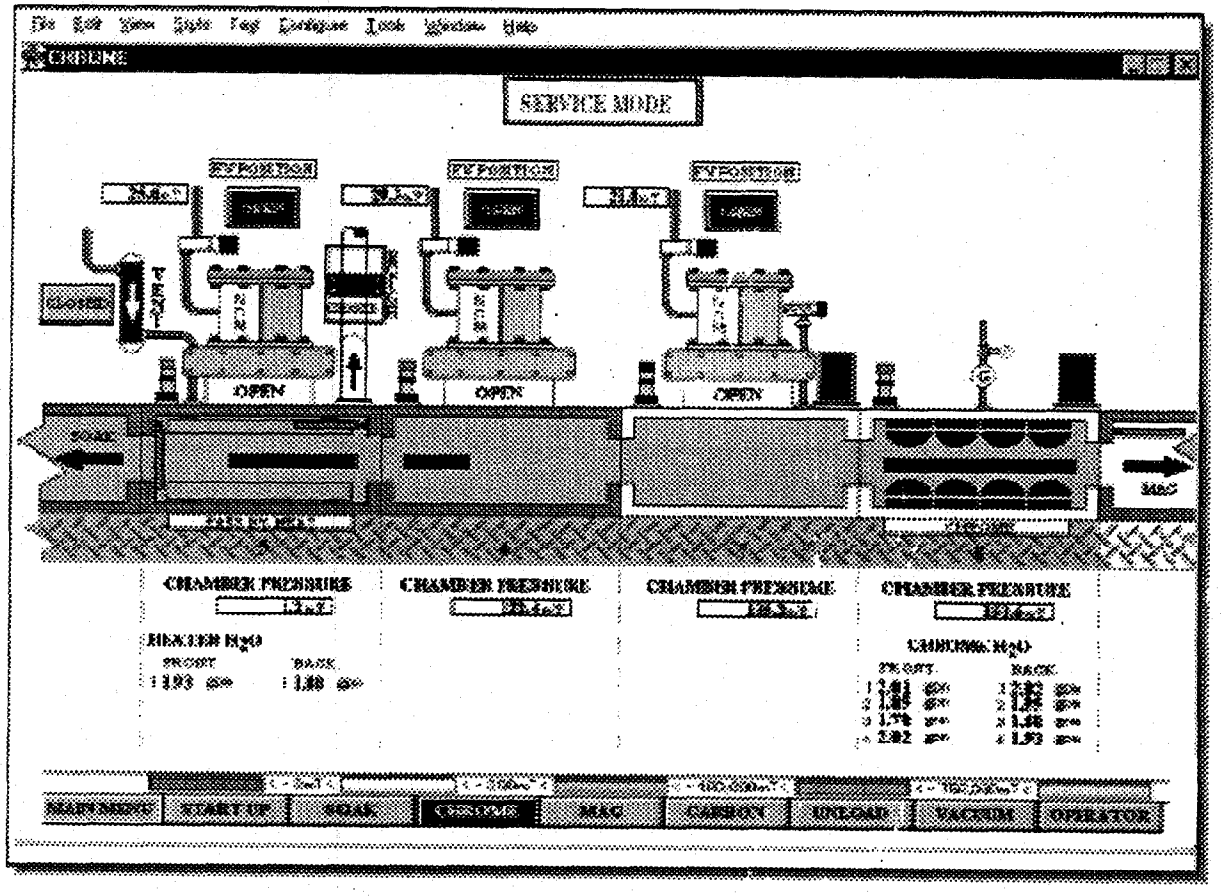
OptoControl's animated, real-time debugger makes it easy to check out system configuration or follow the flow of control logic to understand what is happening. The debugger presents a tightly integrated user interface that allows the programmer to get an application up and running as fast as possible. The programmer may enter break points, do single step functions and manipulate I/O points and variables while the program is running. This mode of the OptoControl environment speeds checkout of the entire system. It is also a very powerful diagnostic and troubleshooting tool for maintenance personnel after the project is in production.

OptoDisplay is a 32-bit Windows-based graphical multimedia operator interface package designed to work as part of the "Total Control Solution" provided by Opto 22's FactoryFloor suite. In addition to OptoDisplay, FactoryFloor includes:

- OptoControl, a graphical flowchart based development environment
- OptoServer, a robust data server that connects the controller network with the PC-based FactoryFloor network.

OptoDisplay gives operators, technicians and engineers the information they need at a glance. OptoDisplay allows you to construct your operator interface by designing graphical objects. Displays can combine pictures, symbols, bitmaps and 3-D graphics from OptoDisplay's extensive library. Display functions can include controller-driven animation and operator-driven commands. Operators can also utilize real-time data for trend plotting. OptoDisplay is easy to program — just point, click and associate. The power of OptoDisplay lies in its tight integration with the OptoControl software and its ability to monitor and interact with Opto 22's world-class hardware. Advanced features enable you to animate any graphical control object and to associate it with real-world events by choosing a tag name from the shared OptoControl database. Use your mouse to select the items you want from the OptoControl strategy and associate them with your OptoDisplay graphic objects or historical collection files.

OPTODISPLAY GRAPHICAL MULTIMEDIA OPERATOR INTERFACE



OptoServer is the client-server application component of FactoryFloor that gathers and serves requested data among the clients on the FactoryFloor network.

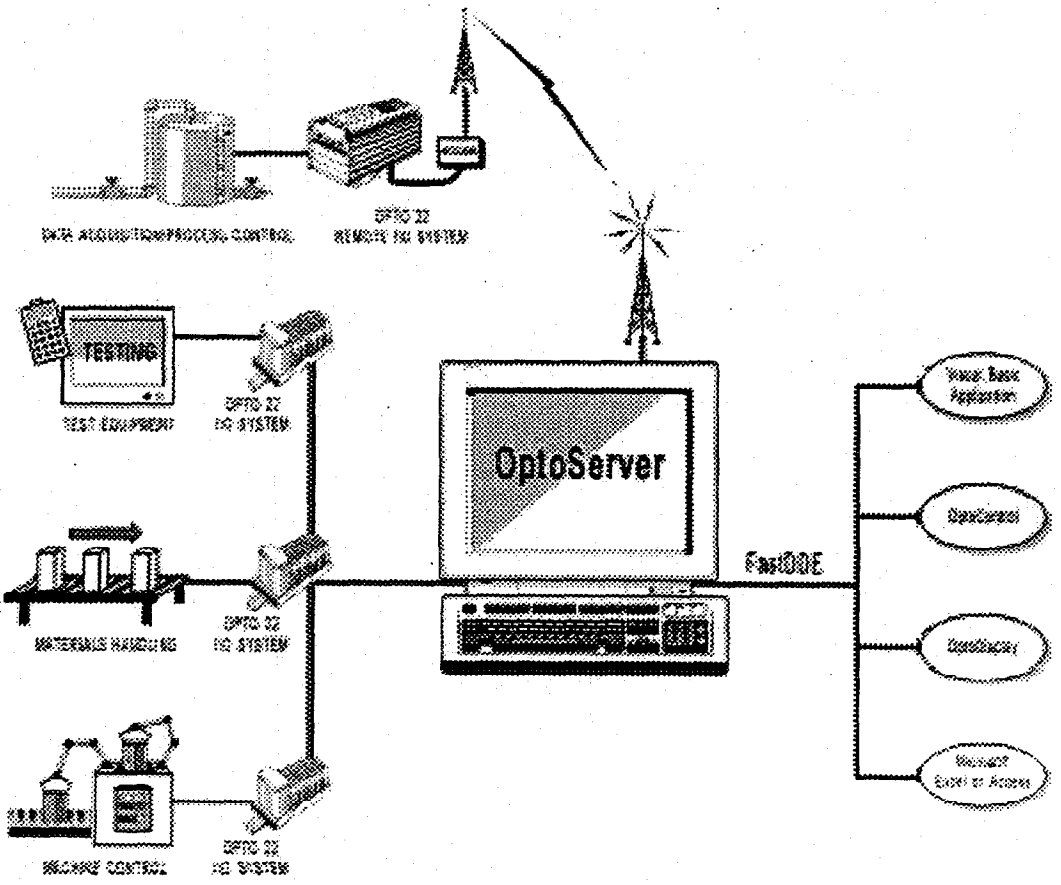
The FactoryFloor network consists of the hardware controllers and the PC-based workstations that control them. Combined with Microsoft's communication enabling technologies, OptoServer becomes the universal I/O server.

OptoServer is fully integrated with OptoDisplay and OptoControl and is used in stand-alone applications or within a complex client/server architecture. OptoServer can also be integrated with Microsoft products, third-party packages, and/or user-developed custom applications created with tools such as Microsoft Visual Basic®.

OptoServer is another example of how FactoryFloor uses Microsoft Windows-based standards to provide world-class support to Opto 22 customers. FactoryFloor encourages open systems solution development by customers, integrators and third-party developers. For example, you can use OptoServer to access FactoryFloor data from custom solutions built with Microsoft Access, Microsoft Visual Basic or Microsoft Excel. OptoServer is designed to help you reach out, not to fence you in.

Opto 22 designed OptoServer to be easy to manage with features like built-in diagnostics, report by exception and support for backup servers.

OPTOSERVER SYSTEM CONFIGURATION



Opto 22 • 43044 Business Park Drive • Temecula, CA 92590 • Phone: (909) 695-3000 • (800) 321-OPTO • Fax: (909) 695-3095 • Internet: http://www.opto22.com
Inside Sales: (800) 452-OPTO • Product Support: (800) TEK-OPTO • (909) 695-3080 • Fax: (909) 695-3017 • E-mail: support@opto22.com

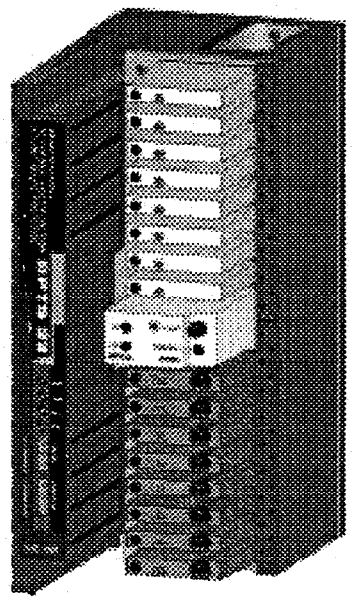
Form 640L-970611

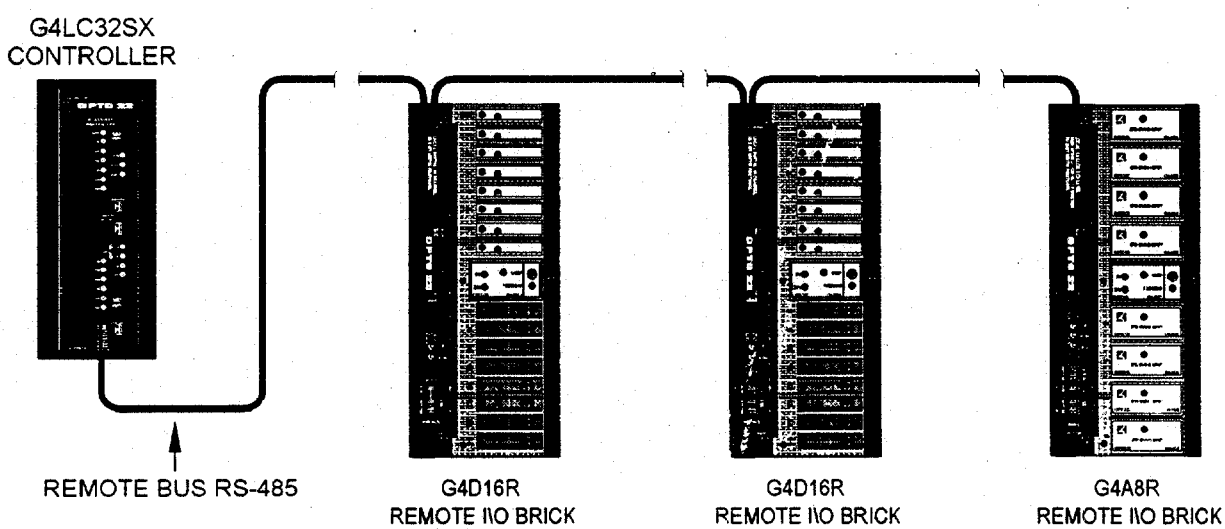
Part Number	Description
G4D16R	Remote Digital 16-Channel Multifunction I/O Unit Mistic Protocol

Description

The G4D16R is a high-performance digital I/O brick for the Opto 22 family of processors and I/O. It provides intelligent and flexible single-point I/O control for up to 16 digital I/O modules in a rugged, deadfront, compact package. Onboard brick intelligence offers latching, pulse train generation, time delays, counting, event/reactions, and many other control functions. Event/reactions execute high-speed deterministic responses to sophisticated control sequences, alarm monitors, diagnostics, and host interrupts.

Digital bricks utilize Opto 22's Mistic protocol and high-speed serial communications. Programming is accomplished with Opto 22's intuitive multitasking, flowchart-based languages OptoControl or Cyrano. Custom software development is achieved using a host computer and Opto 22's Misticware software driver with the high-level software language of your choice.





Setup And System Commands
IDENTIFY UNIT
POWER UP CLEAR
REPEAT LAST RESPONSE
RESET
RESET ALL PARAMETERS TO DEFAULT
SET COMM LINK WATCHDOG MOMO* AND DELAY
SET RESPONSE DELAY
SET SYSTEM OPTIONS

Digital I/O Configuration Commands
READ MODULE CONFIGURATION
SET CHANNEL CONFIGURATION
SET I/O CONFIGURATION-GROUP
STORE SYSTEM CONFIGURATION

Digital Read/Write, Latch Commands
CLEAR OUTPUT
READ AND OPTIONALLY CLEAR INPUT LATCHES GROUP
READ AND OPTIONALLY CLEAR INPUT LATCH
READ MODULE STATUS
SET OUTPUT MODULE STATE-GROUP
SET OUTPUTS

Digital Counter, Frequency Commands
CLEAR COUNTER
ENABLE/DISABLE COUNTER GROUP
ENABLE/DISABLE COUNTER
READ 16-BIT COUNTER
READ 32-BIT COUNTER GROUP
READ 32-BIT COUNTER
READ AND CLEAR 16-BIT COUNTER
READ AND CLEAR 32-BIT COUNTER GROUP
READ AND CLEAR 32-BIT COUNTER
READ AND CLEAR ENABLE/DISABLE STATUS
READ FREQUENCY MEASUREMENT
READ FREQUENCY MEASUREMENT GROUP

Digital Time Delay, Pulse Output Commands
GENERATE N PULSES
READ OUTPUT TIMER COUNTER
SET TIME PROPORTIONAL OUTPUT PERIOD
SET TIME PROPORTIONAL OUTPUT PERCENTAGE
START CONTINUOUS SQUARE WAVE
START OFF PULSE
START ON PULSE

Digital Pulse/Period Measurement Commands
READ 16-BIT PULSE/PERIOD MEASUREMENT
READ 32-BIT PULSE/PERIOD GROUP
READ 32-BIT PULSE/PERIOD MEASUREMENT
READ AND RESTART 16-BIT PULSE/PERIOD
READ AND RESTART 32-BIT PULSE/PERIOD
READ AND RESTART 32-BIT PULSE/PERIOD GROUP
READ PULSE/PERIOD COMPLETE STATUS

Event Reaction Commands
CLEAR EVENT/REACTION TABLE
CLEAR EVENT ENTRY
CLEAR INTERRUPT
ENABLE/DISABLE EVENT ENTRY GROUP
ENABLE/DISABLE EVENT ENTRY
READ AND OPTIONALLY CLEAR EVENT LATCH
READ AND CLEAR EVENT LATCHES
READ EVENT ENABLE/DISABLE STATUS
READ EVENT LATCHES
READ EVENT/DATA HOLD BUFFER
READ EVENT ENTRY
SET EVENT INTERRUPT STATUS
SET EVENT ON A COMMUNICATIONS WATCHDOG TIME OUT
SET EVENT ON COUNTER GREATER OR EQUAL
SET EVENT ON TIMER GREATER OR EQUAL
SET EVENT ON COUNTER LESS THAN OR EQUAL
SET EVENT ON TIMER LESS THAN OR EQUAL
SET EVENT ON MOMO* MATCH
SET REACTION TO NULL
SET REACTION TO CLEAR COUNTER/TIMER
SET REACTION TO OUTPUT A MODULE STATE
SET REACTION TO ENABLE/DISABLE COUNTER
SET REACTION TO ENABLE/DISABLE AN EVENT
SET REACTION TO ENABLE/DISABLE EVENT GROUPS
SET REACTION TO START OFF-PULSE
SET REACTION TO START ON-PULSE
SET REACTION TO READ AND HOLD COUNTER VALUE
SET REACTION TO READ AND HOLD TIMER VALUE
SET REACTION TO WRITE MOMO*

* MOMO-Must Be On, Must Be Off. Used to set or test state of digital outputs or inputs.

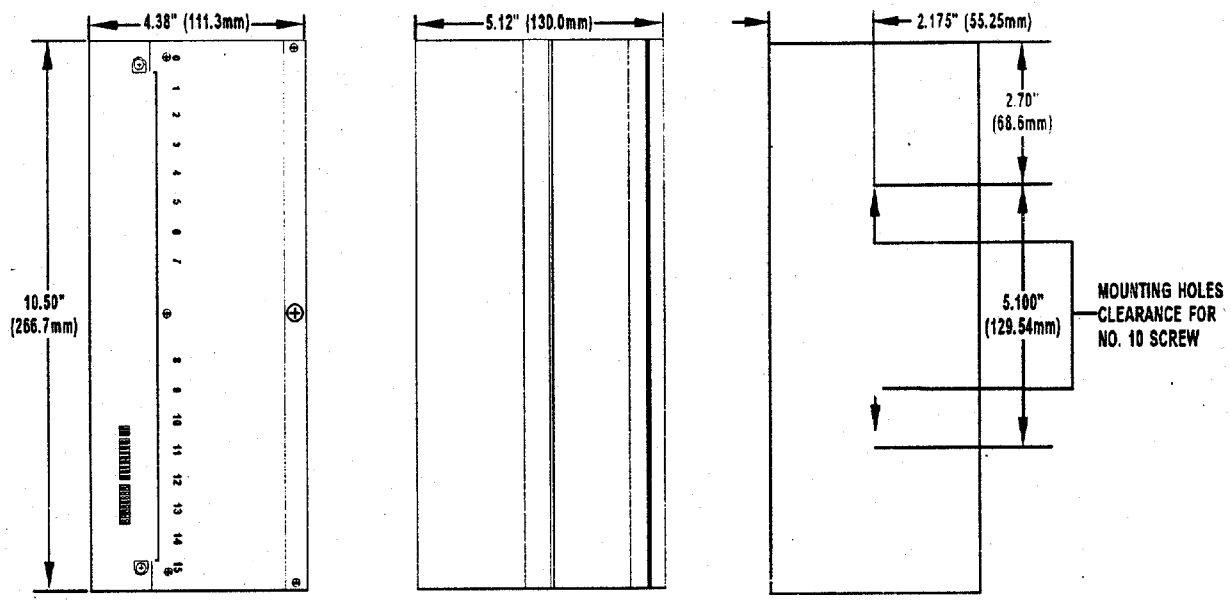
Specifications

Multifunction Digital Brick Specifications

CPU CPU clock frequency	16-bit, Intel 80C196 processor 12 MHz processor
Communications Bus speed Cable type Maximum cable length Mode	 300 - 115.2 KBd 3 wire, twisted pair + GND, Interrupt uses 2nd wire pair 3,000 ft (more with repeaters) Binary or ASCII
Typical I/O times (includes communication transfer time) Read 16 channels Write 16 channels	 1.76 ms 2.27 ms
Counters (frequency measure) Maximum rate Data size Minimum pulse width ON Minimum pulse width OFF	 20 KHz 32 bits 10 µs 10 µs
Latching (minimum pulse width)	10 µs
Output pulse Maximum continuous rate Minimum pulse width ON Minimum pulse width OFF	 500 Hz 1 ms 1 ms
Time-proportional output (TPO) minimum period	100 ms
Typical Event/Reaction time (≤16 Event/Reactions)	4 ms
System power consumption @ 24 VDC æ 0.1V Terminated (last brick on the bus) Non-terminated (all other bricks)	 250 mA 250 mA
Temperature Operating Storage	 0°C to 70°C - 40°C to 80°C
Humidity	5% to 95% relative humidity
Software	OptoControl, Cyrano 200 and Misticware

Dimensions

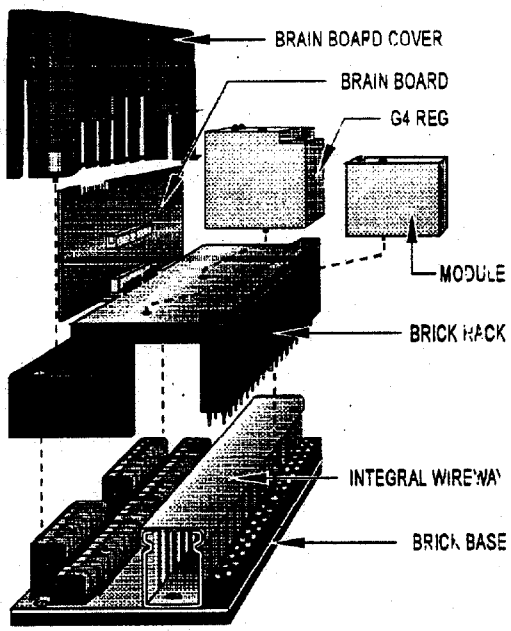
Digital Brick Dimensions



Assembly

TOLERANCES: .XX +/- .02 (.5) .XXX +/- .010 (.25)

Digital Brick Assembly



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SIEMENS

I-T-E GENERAL DUTY ENCLOSED SWITCH

QTY

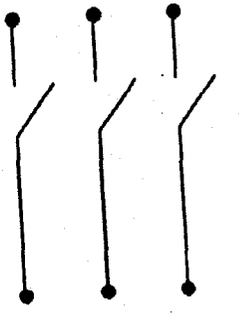
1 NFR323

Series B

100 Amps 240 VAC 3 Pole

Type 3R Enclosure

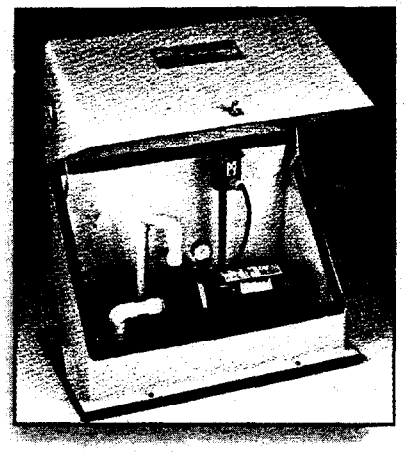
No Fuse Switch



Siemens Energy & Automation Inc.
Bellefontaine, Ohio 43311
Made in U.S.A.
0697

7 83643 11620 7

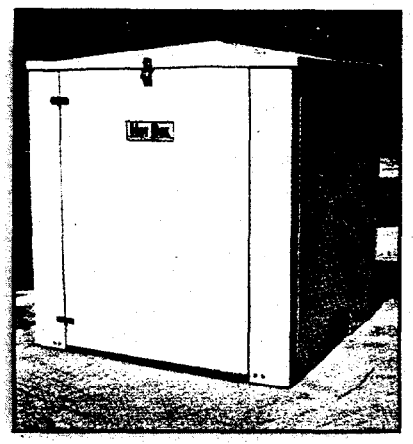
DISCONNECT SWITCH



Models No. HBP-.5, HBP-1 & HBP-3

PUMP GUARD™

by HOT BOX®



Models No. HBP-4 & HBP-5

Model - HBP - .5
for most pumps 1/2HP
Inside dimensions
27"L x 13"W x 23"H

Model - HBP - 1
for most pumps 1 - 2HP
Inside dimensions
33"L x 21"W x 25"H

Model - HBP - 3
for most pumps up to 3HP
Inside dimensions
34"L x 34"W x 42"H

Model - HBP - 4
for pumps from 3HP to 5HP
Inside dimensions
41"L x 41"W x 45"H

Model - HBP - 5
for most pumps up to 5HP
Inside dimensions
47"L x 47"W x 49"H

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PROVEN PROTECTION
from the elements and vandalism!

FEATURES:

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- ★ Ultra Violet Stabilized
- ★ Lockable
- ★ Vented for Cool Pump Operation
- ★ Deters Theft and Damage

OPTIONAL:

- ★ Powered Exhaust with Louvers, Thermostat Controlled (not available on HBP-.5 or HBP-1)
- ★ Thermostatically Controlled Heat
- ★ Custom Colors Available
- ★ Custom Sizes Available

All units are vented, with one-way deck drains, lockable covers, slide/lock cover supports, fiberglass laminate for strength, damage resistant gel coat surface. Easy installation on cement pad.

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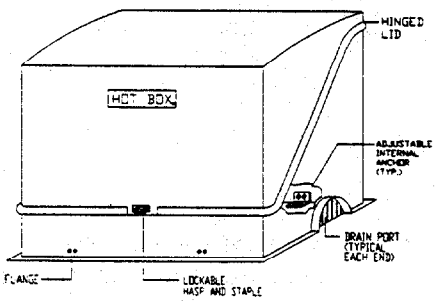
THE ORIGINAL

HOT BOX®

"THE ENGINEERED ENCLOSURE"™

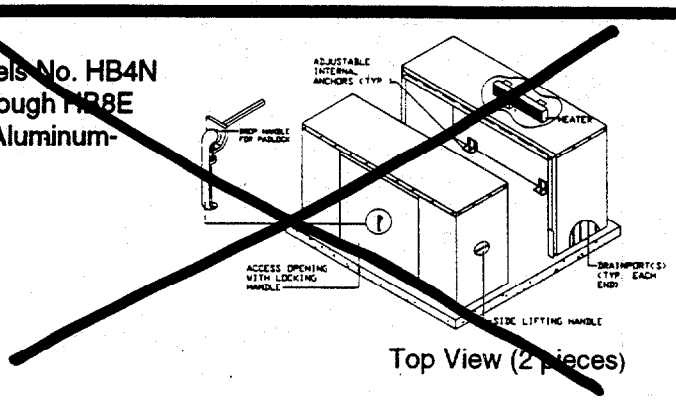
SUBMITTAL DATA SHEET
BULLETIN NO: 35

Models No.:
HB.75 through HB3E
-Fiberglass-



Fiberglass is Available in Standard Beige. Optional Colors Available at Modest Upcharge.

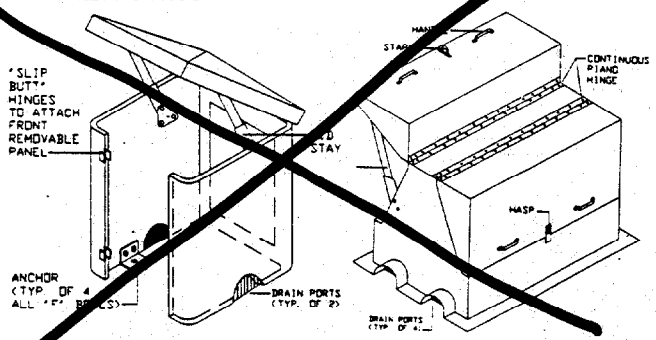
Models No. HB4N through HB8E
-Aluminum-



Top View (2 pieces)

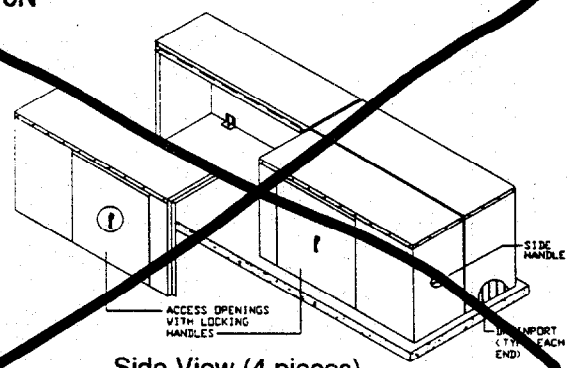
Models No. HB4FE through HB8FE*
-Fiberglass-
"DESIGNER Series"

Models No. HB10FE
-Fiberglass-



Patent Pending
* "F" enclosures designed for "N" Pattern Valves.

Models No. HB10N and HB10E
-Aluminum-



Side View (4 pieces)

SPECIFICATION:

Exposure to freezing conditions will result in improper functioning of a backflow prevention assembly. Devices subjected to potential freezing conditions shall be protected with the **HOT BOX®** insulated enclosure as designed and manufactured by **HOT BOX®** of Jacksonville, Florida.

The enclosure shall be of reinforced aluminum or fiberglass construction, providing access through doors and/or a hinged lid for testing/certification and being totally removable for maintenance purposes. The enclosure shall be structurally lined with a spray applied, or sandwich laminate, unicellular non-wicking insulation and contain a thermostatically controlled heat source mounted to the interior wall or to the BFP device, for protection to -30° F. No bare wood or "Particle Board" shall be allowed in assembly. Glue applied insulation shall be cause for rejection. Power source will be protected with a ground fault circuit interrupting receptacle, U.L. 943, N.E.M.A. 3R, installed by others, inside the box.

The enclosure shall contain drain openings for "RP" devices sized to accommodate the maximum discharge of the "RP" and to open for discharge under the most severe conditions. These openings are protected against intrusion of either wind, debris or animal. The enclosure is provided with means of permanent anchor and "lockable" access doors and/or lid to prohibit theft or vandalism.

The enclosure shall be <u>certified</u> as meeting the requirements of ASSE 1060 - "Performance Requirements For Outdoor Enclosures".

U.S. PATENT #33,523

PHYSICAL PROPERTIES:

1. Minimum 18 gauge construction.
2. Structural unicellular insulation.
3. Lockable.
4. Relief ports at enclosure grade level.
5. **HOT BOX®** designed to protect to -30° F.
6. Minimum R of 8
7. Unit is a LOK BOX™ when supplied without heat.

HOT BOX® FEATURES:

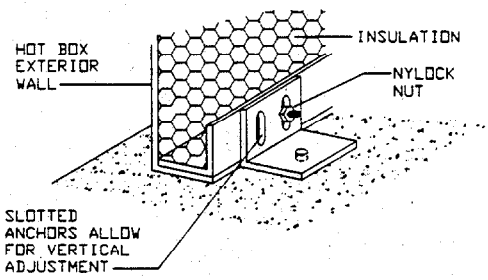
1. Allows for the installation of the BFP device "at the service connection" in accordance with AWWA Standards.
2. Is specifically designed to meet N.F.P.A. guide-lines. The enclosure provides freeze protection to maintain the water supply to a property's fire sprinkler system. (N.F.P.A. 3-3.1.8 & 3-6.1.3.2)
3. Is the logical alternative to "pit installations" (which are seldom recommended by BFP manufacturers, and often are against local code), eliminating "confined entry" hazards.
4. Strategically placed access doors allow for the periodic maintenance encountered, and the systematic testing/certification required by local codes - without removal of the entire unit.
5. Is completely collapsible, removable and replaceable; allowing for major maintenance and/or replacement of backflow prevention equipment without the need for replacement of freeze protection services.
6. Custom enclosures are readily available for most individual applications.

HOT BOX®

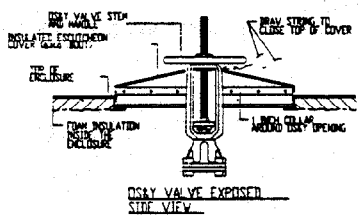
"THE ENGINEERED ENCLOSURE"™

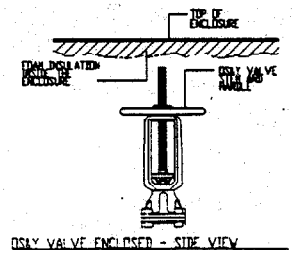
Application:

1. Enclosure supplied with "anchor angles" at grade.
   a. Recommended installation: on concrete slab
   b. "Anchor angles" anchored to grade with mechanical fasteners (interior)



2. N.R.S. (non-rising stem) valve handles enclosed inside enclosure.
3. O S & Y (outside stem and yoke) valve handles and stems concealed inside enclosure roof ("E").





4. O S & Y valve handles and stems can also be exposed outside enclosure ("O") as a custom unit.
5. Door and construction hardware is lockable to prevent theft, vandalism or unauthorized entry.

STANDARD ENCLOSURE INFORMATION

MODEL NUMBER	PIPE SIZE	INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	HEATER SIZING (120V, 1Ø)	SHIPPING WEIGHTS	MOUNTING PAD SIZE
				FIBERGLASS			
HB.75	3/4" - 1"	19"	11"	22"	30W CABLE	30#	28 X 20
HB1	3/4" - 1"	27"	13"	23"	60W CABLE	35#	36 X 22
HB1T*	3/4" - 1"	27"	13"	35"	60W CABLE	50#	36 X 22
HB1.5	3/4" - 1-1/2"	33"	21"	25"	60W CABLE	65#	44 X 32
HB2	1-1/4" - 2"	39"	13"	28"	90W CABLE	50#	50 X 24
HB2T*	1-1/4" - 2"	39"	13"	36"	90W CABLE	60#	50 X 24
HB3N	2-1/2" - 3"	70"	26"	45"	1000W HEATER	325#	82 X 38
HB3E	2-1/2" - 3"	70"	26"	55"	1500W HEATER	385#	82 X 38
HB4FE+	2-1/2" - 4"	41"	41"	45"	1000W HEATER	310#	53 x 53
HB6FE+	6"	47"	47"	49"	1500W HEATER	340#	57 x 57
HB8FE+	8"	53"	53"	56"	1500W HEATER	400#	63 x 63
HB10FE+	10"	64"	53"	56"	2000W HEATER	490#	74 x 66
				ALUMINUM			
HB4N	4"	90"	32"	50.5"	2000W HEATER	370#	102 X 44
HB4E	4"	90"	32"	57.5"	2000W HEATER	400#	102 X 44
HB6N	6"	105"	36"	53"	2000W HEATER	450#	117 X 48
HB6E	6"	105"	36"	64"	2/1500W HEATERS	500#	117 X 48
HB8N	8"	118"	40"	58"	2/1500W HEATERS	540#	130 X 52
HB8E	8"	118"	40"	74"	2/1500W HEATERS	575#	130 X 52
HB10N	10"	142"	42"	65"	2/1500W HEATERS	600#	154 X 54
HB10E	10"	142"	42"	85"	2/2000W HEATERS	700#	154 X 54

* "T" = 30° Centerline BFP mounting.
\+ "F" = Enclosures designed for "N" Pattern Valves.
\+ 4", 6" and 8" are available as either "Flip Top" -or- DESIGNER Series.
Custom designed and sized enclosures available - consult factory.
Substitute "LB" above for "HB" when ordering unit without heat.

(N = NRS, O = OS&Y Exposed, E = OS&Y Enclosed, F = Designed for "N" Pattern Valves)

Heater Notes:

1. 30W through 90W are heating cables, UL listed, CSA certified.
2. 1000W+ are wall mounted air heaters, ETL listed.
3. All circuits are 120 volt, single phase.
4. Service to HOT BOX® must be installed in accordance with the National Electric Code and local ordinances, and protected with a G.F.I.

DISTRIBUTED BY:

LIMITED WARRANTY: Hot Box® makes every effort to assure that its products meet high quality and durability standards; and warrants to the original retail customer that our product will be free from defects in material and workmanship as follows:
— 1-year limited warranty on all products from date of purchase. Should any trouble develop, return the COMPLETE unit prepaid to the factory after obtaining a return authorization number. If inspection shows trouble is caused by defective workmanship or materials, repair and return will be made without charge. The company will not be responsible for any expenses incurred in installation, removal from service, transportation cost, or for damages of any type whatsoever, including incidental or consequential damages. This warranty does not apply to defects due to misuse, abuse, negligence, accidents, repairs, or alterations outside our facility or to a lack of maintenance. We shall in no event be liable for death, injuries to persons or property, or for incidental, contingent, special or consequential damages arising from the use of our product. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.
Owner should test heater annually prior to each winter season.

U.S. PATENT #33,523
35.498

*Hot Box

*Company & Products

*CAD Library

*Custom Design

*Pump Guard

*Hot Rok

*Confined Spaces

*Valve Guard

*Sample Specification

*Information Request

*Hot Box The Engieered Enclosure

PHYSICAL PROPERTIES

Model Number	Pipe Size	Inside Length	Inside Width	Inside Height	Heater Sizing (120V)	Shipping Weights	Mounting Pad Size
Fiberglass							
HB.75	.75"-1"	19"	11"	22"	30W Cable	35#	28x20
HB1	.75"-1"	27"	13"	23"	60W Cable	38#	36x22
HB1T*	.75"-1"	27"	13"	35"	60W Cable	60#	36x22
HB1.5	.75"-1.5"	33"	21"	25"	60W Cable	65#	44x32
HB2	1.25"-2"	39"	13"	28"	90W Cable	75#	50x24
HB2T*	1.25"-2"	39"	13"	35"	90W Cable	90#	50x24
HB3N	2.5"-3"	70"	26"	45"	1000W Heater	250#	82x38
HB4FE+	2.5"-4"	41"	41"	45"	1000W Heater	210#	53x53
HB6FE+	6"	45"	45"	49"	1500W Heater	250#	57x57
HB8FE+	8"	51"	51"	56"	1500W Heater	325#	63x63
HB10FE+	10"	62"	54"	56"	2000W Heater	375#	74x66
Aluminum							
HB4N	4"	90"	32"	50.5"	2000W Heater	325#	102x44
HB4E	4"	90"	32"	57.5"	2000W Heater	375#	102x44
HB3E							
HB6N	6"	105"	36"	53"	2000W Heater	500#	117x48
HB6E	6"	105"	36"	64"	2/1500W Heaters	540#	117x48
HB8N	8"	118"	40"	58"	2/1500W Heaters	550#	130x52
HB8E	8"	118"	40"	74"	2/1500W Heaters	625#	130x52
HB10N	10"	142"	42"	65"	2/1500W Heaters	650#	154x54
HB10E	10"	142"	42"	85"	2/1500W Heaters	800#	154x54

Factory modifications to length, width or height available on request.
See SIZING MATRIX for balance of standard sizes by BFP make and model.
Heating cables are UL Listed & CSA Certified - Heaters are ETL Listed - Electric service must be in accordance with N.E.C. and local ordinances - GFI may be required

HOT BOX®

"THE ENGINEERED ENCLOSURE"™

BULLETIN NO. 55: HOT BOX® INSTALLATIONS GUIDELINES

(Drawings on Reverse)

1. Provide applicable GFI protected power, U.L. STND. 943-NEMA 3R, inside enclosures requiring heat. Mount at least 6" above any water discharge point and near the pipe riser on the enclosure access side - or - per local code.
2. Pour a full concrete pad 4" thick around valve, allowing a minimum 1" radial space between valve risers and pad.

   OR

   Pour a 10" wide x 4" deep footer around the valve.
   A. Slab should be at least 4" greater than enclosure in length and width.
3. Place HOT BOX® over valve onto pad or footer - sectional BOXES should be completely assembled before proceeding.

   ***** CAUTION *****

   Note tongue & groove joints in roof and vertical seams of aluminum enclosures (see drawings on reverse).

   ***** CAUTION *****

   A. Eye bolts, inside aluminum boxes on roof seams, <u>must be secured</u>, locking sections together.
4. Use a masonry bit to drill through base mounting holes.
   A. Insert wedge anchors and bolt firmly to concrete.
   B. Tighten slotted anchors on aluminum and fiberglass enclosures (which allow vertical adjustment for uneven concrete slabs).
5. For BOXES using self regulating tape heat source, secure tape to valve with wire ties or electrician's tape. No covering is necessary. The HOT BOX® provides the necessary insulation.
6. Plug the heat source into the specified circuit, <u>after</u> verifying proper voltage.
7. Secure OS&Y & siamese insulation covers tightly, where applicable.

"La Caja de Indenieria"

Boletin No. 55: HOT BOX® GUIA DE INSTALACION

(Dibujos en la parte de atras)

1. Proporcionar el recibidor de electricided por codigo local, hubicarlo por lo menos 6" encima de cualquier punto de descargo de agua y cerca de el tubo de agua que se localiza cerce de la puerta de entrada.
2. Eche 4" de concreto grueso alrededor de la valvula, dejando aproximadamente 1" de espacio alrededor de el tubo.
   A. El trozo de concreto debe de ser 4" mas ancho y largo que la caja.
3. Colocar la HOT BOX® sobre la valvula y despues ponerla encima del baze de concreto. Todas las otras plezas deben de ser armadas antes de proceder.

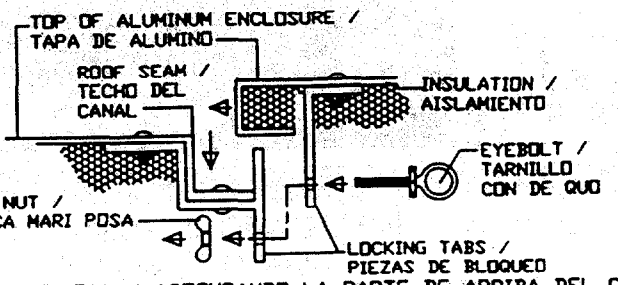
   *****CUIDADO*****

   Note meter el perno en el oyo yen el canal encajados en el techo y el canal vertical de aluminio de la caja.

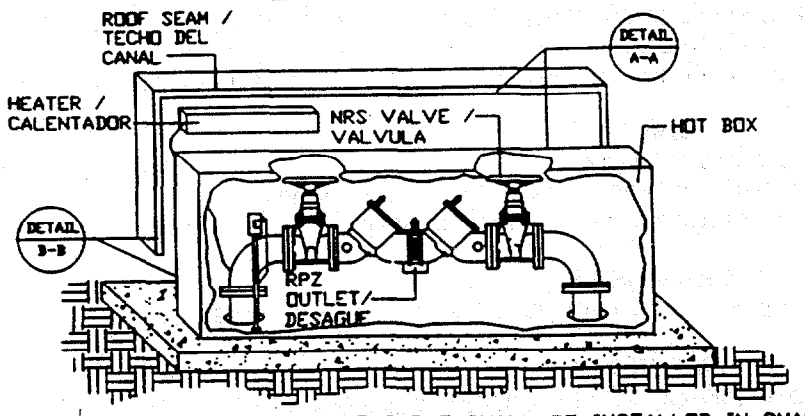
   *****CUIDADO*****

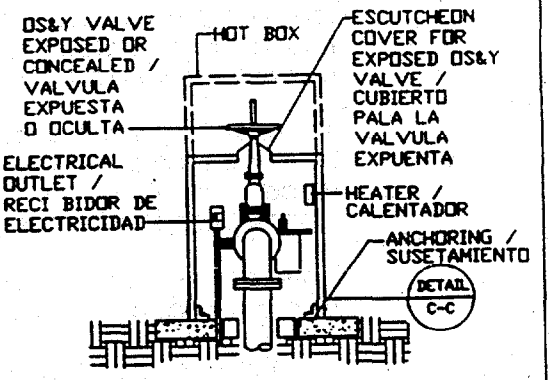
   A. Los tornillos que tiene el techo del el hueco, se encuentra en la grieta de el techo de la caja de aluminio. Este tornillo debe de ser firmemente asegurado, juntanto las secciones.
4. Use un taladro especial para concreto, haci podra perforar los huecos en el concreto que se necesitan para el montamiento.
   A. Insertar cunas de sujeto y tornillos firmemente en el concreto.
   B. Apretar las cunas de sujetamiento en la caja de aluminip el fibra de vidrio (esto permite un adjustmiento vertical para los pedazos de concreto que esten desiguales).
5. Para las cajas que usan cinta regulatoria como fuente de calentamiento, asegure la cinta a la valvula con alambre de atar o cinta de electricista. No es necesario cubrir el cable. HOT BOX® provee el aislamiento necesario.
6. Conectar el recurso de calefaccion dentro de el circuito especificado Despues de verificar el voltage apropiado.
7. Asegurar la cubierta de la valvula de aislamiento (apretando); si es necesario.

HOT BOX®
250 LANE AVENUE N
JACKSONVILLE, FLORIDA 32254-2
(904) 786-0204 • (800) 736-023
FAX (904) 783-6965
http://www.hot-box.com

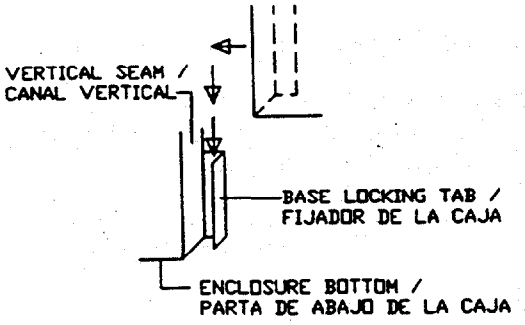


SECURING THE TOP SEAM / ASEGURANDO LA PARTE DE ARRIBA DEL CANAL (DETAIL A-A)

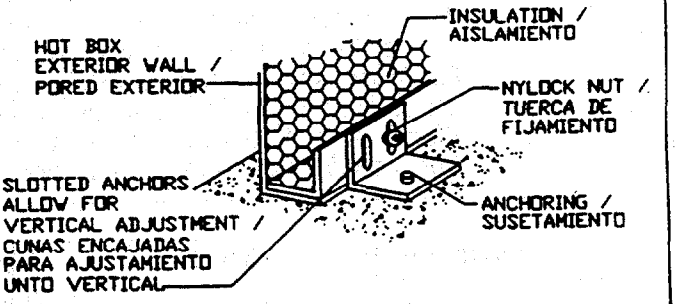




NOTE : HEAT CABLE SHALL BE INSTALLED IN SMALLER ENCLOSURES. / EL CABLE DE CALENTAMIENTO DEBE DE SER INSTALADO CAJAS PEQUENAS.

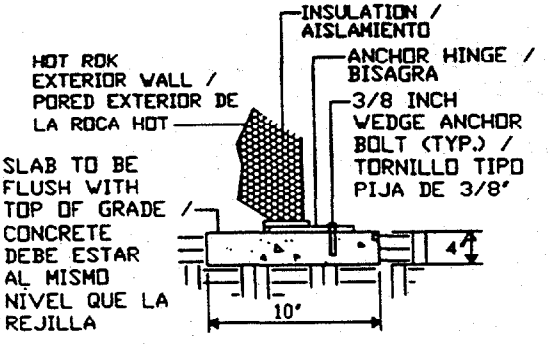


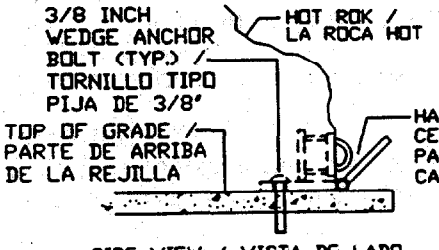
SECURING THE SIDE SEAM / ASEGURANDO EL CANAL DE EL LADO (DETAIL B-B)



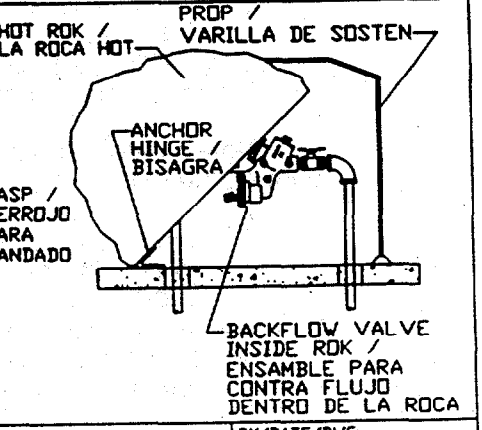
ALUMINUM AND FIBERGLASS ENCLOSURES / CAJA DE ALUMINO EL D FIBRA DE VIDRIO (DETAIL C-C)

ALUMINUM ENCLOSURES / CAJA DE ALUMINO





SIDE VIEW / VISTA DE LADO



HOT ROK ENCLOSURES / ROCA 'HOT'

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250 LANE AVE N.
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TITLE : BULLETIN # 55
BOX / ROK INSTALLATION GUIDELINES
TITUOL : BOLETIN # 55
CAJA/PIEDRA CALENTE GUIA DE INSTALACION

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SBT / 5-9-95
ABINST55

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INGENIERO / CONSTRUCTOR :

LOCATION :
LOCACION :

APPROVED/DATE :
APPROVADO / DIA :

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ERDCO

ERDCO Engineering Corporation
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Evanston, Illinois 60204 USA

Telephone: 847-328-0550
Telefax: 847-328-3535

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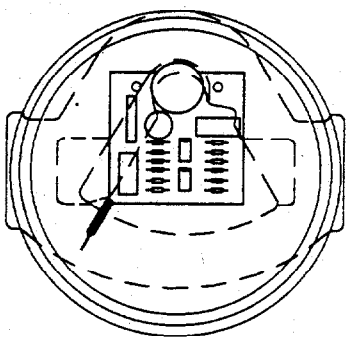
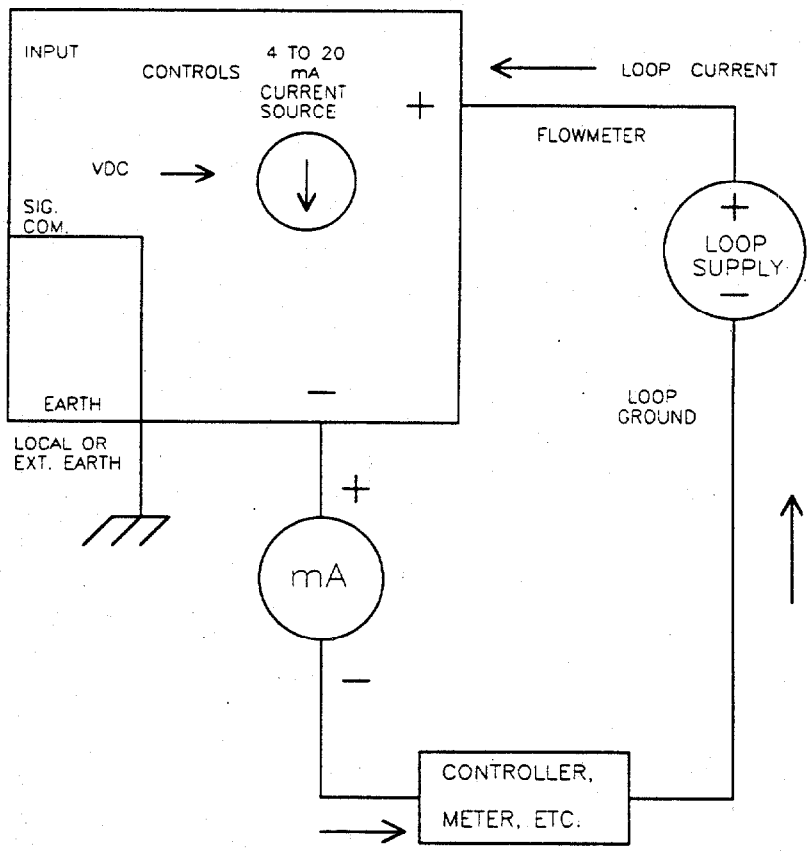
ITEM NUMBER	ITEM DESCRIPTION	UM	ORDER QUANTITY	SHIP QTY
623-04T0	ARMOR-FLO METER W/TRANSMITTER SN: 981525-527 GLASS WINDOW; BUNA O-RING 0.7-7 GPM WATER 60 F; 60 PSIG SG 1.0 ; VIS 1.0 CS 4-20 MA 2 WIRE XMTTR	EA	3	3

This sale is subject to ERDCO "Standard Terms and Conditions" in effect at the date of Order Acknowledgement.
Copies are available by contacting ERDCO Engineering Corporation, Evanston, IL 60204-6318, USA

Transmitter
FM-15425
TECHNICAL MANUAL





ARMOR–FLO 4–20 mA
(2) WIRE TRANSMITTER

ERDCO Engineering Corporation
P.O. Box 6318, 721 Custer Ave.
Evanston, Illinois 60202-6318 USA
Telephone: 847-328-0550
Fax: 847-328-3535

Data Form: FM-15445

CONTENTS

		Page
Purpose	Section I	1
Information	Section II	1
Specifications	Section III	2
Installation	Section IV	3
Alignment	Section V	4
Circuit Description	Section VI	5
Schematic Diagram	Figure 2	6
Warranty		7

Section I

Purpose

The ERDCO Series 3600/3700 Flowmeter with integral Transmitter provides an interface between an ERDCO Direct Reading Flowmeter and the user's electrical control, display and/or remote readout. A 4 to 20 mA signal is provided for remote readout, controller operation, recorder, etc.

Section II

Information

ERDCO Direct Reading Flowmeters with integral Transmitter are provided with a precision servo-type potentiometer and integral electronic circuitry to provide a 4 to 20 mA analog output signal.

ERDCO flowmeters are linear over a major portion of the scale range. To achieve this degree of linearity, the flowmeter design dictates scale compression and expansion at the extreme low and high ends respectively. The signal is plotted for each instrument and is included in this manual.

If electrical isolation is required, use devices provided by others.

Section III

Specifications

Operating Loop Voltage Supply	20 to 30v, dc
Operating Temperature Range*	0 to 75°C (32 to 163°F)
Storage Temperature Range	-40°C to 85°C (-40°F to 170°F)
Output Signal	4 to 20 mA
Output Load Range	$0<R_L<750$ ohms
Transmitter Signal Linearity	Better than 5%
Output Signal Repeatability	±0.5% full scale
Circuitry	Two wire

*As the Transmitter is integral to the flowmeter, the flowmeter is to be located in an application whereby the fluid being measured is within this temperature range.

Section IV

Installation

4.1 CONNECTION TO FLOWMETER - The transmitter circuitry which is integral to the flowmeter includes terminals for user connections. For flowmeter with explosion proof enclosure for transmitter, refer to Technical Manual FM-15432. The circuit component placement drawing Fig. 1, below locates the terminals.

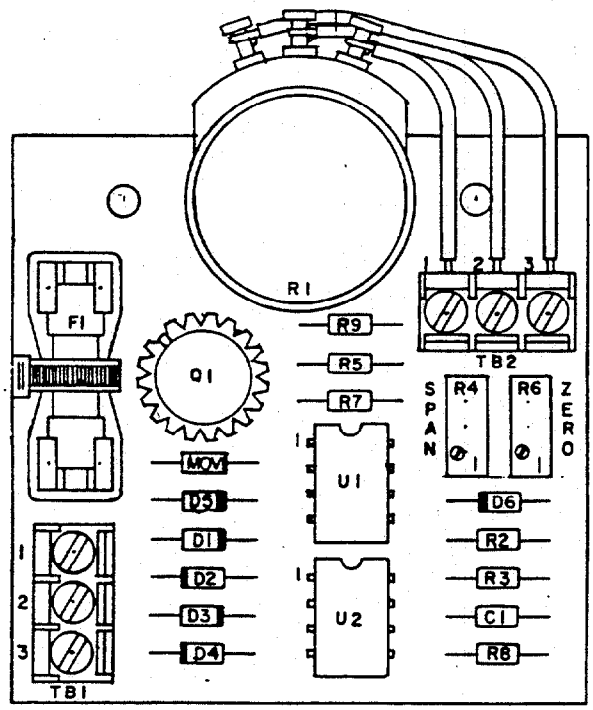


Figure 1

Terminal 1 24v + Nominal

Terminal 2 Controller, Meter, etc.

Terminal 3 Earth Ground (No Internal Connection)

The flowmeter is supplied with a ½ inch NPT(F) electrical conduit connector. This fitting does not prevent the entrance of moisture or any foreign matter into the indicator/electronic area of the flowmeter. Therefore, when conditions may allow the introduction of any material into the electrical conduit, or condensation may occur, a seal must be provided in the user's conduit to protect the flowmeter. A sealing fitting for rigid conduit, such as Appleton Electric Company part number EYSM-50 can be used for this purpose. Be certain that the sealing fitting is oriented so that when potted, no sealing compound is allowed to enter the flowmeter.

4.2 REMOTE POWER CONNECTION - Connect a source of 24 volts, dc capable of supplying 0.05 amperes or more with less than 1 volt peak-to-peak ripple as follows:

Positive to Terminal 1
Negative to Controller, Meter, etc. to Terminal 2
External Earth Ground: Terminal 3 (No internal connection. Provided only for connecting wire shield to local earth ground.)

Section V

Alignment

Each Flowmeter-Transmitter is factory calibrated at room temperature so that the no flow position produces 4mA output and full scale output produces 20mA output. It may be necessary to readjust these settings for a different input range or for a different operating temperature. In such cases, ensure that the unit has fully attained the ambient operating temperature with power on. Then observe the following procedures:

5.1 ADJUSTMENT ACCESSIBILITY - Remove the retaining ring securing the window from the flowmeter and carefully remove the window and "O" ring.

5.2 SCALE ADJUSTMENTS - Refer to Fig. 1 for adjustment locations.

5.2.2 Let the flow indicator rest at no flow position and adjust the ZERO control for an output indication of 3.98mA to 4.02mA or ZERO reading on recorder, etc.

5.2.3 Manually position the flow indicator at maximum scale reading and adjust SPAN control for an output indication of 20.0 milliamperes or maximum scale reading on recorder, controller, etc.

5.2.4 Repeat steps 5.2.2 and 5.2.3 until no further adjustment is required and no flow and maximum flow scale corresponds to 4 and 19.9 to 20.1 mA respectively.

5.2.5 The calibration curve, FMA-14350 identifies the actual signal output as a function of flow for measurement purposes.

5.3 Reinstall the "O" ring, window and retaining ring.

Section VI

Circuit Description

The transmitter section of the Flowmeter is shown schematically in Fig. 2. A diode protects the circuit against reverse polarity in case of miswiring. A 47V MOV and a 50 mA (0.05A) quick blow fuse provides transient overvoltage protection on the nominal 24VDC supply line. A high precision and accuracy 5V regulator produces a floating 5VDC for operation of the transmitter and for voltage reference.

This voltage reference is applied to a precision potentiometer. This potentiometer is rotated by fluid flow via magnetic coupling between the flowmeter vane and the indicator. The potentiometer wiper then produces a voltage which varies with the position of the indicator and hence, the flow.

A low power, low offset voltage operational amplifier (UIB) buffers this voltage into a voltage to current converter, which is comprised mainly of UIA, transistor Q1 and their ancillary components. This converter regulates the output current through the current loop by monitoring the voltage across R8.

Independent potentiometers are provided for ZERO and SPAN. As long as the minimum output current is 4mA or more, adjustments on either potentiometers do not affect the setting of the other. Operation of the circuit is also insensitive to load resistance of the loop, with the maximum load at 750 Ohms including the resistance of the electrical conductors in the loop.

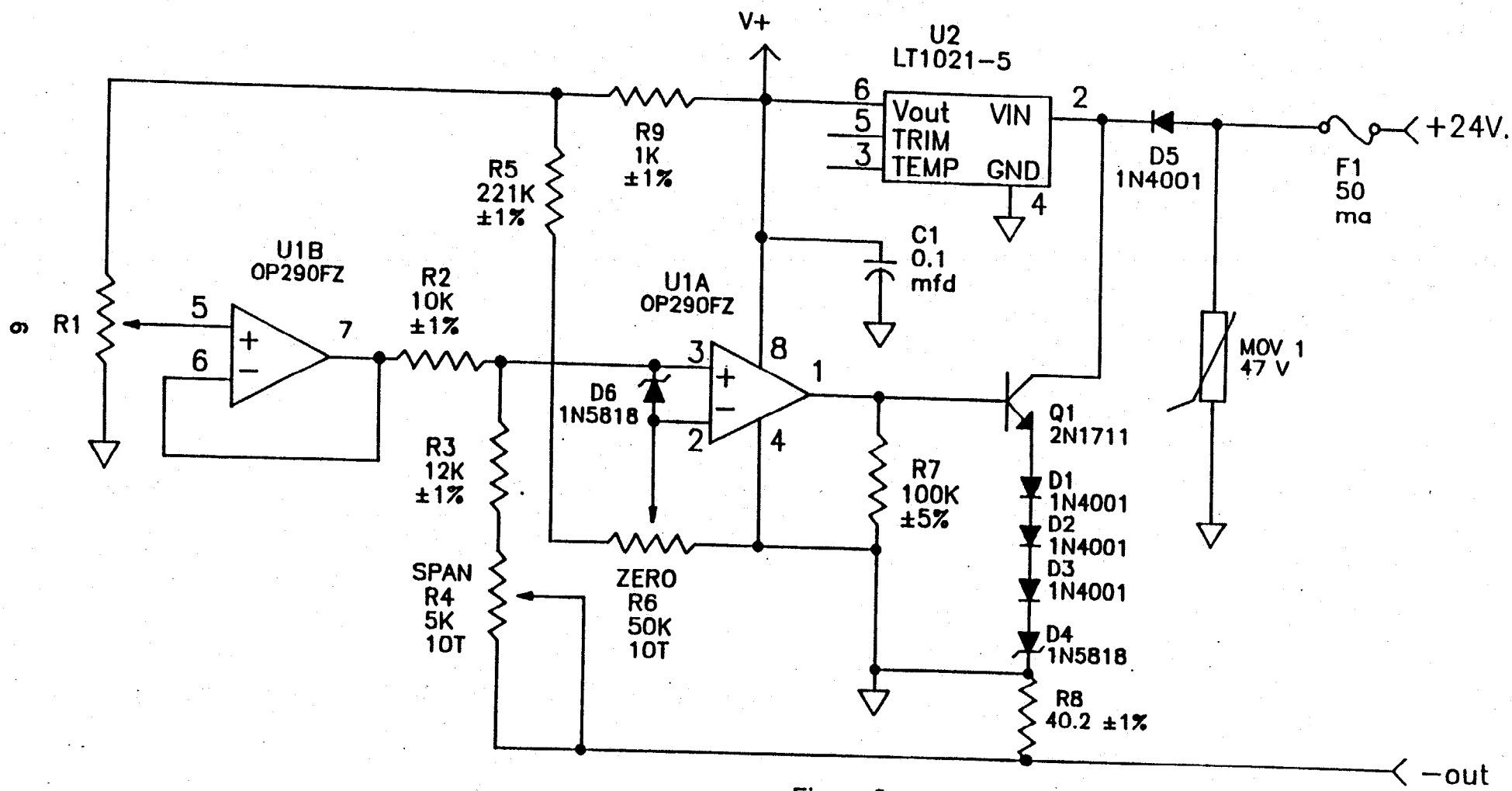

V+
U2
LT1021-5
Vout
TRIM
TEMP
VIN
GND
R9
1K
±1%
R5
221K
±1%
C1
0.1
mfd
U1B
OP290FZ
R2
10K
±1%
U1A
OP290FZ
R1
D6
1N5818
R3
12K
±1%
SPAN
R4
5K
10T
ZERO
R6
50K
10T
R7
100K
±5%
Q1
2N1711
D1
1N4001
D2
1N4001
D3
1N4001
D4
1N5818
R8
40.2 ±1%
D5
1N4001
MOV 1
47 V
F1
50
ma
+24V.
-out

Figure 2

Warranty Disclaimer

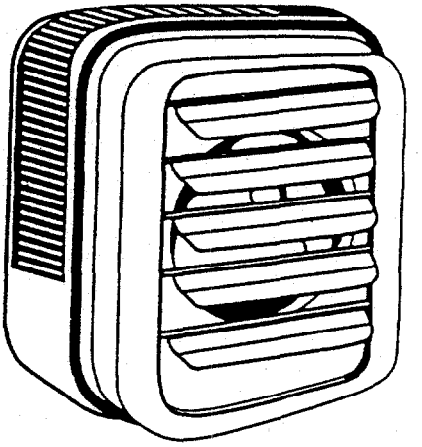
Any Buyer of goods or services from the Company agrees with the Company that the sole and exclusive remedies for breach of any warranty concerning the goods or services shall be for the Company, at its option, to repair or replace the goods or services or refund the purchase price. **The Company shall in no event be liable for any consequential or incidental damages even if the Company fails in any attempt to remedy defects in the goods or services, but in such case the Buyer shall be entitled to no more than a refund of all monies paid to the Company by the Buyer for purchase of the goods or services.** Any cause of action for breach of any warranty shall be commenced by the Buyer no later than twelve months from date of instrument shipment from ERDCO.

Return Policy

For a period of twelve (12) months from the date of shipment, and under normal conditions of use and service, ERDCO ("The Company") will at its option replace, repair or refund the purchase price for any of its manufactured products found, upon return to the Company (transportation charges prepaid and otherwise in accordance with the return procedures established by the Company), to be defective in material or workmanship. This policy extends to the original Buyer only and not to Buyer's customers or the users of Buyer's products, unless Buyer is an engineering contractor in which case the policy shall extend to Buyer's immediate customer only. This policy shall not apply if the product has been subjected to alteration, misuse, accident, neglect or improper application, installation, or operation. **The Company shall in no event be liable for any incidental or consequential damages.**

ELECTRIC HEATER
FOR EQUIPMENT BLDG.

QMARK®
A Division of Marley Electric Heating



MUH Series
Modular Unit Heaters

LISTED
FILE #E21609

Installation & Maintenance Instructions

Dear Owner,

Congratulations! Thank you for purchasing this new heater manufactured by a division of Marley Electric Heating. You have made a wise investment selecting the highest quality product in the heating industry. Please carefully read and follow the installation and maintenance directions shown in this manual. You should enjoy years of efficient heating comfort with this product from Marley Electric Heating... the industry's leader in design, manufacturing, quality and service.

... The Employees of
Marley Electric Heating

⚠ WARNING ⚠

Read Carefully - These instructions are written to help you prevent difficulties that might arise during installation of heaters. Studying the instructions first may save you considerable time and money later. Observe the following procedures, and cut your mounting time to a minimum.

To reduce risk of fire or electric shock:

1. To prevent electrical shock, disconnect all power coming to heater at main service panel before wiring or servicing.
2. All wiring must be in accordance with the National and Local Electrical Codes and the heater must be grounded as a precaution against possible electric shock.
3. Verify the power supply voltage coming to heater matches the ratings printed on the heater name plate before energizing.
4. This heater is hot when in use. To avoid burns, do not let bare skin touch hot surfaces.
5. Do not insert or allow foreign objects to enter any ventilation or exhaust opening as this may cause an electric shock, fire,or damage to the heater.
6. To prevent a possible fire, do not block air intakes or exhaust in any manner. Keep combustible materials, such as crates, drapes, etc., away from heater. Do not install behind door, furniture, towels, or boxes.
7. A heater has hot and arcing or sparking parts inside. Do not use it in areas where gasoline, paint or flammable liquids are stored.
8. Use this heater only as described in this manual. Any other use not recommended by the manufacturer may cause fire, electric shock, or injury to persons.
9. This heater is not approved for use in corrosive atmospheres such as marine, green house or chemical storage areas.

SAVE THESE INSTRUCTIONS

IMPORTANT

CAUTION

THE HEATER MUST BE MOUNTED AT LEAST 7' (2134mm) ABOVE THE FLOOR TO PREVENT ACCIDENTAL CONTACT WITH THE FAN BLADE WHICH COULD CAUSE INJURY.

CAUTION

THE CEILING MOUNTING STRUCTURE AND THE ANCHORING PROVISIONS MUST BE OF SUFFICIENT STRENGTH TO SUPPORT THE COMBINED WEIGHT OF THE HEATER AND MOUNTING BRACKET. (SEE TABLE 4).

CAUTION

ALL BUILT-IN THERMOSTATS: IF THE HEATER IS USED TO PREVENT PIPING OR LIQUIDS FROM FREEZING, AND IF THE THERMOSTAT IS SET BELOW 45° F (7°C), THE FAN MUST RUN CONTINUOUSLY.

CAUTION

TO PREVENT POSSIBLE OVERHEATING OR DAMAGE DUE TO OVERHEATING, KEEP AT LEAST 5' (1524mm) CLEARANCE IN FRONT OF HEATER. REFER TO TABLE 1 FOR SIDE, TOP, AND BACK CLEARANCE REQUIREMENTS.

DO NOT MOUNT MERCURY TYPE THERMOSTAT DIRECTLY ON UNIT. VIBRATION COULD CAUSE HEATER TO MALFUNCTION.

MANUAL RESET LIMIT (FACTORY INSTALLED OPTION ONLY.) THE LIMIT SWITCH IS LOCATED INTERNALLY ON THE REAR OF THE HEATER. ON THE MUH03 AND MUH05 MODELS, THE ACCESS TO THE RESET BUTTON IS ON THE RIGHT SIDE (WHEN FACING REAR OF HEATER); ON ALL OTHER MODELS IT IS NEAR THE TOP REAR OF THE HEATER.

THE MANUAL RESET LIMIT IS IN SERIES WITH THE AUTOMATIC RECYCLING PROTECTOR (LIMIT). THE MANUAL RESET LIMIT WILL NOT RESET UNTIL THE HEATER HAS COOLED AND THE BUTTON IS PUSHED IN.

HEATER LOCATION INSTRUCTIONS

Arrange units so their discharge air streams:

a. are subjected to a minimum of interference from columns, machinery and partitions;
b. wipe exposed walls without blowing directly at them;
c. are directed away from room occupants in comfort heating;
d. are directed along the windward side when installed in a building exposed to a prevailing wind.

Locate thermostats approximately 5' (1524mm) above the floor on interior partition walls or post away from cold drafts, internal heat sources and away from heater discharge air streams.

Small rooms can be heated by one unit heater.

Large rooms require multi-unit installations. Number and capacity of units will be determined by volume of building and square feet of floor area to be heated. Arrange units to provide perimeter air circulation where each unit supports the air stream from another.

MOUNTING THE HEATER

GENERAL

The heater may be mounted to discharge the heated air either horizontally or vertically. When the heater is mounted for vertical discharge, it is recommended that the heater be positioned so that the access door will open away from the wall to provide greater access to the wiring and control compartment. If the heater is to be mounted with the access door facing a wall, the heater must be mounted far enough from that wall to allow full opening of the access door (a distance approximately equal to the width of the heater ... check clearance before installing). Refer to Table 1 for wall and ceiling clearances before mounting heater.

The heater may be mounted for either vertical or horizontal discharge by the use of threaded rods. (Refer to Table 2 for threaded rod sizes required.) Observe the detailed procedures in the following installation instructions.

The heater may also be suspended from the wall or ceiling by means of an optional mounting bracket (type MMB or MCMB) which permits horizontal pivoting of the heater.

After the heater is installed, the louvers may be positioned to

direct the heated air in the desired direction. When the heater is installed for horizontal discharge, the louvers should direct the air either straight ahead or downward. Directing the air upward nay cause the heated air to remain in the ceiling area and waste energy.

HORIZONTAL DISCHARGE (Rod-mount from Ceiling)

1. Install four threaded mounting rods in the threaded holes and secure in place using lock nuts. (See Table 2).
2. Securely attach the four mounting rods to the ceiling. (Refer to Table 1 for wall and ceiling clearances, and Table 2 for mounting rod spacing).

Table 1. Wall and Ceiling Clearance, inches (mm)

Unit	Discharge	Ceiling	Side Wall	Back Wall
3 & 5 kW	Horiz.	2 (50.8)	6 (152.4)	9 (228.6)
	Vert.	6 (152.4)	18 (457.2)	18 (457.2)
7.5 to 10 kW	Horiz.	6 (152.4)	6 (152.4)	13 (330.2)
	Vert.	6 (152.4)	24 (609.6)	24 (609.6)
15 to 10 kW	Horiz.	6 (152.4)	9 (228.6)	12½ (317.5)
	Vert	6 (152.4)	24 (609.6)	24 (609.6)
25 to 50 kW	Horiz.	16 (406.4)	12 (304.8)	18½ (470.0)
	Vert.	12 (304.8)	39 (914.4)	39 (914.4)

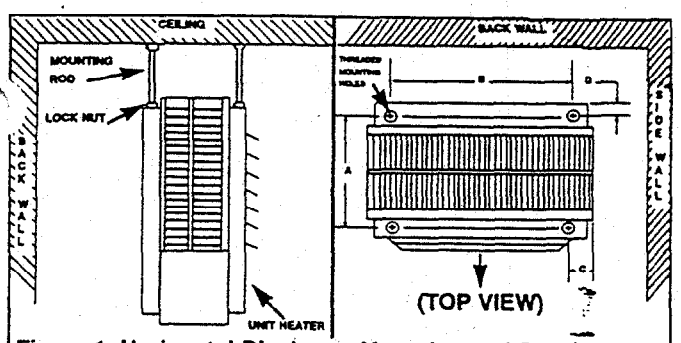


Figure 1. Horizontal Discharge Mounting and Spacing.

Table 2. Rod Thread and Spacing Dimensions, inches (mm) for Horizontal Discharge

Unit	Rod Thread Type	A	B	C	D
3 & 5 kW	5/16 - 18	6 1/16 (153.9)	6 (152.4)	4 1/16 (103.1)	3/4 (19.0)
7.5 - 10 kW			8 7/8 (225.6)	5 1/8 (130.3)	3/4 (19.0)
15 - 20 kW		11 3/8 (289.0)			
25 - 30 kW	3/8 - 16	10 9/16 (268.2)	14 - 12 (368.3)	6 3/16 (157.2)	5/8 (16.0)
40 - 50 kW		15 15/16 (404.9)	14 - 12 (368.3)	6 3/16 (157.2)	5/8 (16.0)

VERTICAL DISCHARGE (Rod-Mount from Ceiling)

1. Remove bolts from the threaded holes in the back of the heater.
2. Install four threaded mounting rods in the threaded holes and and secure in place using lock nuts.
3. Securely attach the four mounting rods to the ceiling. (Refer to Table 1 for wall and ceiling clearances, and Table 3 for mounting rod spacing dimensions.)

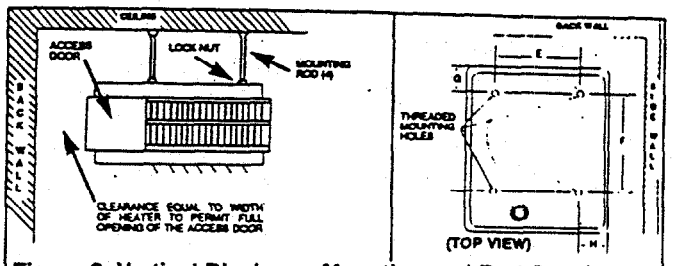


Figure 2. Vertical Discharge Mounting and Rod Spacing

Table 3. Rod Thread Type and Spacing Dimensions, inches (mm) for Vertical Discharge

Unit	Rod Thread Type	E	F	G	H
3 & 5 kW	5/16 - 18	6 (152.4)	9 3/4 247.7)	2 (50.8)	4 1/16 (103.1)
7.5 - 20 kW		8 7/8 (225.6)	14 6/8 (371.8)	2 (50.8)	5 1/8 (130.3)
25 - 30 kW	3/8 - 16	14 1/2 (368.3)	21 1/4 (539.8)	2 3/16 (56.0)	6 3/16 (157.2)

WIRING

BRANCH CIRCUIT (POWER)

1. Connect heater only to the voltage, amperage and frequency specified on the nameplate.
2. Field wiring must be properly sized to carry the amperage in accordance with the NEC.
3. The access door is hinged. There are either one or two screws accessible from the side that must be loosened to gain access. These screws are the captive type; do not try to remove them.
4. A knockout is provided in the back of the heater close to the power terminal block and the control terminal board. The control terminal board knockout is 1/2 inch (12.7 mm) conduit size. The power terminal block knockout is multiple diameter. Use the diameter that fits the required conduit size.
5. A ground terminal is provided near the power terminal board. The ground wire should be connected before other connections are made.
6. The power terminal board is equipped with box terminals sized to accept the correct size power supply wire. Wire rated at 600 V and 60° C is satisfactory for the heater branch circuit. Either aluminum or copper wire is satisfactory for connection to the heater power terminal board box terminal. Copper wire is recommended and must be used with built-in disconnect switch.

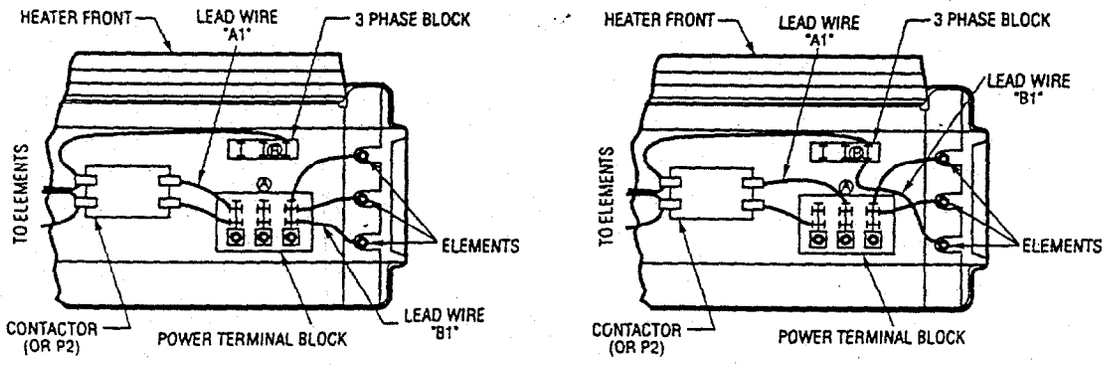
7. Each heater has a wiring diagram affixed to the inside of the access door. Consult this diagram before making any field connections.
8. Single or three-phase power connections may be used with heater models MUH0521, MUH07, MUH0581, MUH07, MUH078, MUH102, MUH108, and MUH158. These units are factory wired for single-phase operation. If these heaters are for use with three-phased power, reconnect the wires as indicated in the wiring diagram attached to the heater. Additional information can be found by looking at the wiring illustrations in Figures 3a and 3b and following the directions shown below.

On models MUH0521,MUH0581, MUH072, MUH078, MUH102, and MUH058 (Figure 3a), move only the two wires marked "A1" and marked "B1"; do not move or change any other wiring. The element lead wire marked "B1" which is factory connected to the power terminal block (terminal located closest to the elements) must be moved to terminal "B" on the three-phase terminal block.

The relay (contactor) lead wire "A1" must be moved from the end terminal of the power terminal block (terminal closest to the contactor or control terminal board) to the "A" terminal of the lower terminal block (center terminal).

Model MUH158 (Figure 3b) has two three-phase terminal blocks located adjacent to the relays (contactors). Move only the two wires marked "C1" and "D1" on each of these two three-phase terminal blocks to terminal "B". Do not move or change any other wires.

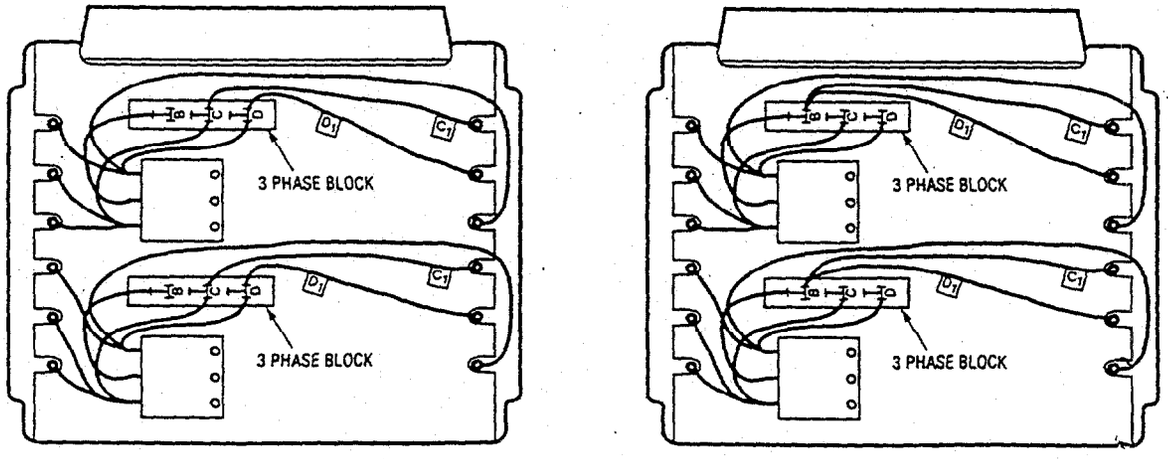
9. Electrical Accessories, either kits or factory-installed options, are shown connected by a dash line on the heater wiring diagram.
10. **208/240 VOLT HEATER.** Interchange transformer red and black primary leads (see wiring diagram) when the heater is to be connected to 208 volts supply.



FACTORY-WIRED FOR SINGLE-PHASE POWER

FIELD-WIRED FOR THREE-PHASE POWER

Figure 3a. Wiring Connections for Single-Phase and Three -Phase Power(MUH0521, MUH0581, MUH072, MUH078, MUH102 and MUH108)



FACTORY-WIRED FOR SINGLE-PHASE POWER

FIELD-WIRED FOR THREE-PHASE POWER

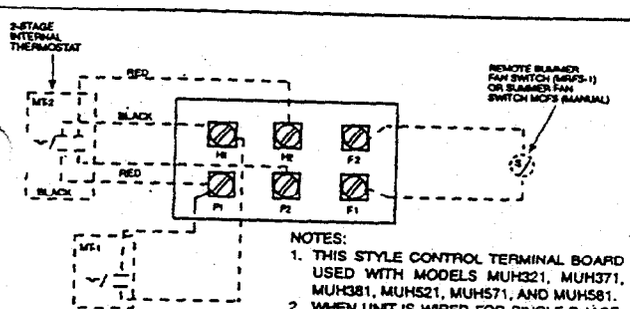
Figure 3b. Wiring Connections for Single-Phase and Three -Phase Power (MUH158)

CONTROL WIRING

WARNING

LINE VOLTAGE IS PRESENT ON SOME OF THE TERMINALS ON THE CONTROL TERMINAL BOARD. ALWAYS DISCONNECT THE POWER FROM THE HEATER BEFORE MAKING ANY CONNECTIONS TO THE CONTROL BOARD TO PREVENT ELECTRIC SHOCK HAZARD.

1. Use 600 volts, NEC Class 1 insulated wire with a minimum 18 gage for thermostats and a minimum 14 gage for line voltage motor switch (remote fan switch without relay).
2. Use a crimp-on type fork terminal on the wire end that attaches to the MUH control terminal board if more than one connection is to be made under the terminal screw.
3. Wire per Figure 4 for unit without contactors.
4. Wire per Figure 5 for unit with contactors.

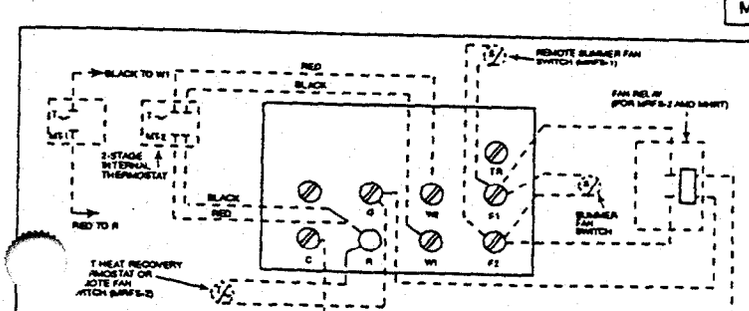


NOTES:
1. THIS STYLE CONTROL TERMINAL BOARD USED WITH MODELS MUH321, MUH371, MUH381, MUH521, MUH571, AND MUH581.
2. WHEN UNIT IS WIRED FOR SINGLE-PHASE, JUMPER H1 TO H2. IF SINGLE-POLE THERMOSTAT IS USED WITH SINGLE-PHASE UNIT, CONNECT THERMOSTAT LEADS TO P1 AND H1.
3. EXTERNAL LINE VOLTAGE THERMOSTATS SHOULD BE TREATED AS SINGLE STAGE ONLY.

Figure 4. Control Terminal Board (for Heaters Without Contactors)

Table 4. Specifications

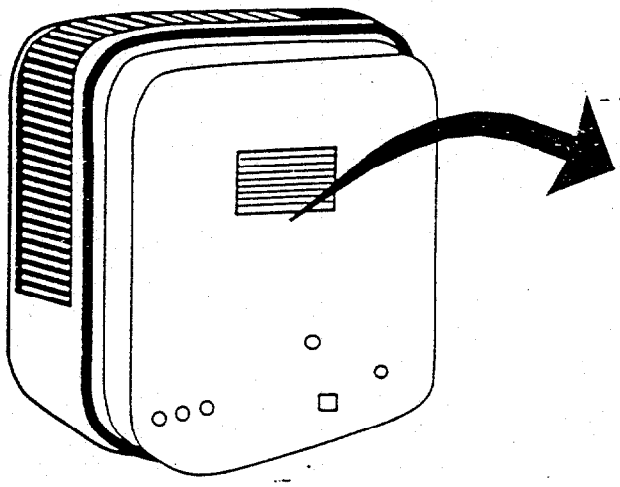
Basic Model No.	Height in (mm)	Width in. (mm)	Depth in. (mm)	Mounting Weight lbs. (kg)	Wiring Compartment Volume
MUH0381	16 (406.4)	14 (355.6)	7½ (190.5)	27 (12.2)	90 in³ (14.70 cm³)
MUH0321				27 (12.2)	
MUH0371				27 (12.2)	
MUH0341				30 (13.6)	
MUH0581				27 (12.2)	
MUH0521				27 (12.2)	
MUH0571				27 (12.2)	
MUH0541				30 (13.6)	
MUH0331				30 (13.6)	
MUH0361				30 (13.6)	
MUH0531				30 (13.6)	
MUH0561				30 (13.6)	
MUH078	21¾ (552.5)	19 (482.6)	7½ (190.5)	38 (17.2)	100 in³ (1639 cm³)
MUH072				38 (17.2)	
MUH077				38 (17.2)	
MUH074				38 (17.2)	
MUH108				38 (17.2)	
MUH102				38 (17.2)	
MUH107				38 (17.2)	
MUH104				38 (17.2)	
MUH073				38 (17.2)	
MUH076				38 (17.2)	
MUH103				38 (17.2)	
MUH106				38 (17.2)	
MUH158	21¾ (552.5)	19 (482.6)	12¾ (323.9)	54 (24.5)	140 in³ (2295 cm³)
MUH152				50 (22.7)	
MUH154				50 (22.7)	
MUH208				60 (27.2)	
MUH202				55 (24.9)	
MUH204				55 (24.9)	
MUH156				55 (24.9)	
MUH206				55 (24.9)	
MUH252	30 (76.2)	26⅝ 676.4)	11¾ (298.5)	89 (40.4)	504 in³ (8260 cm³)
MUH254				89 (40.4)	
MUH308				89 (40.4)	
MUH302				89 (40.4)	
MUH304				89 (40.4)	
MUH256				89 (40.4)	
MUH306				89 (40.4)	
MUH402	30 (76.2)	26⅝ 676.4)	17¼ (435.1)	119 (54.0)	648 in³ (10620 cm³)
MUH404				119 (54.0)	
MUH508				119 (54.0)	
MUH502				119 (54.0)	
MUH504				119 (54.0)	
MUH406				119 (54.0)	
MUH506				119 (54.0)	



NOTES:
1. THIS STYLE CONTROL TERMINAL BOARD USED WITH MODELS EXCEPT MUH321, MUH371, MUH381, MUH521, MUH571, AND MUH581.
2. REMOVE JUMPER W1 TO W2 WHEN 2-STAGE THERMOSTAT IS USED.
3. *ONLY ONE OF THESE ACCESSORIES MAY BE INSTALLED IN A SINGLE HEATER.
4. EXTERNAL LINE VOLTAGE THERMOSTATS SHOULD BE TREATED AS SINGLE STAGE ONLY.

Figure 5. Control Terminal Board (for Heaters With Contactors)

IMPORTANT INFORMATION



NAMEPLATE

MODEL NO. / MFG. NO. MUH321 — DATE CODE 0395

VOLTS AC 60 HZ	KILOWATTS	PHASE	MIN. SUPPLY CIR. AMPACITY
208 / 240	2.2 /3	1	

MAX. FUSE	MOTOR		CONTROLS	CUSTOMER NO
	VAC	AMP	VAC	
	208/240	.25	208/240	

AIR FLOW	MINIMUM MOUNTING CLEARANCE SIDE	BACK	CEILING	FLOOR
HORIZ.	6"	9.5"	2"	7'
VERT.	18"	18"	6"	7'

WARNING: DO NOT TURN LOUVERS ABOVE LEVEL OF THE UNIT. DISCONNECT POWER BEFORE SERVICING. IF EXTERNAL CONTROL IS USED, ALSO DISCONNECT EXTERNAL POWER SUPPLY.

NE PAS RELEVER LES LAMES AU-DEL A DU NIVEAU PREVU DE L'APPAREIL. METTRE HORS TENSION AVANT DE PROCEDER A L'ENTRETIEN. SI UNE COMMANDE EXTERNE EST UTILISEE, COUPER AUSSE L'ALIMENTATION EXTERNE. ASSURER UN DEGAGEMENT D'AU MOINS 6 PI ENTRE L'APPAREIL DE CHAUFFAGE ET LEPLANCHER.

UL c UL 774G LISTED AIR HEATER

MARLEY ELCTRIC HEATING
BENNETTSVILLE, SC 29512

4104-0275-036

LIMITED WARRANTY

All products manufactured by Marley Electric Heating are warranted against defects in workmanship and materials for one year from date of installation, except heating elements which are warranted against defects in workmanship and materials for five years from date of installation. This warranty does not apply to damage from accident, misuse, or alteration; nor where the connected voltage is more than 5% above the nameplate voltage; nor to equipment improperly installed or wired or maintained in violation of the product's installation instructions. All claims for warranty work must be accompanied by proof of the date of installation.

The customer shall be responsible for all costs incurred in the removal or reinstallation of products, including labor costs, and shipping costs incurred to return products to Marley Electric Heating Service Center.Within the limitations of this warranty, inoperative units should be returned to the nearest Marley authorized service center or the Marley Electric Heating Service Center, and we will repair or replace, at our option, at no charge to you with return freight paid by Marley. It is agreed that such repair or replacement is the exclusive remedy available from Marley Electric Heating.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT. MARLEY ELECTRIC HEATING SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES ARISING WITH RESPECT TO THE PRODUCT, WHETHER BASED UPON NEGLIGENCE, TORT, STRICT LIABILITY, OR CONTRACT.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

For the address of your nearest authorized service center, contact Marley Electric Heating in Bennettsville, SC, at 1-800-642-4326. Merchandise returned to the factory must be accompanied by a return authorization and service identification tag, both available from Marley Electric Heating. When requesting return authorization, include all catalog numbers shown on the products.

HOW TO ORDER REPAIR PARTS

In order to obtain any needed repair or replacement parts, warranty service or technical information, please contact Marley Electric Heating Service Center toll-free by calling 1-800-642-HEAT.

When ordering repair parts, always give the information listed as follows:

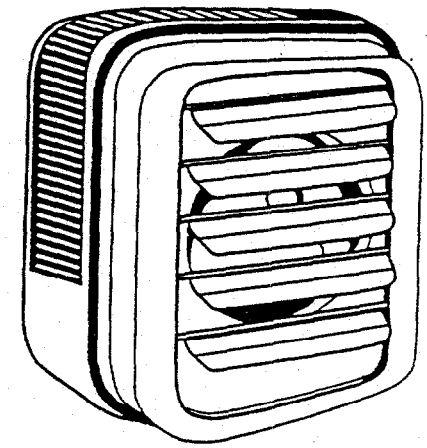
1. The Part Number
2. The Model Number
3. The Part Description
4. Date of Manufacture

Marley Electric Heating
A United Dominion Company
470 Beauty Spot Rd. East
Bennettsville, SC 29512 USA

ECR 33386
2/97

Part No. 5200-0722-009

QMARK®
Una División de Marley Electric Heating



Serie MUH
Unidades de Calentadores Modulares

LISTED
EXPEDIENTE No. E21609

Instrucciones de Instalación y Mantenimiento

Estimado propietario:

¡Felicitaciones! Gracias por comprar este nuevo calentador fabricado por una división de Marley Electric Heating. Usted ha efectuado una sabia inversión al seleccionar el producto de la más alta calidad en la industria de calefacción. Por favor lea cuidadosamente las instrucciones de instalación y mantenimiento indicadas en este manual. Usted debería gozar de años de calefacción eficiente con este producto de Marley Electric Heating...el líder de la industria en diseño, fabricación, calidad y servicio.

... Los empleados de
Marley Electric Heating

⚠ ADVERTENCIA ⚠

Lea cuidadosamente - Estas instrucciones están escritas para ayudarle a prevenir dificultades que podrían surgir durante la instalación de los calentadores. El estudiar primero las instrucciones puede ahorrarle un tiempo considerable y dinero después. Observe los procedimientos siguientes, y reduzca a un mínimo su tiempo de instalación.

Para reducir el riesgo de incendio o choque eléctrico:

1. Antes de cablear o prestar servicio y para prevenir el choque eléctrico, desconecte la potencia entrante al calentador por el panel principal de servicio.
2. Todo el cableado debe conformar con los códigos eléctricos nacionales y locales, y el calentador debe estar conectado a tierra como precaución contra un choque eléctrico posible.
3. Antes de activar, verifique que el voltaje del suministro de potencia entrante al calentador corresponda a las clasificaciones principales impresas en la placa de nombre.
4. Este calentador está caliente durante el uso. Para evitar quemaduras, no permita que la piel expuesta toque las superficies calientes.
5. No inserte ni permita que objetos extraños entren a ninguna apertura de ventilación o escape ya que esto puede causar un choque eléctrico, incendio o daños al calentador.
6. No bloquee de ninguna manera las tomas de aire o los escapes, para prevenir un posible incendio. Mantenga los materiales combustibles, tales como cajas de madera, cortinas, etc. alejados del calentador. No instale detrás de puertas, muebles, toallas, o cajas.
7. Un calentador tiene adentro piezas calientes y productoras de arcos eléctricos o de chispas. No use en áreas donde estén almacenados gasolina, pintura o líquidos inflamables.
8. Use este calentador solo de la manera descrita en este manual. Cualquier otro uso no recomendado por el fabricante puede causar incendio, choque eléctrico, o lesiones a las personas.
9. Este calentador no está aprobado para usar en atmósferas corrosivas tales como de mar, invernaderos o áreas de almacenamiento de productos químicos.

GUARDE ESTAS INSTRUCCIONES

IMPORTANTE

PRECAUCION

EL CALENTADOR DEBE SER INSTALADO POR LO MENOS 7'(2134 mm) SOBRE EL PISO PARA PREVENIR QUE EL CONTACTO ACCIDENTAL CON LAS HOJAS DEL ABANICO PUEDA CAUSAR LESIONES.

PRECAUCION

LA ESTRUCTURA DE MONTAJE EN EL TECHO Y LAS PROVISIONES PARA SU ASEGURAMIENTO DEBEN SER LO SUFICIENTEMENTE FUERTES PARA SOPORTAR EL PESO COMBINADO DEL CALENTADOR Y DEL SOPORTE DE MONTAJE. (VEA TABLA 4).

PRECAUCION

TODOS LOS TERMOSTATOS INCORPORADOS: SI EL CALENTADOR ES UTILIZADO PARA PREVENIR QUE TUBERIAS O LIQUIDOS SE CONGELEN, Y SI EL TERMOSTATO SE AJUSTA A MENOS DE 45°F (7°C). EL ABANICO DEBE DE FUNCIONAR CONTINUAMENTE.

PRECAUCION

PARA PREVENIR POSIBLE SOBRECALENTAMIENTO O DAÑOS POR SOBRECALENTAMIENTO, MANTENGA UN ESPACIO MINIMO DE 5' (1524 mm) EN LA PARTE FRONTAL DEL CALENTADOR. REFIERASE A LA TABLA 1 PARA LOS REQUERIMIENTOS DE ESPACIO A LOS LADOS, ARRIBA Y ABAJO.

NO INSTALE TERMOSTATOS DE MERCURIO DIRECTAMENTE EN LA UNIDAD. LA VIBRACION PUEDE CAUSAR FALLAS EN EL CALENTADOR.

LIMITE DE REPOSICIONAMIENTO MANUAL (OPCION INSTALADA EN LA FABRICA SOLAMENTE.) EL INTERRUPTOR DE LIMITE ESTA COLOCADO INTERNAMENTE EN LA PARTE TRASERA DEL CALENTADOR. EN LOS MODELOS MUH03 Y MUH05, EL ACCESO AL BOTON DE REPOSICIONAMIENTO ESTA A LA DERECHA (OBSERVANDO AL CALENTADOR DESDE ATRAS); EN TODOS LOS DEMAS MODELOS, EL BOTON ESTA CERCA DE LA PARTE SUPERIOR TRASERA DEL CALENTADOR.

EL LIMITE DE REPOSICIONAMIENTO MANUAL ESTA EN SERIE CON EL PROTECTOR DE RECICLAJE AUTOMATICO (LIMITE). EL LIMITE DE REPOSICIONAMIENTO MANUAL NO VA A REPOSICIONAR HASTA QUE EL CALENTADOR SE HAYA ENFRIADO Y EL BOTON SEA PRESIONADO.

INSTRUCCIONES PARA UBICAR EL CALENTADOR

Coloque las unidades de manera tal que las corrientes de aire de descarga:

a. sean sujetas a un minimo de interferencia por columnas, maquinaria y particiones;
b. contacten las paredes expuestas sin soplar directamente a ellas;
c. no se dirijan directamente a los ocupantes de un cuarto en calor confortable;
d. estén dirigidas barlovento cuando son instaladas en edificios expuestos a vientos imperantes.

Ubique los termostatos aproximadamente a 5' (1524 mm) sobre el piso, en paredes de división interior o postes lejos de corrientes de aire frías, fuentes internas de calor y lejos de corrientes de aire de descarga de calentadores.

Cuartos pequeños pueden ser calentados por un solo calentador.

Cuartos grandes requieren de la instalación de varias unidades. El número y la capacidad de las unidades serán determinados con base en el volumen del edificio y la dimensión, en pies cuadrados, del área de piso que va a ser calentada. Coloque las unidades de manera tal que el aire circule en forma circular cuando cada unidad coopera con la corriente de aire de otra unidad.

COMO INSTALAR EL CALENTADOR

GENERAL

El calentador puede ser instalado para que descargue el aire caliente vertical u horizontalmente. Cuando el calentador es instalado para que descargue verticalmente, se recomienda que el calentador sea ubicado de manera tal que la puerta de acceso abra hacia el lado contrario de la pared, para permitir mayor acceso al compartimiento de control y cableado. Si el calentador va a ser instalado con la puerta de acceso mirando hacia la pared, el calentador debe ser instalado con suficiente espacio, que permita que la puerta de acceso pueda abrirse en su totalidad (una distancia aproximadamente igual al ancho del calentador ... confirme el espacio antes de la instalación). Refiérase a la Tabla 1 para los espacios en el techo y la pared antes de instalar el calentador.

El calentador puede ser instalado para descarga vertical u horizontal mediante el uso de varillas con rosca. (Refiérase a la Tabla 2 para los tamaños de varilla con rosca requeridos). Observe los procedimientos en forma detallada en las siguientes instrucciones para la instalación.

El calentador también puede ser suspendido desde la pared o techo con la ayuda de un soporte de montaje opcional (tipo MMB o MCMB), el cual permite que el calentador gire horizontalmente.

Luego de que el calentador ha sido instalado, las persianas pueden ser colocadas para dirigir el aire caliente en la dirección deseada.

Cuando el calentador ha sido instalado para descarga horizontal, las persianas deben dirigir el aire ya sea hacia el frente o hacia abajo. Dirigir el aire hacia arriba puede causar que el aire caliente se quede en el área del techo, lo que es un desperdicio de energía.

DESCARGA HORIZONTAL
(Instalado con varillas desde el techo)

1. Instale cuatro varillas de montaje con rosca en los huecos con rosca y asegure utilizando tuercas de seguridad. (Vea Tabla 2).
2. Pegue firmemente las cuatro varillas de montaje al techo. (Refiérase a la Tabla 1 para los espacios de las paredes y el techo y a la Tabla 2 para la separación entre varillas de montaje).

Tabla 1. Espacios de pared y techo, en pulgadas (mm)

Unidad	Descarga	Techo	Pared Lateral	Pared Trasera
3 y 5 kW	Horiz.	2 (50.8)	6 (152.4)	9 (228.6)
	Vert.	6 (152.4)	18 (457.2)	18 (457.2)
7.5 a 10 kW	Horiz.	6 (152.4)	6 (152.4)	13 (330.2)
	Vert.	6 (152.4)	24 (609.6)	24 (609.6)
15 a 10 kW	Horiz.	6 (152.4)	9 (228.6)	12½ (317.5)
	Vert	6 (152.4)	24 (609.6)	24 (609.6)
25 a 50 kW	Horiz.	16 (406.4)	12 (304.8)	18½ (470.0)
	Vert.	12 (304.8)	39 (914.4)	39 (914.4)

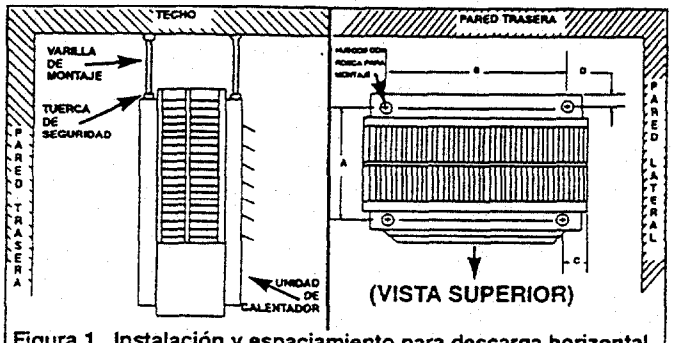


Figura 1. Instalación y espaciamiento para descarga horizontal

Tabla 2. Rosca de varilla y dimensiones de espaciamiento, en pulgadas (mm), para descarga horizontal

Unidad	Tipo de rosca de varilla	A	B	C	D
3 - 5 kW	5/16 - 18	6 1/16 (153.9)	6 (152.4)	4 1/16 (103.1)	3/4 (19.0)
7.5 - 10 kW			8 7/8 (225.6)	5 1/8 (130.3)	3/4 (19.0)
15 - 20 kW		11 3/8 (289.0)			
25 - 30 kW	3/8 - 16	10 9/16 (268.2)	14 - 12 (368.3)	6 3/16 (157.2)	5/8 (16.0)
40 - 50 kW		15 15/16 (404.9)	14 - 12 (368.3)	6 3/16 (157.2)	5/8 (16.0)

DESCARGA VERTICAL
(Instalado con varilla desde el techo)

1. Remueva los tornillos de los huecos con rosca en la parte trasera del calentador.
2. Instale cuatro varillas de montaje con rosca en los huecos con rosca y asegure utilizando tuercas de seguridad.
3. Pegue firmemente las cuatro varillas de montaje al techo. (Refiérase a la Tabla 1 para los espacios de las paredes y el techo y a la Tabla 3 para la separación entre varillas de montaje).

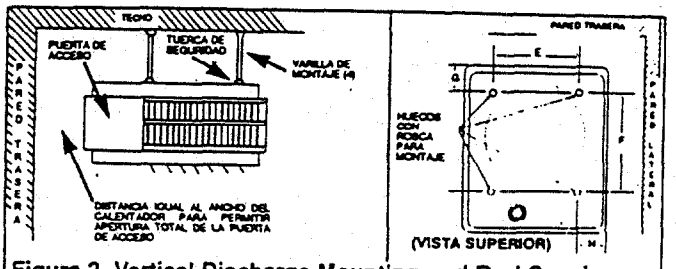


Figura 2. Vertical Discharge Mounting and Rod Spacing

Tabla 3. Tipos de rosca de varilla y dimensiones de espaciamiento, en pulgadas (mm), para descarga vertical

Unidad	Tipo de rosca de varilla	E	F	G	H
3 - 5 kW	5/16 - 18	6 (152.4)	9¾ 247.7)	2 (50.8)	4 1/16 (103.1)
7.5 - 20 kW		8 7/8 (225.6)	14⅝ (371.6)	2 (50.8)	5⅛ (130.3)
25 - 30 kW	⅜ - 16	14½ (368.3)	21¼ (539.8)	2 9/16 (56.0)	6 3/16 (157.2)

CABLEADO
CIRCUITO DERIVADO (ALIMENTACION)

1. Conecte el calentador solo al voltaje, amperaje y frecuencia especificadas en la placa del fabricante.
2. El tamaño del cableado de campo debe ser el apropiado para el amperaje que se va a movilizar, de acuerdo al NEC.
3. La puerta de acceso tiene bisagras. Existen uno o dos tornillos, accesibles desde el lado, que deben de ser aflojados para accesar. Estos tornillos son cautivos, no trate de sacarlos totalmente.
4. Se provee un agujero en la parte de atrás del calentador, cerca del bloque de terminales de alimentación y de la tarjeta de terminales de control. El agujero de la tarjeta de terminales de control es del tamaño de una tubería eléctrica de 1/2 pulgada (12.7 mm). El agujero del bloque de terminales de alimentación sirve para varios diámetros. Utilice el diámetro que calza con el tamaño de la tubería eléctrica.
5. Se provee de una terminal tierra cerca de la tarjeta de terminales de alimentación. El cable tierra debe ser conectado antes de que cualquier otra conexión se lleve a cabo.
6. La tarjeta de terminales de alimentación está equipada con cajas terminales dimensionadas para aceptar el tamaño adecuado del cable fuente de alimentación. Cable especificado para 600V y 60°C es satisfactorio para el circuito derivado del calentador. Tanto cable de aluminio como de cobre son satisfactorios para la conexión con la caja terminal de la tarjeta de terminales de alimentación del calentador. Se recomienda cable de cobre y debe ser usado con interruptores de desconexión incorporados.

7. Cada calentador tiene un diagrama de cableado pegado en la parte interior de la puerta de accéso. Consulte este diagrama antes de hacer cualquier conexión de campo.
8. Para los calentadores modelo MUH0521, MUH07, MUH0581, MUH07, MUH078, MUH102, MUH108 y MUH158 se pueden utilizar conexiones de alimentación tri-fásicas o mono-fásicas. Estas unidades son cableadas de fabrica para operación mono-fásica. Si los calentadores se van a utilizar con alimentación tri-fásica, reconecte los cables tal y como es indicado en el diagrama de cableado pegado al calentador. Información adicional puede ser encontrada en las ilustraciones de cableado en las Figuras 3a y 3b y siguiendo las indicaciones presentadas a continuación.

En los modelos MUH0521, MUH0581, MUH072, MUH078, MUH102 y MUH058 (Figura 3a) mueva solamente los dos cables marcados con "A1" y "B1", no mueva o cambie ningún otro cable. El cable del elemento marcado "B1", el cual es el cable conectado de fabrica, al bloque de terminales de alimentación (terminal localizada más cerca de los elementos) debe ser movido a la terminal "B" en el bloque de terminales tri-fásico. El cable relé (contactor) "A1" debe ser movido de la terminal final del bloque de terminales de alimentación (terminal más cercana al contactor o tarjeta de terminales de control) a la terminal "A" del bloque de terminales inferior (terminal central).

El modelo MUH158 (Figura 3b) tiene dos bloques de terminales tri-fásicos colocados a la par de los relés (contactores). Mueva solamente los dos cables marcados "C1" y "D1" en cada uno de esos bloques de terminales tri-fásicos a la terminal "B". No mueva o cambie ningún otro cable.

El modelo MUH158 (Figura 3b) tiene dos bloques de terminales tri-fásicos colocados a la par de los relés (contactores). Mueva solamente los dos cables marcados "C1" y "D1" en cada uno de esos bloques de terminales tri-fásicos a la terminal "B". No mueva o cambie ningún otro cable.

9. Accesorios eléctricos, ya sea juegos u opciones instaladas de fábrica, se presentan conectados por una línea de rayas en el diagrama de cableado del calentador.
10. **CALENTADOR DE 208/240 VOLTIOS.** Intercambie los cables primarios negro y rojo del transformador (vea diagrama de cableado) cuando el calentador vaya a ser conectado a una fuente de 208 voltios.

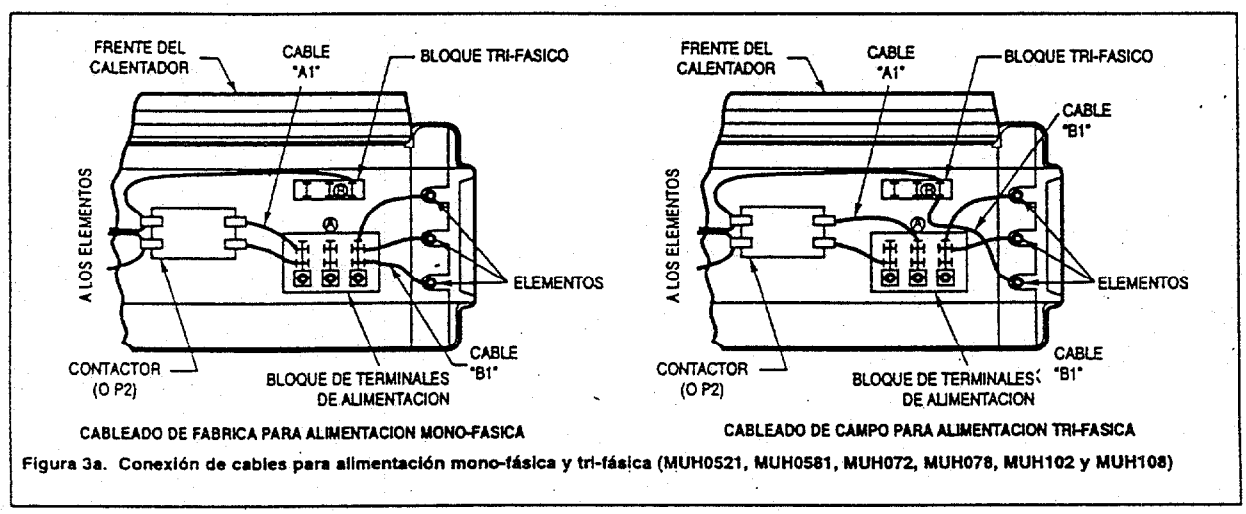


Figura 3a. Conexión de cables para alimentación mono-fásica y tri-fásica (MUH0521, MUH0581, MUH072, MUH078, MUH102 y MUH108)

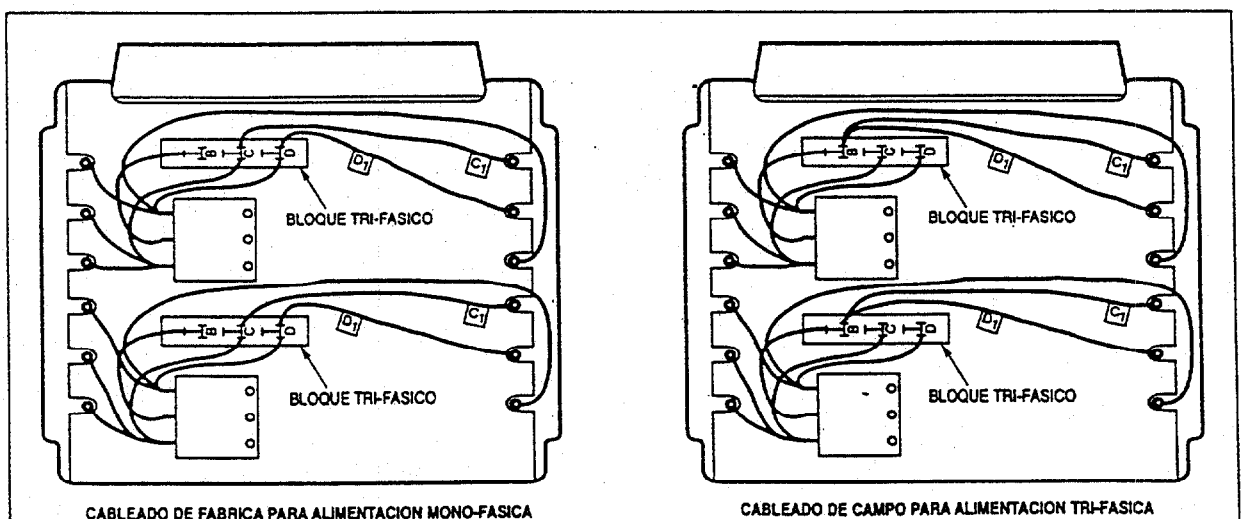


Figura 3b. Conexiones de cableado para alimentaciones mono-fásicas y tri-fásicas

CABLEADO DE CONTROL

⚠ ADVERTENCIA ⚠

ALGUNAS DE LAS TERMINALES EN LA TARJETA DE TERMINALES DE CONTROL PUEDEN PRESENTAR VOLTAJE DE LINEA. SIEMPRE DESCONECTE LA ALIMENTACION DEL CALENTADOR ANTES DE HACER CUALQUIER CONEXION A LA TARJETA DE CONTROL PARA PREVENIR EL PELIGRO DE CHOQUES ELECTRICOS.

1. Use cable aislado, clase NEC 1 de 600 voltios, calibre mínimo 18, para el termostato y un cable calibre mínimo 14 para el interruptor del motor del voltaje de línea (interruptor remoto del abanico sin relé).
2. Use una terminal de horquilla en el extremo del cable que se pega a la tarjeta de terminales de control MUH si se debe hacer más de una conexión en el tornillo de la terminal.
3. Cablee de acuerdo a la Figura 4 para unidades sin contactor.
4. Cablee de acuerdo a la Figura 5 para unidades con contactor.

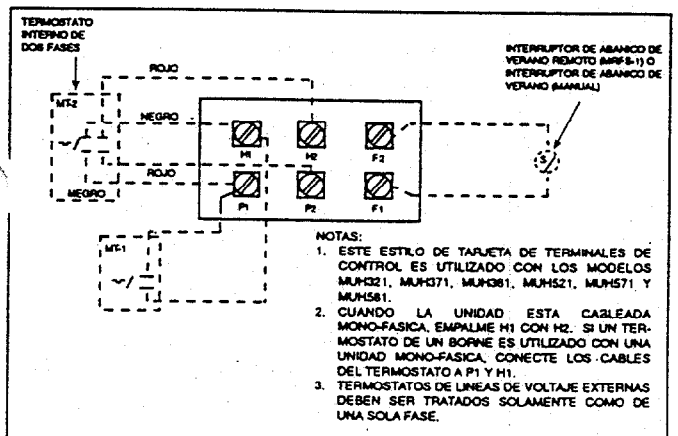


Figura 4. Tarjeta de Terminales de Control (para Calentadores sin Interruptor)

Tabla 4. Especificaciones

Modelo Básico Nº	Altura pulgadas (mm)	Ancho pulgadas (mm)	Profundidad pulgadas (mm)	Peso de Instalación lbs. (kg)	Volumen del Compartimiento de Cableado
MUH0381	16 (406.4)	14 (355.6)	7½ (190.5)	27 (12.2)	90 in³ (14.70 cm³)
MUH0321				27 (12.2)	
MUH0371				27 (12.2)	
MUH0341				30 (13.6)	
MUH0581				27 (12.2)	
MUH0521				27 (12.2)	
MUH0571				27 (12.2)	
MUH0541				30 (13.6)	
MUH0331				30 (13.6)	
MUH0361				30 (13.6)	
MUH0531				30 (13.6)	
MUH0561				30 (13.6)	
MUH078	21¾ (552.5)	19 (482.6)	7½ (190.5)	38 (17.2)	100 in³ (1639 cm³)
MUH072				38 (17.2)	
MUH077				38 (17.2)	
MUH074				38 (17.2)	
MUH108				38 (17.2)	
MUH102				38 (17.2)	
MUH107				38 (17.2)	
MUH104				38 (17.2)	
MUH073				38 (17.2)	
MUH076				38 (17.2)	
MUH103				38 (17.2)	
MUH106				38 (17.2)	
MUH158	21¾ (552,5)	19 (482.6)	12¾ (323.9)	54 (24.5)	140 in³ (2295 cm³)
MUH152				50 (22.7)	
MUH154				50 (22.7)	
MUH208				60 (27.2)	
MUH202				55 (24.9)	
MUH204				55 (24.9)	
MUH156				55 (24.9)	
MUH206				55 (24.9)	
MUH252	30 (76.2)	26⅝ 676.4)	11¾ (298.5)	89 (40.4)	504 in³ (8260 cm³)
MUH254				89 (40.4)	
MUH308				89 (40.4)	
MUH302				89 (40.4)	
MUH304				89 (40.4)	
MUH256				89 (40.4)	
MUH306				89 (40.4)	
MUH402	30 (76.2)	26⅝ 676.4)	17¼ (435.1)	119 (54.0)	648 in³ (10620 cm³)
MUH404				119 (54.0)	
MUH508				119 (54.0)	
MUH502				119 (54.0)	
MUH504				119 (54.0)	
MUH406				119 (54.0)	
MUH506				119 (54.0)	

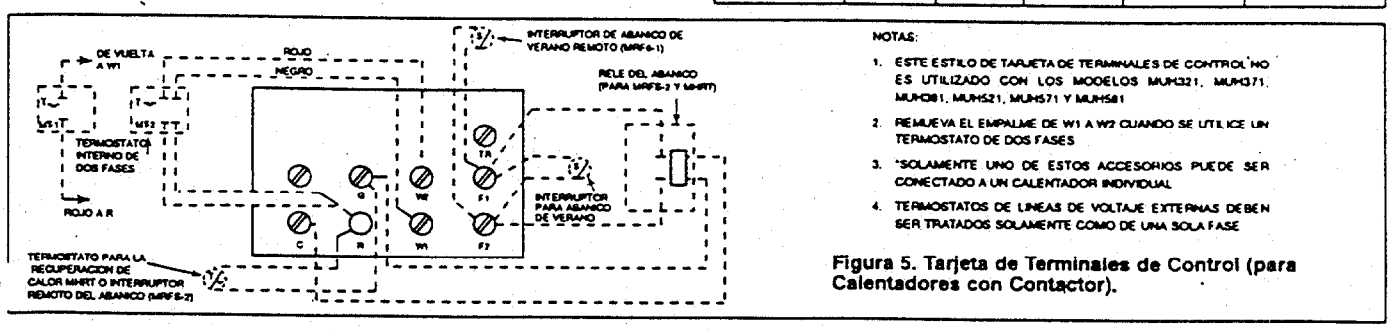
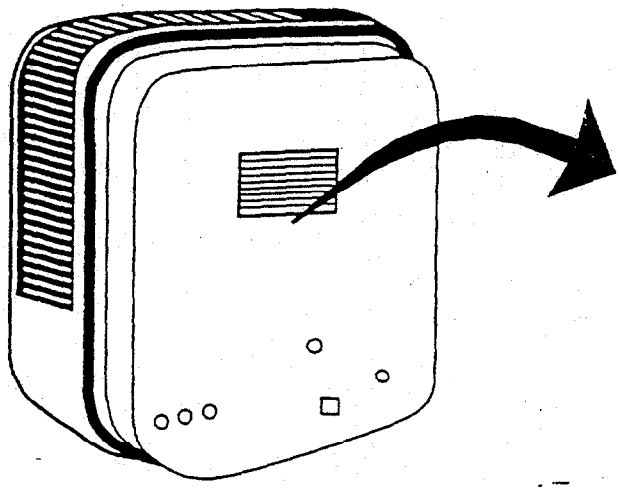


Figura 5. Tarjeta de Terminales de Control (para Calentadores con Contactor).

INFORMACION IMPORTANTE



PLACA DEL FABRICANTE

MODELO NO. MFG. NO. MUH321 — CODIGO DE FECHA 0395

VOLTS AC 60 HZ	KILOWATTS	FASE	AMPACIDAD MIN. DE ALIMENTACION DE CIR.
208 / 240	2.2 /3	1	

MAX. FUSIBLE	MOTOR VAC	MOTOR AMP	CONTROLES VAC	CLIENTE Nº
	208/240	.25	208/240	

FLUJO DE AIRE	ESPACIO MINIMO DE INSTALACION LADO	ATRAS	TECHO	PISO
HORIZ.	6"	9.5"	2"	7'
VERT.	18"	18"	6"	7'

¡ADVERTENCIA! NO VOLTEE LAS PERSIANAS POR ENCIMA DEL NIVEL DE LA UNIDAD. DESCONECTE ANTES DE REPARAR. SI SE UTILIZA CONTROL EXTERNO, TAMBIEN SE DEBE DESCONECTAR LA FUENTE DE ALIMENTACION EXTERNA.

NE PAS RELEVER LES LAMES AU-DEL A DU NIVEAU PREVU DE L'APPAREIL. METTRE HORS TENSION AVANT DE PROCEDER A L'ENTRETIEN. SI UNE COMMANDE EXTERNE EST UTILISEE, COUPER AUSSE L'ALIMENTATION EXTERNE. ASSURER UN DEGAGEMENT D'AU MOINS 6 PI ENTRE L'APPAREIL DE CHAUFFAGE ET LEPLANCHER.

UL c UL CALENTADOR DE AIRE LISTADO 774G

MARLEY ELCTRIC HEATING
BENNETTSVILLE, SC 29512

4104-0275-036

GARANTIA LIMITADA

Todos los productos fabricados por Marley Electric Heating están garantizados contra defectos de mano de obra y materiales durante un año a partir de la fecha de instalación, excepto los elementos calefactores que están garantizados contra defectos en mano de obra y materiales durante cinco años a partir de la fecha de instalación. Esta garantía no se aplica por daños ocurridos por accidente, mal uso, o alteración, ni cuando el voltaje conectado sea 5% mayor que el indicado en la placa de nombre; ni al equipo instalado o cableado indebidamente, o mantenido en violación de esta hoja de instrucciones. Todos los reclamos de trabajo de garantía deben estar acompañados por prueba de la fecha de instalación.

El cliente será responsable por todos los costos incurridos en la extracción o reinstalación de los productos, incluyendo costos de mano de obra, y costos de transporte incurridos al retornar los productos a Marley Electric Heating Service Center, y nosotros las repararemos o reemplazaremos, a nuestra opción, sin cargo para usted, con transporte de regreso pagado por Marley. Se acuerda mutuamente que tal reparación o reemplazo es el remedio exclusivo disponible de Marley Electric Heating.

LAS GARANTIAS INDICADAS ARRIBA SON A CAMBIO DE CUALQUIER OTRA GARANTIA EXPRESA O IMPLICITA Y SE DESCONOCEN Y EXCLUYEN DE ESTE ACUERDO TODAS LAS GARANTIAS IMPLICITAS DE COMERCIALIZACION Y APTITUD PARA UN FIN PARTICULAR QUE EXCEDAN LAS GARANTIAS PREVIAMENTE EXPRESADAS. MARLEY ELECTRICAL NO SERA RESPONSABLE POR DAÑOS CONSECUENTES ORIGINADOS POR EL PRODUCTO, YA SEAN QUE ESTEN BASADOS EN NEGLIGENCIA, LITIGACION, RESPONSABILIDAD ESTRICTA O CONTRATO.

Algunos estados no permiten la exclusión o limitación de los daños incidentales o consecuentes, de manera que la exclusión o limitación indicada arriba puede no aplicarse a usted. Esta garantía le otorga derechos legales específicos, y usted puede tener también otros derechos que varían de estado a estado.

Llame a Marley Electric Heating en Bennettsville, SC al 1-800-642-4328 para la dirección de su centro autorizado de servicio más cercano. La mercancía retornada a la fábrica debe estar acompañada por una autorización de retorno y una etiqueta de identificación de servicio, ambas disponibles de la ubicación indicada. Incluya todos los números de catálogo mostrados en el producto, al requerir autorización de retorno.

COMO ORDENAR PIEZAS DE REPUESTO

Por favor llame libre de cargo al Centro de Servicio de Marley Electric Heating, al 1-800-642-HEAT para obtener todas las piezas de reparación o repuesto, servicio de garantía o información técnica, requeridas.

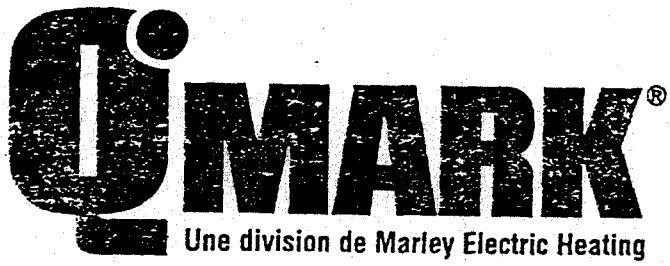
Siempre comunique la información listada como sigue al ordenar piezas de repuesto:

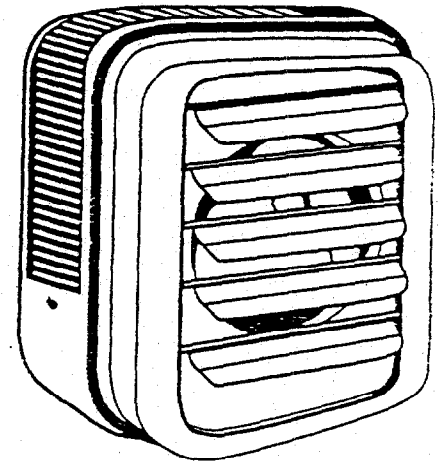
1. El número de pieza
2. El número de modelo
3. La descripción de la pieza
4. Fecha de fabricación

Marley Electric Heating
Una Compañía United Dominion
470 Beauty Spot Rd. East
Bennettsville, SC 29512 EE.U.U.

ECR 33386
2/97

No. de Pieza 5200-0722-009





Série MUH
Radiateurs modulaires

Homologués U.L.

Notice d'installation et d'entretien

Cher utilisateur,

Félicitations ! Nous vous remercions d'avoir fait l'acquisition de ce nouveau radiateur fabriqué par une division de Marley Electric Heating. Vous avez fait un bon investissement en choisissant un appareil de qualité imbattable. Veuillez lire attentivement et suivre scrupuleusement les consignes de ce manuel concernant l'installation et l'entretien. Nous sommes sûrs que vous bénéficierez de nombreuses années de confort grâce à cet appareil de chauffage efficace de Marley Electric Heating... le numéro 1 du secteur du chauffage en matière de conception, fabrication, qualité et service.

... Les employés de
Marley Electric Heating

⚠ AVERTISSEMENT ⚠

À lire attentivement : Cette notice a pour objet de vous aider à éviter les difficultés qui pourraient surgir lors de l'installation des radiateurs. Vous économisez beaucoup de temps, et réaliserez des économies plus tard en prenant connaissance de cette notice. Procédez de la façon indiquée ci- dessous et abrégez le temps nécessaire à l'installation.

Pour diminuer les risques d'incendie et d'électrocution :

1. Pour empêcher tout risque possible d'électrocution, couper le courant arrivant au radiateur au niveau du tableau de distribution principal avant d'entreprendre un câblage ou une réparation.
2. Tout câblage doit être conforme aux codes électriques national et local en vigueur et le radiateur doit être raccordé à la terre, pour les mesures préventives contre les risques d'électrocution.
3. Vérifier que la tension d'alimentation vers l'appareil et la tension du circuit de commande arrivant au radiateur et aux accessoires correspondent aux valeurs nominales indiquées sur la plaque signalétique du radiateur et des accessoires avant de les mettre sous tension.
4. La surface de ce radiateur est chaude pendant son utilisation. Pour éviter de se brûler, ne pas laisser la peau nue entrer en contact avec la surface chaude.
5. Ne pas introduire ou ne pas laisser pénétrer de corps étrangers dans les ouvertures de ventilation ou d'échappement, cela pouvant provoquer électrocution, incendie ou dommages au radiateur.
6. Pour empêcher tout risque d'incendie, ne pas obstruer les prises d'air ni les orifices d'échappement de quelque façon que ce soit. Éloigner les matériaux combustibles tels que caisses, tentures, etc. du radiateur. Ne pas installer cet appareil de chauffage derrière une porte, un meuble, un porte-serviettes ou des cartons.
7. Un radiateur comporte des pièces internes chaudes dans lesquelles se produisent des arcs ou des étincelles. Ne pas s'en servir dans des lieux dans lesquels on utilise ou entrepose de l'essence, de la peinture ou des liquides inflammables.
8. N'utiliser ce radiateur que de la façon décrite dans cet ouvrage. Toute autre utilisation non conseillée par le manufacturier risque de provoquer incendie, électrocution ou blessures.
9. Ce radiateur n'est pas agréé pour une utilisation dans une atmosphère corrosive telle que celle d'un bateau, d'une serre ou d'un entrepôt de produits chimiques.

CONSERVER CETTE NOTICE

AVIS IMPORTANTS ⚠

MISE EN GARDE ⚠

MONTER LE RADIATEUR À 213.4 cm (7 PIEDS) MINIMUM AU-DESSUS DU SOL AFIN D'EMPÊCHER TOUT CONTACT ACCIDENTEL AVEC LES PALES DU VENTILATEUR, CE QUI POURRAIT PROVOQUER DES BLESSURES.

MISE EN GARDE ⚠

IL FAUT QUE LA STRUCTURE DE MONTAGE AU PLAFOND ET QUE LES DISPOSITIFS D'ANCRAGE SOIENT SUFFISAMMENT RÉSISTANTS POUR POUVOIR SUPPORTER LE POIDS DU RADIATEUR ET DU SUPPORT DE MONTAGE. (VOIR LE TABLEAU 4).

MISE EN GARDE ⚠

POUR TOUS LES APPAREILS À THERMOSTATS INTÉGRÉS : SI LE RADIATEUR SERT À EMPÊCHER DES TUYAUX OU DES LIQUIDES DE GELER, ET SI LE THERMOSTAT EST RÉGLÉ À MOINS DE 7°C (45°F), IL FAUT QUE LE VENTILATEUR TOURNE EN PERMANENCE.

MISE EN GARDE ⚠

POUR EMPÊCHER TOUT RISQUE POSSIBLE DE SURCHAUFFE OU DE DOMMAGES PROVOQUÉS PAR UNE SURCHAUFFE, LAISSER UNE DISTANCE DE 152.4 cm (5 PIEDS) MINIMUM À L'AVANT ET CONSULTER LE TABLEAU 1 POUR CONNAÎTRE LES DISTANCES MINIMALES SUR LES CÔTÉS ET À L'ARRIÈRE.

NE JAMAIS MONTER DE THERMOSTAT À MERCURE DIRECTEMENT SUR L'APPAREIL. LES VIBRATIONS POURRAIENT PROVOQUER UN MAUVAIS FONCTIONNEMENT DU RADIATEUR.

INTERRUPTEUR MANUEL DE REMISE EN MARCHE (OPTION INSTALLÉE EN USINE UNIQUEMENT). L'INTERRUPTEUR MANUEL DE REMISE EN MARCHE EST SITUÉ À L'INTÉRIEUR DU RADIATEUR, À LA PARTIE ARRIÈRE. SUR LES MODÈLES MUH03 ET MUH05, L'ACCÈS AU BOUTON MANUEL DE REMISE EN MARCHE EST SITUÉ SUR LE CÔTÉ DROIT (LORSQU'ON SE PLACE À L'ARRIÈRE DE L'APPAREIL); SUR TOUS LES AUTRES MODÈLES IL EST SITUÉ PRÈS DE LA PARTIE SUPÉRIEURE ARRIÈRE DU RADIATEUR.

L'INTERRUPTEUR MANUEL DE REMISE EN MARCHE EST MONTÉ EN SÉRIE AVEC LE PROTECTEUR DE RECYCLAGE AUTOMATIQUE (LIMITE). L'APPAREIL NE REFONCTIONNERA PAS TANT QUE L'ON N'AURA PAS APPUYÉ SUR CE BOUTON.

CONSEILS POUR L'EMPLACEMENT DU RADIATEUR

Disposer les radiateurs pour que le flux d'air chaud :

a. rencontre un minimum d'obstacles tels que colonnes, machines ou cloisons;
b. balaie les murs exposés sans souffler directement sur eux;
c. soit dirigé à l'opposé des occupants de la pièce dans le cas d'un chauffage de confort;
d. soit dirigé du côté venté lorsque les radiateurs sont installés dans un bâtiment exposé à un vent prédominant.

Placer les thermostats à 1524 mm (5 pieds) du sol sur des cloisons intérieures, ou sur des colonnes à l'abri de courants d'air froid, de sources de chaleur internes et de flux d'air chaud provenant de radiateurs.

Les petites pièces peuvent être chauffées par un seul appareil de chauffage.

Les plus grandes pièces nécessitent plusieurs appareils. Le nombre et la puissance des appareils dépendra du volume des locaux et de la superficie à chauffer. Disposer les appareils pour fournir un périmètre de circulation d'air où chaque appareil favorise le courant d'air d'un autre appareil.

MONTAGE DU RADIATEUR
GÉNÉRALITÉS

Le radiateur peut être monté de façon à décharger l'air chaud soit horizontalement, soit verticalement. Lorsque le radiateur est monté pour une décharge verticale, il est conseillé de le disposer de façon à ce que la porte d'accès se trouve ailleurs que face à un mur afin de faciliter l'accès au compartiment de câblage et de commande. Si le radiateur est monté de façon à ce que la porte d'accès se trouve face au mur, laisser une distance au mur suffisante pour permettre la pleine ouverture de la porte d'accès (la distance doit être environ égale à la largeur du radiateur... vérifier qu'il existe un espace suffisant avant l'installation). Avant de monter le radiateur, se reporter au tableau 1 qui indique les distances à respecter par rapport au mur et au plafond.

Le radiateur peut se monter pour une décharge verticale ou horizontale à l'aide de tiges filetées. (Se reporter au tableau 2 pour connaître les dimensions des tiges filetées requises). Suivre les méthodes détaillées dans les instructions d'installation suivantes.

Le radiateur peut aussi se suspendre au mur ou au plafond à l'aide d'un support en option (de type MMB ou MCMB) qui permet le pivotement horizontal du radiateur.

Une fois le radiateur installé, on peut orienter les persiennes de manière à diriger le flux d'air chaud de la façon souhaitée.

Lorsque le radiateur est installé pour une décharge horizontale, les persiennes doivent diriger l'air tout droit ou vers le bas. L'air dirigé vers le haut peut rester dans la zone du plafond, ce qui gaspille de l'énergie.

DÉCHARGE HORIZONTALE (Montage sur tige au plafond)

1. Monter quatre tiges filetées de fixation dans les trous filetés et les bloquer en place à l'aide de contre-écrous (Voir tableau 2).
2. Fixer fermement les quatre tiges filetées au plafond. (Se reporter au tableau 1 indiquant les distances à respecter par rapport aux murs et au plafond et au tableau 2 qui indique l'espacement des tiges de fixation).

Tableau 1. Distances par rapport aux murs et au plafond en mm (pouces)

Appareil	Dégagement	Plafond	Mur latéral	Mur arrière
3 & 5 kW	Horiz.	50.8 (2)	152.4 (6)	228.6 (9)
	Vert.	152.4 (6)	457.2 (18)	457.2 (18)
7.5 à 10 kW	Horiz.	152.4 (6)	152.4 (6)	330.2 (13)
	Vert.	152.4 (6)	609.6 (24)	609.6 (24)
15 à 20 kW	Horiz.	152.4 (6)	228.6 (9)	317.5 (12½)
	Vert	152.4 (6)	609.6 (24)	609.6 (24)
25 à 50 kW	Horiz.	406.4 (16)	304.8 (12)	470.0 (18½)
	Vert.	304.8 (12)	914.4 (39)	914.4 (39)

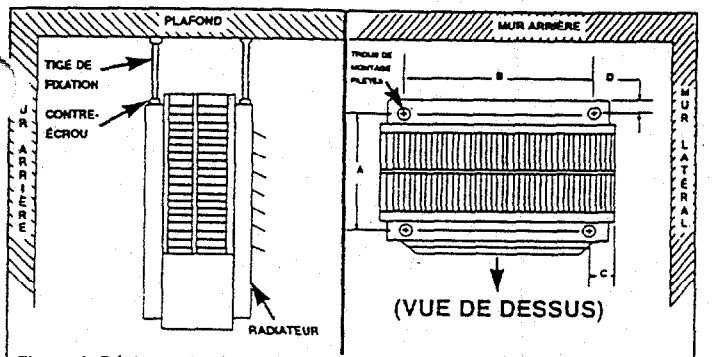


Figure 1. Décharge horizontale, montage et espacements.

Tableau 2. Filetage de la tige et dimensions de l'espacement en mm (po) pour décharge horizontale

Appareil	Type de filetage de la tige	A	B	C	D
3 - 5 kW	5/16 - 18	153.9 (6 1/16)	152.4 (6)	103.1 (4 1/16)	19.0 (3/4)
7.5 - 10 kW			225.6 (8 7/8)	130.3 (5 1/8)	19.0 (3/4)
15 - 20 kW		289.0 (11 3/8)			
25 - 30 kW	3/8 - 16	268.2 (10 9/16)	368.3 (14 - 12)	157.2 (6 3/16)	16.0 (5/8)
40 - 50 kW		404.9 (15 15/16)	368.3 (14 - 12)	157.2 (6 3/16)	16.0 (5/8)

DÉCHARGE VERTICALE (Tige montée au plafond)

Enlever les boulons des tiges filetées à l'arrière du radiateur.

2. Monter quatre tiges de fixation filetées dans les trous filetés et fixer en place à l'aide de contre-écrous.
3. Fixer solidement les quatre tiges filetées au plafond. (Se reporter au tableau 1 où figurent les distances à respecter par rapport au mur et au plafond et au tableau 3 indiquant les dimensions pour l'espacement des tiges de fixation).

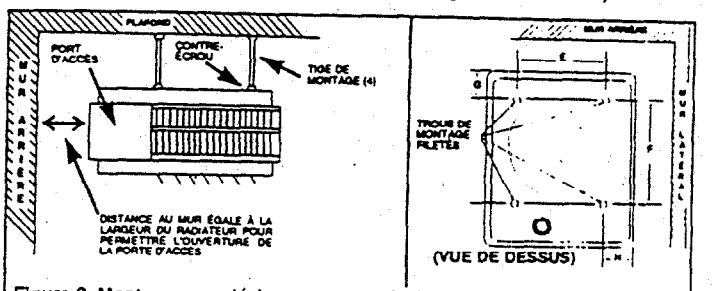


Figure 2. Montage pour déchargement vertical et espacement des tiges

Tableau 3. Type de tiges filetées et dimensions de l'espacement des tiges en mm (po) pour une décharge verticale

Appareil	Type de filetage de la tige	E	F	G	H
3 - 5 kW	5/16 - 18	152.4 (6)	247.7 (9 3/4)	50.8 (2)	103.1 (4 1/16)
7.5 - 20 kW		225.6 (8 7/8)	371.6 (14 5/8)	50.8 (2)	130.3 (5 1/8)
25 - 30 kW	3/8 - 16	368.3 (14 1/2)	539.8 (21 1/4)	56.0 (2 3/16)	157.2 (6 3/16)

CÂBLAGE

CIRCUIT D'ALIMENTATION (PUISSANCE)

1. Brancher le radiateur uniquement à la tension, au courant et à la fréquence spécifiés sur la plaque de firme.
2. La taille des fils de câblage sur site doit être convenablement choisie pour transporter l'ampérage en conformité avec le NEC.
3. La porte d'accès est munie de charnières. Il faut desserrer une ou deux vis accessibles par les côtés pour y accéder. Il s'agit de vis prisonnières : ne pas essayer de les retirer.
4. Une pastille défonçable est fournie à l'arrière du radiateur près du bornier secteur et de la plaque à bornes de commande. La partie défonçable du bornier de commande est pour un conduit de 12,7 mm (1/2 po). La pastille défonçable pour bornier de puissance est de diamètre multiple. Utiliser le diamètre correspondant à la taille requise du conduit.
5. Une borne de masse est fournie près de la plaque à bornes de puissance. Le fil de masse doit être branché avant d'effectuer tout autre raccordement.
6. La plaque à bornes de puissance est équipée de bornes d'une taille suffisante pour accepter la taille adéquate de fil d'alimentation de puissance. Un fil prévu pour 600 V et 60°C est satisfaisant pour le circuit d'alimentation du radiateur. Un fil de cuivre ou d'aluminium est satisfaisant pour le raccordement au bornier de la boîte de puissance. Un fil de cuivre est conseillé et doit être utilisé avec un sectionneur intégré.

7. Un schéma de câblage est collé sur la face interne de la porte d'accès. Se reporter au schéma avant d'effectuer un quelconque raccordement sur le site.
8. Un raccordement sur secteur monophasé ou triphasé peut être utilisé sur les radiateurs modèles MUH0521, MUH07, MUH0581, MUH07, MUH078, MUH102, MUH108, et MUH158. Ces unités sont câblées en usine pour un fonctionnement en monophasé. Si ces radiateurs doivent être utilisés sur une alimentation en triphasé, rebrancher les fils comme l'indique le schéma de câblage livré avec le radiateur. Les figures 3a et 3b illustrant le câblage ainsi que les consignes ci-dessous apportent des renseignements supplémentaires.

Sur les modèles MUH0521, MUH0581, MUH072, MUH078, MUH102, et MUH058 (figure 3a), déplacer uniquement les deux fils marqués "A1" et "B1"; ne déplacer et ne changer aucun autre fil. Le fil principal de l'élément marqué "B1" qui est branché en usine sur le bornier de puissance (le bornier le plus proche des éléments) doit être déplacé sur la borne marquée "B" du bornier triphasé.

Le fil du relais (contacteur) "A1" doit être déplacé de la borne d'extrémité du bornier de puissance (borne la plus proche du contacteur ou de la plaque à bornes de commande) vers la borne "A" du bornier inférieur (borne centrale).

Le modèle MUH158 (figure 3b) est doté de deux blocs de borniers de triphasé situés tout près des relais (contacteurs). Déplacer uniquement les deux fils marqués "C1" et "D1" de chacun de ces blocs de borniers de triphasé vers le bornier "B". Ne déplacer et ne changer aucun autre fil.

9. Les accessoires électriques, kits ou options installés en usine, sont indiqués par un trait en pointillé sur le schéma de câblage du radiateur.
10. **RADIATEUR DE 208/240 V.** Échanger les fils rouge et noir primaires du transformateur (voir schéma de câblage) si le radiateur doit être branché sur du secteur en 208 Volts.

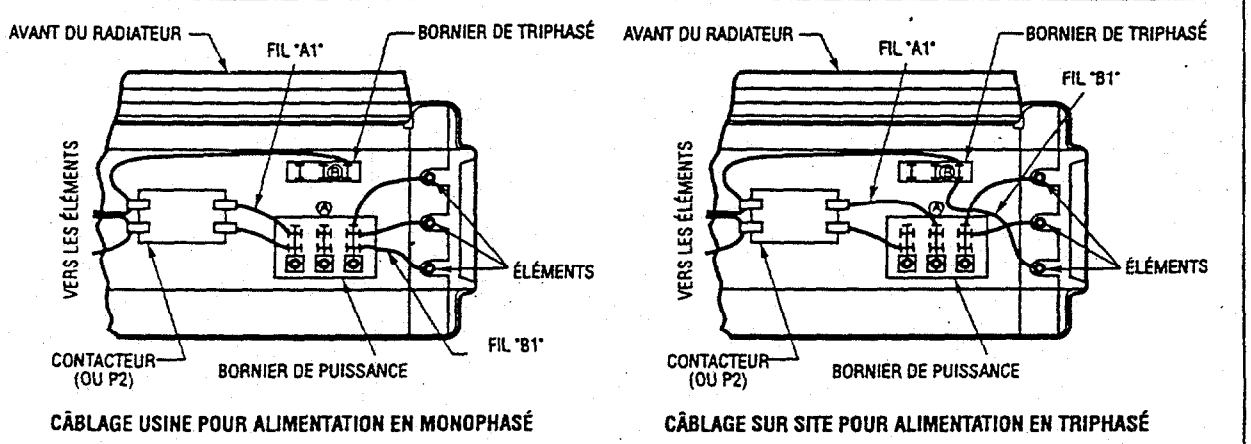


Figure 3a. Câblage pour alimentation en monophasé et triphasé (MUH0521, MUH0581, MUH072, MUH078, MUH102 et MUH108)

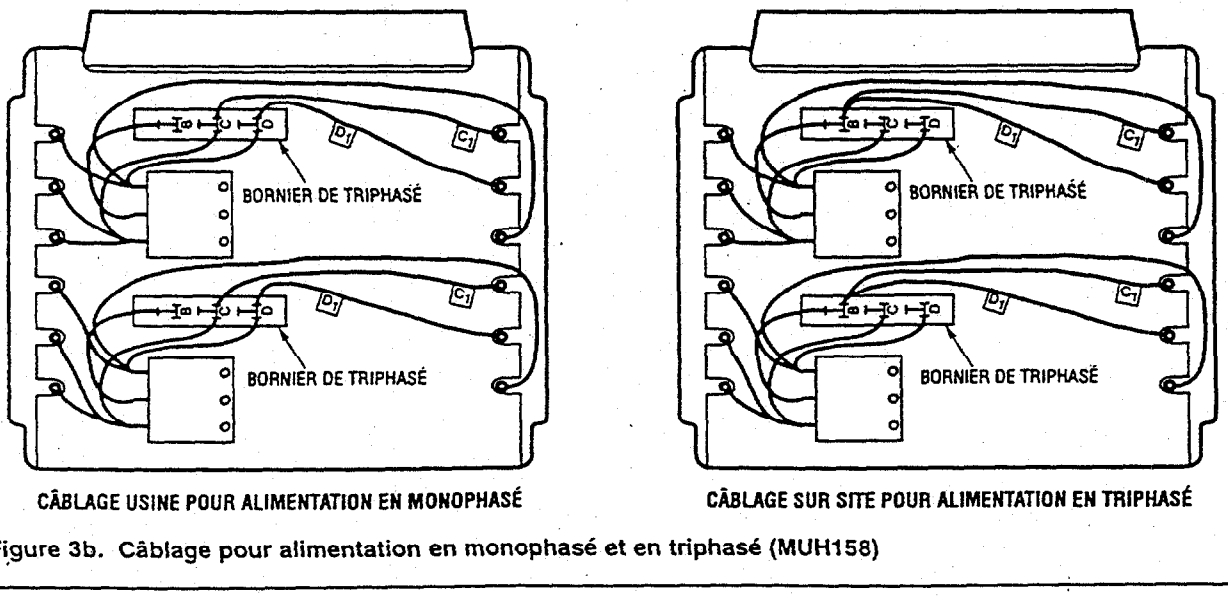


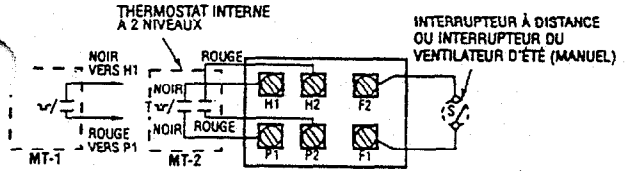
Figure 3b. Câblage pour alimentation en monophasé et en triphasé (MUH158)

CÂBLAGE DE COMMANDE

AVERTISSEMENT

TENSION SECTEUR EST PRÉSENTE SUR CERTAINES DES BORNES DE LA PLAQUE À BORNES DE COMMANDE. TOUJOURS DÉBRANCHER L'ALIMENTATION DU RADIATEUR AVANT DE PROCÉDER À UN RACCORDEMENT SUR LA PLAQUE DE COMMANDE AFIN D'ÉVITER TOUT RISQUE D'ÉLECTROCUTION.

1. Utiliser des fils isolés de 600 V NEC classe 1 d'un calibre minimum de 18 pour le thermostat et d'un calibre minimum 14 pour l'interrupteur moteur de la tension secteur (interrupteur de ventilateur à distance sans relais).
2. Utiliser une cosse à sertir en forme de fourche sur les extrémités des fils qui se fixent sur la plaque à bornes de commande du MUH si plus d'un raccordement doit être effectué sous la borne à vis.
3. Câbler en suivant le schéma de la figure 4 pour les appareils sans contacteur.
4. Câbler en suivant le schéma de la figure 5 pour les appareils avec contacteurs.

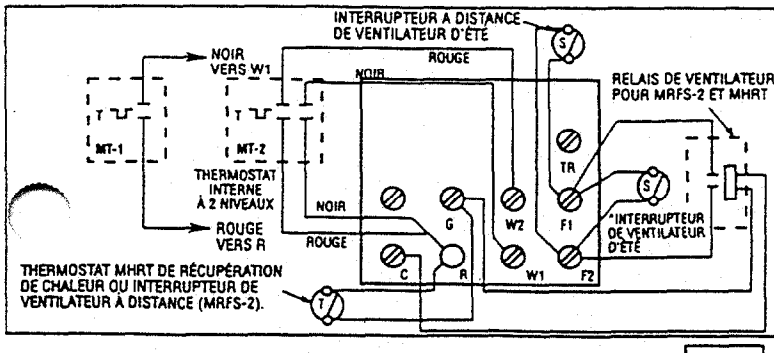


REMARQUES :
1. CE TYPE DE PLAQUE À BORNES DE COMMANDE EST UTILISÉ SUR MODÈLES MUH321, MUH371, MUH381, MUH521, MUH571 ET MUH581.
2. LORSQUE L'APPAREIL EST CÂBLÉ POUR DU MONOPHASÉ, METTRE UN CAVALIER DE H1 À H2. SI ON UTILISE UN THERMOSTAT UNIPOLAIRE SUR UN APPAREIL MONOPHASÉ, RACCORDER LES FILS DU THERMOSTAT À P1 ET H1.
3. TRAITER UN THERMOSTAT EXTERNE SUR SECTEUR EXCLUSIVEMENT COMME UN THERMOSTAT À NIVEAU UNIQUE.

Figure 4. Plaque à bornes de commande (pour radiateur sans contacteurs)

Table 4. Spécifications

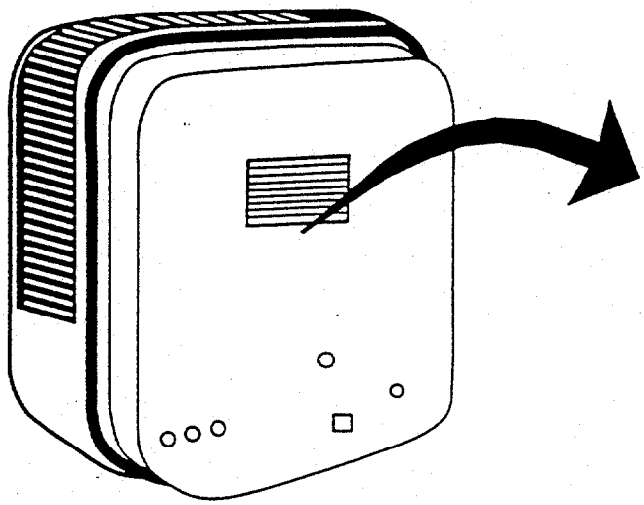
Modèle de base N°	Hauteur po (mm)	Largeur po (mm)	Profondeur po (mm)	Poids monté kg (livres)	Volume du compartiment de câblage
MUH0381	16 (406.4)	14 (355.6)	7½ (190.5)	27 (12.2)	90 in³ (1470 cm³)
MUH0321				27 (12.2)	
MUH0371				27 (12.2)	
MUH0341				30 (13.6)	
MUH0581				27 (12.2)	
MUH0521				27 (12.2)	
MUH0571				27 (12.2)	
MUH0541				30 (13.6)	
MUH0331				30 (13.6)	
MUH0361				30 (13.6)	
MUH0531				30 (13.6)	
MUH0561				30 (13.6)	
MUH078	21¾ (552.5)	19 (482.6)	7½ (190.5)	38 (17.2)	100 in³ (1639 cm³)
MUH072				38 (17.2)	
MUH077				38 (17.2)	
MUH074				38 (17.2)	
MUH108				38 (17.2)	
MUH102				38 (17.2)	
MUH107				38 (17.2)	
MUH104				38 (17.2)	
MUH073				38 (17.2)	
MUH076				38 (17.2)	
MUH103				38 (17.2)	
MUH106				38 (17.2)	
MUH158	21¾ (552.5)	19 (482.6)	12¾ (323.9)	54 (24.5)	140 in³ (2295 cm³)
MUH152				50 (22.7)	
MUH154				50 (22.7)	
MUH208				60 (27.2)	
MUH202				55 (24.9)	
MUH204				55 (24.9)	
MUH156				55 (24.9)	
MUH206				55 (24.9)	
MUH252	30 (762.0)	26⅝ (676.4)	11¾ (298.5)	89 (40.4)	504 in³ (8260 cm³)
MUH254				89 (40.4)	
MUH308				89 (40.4)	
MUH302				89 (40.4)	
MUH304				89 (40.4)	
MUH256				89 (40.4)	
MUH306				89 (40.4)	
MUH402	30 (762.0)	26⅝ (676.4)	17¼ (435.1)	119 (54.0)	648 in³ (10620 cm³)
MUH404				119 (54.0)	
MUH508				119 (54.0)	
MUH502				119 (54.0)	
MUH504				119 (54.0)	
MUH406				119 (54.0)	
MUH506				119 (54.0)	



REMARQUES :
1. CE TYPE DE PLAQUE À BORNES DE COMMANDE EST UTILISÉ SUR LES MODÈLES À L'EXCEPTION DE MUH321, MUH371, MUH381, MUH521, MUH571 ET MUH581.
2. RETIRER LE CAVALIER ENTRE W1 ET W2 LORSQU'ON UTILISE UN THERMOSTAT À 2 NIVEAUX.
3. *ON NE PEUT UTILISER QU'UN SEUL DE CES ACCESSOIRES SUR UN RADIATEUR UNIQUE.
4. TRAITER UN THERMOSTAT EXTERNE SUR SECTEUR EXCLUSIVEMENT COMME UN THERMOSTAT À NIVEAU UNIQUE

Figure 5. Plaque à bornes de commande (pour radiateur avec contacteurs)

RENSEIGNEMENT IMPORTANT



PLAQUE SIGNALÉTIQUE

MODEL NO. / MFG. NO. MUH321 — DATE CODE 0395

VOLTS AC 60 HZ	KILOWATTS	PHASE	MIN. SUPPLY CIR. AMPACITY
208 / 240	2.2 /3	1	

MAX. FUSE	MOTOR		CONTROLS	CUSTOMER NO
	VAC	AMP	VAC	
	208/240	.25	208/240	

AIR FLOW	MINIMUM MOUNTING CLEARANCE SIDE	BACK	CEILING	FLOOR
HORIZ.	6"	9.5"	2"	7'
VERT.	18"	18"	6"	7'

WARNING: DO NOT TURN LOUVERS ABOVE LEVEL OF THE UNIT. DISCONNECT POWER BEFORE SERVICING. IF EXTERNAL CONTROL IS USED, ALSO DISCONNECT EXTERNAL POWER SUPPLY.

NE PAS RELEVER LES LAMES AU-DEL A DU NIVEAU PREVU DE L'APPAREIL. METTRE HORS TENSION AVANT DE PROCEDER A L'ENTRETIEN. SI UNE COMMANDE EXTERNE EST UTILISEE, COUPER AUSSE L'ALIMENTATION EXTERNE. ASSURER UN DEGAGEMENT D'AU MOINS 6 PI ENTRE L'APPAREIL DE CHAUFFAGE ET LEPLANCHER.

774G LISTED AIR HEATER

MARLEY ELCTRIC HEATING
BENNETTSVILLE, SC 29512

4104-0275-036

GARANTIE LIMITÉE

Tous les produits mentionnés dans la présente notice sont garantis contre tout vice de matière et de construction pour une durée d'une année à partir de la date de montage, à l'exception des éléments de chauffage qui sont garantis contre tout défaut de matière et de construction pour une durée de cinq années à partir de la date de montage. Cette garantie ne s'applique pas aux dommages provoqués par un accident, une mauvaise utilisation ou une modification; elle ne s'applique pas non plus lorsque l'appareil a été branché sur un courant de tension supérieure de plus de 5% à la tension indiquée sur la plaque signalétique, ni à du matériel incorrectement monté, câblé ou entretenu, des instructions de'installation du produit. Toute réclamation dans le cadre de la garantie doit être accompagnée d'une preuve de la date de montage.

Les frais de démontage et de remontage des produits, y compris de main- d'oeuvre ainsi que les frais d'expédition à un centre de réparation Marley Electric Heating seront à la charge du client. Retourner, dans les limites de cette garantie, l'appareil en panne, à l'atelier de réparations agréé Marley le plus proche ou au Centre de réparations Marley Electric Heating et nous le réparerons ou le remplacerons à notre choix, sans frais pour vous, l'expédition de retour étant à notre charge. Il est entendu que la réparation ou le remplacement constitue le remède exclusif fourni par Marley Electric Heating.

LES GARANTIES CI-DESSUS REMPLACENT TOUTES LES AUTRES GARANTIES EXPLICITES OU IMPLICITES ET TOUTES LES GARANTIES IMPLICITES DE QUALITÉ MARCHANDE ET D'ADAPTATION À UN BUT PARTICULIER DÉPASSANT LES GARANTIES EXPLICITES SUS-MENTIONNÉES SONT REJETÉES ET EXCLUES DE CE CONTRAT. MARLEY ELECTRIC HEATING NE SERA PAS RESPONSABLE DES DOMMAGES INDIRECTS PROVOQUÉS PAR LE PRODUIT, QUE LA RÉCLAMATION SE FONDE SUR UNE FAUTE, LA NÉGLIGENCE, LA STRICTE RESPONSABILITÉ OU LE CONTRAT.

Certains états ne permettent pas les exclusions ou les limites aux dommages indirects ou consécutifs; los exclusions ou limites exposées ci-dessus risquent donc de ne pas s'appliquer à vous. Cette garantie vous donne des droits spécifiques face à la loi et vous pouvez disposer d'autres droits, variables d'un état à un autre.

Pour obtenir l'adresse du centre de réparation autorisé le plus proche, appelez Marley Electric Heating à Bennettsville, SC, États-Unis, au 1-800-642-4328. Les marchandises retournées à l'usine doivent être accompagnées du numéro d'autorisation et de l'étiquette d'identification du service,tous deux fournis par Marley Electric Heating. Inclure toutes les références figurant sur les produits dans toute demande d'autorisation de retour.

COMMENT COMMANDER DES PIÈCES DE RECHANGE

Afin d'obtenir des pièces détachées ou de remplacement, une réparation sous garantie ou un renseignement technique, veuillez contacter Marley Electric Heating Service Center sans frais en appelant le 1-800-642-HEAT.

Pour commander des pièces détachées, toujours mentionner les informations indiquées ci-dessous:

1. La référence de la pièce
2. Le numéro du modèle
3. La description de la pièce
4. La date de fabrication

Marley Electric Heating
Un Société United Dominion
470 Beauty Spot Rd. East
Bennettsville, SC 29512 USA

ECR 33386
02/97
Part No. 5200-0722-009

MUH REPLACEMENT PARTS

MUH

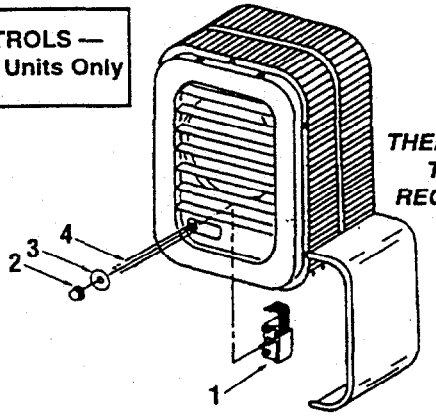
Built-in Controls

Key No.	Description	Part Number
1	Thermostat, One Pole (MT-1)	5813-0036-000
	Thermostat, Two Stage (MT-2)	5813-0035-000
2	Knob, Thermostat	3301-0060-000
3	Label, Thermostat	3502-1781-000
4	Screws, Fl. Hd., 6-32 x 1/4	5202-7009-021
5	Clip, Thermostat	1403-0041-000
6	Switch, 25A, OEM	5216-0132-000
	Switch, 25A, K & N	5216-0204-000
	Switch, 63A, OEM	5216-0131-000
	Switch, 63A, K & N	5216-0203-000
	Switch 25A, Electro	5216-0200-000
7	Screw, M4 x 10, Rd. Hd., (25A)	—
	Screw, 63A, M5 x 16, Rd. Hd.	—
8	Knob, 25A, OEM "T1"	OEM "T1"
	Knob, 25A, K & N	K & N S1B 6001
	Knob, 63A, OEM	OEM "S4"
	Knob, 63A, K & N	K & N S2B G001
	Knob, Electro	EI 141747
9	Switch, Toggle, 600V	5216-0130-000
10	Relay, Fan, 24V Coil	5018-0008-000
11	Switch Assembly	5216-0199-000
12	Manual Reset Limit	4520-0012-000

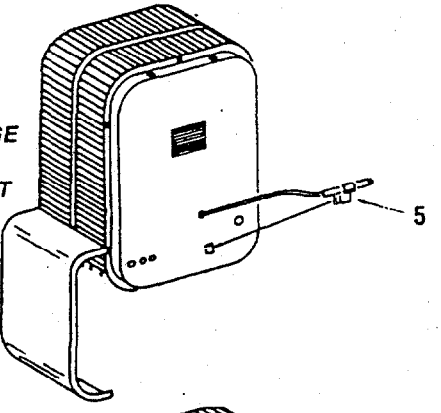
Heater Replacement Parts

Key No.	Description	Part Number
1	Spring, Element (used on MUH03 thru MUH-20 only)	5208-0073-000
	Spring, Element (used on MUH-25 thru MUH-50 only)	5208-0073-001
2	Spring, Capillary Tube	5208-0072-000
3	Spring, Element Retainer	5208-0074-000
4	Switch (used on MUH-25 thru MUH-50 only)	5216-7076-001
5	Insulator (used on MUH-25 thru MUH-50 only)	2900-0031-000
6	Bracket Extension (used on MUH-15, MUH-20, MUH-40 and MUH-50 only)	1215-0282-000
7	Switch Bracket	1215-0256-000
8	Fan Delay Protector	4520-0010-000
14	Speed Nut	4100-7036-026
15	Bracket, Captive Screw (used on MUH-03 thru MUH-20 only)	1215-0291-000
	Bracket, Captive Screw (used on MUH-25 thru MUH-50 only)	1215-0289-000
17	Protector, Linear Limit (used on MUH03 thru MUH05 only)	4520-0011-000
	Protector, Linear Limit (used on MUH-07 thru MUH-20 only)	4520-0011-001
	Protector, Linear Limit (used on MUH-25 thru MUH-50 only)	4520-0011-002
20	Clamp (used on MUH-20 thru MUH-50 only)	1417-5004-000
	Bracket, Mounting Capacitor (used on MUH-20-8 only)	1215-0314-000
22	Terminal Lug (used on MUH-07 thru MUH-50 only)	3504-7002-001
25	Bushing (used on MUH-20 thru MUH-50 only)	25221-60131
26	Washer, Ground (used on MUH03 thru MUH05 only)	6401-0084-000
27	Screw, Ground (used on MUH03 thru MUH05 only)	5202-0290-002
28	Louver (used on MUH03 thru MUH05 only)	3503-0036-000
	Louver (used on MUH-07 thru MUH-20 only)	3503-0036-001
	Louver (used on MUH-25 thru MUH-50 only)	3503-0036-002
29	Spring, Louver	5208-7005-001
32	Terminal Block, 3-Phase (used on MUH05-21, MUH-07-02, and MUH-10-2 only)	5823-0003-000
	Terminal Block, 3-Phase (used on MUH05-81, MUH-07-8, and MUH-15-8 only)	5823-0003-000
33	Terminal Doublers (used where required)	5819-7012-005

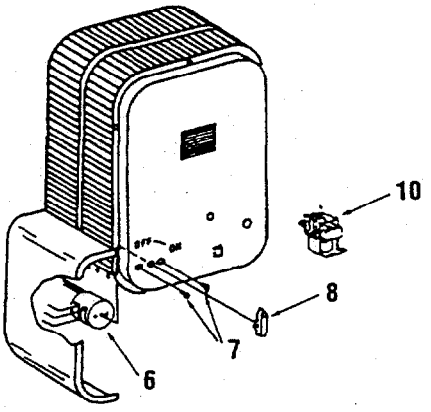
BUILT-IN CONTROLS — Made-to-Order Units Only



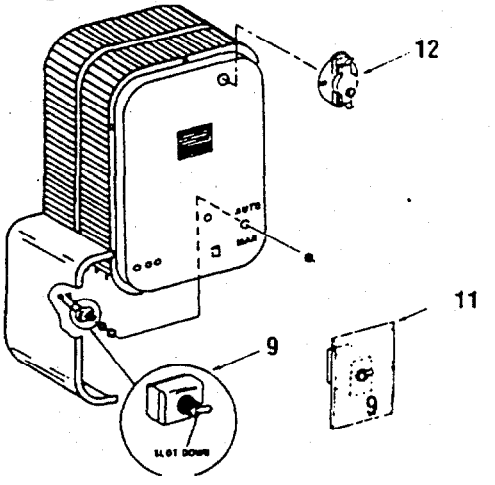
SINGLE-POLE THERMOSTAT, TWO-STAGE THERMOSTAT, HEAT RECOVERY THERMOSTAT



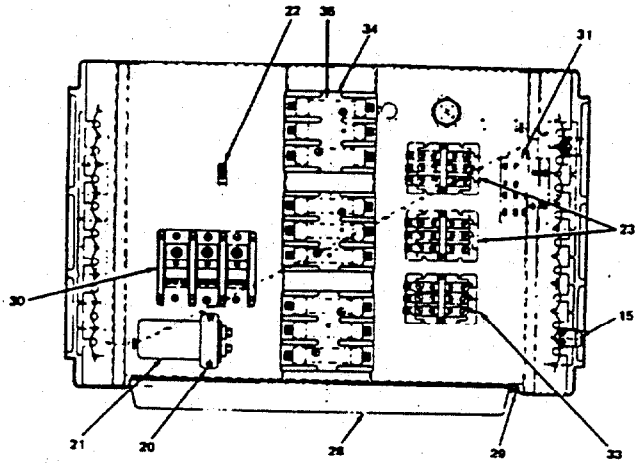
POWER DISCONNECT SWITCH



SUMMER FAN SWITCH

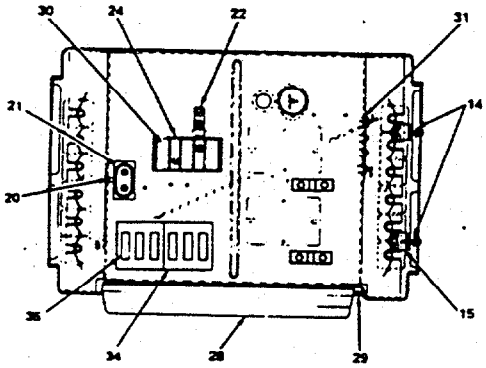


MUH (Con't.)



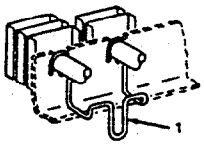
VIEW D-D
(MUH-25 THRU MUH-50 ONLY)

TERMINAL DOUBLER
(USED AS REQUIRED)

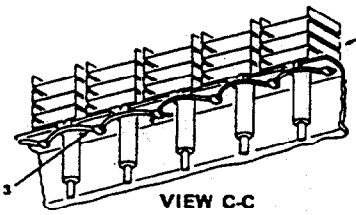


VIEW D-D
(MUH-07 THRU MUH-20 ONLY)

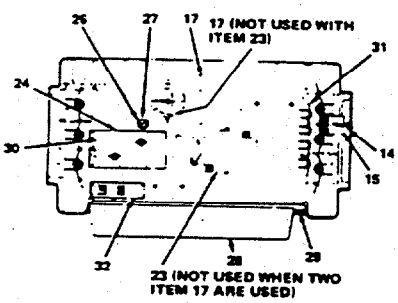
VIEW A-A



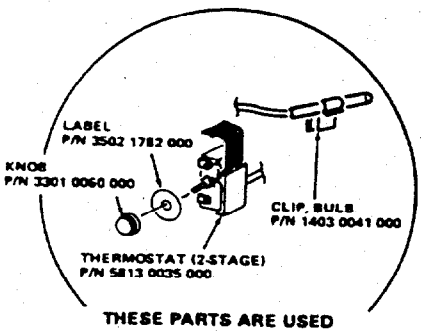
VIEW B-B



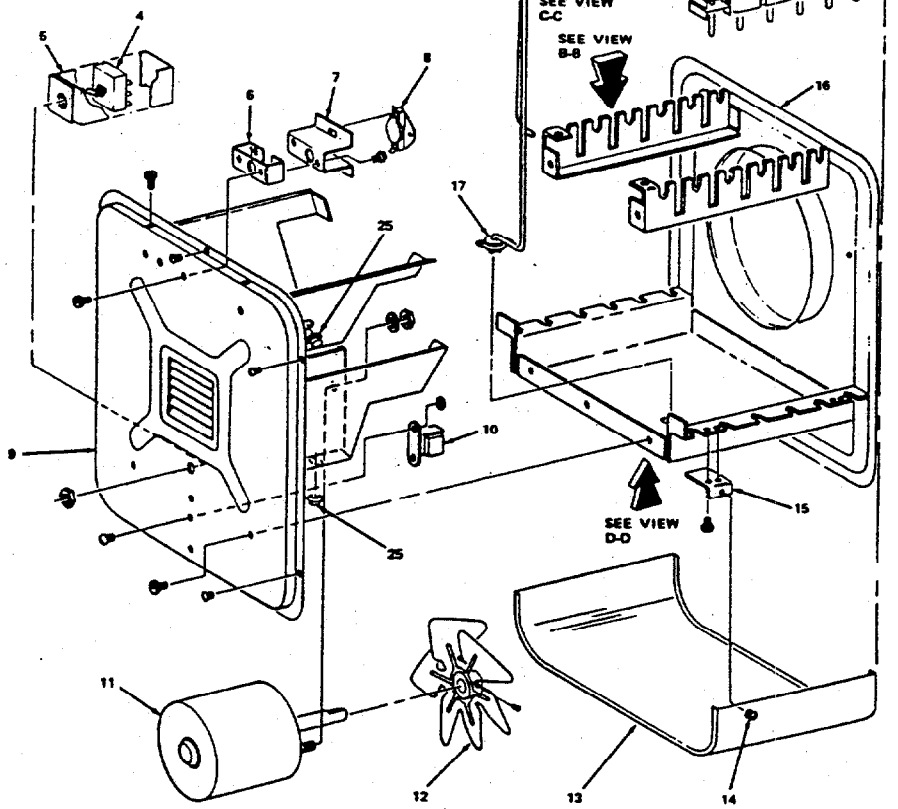
VIEW C-C



VIEW D-D
(MUH03 THRU MUH05 ONLY)



THESE PARTS ARE USED
ON MODEL MUH05-21T ONLY



MUH (Con't.)

Model No.	⑨ Back Case	⑩ Transformer**	⑪ Motor	⑫ Fan Blade	⑬ Cover	⑯ Front Case	⑱ Element Assy.	⑲ Element Guard	㉑ Capacitor
MUH03-21	1425-2004-000	–	3900-2002-006	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-000	2504-0011-000	–
MUH03-41	1425-2004-000	5814-0003-002	3900-2005-000	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-002	2504-0011-000	–
MUH03-71	1425-2004-000	–	3900-2002-007	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-001	2504-0011-000	–
MUH03-81	1425-2004-000	–	3900-2002-006	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-024	2504-0011-000	–
MUH05-21	1425-2004-000	–	3900-2002-006	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-003	2504-0011-000	–
MUH05-41	1425-2004-000	5814-0003-002	3900-2005-000	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-005	2504-0011-000	–
MUH05-71	1425-2004-000	–	3900-2002-007	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-004	2504-0011-000	–
MUH05-81	1425-2004-000	–	3900-2002-006	1210-2000-000	1402-0336-001	1425-0009-005	1802-0087-025	2504-0011-000	–
MUH-07-2	1425-0010-004	5814-0003-000	3900-2014-002	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-006	2504-0013-001	–
MUH-07-4	1425-0010-004	5814-0003-002	3900-0347-005	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-008	2504-0013-001	–
MUH-07-7	1425-0010-004	5814-0003-001	3900-2014-003	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-007	2504-0013-001	–
MUH-07-8	1425-0010-004	5814-0003-000	3900-2014-001	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-031	2504-0013-001	–
MUH-10-2	1425-0010-004	5814-0003-000	3900-2014-002	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-031	2504-0013-001	–
MUH-10-4	1425-0010-004	5814-0003-002	3900-0347-005	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-011	2504-0013-001	–
MUH-10-7	1425-0010-004	5814-0003-001	3900-2014-003	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-010	2504-0013-001	–
MUH-10-8	1425-0010-004	5814-0003-000	3900-2014-001	1210-0090-000	1402-0339-002	1425-0009-006	1802-0087-036	2504-0013-001	–
MUH-15-2	1425-0014-000	5814-0003-000	3900-0361-000	1210-0090-001	1402-0339-003	1425-0009-007	1802-0087-012	2504-0012-001	–
MUH-15-4	1425-0014-000	5814-0003-002	3900-0361-001	1210-0090-001	1402-0339-003	1425-0009-007	1802-0087-013	2504-0012-001	–
MUH-15-8	1425-0014-000	5814-0003-000	3900-0361-002	1210-0090-001	1402-0339-003	1425-0009-009	1802-0087-031	2504-0012-001	–
MUH-20-2	1425-0013-000	5814-0003-000	3900-0362-000	1210-0096-000	1402-0339-003	1425-0009-007	1802-0087-014	2504-0012-001	1432-0002-003
MUH-20-4	1425-0013-000	5814-0003-002	3900-0362-001	1210-0096-000	1402-0339-003	1425-0009-007	1802-0087-015	2504-0012-001	1432-0002-003
MUH-20-8	1425-0013-000	5814-0003-000	3900-0362-002	1210-0096-000	1402-0339-003	1425-0009-011	1802-0087-026	2504-0012-001	1432-0002-003
MUH-25-2	1425-0011-003	5814-0003-000	3900-0364-000	1210-0098-000	1402-0340-002	1425-0012-003	1802-0087-016	2504-0014-001	1432-0002-001
MUH-25-4	1425-0011-003	5814-0003-002	3900-0363-001	1210-0098-000	1402-0340-002	1425-0012-003	1802-0087-017	2504-0014-001	1432-0002-003
MUH-30-2	1425-0011-003	5814-0003-000	3900-0364-000	1210-0098-000	1402-0340-002	1425-0012-003	1802-0087-018	2504-0014-001	1432-0002-001
MUH-30-4	1425-0011-003	5814-0003-002	3900-0363-000	1210-0098-000	1402-0340-002	1425-0012-003	1802-0087-019	2504-0014-001	1432-0002-003
MUH-30-8	1425-0011-003	5814-0003-000	3900-0364-000	1210-0098-000	1402-0340-002	1425-0009-009	1802-0087-028	2504-0014-001	1432-0002-001
MUH-40-2	1425-0011-001	5814-0003-000	3900-0350-000	1210-0097-000	1402-0340-003	1425-0012-002	1802-0087-020	2504-0015-001	1432-0002-004
MUH-40-4	1425-0011-001	5814-0003-002	3900-0350-001	1210-0097-000	1402-0340-003	1425-0012-002	1802-0087-021	2504-0015-001	1432-0002-004
MUH-50-2	1425-0011-001	5814-0003-000	3900-0350-000	1210-0097-000	1402-0340-003	1425-0012-002	1802-0087-022	2504-0015-001	1432-0002-004
MUH-50-4	1425-0011-001	5814-0003-002	3900-0350-001	1210-0097-000	1402-0340-003	1425-0012-002	1802-0087-023	2504-0015-001	1432-0002-004
MUH-50-8	1425-0011-001	5814-0003-000	3900-0350-002	1210-0097-000	1402-0340-003	1425-0012-002	1802-0087-030	2504-0015-001	1432-0002-004

Model No.	㉓ Relay***	㉔ Insulator	㉚ Terminal Block, Power	㉛ Terminal Block, Control	㉞ Fuse Block	㉟ Fuse
MUH03-21	–	–	5823-0004-000	5823-0001-000	–	–
MUH03-41	5018-0004-100	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH03-71	–	2900-0030-000	5823-0004-000	5823-0001-000	–	–
MUH03-81	–	–	5823-0004-000	5823-0001-000	–	–
MUH05-21	–	–	5823-0004-000	5823-0001-000	–	–
MUH05-41	5018-0004-100	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH05-71	–	2900-0030-000	5823-0004-000	5823-0001-000	–	–
MUH05-81	–	–	5823-0004-000	5823-0001-000	–	–
MUH-07-2	5018-0003-000	–	5823-0004-000	5823-0002-000	–	–
MUH-07-4	5018-0004-100	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH-07-7	5018-0004-100	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH-07-8	5018-0003-000	–	5823-0004-000	5823-0002-000	–	–
MUH-10-2	5018-0003-000	–	5823-0004-000	5823-0002-000	–	–
MUH-10-4	5018-0004-100	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH-10-7	5018-0003-000	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH-10-8	5018-0004-100	–	5823-0004-000	5823-0002-000	–	–
MUH-15-2	5018-0005-004	–	5823-0004-001	5823-0002-000	–	–
MUH-15-4	5018-0004-100	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH-15-8	5018-0005-008	–	5823-0004-003	5823-0002-000	2025-0002-000	2019-0007-010
MUH-20-2	5018-0006-000	–	5823-0004-002	5823-0002-000	–	–
MUH-20-4	5018-0004-100	2900-0030-000	5823-0004-000	5823-0002-000	–	–
MUH-20-8	5018-0005-000	–	5823-0004-002	5823-0002-000	2025-0002-000	2019-0007-008
MUH-25-2	5018-0005-004	–	5823-0004-002	5823-0002-000	2025-7002-000	2019-7008-077
MUH-25-4	5018-0005-004	2900-0030-000	5823-0004-001	5823-0002-000	–	–
MUH-30-2	5018-0005-004	–	5823-0004-003	5823-0002-000	2025-7002-000	2019-7008-079
MUH-30-4	5018-0005-004	2900-0030-000	5823-0004-001	5823-0002-000	–	–
MUH-30-8	5018-0006-000	–	5823-0005-000	5823-0002-000	2025-7002-000	2019-7008-080
MUH-40-2	5018-0005-004	–	5823-0005-000	5823-0002-000	2025-7002-000	2019-7008-079
MUH-40-4	*	2900-0030-000	5823-0004-002	5823-0002-000	2025-7002-000	2019-7008-079
MUH-50-2	5018-0005-004	–	5823-0005-000	5823-0002-000	2025-7002-000	2019-7008-080
MUH-50-4	*	2900-0030-000	5823-0004-002	5823-0002-000	–	–
MUH-50-8	5018-0006-000	–	5823-0005-000	5823-0002-000	2025-7002-000	2019-7008-078

Two relays are used: 35A relay P/N 5018-0004-000 and 40A relay P/N 5018-0005-12.

** 24V secondary shown. For 120V secondary, increase last digit by 3. (i.e. for MUH03-41, 24V secondary use 5814-0003-002; for 120V secondary use 5814-0003-005)

*** 24V H.C. shown. For 120 H.C., increase last digit by 1. (i.e.: for MUH03-41, 24V H.C. use 5018-0004-000; for 120V H.C. use 5018-0004-001.)

QMARK®
A Division of Marley Electric Heating
470 Beauty Spot Rd. East
Bennettsville, SC 29512

Marley Electric Heating
A United Dominion Company

Mechanical Accessories

For MUH, HUHAA, Dayton 3UF75 - 3UF99 Series Unit Heaters

INSTALLATION OF VERTICAL SECTION (Common Part for Radial and Anemostat Diffusers)

1. Remove louvers from front of heater by gripping louver close to spring and compressing spring until other end of the louver is free.
2. For Dayton Unit Heaters - Remove bird screen from venturi opening.
3. Position vertical section over venturi outlet and rotate vertical section until holes in mounting brackets align with matching hole in front of heater.
4. Secure vertical section with four No. 6-32 x 3/8" (9.5mm) mounting screws (supplied) as shown in Figure 1.

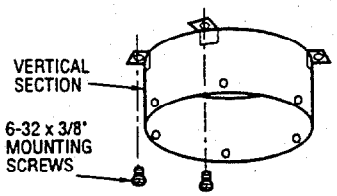


Figure 1. Installation of Vertical Section

INSTALLATION OF RADIAL DIFFUSER

1. Mount vertical section (supplied as part of radial diffuser). (Refer to INSTALLATION OF VERTICAL SECTION above.)
2. Loosen all six screws in radial diffuser hub until blades move freely (See Figure 2, View A).
3. Rotate the radial diffuser hub clockwise until the radial diffuser can be inserted into the vertical section.
4. Insert blade rods into matching holes in vertical section while rotating the radial diffuser hub counter-clockwise. (See Figure 2, View B).
5. Center all blades radially and tighten screws enough to allow each blade to rotate yet maintain a set position.
6. Rotate each blade to desired position and tighten screws to secure blades.

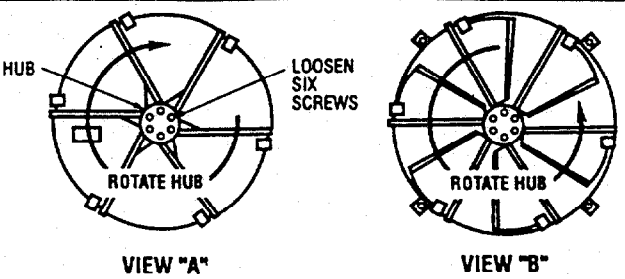


Figure 2. Installation of Radial Diffuser

INSTALLATION OF ANEMOSTAT DIFFUSER

1. Mount vertical section (supplied as part of anemostat diffuser). (Refer to INSTALLATION OF VERTICAL SECTION.)
2. For small (-S) and large (-L) diffusers, slide anemostat over vertical section and secure with three No. 10-32 x 3/8" (9.5mm) bolts and nuts. (See Figure 3, View A).
3. For medium (-M) diffuser, slide anemostat into vertical section and secure with three No. 10-32 x 3/4" (19mm) bolts, nuts and spacers. (See Figure 2, View B).

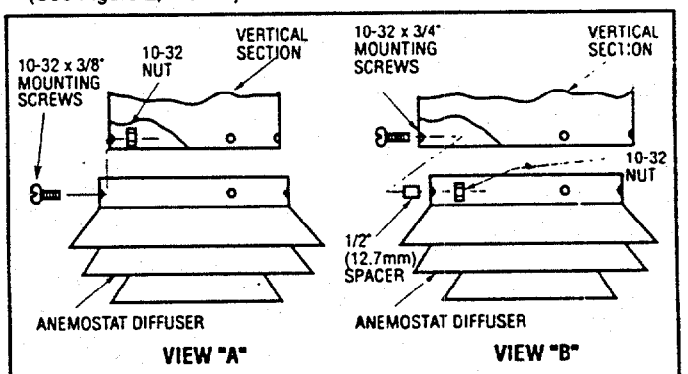
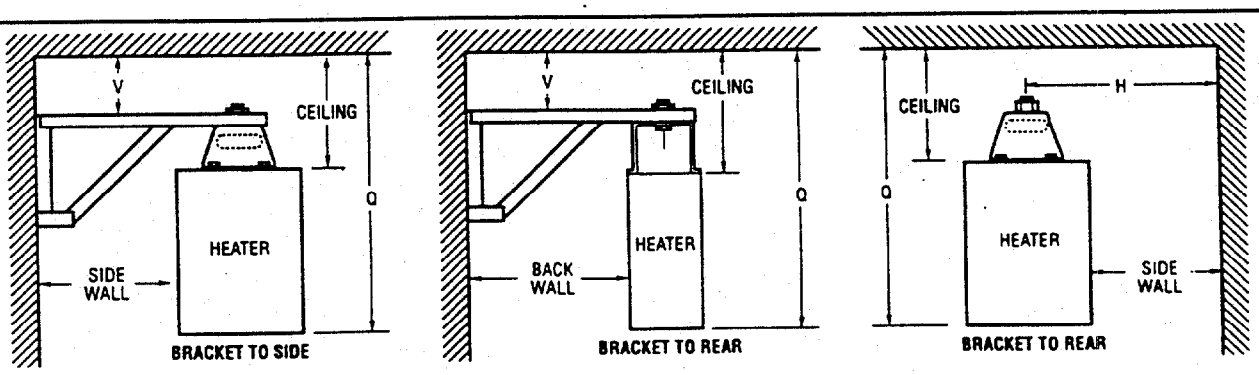


Figure 3. Installation of Anemostat Diffuser



Minimum Mounting Clearances

Heaters	Discharge	Ceiling	Side Wall	Back Wall	H (Min.)	V (Min.)	Q
3 KW - 5 KW	Horizontal	2" (50.8mm)	6" (152.4mm)	9" (228.6mm)	13" (330.2mm)	"0"	18 3/16" (462.0mm)
7.5 KW - 10 KW	Horizontal	6" (152.4mm)	6" (152.4mm)	13" (330.2mm)	15 1/2" (393.7mm)	2" (50.8mm)	27 7/8" (708.2mm)
15 KW - 20 KW	Horizontal	6" (152.4mm)	9" (228.6mm)	12 1/2" (317.5mm)	18 1/2" (470.0mm)	2" (50.8mm)	27 7/8" (708.2mm)
25 KW - 50 KW	Horizontal	16"	12"	18 1/2"	25 1/2"	10 5/8"	46 3/16"

Figure 4. Mounting Bracket Clearances

INSTALLATION OF LOUVERED DIFFUSER ON MUH HEATERS

1. Louvers may be left in place or removed from the heater. (Refer to Step 1, INSTALLATION OF VERTICAL SECTION on previous page).
2. Insert mounting springs into four 3/16" (4.8mm) holes in inside flange of front cover.
3. Place louvered diffuser against front of unit.

NOTE: Position locating tabs toward the top and sides of heater flange.

4. Secure louvered diffuser to heater by using long-nosed pliers to hook free ends of springs into four 3/16" (4.8mm) holes in inside flange of louvered diffuser.

INSTALLATION OF LOUVERED DIFFUSER ON HUHAA & DAYTON HEATERS

1. Louvers may be left in place or removed from the heater. (Refer to Step 1, INSTALLATION OF VERTICAL SECTION on previous page).
2. Place louvered diffuser against front of unit.

NOTE: Position locating tabs toward the top and sides of heater flange.

3. Secure louvered diffuser to heater with three (3) screws (provided) through the mounting tabs.

INSTALLATION OF B SERIES MOUNTING BRACKETS

WARNING

THE BUILDING STRUCTURE AND THE ANCHORING PROVISIONS MUST BE SUFFICIENT TO SUPPORT THE COMBINED WEIGHT OF THE HEATER AND MOUNTING BRACKET.

1. Locate the position of the heater wall mounting bracket. Refer to Figure 4 for minimum mounting clearances. Refer to Figure 5 for mounting bracket dimensions.

WARNING

MOUNTING BRACKET MUST BE INSTALLED WITH OPENING IN BRACKET TOWARD REAR OF HEATER.

2. The hole locations for the mounting bracket can be determined by holding the bracket in position and marking through the holes. Mounting bracket dimensions with hole locations are also given in Figure 5.
3. A minimum screw size of 3/8-inch (9.5mm) diameter should be used to mount the bracket to the wall or ceiling. A heavy washer should be used between the bolt head and the bracket. USE THE TYPE OF SCREW THAT IS BEST SUITED TO THE BUILDING STRUCTURE.
4. Remove four bolts and washers from top of heater and secure unit mounting bracket to top of heater using the four bolts and washers. (See Figure 6).
5. Bolt the unit mounting bracket to the wall mounting bracket using one 1/2-13 pivot bolt, two flat washers, one split lockwasher, and one 1/2-13 nut. (See Figure 7).

INSTALLATION OF CMB MOUNTING BRACKETS

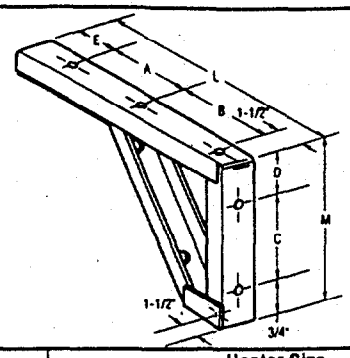
1. Mount bracket per step 4 above.
2. Hang heater from ceiling using center hole in unit mounting bracket, maintaining clearances shown in Figure 4.

INSTALLATION OF VDMB MOUNTING BRACKETS

WARNING

THE BUILDING STRUCTURE AND THE ANCHORING PROVISIONS MUST BE SUFFICIENT TO SUPPORT THE COMBINED WEIGHT OF THE HEATER AND MOUNTING BRACKET.

1. Locate the position of the vertical discharge mounting bracket. Refer to Figure 4 for minimum mounting clearances. Refer to Figure 8 for bracket dimensions.
2. A minimum screw size 3/8" diameter should be used to mount two of the brackets to the ceiling. A heavy washer should be used between the bolt head and the bracket. **Use the type of screw that is best suited to the building structure.**
3. Remove four bolts and washers from the back of the heater and secure the other two brackets to the back of the heater using the four bolts and washers.
4. Bolt the unit mounted brackets to the ceiling mounted brackets using the 5/16" bolts, split lockwashers and nuts provided. See Figure 8.



Dimensions	Heater Size 3-20 KW	Heater Size 25-50KW
A	7¼" (184.2mm)	9 7/16" (239.8mm)
B	9½" (241.3mm)	14⅜" (365.3mm)
C	7¼" (184.2mm)	12⅛" (308.1mm)
D	1 15/16" (49.3mm)	2 1/16" (52.3mm)
E	2¼" (57.2mm)	3" (76.2mm)
L	20½" (520.7mm)	28 5/16" (719.1mm)
M	9 15/16" (252.5mm)	14 15/16" (379.5mm)

Figure 5. Mounting Bracket Hole Dimensions

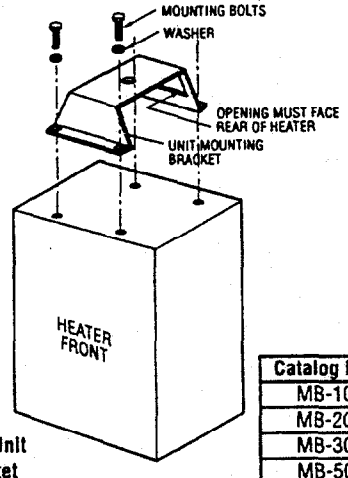


Figure 6. Installation of Unit Mounting Bracket

Catalog No.	Used on
MB-10	3 - 10 KW
MB-20	15 - 20 KW
MB-30	25 - 30 KW
MB-50	40 - 50 KW
CMB-10	3 - 10 KW
CMB-20	15 - 20 KW
CMB-30	25 - 30 KW
CMB-50	40 - 50 KW

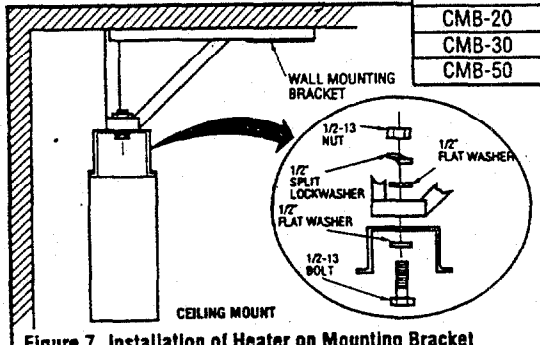
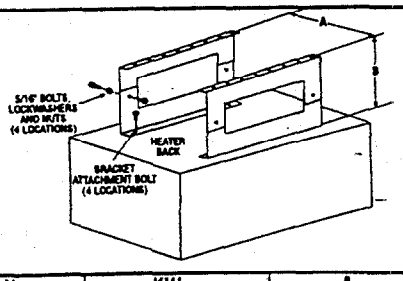


Figure 7. Installation of Heater on Mounting Bracket



Model No.	KW	A	B
VDMB5	3 - 5 KW	6"	6⅛"
VDMB20	7.5 - 20 KW	8⅞"	6⅛"
VDMB50	25 - 50 KW	12½"	12⅛"

Figure 8. Installation of Heater on Mounting Bracket

Marley Electric Heating
A United Dominion Company

Electrical Accessories

For MUH, HUHAA & 3UF77-3UF98 Series Unit Heaters

INSTALLATION OF INTERNAL THERMOSTAT

1. Remove 5/16" (7.9mm) knockout from back of heater and route capillary tube through hole (Figure 1).
2. Install thermostat bulb clip in slot provided in the back panel of the heater. Secure capillary bulb in clip.
3. Press on left side of logo label on front of heater to locate shaft and screw holes. Punch holes through label.
4. Install thermostat as shown in Figure 2, coiling any excess capillary tubing inside the heater.

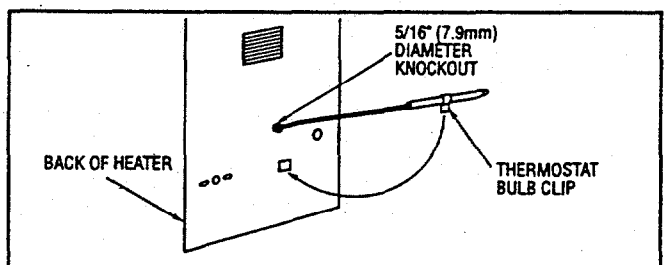


Figure 1. Installation of Internal Thermostat Capillary

WARNING

TO PREVENT POSSIBLE ELECTRICAL SHORT CIRCUIT OR FIRE, KEEP CAPILLARY TUBING AWAY FROM INTERNAL ELECTRICAL COMPONENTS.

5. Refer to wiring diagram, Figure 6, for wiring procedure on 3KW and 5KW (208V, 240V and 277V only). Refer to wiring diagram, Figure 7, for wiring procedure on all other heaters.
6. Remove backing from label (supplied) and install over thermostat shaft. Install knob by pushing onto the thermostat shaft.

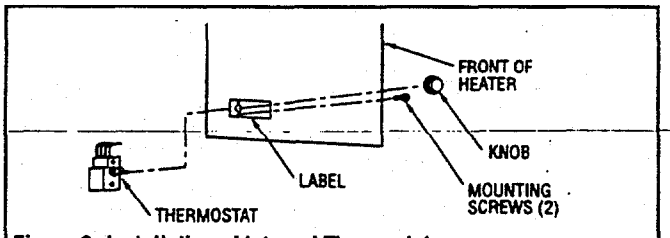


Figure 2. Installation of Internal Thermostat

INSTALLATION OF FAN SWITCH

1. Remove 1/2" (12.7mm) knockout (located between ON and AUTO) from back of heater (Figure 3).
2. Install manual fan switch as shown in Figure 3. (Note orientation of slot in switch nozzle. Locate slot in the switch nozzle towards the "AUTO" position.) Be sure to use lockwasher to prevent rotation of switch.

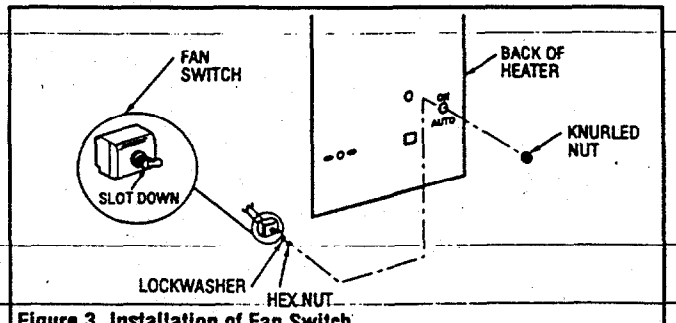


Figure 3. Installation of Fan Switch

3. Install leads to terminal block. Refer to wiring diagram, Figure 6, for wiring procedure on 3KW and 5KW units (208V, 240V, and 277V only). Refer to wiring diagram, Figure 7, for wiring procedure on all other heaters.

INSTALLATION OF REMOTE FAN SWITCH

The Remote Fan Switch is mounted external and remote from the unit heater. The voltage of the remote fan switch circuit is the same as the supply voltage to the heater.

1. Use 14 gauge copper, NEC Class 1, 600V rated insulated wire. Wiring must meet all local and NEC requirements.
2. Install the remote fan switch in a standard wall box in any convenient location that is protected from traffic or other accidental damage.
3. Connect the 14 gauge copper field wire to the switch lead wires with suitable connectors.
4. A 1/2-inch (12.7mm) knockout is provided in the back of the heater adjacent to the control terminal board. Use a crimp-on terminal suitable for No. 8 screw on the control terminal board. Connect one field wire terminated lead to terminal F1 and the other terminated lead to terminal F2. Refer to Figure 6 for connecting to heaters <u>without</u> built-in contactors. Refer to Figure 7 for connecting to heaters equipped <u>with</u> built-in contactors.

INSTALLATION OF REMOTE PILOT DUTY FAN SWITCH (Including Wall Switch and Relay)

The Remote Fan Switch is mounted external and remote from the unit heater.

1. Use 18 gauge (min.), NEC Class 1, 600V wiring that meets all local and NEC requirements.
2. Install the remote fan switch in a standard wall box in any convenient location that is protected from traffic or other accidental damage.
3. Connect the field wire to the switch lead wires with suitable connectors.
4. A 1/2-inch (12.7mm) knockout is provided in the back of the heater adjacent to the control terminal board. Use a crimp-on terminal suitable for No. 8 screw on the control terminal board. Connect one field wire terminated lead to terminal "R" and the other terminated field wire lead to terminal "G". Refer to Figure 7.
5. Install relay as indicated below.

INSTALLATION OF FAN RELAY

1. Mount relay in control compartment with two No. 8 mounting screws as shown in Figure 4.
2. Connect the lead wires from the relay to the control terminal board as shown in Figure 7. Each lead wire is marked for proper terminal location; connect the lead wires as indicated.

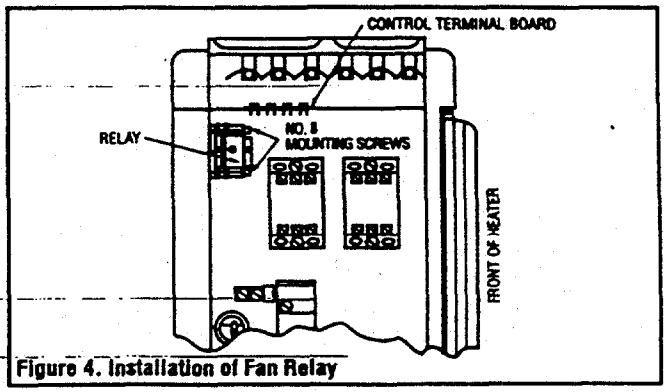


Figure 4. Installation of Fan Relay

INSTALLATION OF HEAT RECOVERY THERMOSTAT

NOTE: This accessory cannot be installed on heaters equipped with built-in single-pole or two-stage thermostats.

(For heaters with 24 Volt Control Circuit refer to Fig. 7 and proceed to step 1. For heaters with Line Voltage Control refer to Fig. 6 and proceed to step 3.)

1. Mount relay in baffle compartment with two No. 8 mounting screws as shown in Figure 4.
2. Connect the lead wires from the relay to the control terminal board as shown in Figure 7. Each lead wire is marked for proper terminal location; connect lead wires as indicated.
3. Remove 5/16" (7.9mm) knockout from back of heater and route capillary tube through hole (See Figure 1).
4. Install thermostat bulb clip in slot provided in the back panel of the heater. Secure capillary bulb in clip.
5. Press on left side of logo label on the front of heater to locate shaft and screw holes. Punch holes through label.
6. Install heat recovery thermostat as shown in Figure 2, coiling any excess capillary tubing inside the heater.
7. Use the wire tie to hold the thermostat leads to other wiring at approximately the midpoint of the leads between control terminal board and thermostat.

WARNING

TO PREVENT A POSSIBLE ELECTRICAL SHORT CIRCUIT OR FIRE, KEEP CAPILLARY TUBING AWAY FROM INTERNAL ELECTRICAL COMPONENTS.

8. Refer to wiring diagram, Figure 6 or Figure 7 for wiring procedure.
9. Remove backing from the label (supplied) and install over thermostat shaft as shown in Figure 2.
10. Install knob by pushing onto the thermostat shaft.
11. Set thermostat for desired turn-on temperature. Full counter-clockwise rotation of the knob is approximately 70°F (21° C). Full clockwise rotation of the knob is approximately 120°F (49° C).

INSTALLATION OF 25 AMP AND 60 AMP POWER DISCONNECT SWITCH

1. Use copper conductor supply wire only when using these switches.
2. Remove the 5/8" (16mm) knockout and the two knockout slots from back of heater, below OFF-ON markings.
3. Install power disconnect switch with two mounting screws as shown in Figure 5.
4. Install the knob with the pointer position at the "OFF" position marking when the switch is rotated to the full counterclockwise position.
5. Before connecting the wires of the switch, check the pointer index. Check to be sure the pointer end of the knob points to "OFF" when the switch is rotated full counterclockwise. It may be necessary to rotate the switch 180° to index the pointer knob.
6. Refer to wiring diagram, Figure 8, for wiring procedure.

(NOTE: For single-phase, remove and discard leads "L2" and "S2").

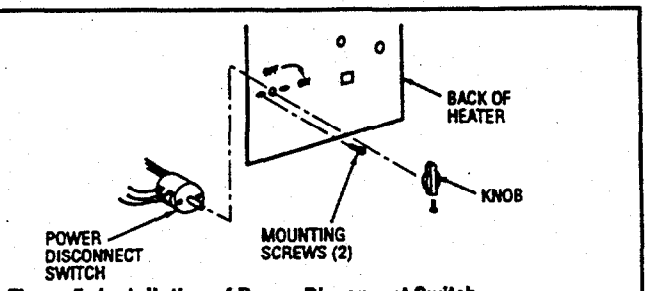
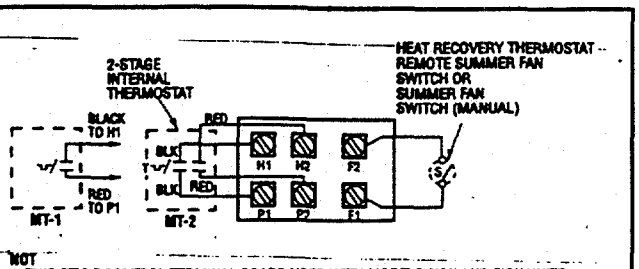
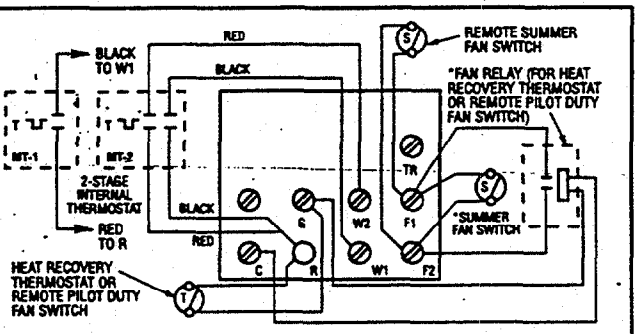


Figure 5. Installation of Power Disconnect Switch



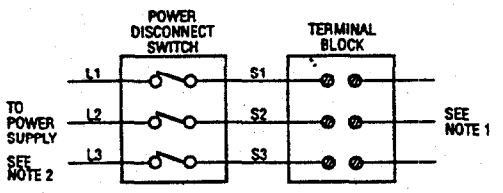
NOT
1. THIS STYLE CONTROL TERMINAL BOARD USED WITH MODELS 3KW AND 5KW UNITS (208V, 240V AND 277V ONLY).
2. WHEN UNIT IS WIRED FOR SINGLE PHASE, JUMPER H1 TO H2. IF SINGLE POLE THERMOSTAT IS USED WITH SINGLE PHASE UNIT, CONNECT THERMOSTAT LEADS TO P1 AND H1.
3. EXTERNAL LINE VOLTAGE THERMOSTAT SHOULD BE TREATED AS SINGLE STAGE ONLY.

Figure 6. Control Terminal Board (for Heaters without Contactors)



NOTES:
1. THIS STYLE CONTROL TERMINAL BOARD USED WITH ALL MODELS EXCEPT 3KW AND 5KW UNITS (208V, 240V AND 277V ONLY).
2. REMOVE JUMPER W1 TO W2 WHEN 2-STAGE THERMOSTAT IS USED.
3. *ONLY ONE OF THESE ACCESSORIES MAY BE INSTALLED IN A SINGLE HEATER.
4. EXTERNAL LINE VOLTAGE THERMOSTATS SHOULD BE TREATED AS SINGLE STAGE ONLY.

Figure 7. Control Terminal Board (for Heaters with Contactors)



NOTES:
1. THIS ILLUSTRATION SHOW WIRING HOOK UP FOR THREE PHASE SERVICE. REMOVE LEAD WIRES MARKED L2 AND S2 WHEN USING ONE PHASE POWER SERVICE.
2. USE COPPER SUPPLY WIRE ONLY WITH THIS SWITCH.

Figure 8. Power Disconnect Switch Wiring Diagram

Marley Electric Heating
A United Dominion Company
470 Beauty Spot Road East
Bennettsville, SC 29512 USA

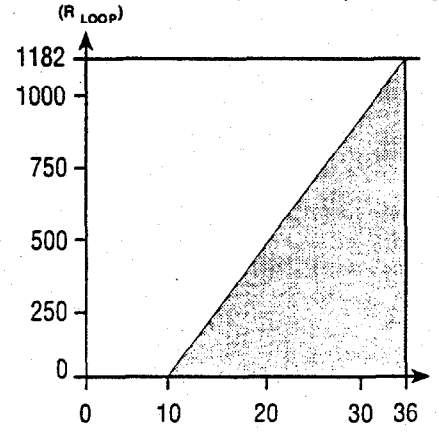
K1, K2, K8
PRESSURE TRANSMITTER INSTRUCTION SHEET

ASHCROFT®

Mounting
The transmitter requires no special mounting hardware, and can be mounted in any plane with negligible position error.
Although the unit can withstand normal vibration without damage or significant output effects, it is always good practice to mount the transmitter where there is minimum vibration.
For units with NPT type pressure fittings apply teflon tape or an equivalent sealant to the threads before installing.
When tightening, apply a wrench to the hex wrench flats located just above the pressure fitting. **DO NOT** tighten by using a pipe wrench on the housing.

Power Supply
The supply voltage for the 1-5 and 1-6 VDC output transmitters must be within the range of 10 to 36 VDC. The maximum supply voltage for a current output transmitter is 36 VDC while the minimum supply voltage is dependent upon the loop resistance of the circuit. The figure below shows the minimum supply voltage (Vmin) required for a given loop resistance (RLOOP).

Load Limitations 4-20mA Output Only



Noise
For minimum noise susceptibility, avoid running the transmitter's cable in a conduit that contains high current AC power cables. Where possible avoid running the cable near inductive

WARNING!

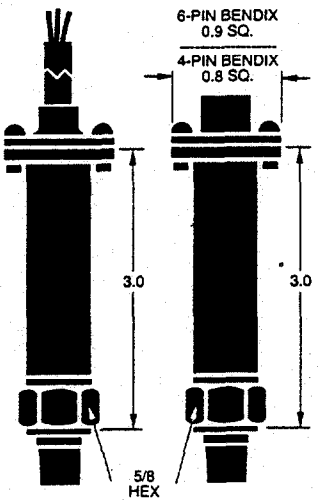
This instrument is susceptible to damage when exposed to static electrical charges. To avoid damage to the transducer observe the following:

- **Ground the body of the transducer *BEFORE* making any electrical connections**
- **When disconnecting, remove the ground *LAST*.**

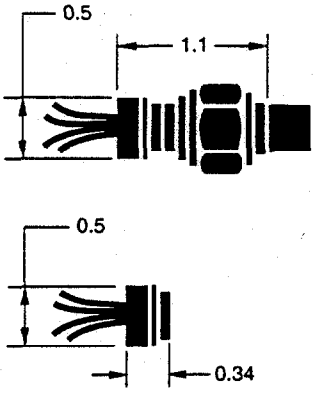
Note: The braided shield and drain wire in the cable (if supplied) is not connected to the transducer body, and is not a suitable ground.

CAUTION: Pressure spikes in excess of the rated overpressure capability of the transmitter (transducer) may cause irreversible electrical and/or mechanical damage to the pressure measuring and containing element(s).

K1, K2 Tranducers



K8 Tranducers



Adjustment Potentiometers
The zero and span pots are accessible through the top of the case. Loosen the four screws and separate the top carefully. The zero pot is marked with a white dot. (Connect the braided shield to the guard terminal on the reading instrument (meter, etc.) if available or to the power supply negative terminal.)

Output
Sensitivity varies between 6-18 mv/V. Zero offset is within ±3 mv/V. Output is proportional to supply voltage.

Excitation – K8 & K2
For proper operation a voltage within the range of 5 to 10 VDC must be applied between the transducer's supply terminals

Printed in U.S.A.

K1 Transducers -Electrical Connections

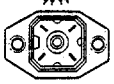
Voltage Output Units 1-5, 1-6 VDC

Cable Type F2

Red = +Power
White = Common
Green = Output

Cable Type C1

Red = + Power
White = Common
Green = Output



Hirshmann Type

PIN-1 = +Power
PIN-2 = Common
PIN-4 = Output

Bendix 4-Pin, 6 Pin

Pin A = +Power
Pin B = Output
Pin D = Common

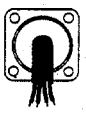
Connector J1

Pin A = +Power
Pin C = Common
Pin E = +Output

Voltage Output Units 0-5, 0-10 VDC

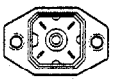
Cable Type F2

Red = +Power
White = −Power
Green = +Output
Black = −Output



Cable Type C1

Red = +Power
White = −Power
Green = +Output
Black = −Output



Hirshmann Type

PIN-1 = +Power
PIN-2 = −Power
PIN-3 = −Output
PIN-4 = +Output

Bendix 4 Pin, 6 Pin

Pin A = +Power
Pin B = +Output
Pin C + −Output
Pin D = −Power

Connector J1

Pin A = +Power
Pin C = −Power
Pin E = +Output
Pin F = −Output

Current Output Units 4-20 mA

Cable Type F2

Red = +Power
Black = −Power

Cable Type C1

Red = +Power
Black = −Power

Hirshmann Type

PIN-1 = +Power
PIN-2 = −Power

Bendix 4 Pin, 6 Pin

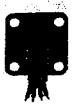
Pin A = +Power
Pin B = −Power

Connector J1

Pin A = +Power
Pin C = −Power

K2 Transducers -Electrical Connections

Sensitivity



Cable Type F2

Red = +Power
White = −Power
Green = +Output
Black = −Output

Cable Type C1

Red = + Power
White = − Power
Green = + Output
Black = − Output

Bendix 4-Pin

Pin A = +Power
Pin B = +Output
Pin C = −Output
Pin D = −Power

*Signal and power commons (neg.) must be electrically isolated from each other.

Bendix 6-pin

Pin A = +Power
Pin D = −Power
Pin B = +Output
Pin C = −Output
Pin E = Shunt Cal.
Pin F = Shunt Cal.

Bendix 6-pin (waterproof)

Pin A = +Power
Pin D = −Power
Pin B = +Output
Pin C = −Output
Pin E = Shunt Cal.
Pin F = Shunt Cal.

K8 Transducers -Electrical Connections

Sensitivity

Cable Type F2

Red = +Power
White = −Power
Green = +Output
Black = −Output

4 Inch Leads

Red = +Power
White = −Power
Green = +Output
Blue = −Output

Special Wiring – See "X" Variation On Unit Label

X Variation	Wire Hookup	Pin
X228	+ Output	A
X27	− Output	B
	+ Power	C
	− Power	D
	Shunt Cal.	E&F**
	** B6 Connector Only	
XTQ	Red = +Power	
	Black = Common	
	White = Output	
XTG	Red = +Power	
	Black = Common	
	Green = Output	

WARNING: READ BEFORE INSTALLATION

Fluid hammer and surges can destroy any pressure transducer and must always be avoided. A pressure snubber should be installed to eliminate the damaging hammer effects. Fluid hammer occurs when a liquid flow is suddenly stopped, as with quick closing solenoid valves. Surges occur when flow is suddenly begun, as when a pump is turned on at full power or a valve is quickly opened.

Liquid surges are particularly damaging to pressure transducers if the pipe is originally empty. To avoid damaging surges, fluid lines should remain full (if possible), pumps should be brought up to power slowly, and valves opened slowly. To avoid damage from both fluid hammer and surges, a surge chamber should be installed.

Symptoms of fluid hammer and surge's damaging effects:

a) Pressure transducer exhibits an output at zero pressure (large zero offset). If zero offset is less than 10% FS, user can usually re-zero transducer, install proper snubber and continue monitoring pressures.

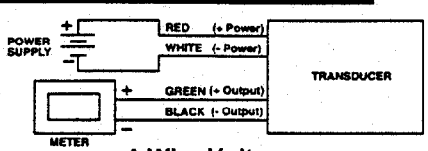
b) Pressure transducer output remains constant regardless of pressure.

c) In severe cases, there will be no output.

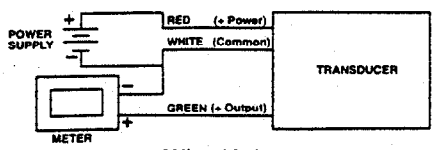
Recalibration Instructions:

1. **Apply 0% Full Scale Pressure.**
2. **Set the output using the *Zero adjustment potentiometer.***
3. **Apply 100% Full Scale Pressure.**
4. **Set the output using the *Span adjustment potentiometer.***
5. **Repeat steps 1 thru 4 as necessary.**

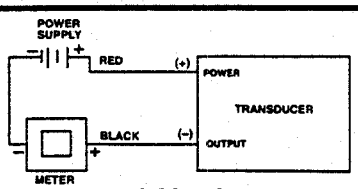
Wiring Diagrams for All Transducers



4-Wire Voltage



3-Wire Voltage



4-20 mA

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MADE IN U.S.A.

TRANSDUCER

ASH – K1 – 7 – M02 – 42 – F2

RANGE: 15 psig **OUT: 4 – 20 ma**
ACCURACY: 1.0% **CONN: 1/4NPTM**
ORDER#: 4A800428 **12/19/1997**

Meter Capacities

Model	Size	Normal Flow	Maximum Flow*
JSJ062	5/8" x 1/2"	10 GPM	20 GPM
JSJ0621	5/8" x 3/4"	10 GPM	20 GPM
JSJ075	3/4" x 3/4"	15 GPM	30 GPM
JSJ100	1" x 1"	25 GPM	50 GPM
JSJ150	1-1/2"	50 GPM	100 GPM
JSJ200	2"	80 GPM	160 GPM

** Running a meter continuously at the maximum rated capacity will greatly reduce the life of the meter.*

NOTE: 5/8" - 1" meter ends have straight threads, not tapered. You must use the couplings provided to install these meters.

Carlon Five-Year Warranty

Carlon will, at no charge, repair or replace any model STD or JSJ meter, when returned, if found to be defective in materials or workmanship under normal potable water use within five years of purchase. This warranty does not apply to defects attributable to misuse or acts or omissions of others. **This warranty is in lieu of all other express or implied warranties, including the implied warranties of merchantability and fitness for a particular purpose.** Carlon shall in no event be liable for consequential damages resulting from meter failure.

For problems and questions on
Carlon Metering Products,
call 1-800-253-3098 or (616) 842-0420 in Michigan.

Installation and Operating Instructions

Model JSJ
Electric Contacting Meters

½" thru 2" Sizes

Carlon Meter Co., Inc.
1710 Eaton Drive
Grand Haven, MI 49417

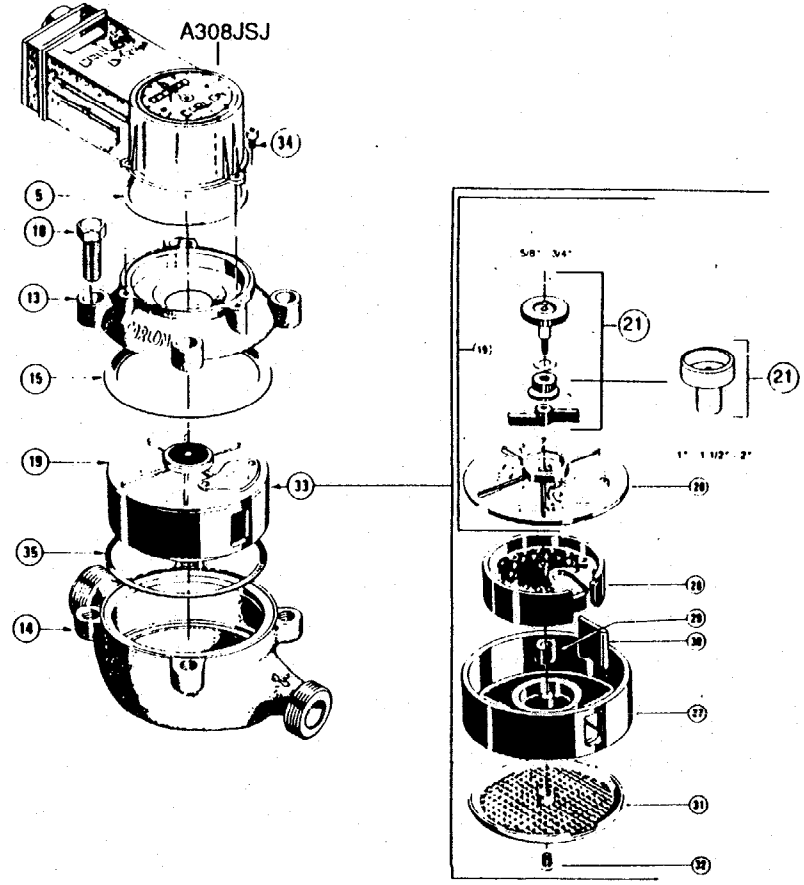
Phone: (616) 842-0420
FAX (616) 842-1265

Installation Instructions:

1. Flush the line thoroughly after plumbing changes to eliminate the possibility of foreign materials reaching the meter.
2. Do not exceed an operating pressure of 150 P.S.I.
3. Install meter horizontally with the register facing up and the inlet port facing the supply water line.
4. It is recommended that if there is any possibility that the water supply contains foreign materials, a strainer be installed between the supply and the meter.
5. Connect the terminals on the pulse head to the meter input on the controlling device. The switch is rated for a maximum of 10 amps at 250V AC. The switch is a normally open type micro-switch.
6. Connect your controlling device to the water treatment equipment (pumps, valves, etc.) Notice G.P.C. setting to determine frequency of operation.
7. The meter is designed to handle a sustained flow of ½ of the rated maximum flow. It is not recommended that the meter be run for long periods of time at the maximum rating as excess wear will result and the life of the meter will be greatly reduced.
8. To reduce potential harmful effects to equipment from water hammers caused by quick closing valves, it is suggested that one of the following actions be taken:
   - A. Install a "slow closing" valve - available from most valve manufacturers.
   - B. Insure that the valve is installed between the supply water line and the meter.
   - C. Install an expansion device between the meter and the valve that will absorb the shock of a water hammer.
9. Protect the meter from freezing and from heat in excess of 105° F.
10. This meter is not designed for outdoor installation.

Parts List
JSJ
Electric Contacting Meters 5/8" thru 2"

Part No.	Name of Part	Part No.	Name of Part
A308JSJ	Pulse Head Complete	21	Magnet Drive Assembly Complete
5	Upper Seal Gasket	27	Measuring Chamber Bottom
13	Upper Main Case	28	Piston
14	Lower Main Case	29	Control Roller
15	Main Case Gasket	30	Division Plate
18	Main Case Bolt	31	Screen
19	Measuring Chamber Top Complete Ass'y	32	Screen Screw
		33	Measuring Chamber Complete Ass'y
20	Measuring Chamber Top Only	34	Head Bolt
		35	Chamber Seal Gasket



McMASTER-CARR supply company

ATLANTA, GEORGIA 30336 USA
TEL.(404)349-9700 FAX(404)349-9515
EMAIL: atl.sales@mcmaster.com

MAIL PAYMENT TO:
P.O. BOX 7690
CHICAGO IL 60680-7690

REFER TO
THIS NUMBER.

INVOICE

NO. 653828201
DATE: MAR-02-98
PAGE 1 OF 1

BILL TO:
BECHTEL ENVIRONMENTAL INC
151 LAFAYETTE DR
OAK RIDGE, TN 37831-0350

SHIPPED TO:
BECHTEL ENVIRONMENTAL INC
151 LAFAYETTE DR
OAK RIDGE, TN 37831-0350

MR KENT PARISH

YOUR PURCHASE ORDER NUMBER: 22567145
KENT PARISH (423) 220-2748
DATE SHIPPED: 3/2/98 VIA: UPS FOB:ORIGIN
TIME SHIPPED: 3:46 P.M.
NO. OF PACKAGES 1 SHIP WT(LBS) 5
OUR ACCOUNT NUMBER: 1245662-00
MCMASTER-CARR REFERENCE: 6538282-01
TERMS:CREDIT CARD

ITEM	MC MASTER-CARR PART NUMBER AND DESCRIPTION	ORDER	BALANCE	SHIPPED	UNIT PRICE	EXTENSION
1	73215K73 LOAD-CENTER SURGE SUPPRESSOR 25 KA SURGE CAP, 120/208V, 495 CLAMPING VOLTAGE	1 EA		1 EA	231.54 EA	231.54

SUBTOTAL:	231.54
SHIPPING CHARGES:	3.20
CREDIT CARD PAYMENT:	234.74
TOTAL:	$.00

THANK YOU FOR PLACING YOUR ORDER WITH MCMASTER-CARR.
THIS ORDER WAS CHARGED TO YOUR CREDIT CARD: KENT PARISH

FEDERAL I.D. # 36-1458720 1546 A

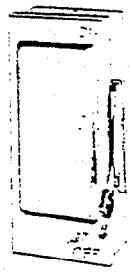
CIRCUIT BREAKERS

General-Duty Fusible Safety Switches

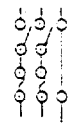
For commercial use in lighting, air conditioning, and appliance applications, as well as for service equipment. Switches have a 100,000-amp short-circuit rating when used with Class R or T fuses, and a 10,000-amp rating when used with Class H fuses. The 3-pole units use 3 fuses, 2-pole units use 2 fuses. Both styles feature spring-driven, quick-make quick-break action. All switches are UL listed, File E2875.

NEMA 1 Enclosures—For indoor use. Meet Federal Specification W-S-865c for 240 VAC Type HD or Type HD switches with single cover interlock. They include separate lockouts to lock handle in the off position and to prevent door from being opened when switch is in the on position.

NEMA 3R Enclosures—For outdoor use. Meet Federal Specification for Type HD switches without interlock.



3-Pole 4-Wire



2-Pole 3-Wire

Description	Amps	VAC	NEMA 1 No.	NEMA 1 NET EACH	NEMA 3R No.	NEMA 3R NET EACH
3-Pole, 4-Wire	30	240	7524K11	$45.50	7524K14	$71.50
3-Pole, 4-Wire	60	240	7524K12	79.00	7524K15	107.50
3-Pole, 4-Wire	100	240	7524K13	137.00	7524K16	198.50
2-Pole, 3-Wire	30	240	7524K21	30.00	7524K24	45.00
2-Pole, 3-Wire	60	240	7524K22	49.00	7524K25	79.00
2-Pole, 3-Wire	100	240	7524K23	103.50	7524K26	117.50

Plug-In Load-Center Circuit Breakers

All circuit breakers are standard 1" format. Interrupting capacity is 10,000 amps, 120/240 or 120 VAC, 60 Hz, 1-phase.

Circuit breakers without trip light, when used with the load centers sold at right, are UL listed.

Circuit breakers with trip light have a built-in LED that glows when the breaker trips and stays lit until it is reset. These breakers are interchangeable with General Electric THCL, Westinghouse Hinds MP, Westinghouse Bryant BHOP, and Sylvania Challenger C. Classified to meet Standard 489.

Single Pole

Single Pole with Ground Fault

Single Pole Tandem

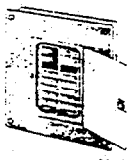
Single Pole with Trip Light

Amps	No.	NET EACH
SINGLE POLE—120/240 VAC		
15	69225K71•	$6.50
20	69225K72•	6.50
30	69225K73	6.50
DOUBLE POLE—120/240 VAC		
15	69225K74	$15.25
20	69225K75	15.25
30	69225K76	15.25
40	69225K77	15.25
50	69225K78	15.25
60	69225K79	15.25
70	69225K81	30.50
SINGLE POLE W/GROUND FAULT—120 VAC		
20	69225K82	$52.50
SINGLE POLE TANDEM—120/240 VAC		
15	69225K83	$13.25
20	69225K84	13.25
SINGLE POLE W/TRIP LIGHT—120/240 VAC		
15	7473K11	$6.50
20	7473K12	6.50
30	7473K13	6.50
40	7473K14	6.50
50	7473K15	6.50
DOUBLE POLE W/TRIP LIGHT—120/240 VAC		
15	7473K21	$15.10
20	7473K22	15.10
30	7473K23	15.10
40	7473K24	15.10
50	7473K25	15.10

•UL listed as SWD (switching duty) for switching 120 VAC fluorescent lighting.

Main Lug and Main Breaker Load Centers

Main Lug



Main Breaker

Load-center circuit breakers give you superior short circuit protection. Split branch neutral allows uniform wire termination and reduces installation time and wire usage. Thermoplastic-insulated interior can be removed from the box. Feed is from the top or bottom. The 2-6 pole units can be surface mounted. 8-40 pole units can be surface or flush mounted. Main lug models are for use as a secondary or add-on load center and connect to the main breaker when spaces for more circuits are needed. Main breaker models are the service-entrance panels which feed off the electrical meter and distribute power throughout the building. All centers have a NEMA 1 enclosure with a corrosion-resistant, baked-enamel finish. Standard interrupting capacity is 10,000 (AIC). Units operate on 3-wire, 120/240 VAC, single phase. Use with circuit breakers sold at left. UL listed.

Amps	Max. # Single Pole Spaces	Dimensions Ht. × Wd. × Dp.	No.	NET EACH
MAIN LUG				
70	2	[illegible]	6914K31	$14.10
70	2	[illegible]	6914K32•	28.00
100	6	[illegible]	6914K33	16.95
100	6	[illegible]	6914K34•	30.50
100	8	[illegible]	6914K36	31.50
100	12	[illegible]	6914K35	31.00
MAIN BREAKER				
100	12	[illegible]	6914K37	74.50
100	20	[illegible]	6914K38	99.00
200	40	[illegible]	6914K39	257.50
No. 6914K41—Lightning Surge Arrestor				NET EACH $23.70

•NEMA 3R raintight

Load-Center and Main-Panel Surge Suppressors

25 kA

Mount these suppressors at the service entrance or branch-circuit load center to provide protection from transient voltage spikes beyond the normal service variation. High-energy metal-oxide varistors are the primary suppression elements. Failure-indicator light. Meet UL 1449.

Surge Cap., kA	VAC	Clamping Voltage	Electrical Service	No.	NET EACH
25	120/240	495	1-phn 3-wire	73215K71	$177.59
25	120/208	495	3-phn 4-wire wye	73215K73	231.54
25	240	730	3-phn 3-wire delta	73215K75	238.76
25	277/480	985	3-phn 4-wire wye	73215K77	279.02

Plug-Base Fuse Breakers and Fuses

BREAKERS—Replace any Edison-base (T-type) fuse with these resetable circuit breakers. Breakers have a push-to-reset button and are rated 125 VAC, UL listed.

Breaker

Fuse

Amps	No.	NET EACH
10	7075K1	$6.51
15	7075K2	6.51
	7075K3	6.51

FUSES—These time-delay fuses have thermal cutout to prevent them blowing on motor-starting current and other temporary loads. Rated 125 VAC, UL listed. Sold in packages of 4.

Type	Edison Base	15 Amp No.	20 Amp No.	30 Amp No.	NET PKG.
T	Yes	7070K52	7070K53	7070K54	$1.00
S	No	7070K55	7070K56	7070K57	5.20
T	Yes	7070K58	7070K59	7070K61	5.00

Service-Entrance Lightning Arresters

These arresters provide lightning protection at your service entrance—just where you need it most. They're hard-wired to protect equipment from surges caused by lightning strikes and can be installed indoors and outdoors.

UL listed and CSA certified.

Description	Max. Voltage	No.	NET EACH
Single Phase—3-Wire	[illegible]	70495K81	$29.77
Three Phase—4-Wire	[illegible]	70495K82	86.54

HAYWARD INDUSTRIAL PRODUCTS
INSTALLATION OPERATION & MAINTENANCE OF SIMPLEX BASKET STRAINER

SOCKET CONNECTION INSTALLATION:

THE COVER OF THE BASKET STRAINER MUST BE REMOVED TO ALLOW THE CEMENT FUMES TO VENT.
Socket end connections are manufactured to ASTM D2467-87A. Solvent cementing of socket end connections to pipe should be performed per ASTM specifications D2855-87. Cut pipe square. Chamfer and deburr pipe. Surfaces must be cleaned and free of dirt, moisture, oil and other foreign material. Apply primer to inside socket surface of the Simplex strainer. Use a scrubbing motion. Repeat applications may be necessary to soften the surface of the socket. Next, liberally apply primer to the male end of the pipe to the length of the socket depth. Again apply to the socket, without delay apply cement to the pipe while the surface is still wet with primer. Next apply cement lightly, but uniformly to the inside of the socket. Apply a second coat of cement to the pipe, and assemble the pipe to the end socket of the Simplex, rotating the pipe 1/4 turn in one direction as it is slipped to full depth into the socket. The connection should be held in position for approx. 30 seconds to allow the connection to "set". After assembly wipe off excess cement. Full set time is a minimum of 30 minutes at 60 to 100 F. Full cure time should be based on the chart below.

JOINT CURE SCHEDULE:

The cure schedules are suggested as guides. They are based on laboratory test data, and should not be taken to be the recommendations of all cement manufacturers. Individual manufacturer's recommendations for their particular cement should be followed.

Temperature Range During Cure Period(B) °F(°C)	Test Pressures for Pipe Sizes 1/2 to 1-1/4 In.		Test Pressures for Pipe Sizes 1-1/2 to 3 In.		Test Pressures for Pipe Sizes 4 to 5 In.		Test Pressures for Pipe Sizes 6 to 8 In.	
	Up to 180 PSI (1240 kPa)	Above 180 to 370 PSI (1240 to 2550 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI 1240) to 2170 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2170 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2170 kPa)
60 to 100 (15 to 40)	1 h	6 h	2 h	12 h	6 h	18 h	8 h	24 h
40 to 60 (5 to 15)	2 h	12 h	4 h	24 h	12 h	36 h	16 h	48 h
20 to 40 (-7 to 5)	6 h	36 h	12 h	72 h	36 h A	4 days A	3 days A	9 days A
10 to 20) (-15 to 7)	8 h	48 h	16 h	96 h	72 h A	8 days A	4 days A	12 days A
Colder than 10 (-15)	Extreme care should be exercised on all joints made where pipe, fittings or cement is below 10°F.							

A: It is important to note that at temperatures colder than 20°F on sizes that exceed 3 in., test results indicate that many variables exist in the actual cure rate of the joint. The data expressed in these categories represent only estimated averages. In some cases, cure will be achieved in less time, but isolated test results indicate that even longer periods of cure may be required.
B: These cure schedules are based on laboratory test data obtained on Net Fit Joints (NET FIT=in a dry fit the pipe bottoms snugly in the fitting socket without meeting interference).

THREADED CONNECTION INSTALLATION: 1" PIPE SIZE

Threaded end connections are manufactured to ASTM specifications D2464-88. F437-88 and ANSI B2.1. Wrap threads of pipe with Teflon tape of 3 to 3-1/2 mil thickness. The tape should be wrapped in a clockwise direction starting at the first or second full thread. Overlap each wrap by, 1/2 the width of the tape. The wrap should be applied with sufficient tension to allow the threads of a single wrapped area to show through without cutting the tape. The wrap should continue for the full effective length of the thread. Pipe sizes 2" and greater will not benefit with more than a second wrap, due to the greater thread depth. To provide a leak proof joint, the pipe should be threaded into the end connection "hand tight". Using a strap wrench only. (Never use a stillson type wrench) tighten the joint an additional 1/2 to 1-1/2 turns past hand tight. Tightening beyond this point may induce excessive stress that could cause failure.

FLANGED CONNECTION INSTALLATION:

Flange bolts should be tight enough to slightly compress the gasket and make a good seal, without distorting or putting excessive stress on the flanges. Suitable washers should be used between the bolt head and flange and the nut and flange. Bolts should be tightened in alternating sequence.

RECOMMENDED FLANGE BOLT TORQUE

FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.	FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.
1/2	1/2	10-15	2	5/8	15-25
3/4	1/2	10-15	2-1/2	5/8	20-25
1	1/2	10-15	3	5/8	20-25
1-1/4	1/2	10-15	4	5/8	20-25
1-1/2	1/2	10-15	6	3/4	30-40
			8	3/4	30-40

NOTE: USE WELL LUBRICATED METAL BOLTS AND NUTS. USE SOFT RUBBER GASKETS.

METAL PIPING INSTALLATION:

Due to different thermal expansion rates between metal and plastic, transmittal of pipe vibration, and pipe loading forces, direct installation of plastic Simplex strainers into metal piping systems can potentially damage the Simplex strainer.

IT IS RECOMMENDED THAT AT LEAST 10 PIPE DIAMETERS IN LENGTH OF PLASTIC PIPING BE INSTALLED UPSTREAM AND DOWNSTREAM OF THE SIMPLEX STRAINER.

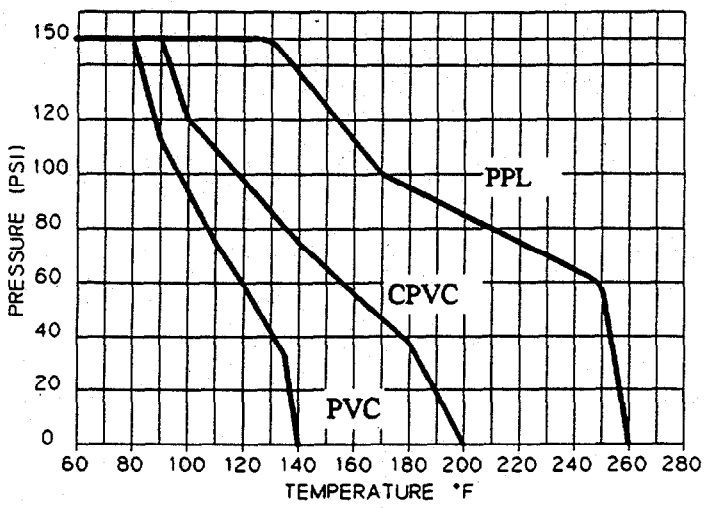
OPERATION and BASKET CLEANING:

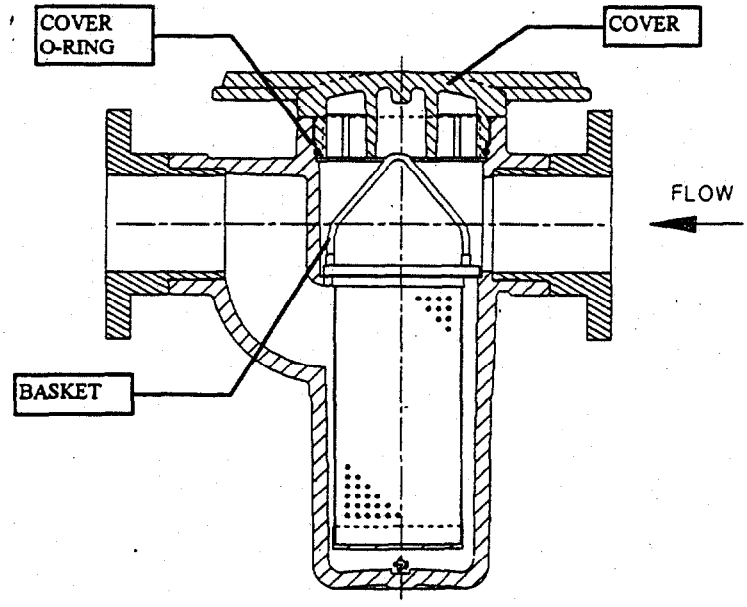
CAUTION: The Simplex basket strainer must be depressurized before proceeding further.
The cover must be installed per Step 5 below on the strainer before the system is pressurized.

The maximum recommended fluid velocity is 8 feet per second. This velocity minimizes the effects of valve closure and pump start up or shut down.

Pressure gauges may be installed on the inlet and the outlet piping to indicate by pressure loss, in excess of 5 psi, when the basket should be cleaned.

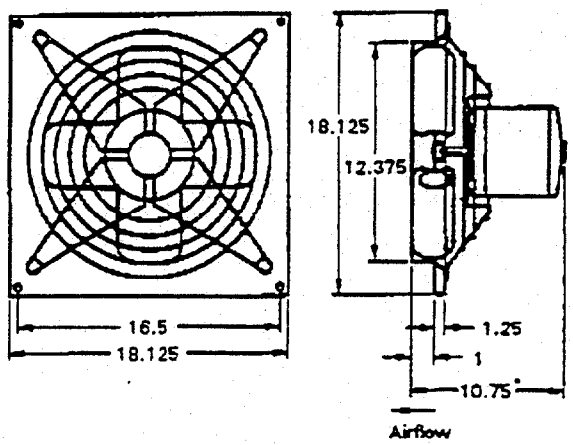
1. Valves should be installed just upstream and downstream of the Simplex Basket strainer. These valves must be closed and/or the system depressurized before proceeding.
2. The drain plug, from the strainer, should carefully be removed to depressurize and partially drain the strainer.
3. The strainer cover is removed by turning in a counter-clockwise direction. No tools are required. *Do not use wrenches or hammers.*
4. When the process fluid has been completely drained, remove the basket. Clean the basket by using a brush or soaking in an appropriate cleaning solution. **DO NOT USE SOLVENTS ON PLASTIC BASKETS.** Baskets should be cleaned as soon as possible after removal from the strainer, otherwise the contents may harden and become more difficult to remove. *Avoid striking baskets to loosen their contents as this may damage the basket.* To clean the basket strainer body wash the inside of the body with an appropriate cleaning solution. (NOT A SOLVENT)
5. Place a clean basket into the basket strainer body. The basket flange should rest squarely on the basket seat inside the body. Before replacing the cover, make sure that the "o"-ring for the cover is undamaged, clean, and lubricated. It is good practice to clean the body threads with a soft brush to remove all foreign material. **TIGHTEN THE COVER USING LIGHT HAND PRESSURE ONLY.** The cover holds the basket in place ensuring no material passes the basket. The cover does not have to be forced against the top surface of the body when tightening, as the seal is performed with a piston sealing action. A slight gap (approximately the thickness of a dime or a matchbook) between the cover and the top of the body will achieve a positive seal.
6. **Reinstall the drain plug.**
7. **Slowly open the upstream valve to pressurize the strainer.** It is good practice to provide a vent fitting so the air can be vented from the strainer.
8. **Slowly open the downstream valve.**





MARK : **EF-2**

SE1 Sidewall Direct Drive Exhaust Fan



NOTES : All dimensions shown are in units of inches.
* - Varies with Motor Selection

Standard Construction Features

• Fan panels of galvanized steel • Aluminum fan blades • Heavy gauge welded wire motor supports and fan guard with Zinc plated coating • Motor mounted to support guard with neoprene isolators • Corrosion resistant fasteners • Motor side guard.

Options & Accessories Selected

- Gravity Damper WD-320 14x14
- Kit - Wall Collar WMC

DIMENSIONS

Damper Size (In)	Wall Openings - Sq. (In)		Approximate Weight (Lb)
	Fan Only	Housing/Collar	
14 x 14	14.5	19.25	20

PERFORMANCE

Qty.	Model	Volume (CFM)	SP (In WC)	FRPM	Power (BHp)	Motor Information			
						Hp	V/C/P	Enclosure	RPM
1	SE1-12-432-D8	1129	0.200	1550	0.11	1/8	115/60/1	Totally Enclosed	1550

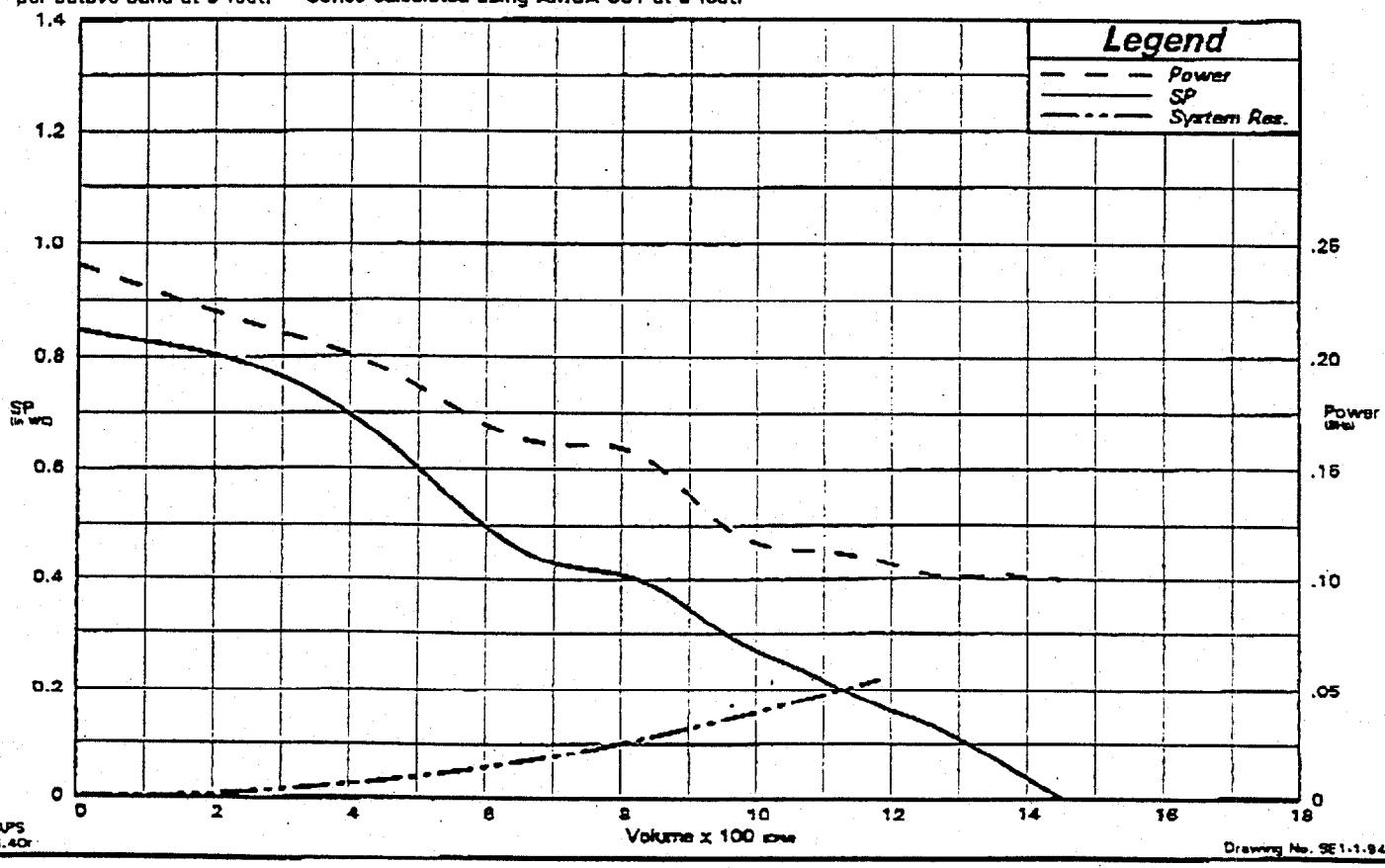
SOUND

Inlet Sound Power by Octave Band								LwA	dBA	Sones
63	125	250	500	1000	2000	4000	8000			
68	83	64	61	61	60	54	47	66	54	7.0

AIR DENSITY

Elevation (Ft)	Airstream Temp. (F)
0	70

LwA - A weighted sound power level, based on ANSI S1.4. dBA - A weighted sound pressure level, based on 11.5 dB attenuation per octave band at 5 feet. Sones calculated using AMCA 301 at 5 feet.



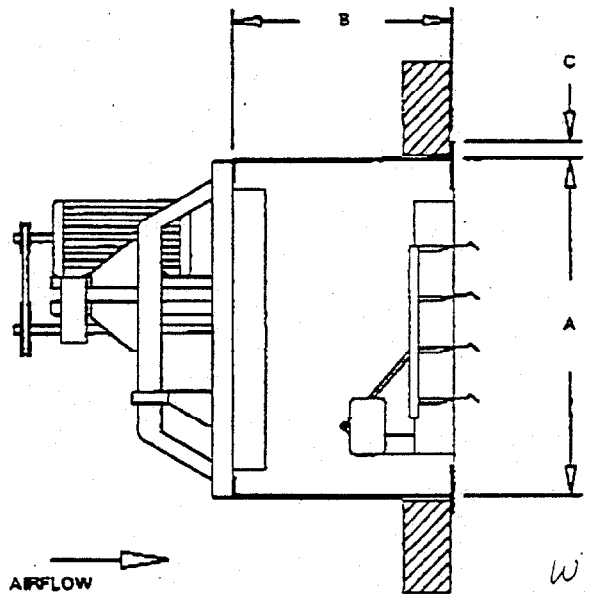
CAPS v6.40r

Drawing No. SE1-1-94

WMC Wall Mount Collar Kit for Exhaust Fans

Standard Construction Features

• Heavy gauge steel construction • Permatector finish • Prepunched mounting holes. ••• Collar, fan, damper, guard, and weatherhood all ship loose for field assembly.•••



WD 320 Gravity Damper

Shown with Optional Damper

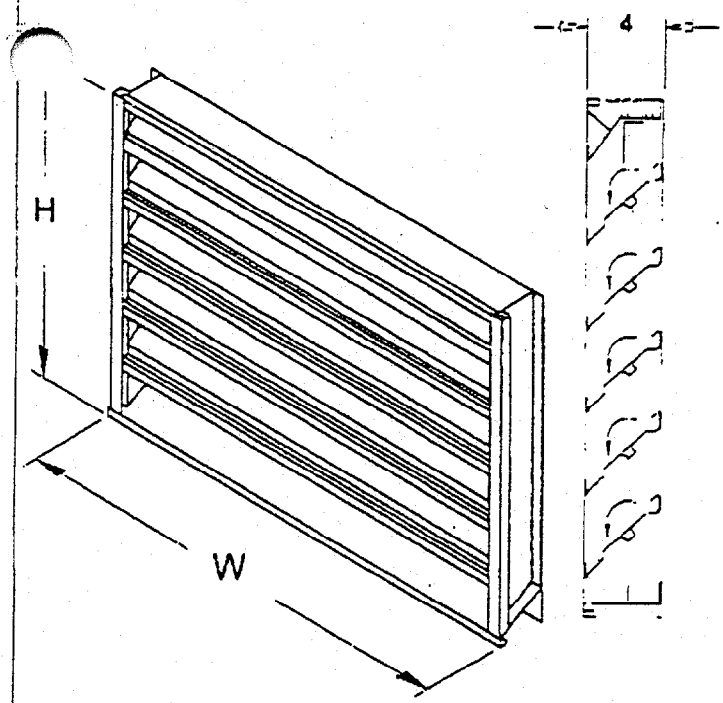
Size	A	B	C	Damper Size	Wall Opening	Wt (Lb)
8	12.875	16.125	1.563	10 x 10	14.25 x 14.25	5
10	14.875	16.125	1.563	12 x 12	16.25 x 16.25	5
12	17.875	16.125	1.563	14 x 14	19.25 x 19.25	5
14	19.875	18.375	1.563	16 x 16	21.25 x 21.25	5
16	21.875	18.375	1.563	18 x 18	23.25 x 23.25	5
18	23.875	18.375	1.563	20 x 20	25.25 x 25.25	5
20	25.875	18.375	3	22 x 22	27.25 x 27.25	5
24	31.875	18.375	3	26 x 26	33.75 x 33.75	5
30	37.875	18.375	3	32 x 32	39.75 x 39.75	5
36	43.875	18.75	3	38 x 38	45.75 x 45.75	5
42	49.875	18.75	3	44 x 44	51.75 x 51.75	5
48	55.875	18.875	3	50 x 50	57.75 x 57.75	5
54	61.875	20.125	3	56 x 56	63.75 x 63.75	5
60	67.875	21	3	62 x 62	69.75 x 69.75	5
72	81.875	22	3	74 x 74	83.75 x 83.75	5

NOTES : All dimensions shown are in units of inches.

2/10/98 | Job: BECHTEL-2-10-98

GREENHECK

Symbol: LVR



EAD-401

Drainable Adjustable Blade

Application & Design

Drainable Adjustable Blade Louver Model EAD-401 is an adjustable louver designed to protect air intake and exhaust openings in building exterior walls that requires tight air shut off. Design incorporates drain gutters in the head member and horizontal blades to channel water to the louver side frames or jambs where water is further channeled through vertical downspouts and out at the louver sill. The EAD-401 is an extremely efficient louver with AMCA LICENSED PERFORMANCE DATA enabling designers to select and apply with confidence.

STANDARD CONSTRUCTION FEATURES
- Frame: Heavy gauge 6063T5 extruded aluminum, 4.0 in. deep.
- Blades: Drainable design, 6063T5 extruded aluminum positioned at 45° angles on approximately 4.0 in. centers.
- Bird Screen: 0.75 in. x 0.051 in. flattened expanded aluminum in removable frame. Mounted on inside (rear).
- Linkage: Side linkage out of airstream.
- Bearings: Synthetic Sleeve.
- Axles: 0.5 in. diameter zinc plated steel.
- Finish: Mill.

Notes: All dimensions shown are in units of inches.
Height & Width furnished approximately 0.25 in. under size.

amca CERTIFIED RATINGS WATER PENETRATION AIR PERFORMANCE

CONSTRUCTION FEATURES

Frame Type:	Channel	Sizing:	Nominal
Blade Thickness (in.):	0.125	Fail Position:	Closed
Adj. Blade Thick. (in.):	0.081	Axle Material:	Steel
Screen:	Bird Screen	Axle Bearings:	Synthetic
Actuator Type:	Manual Internal	Blade / Jamb Seals:	Yes

Options & Accessories

with Flange Frame

ID #	Qty	W (in.)	H (in.)	Drive Arr.	Actuator Model	Act. Qty.	Free Area (Sq. Ft.)	Sect. Wide	Sect. High	Qty. of Ship Sect.
1-1	2	18.000	18.000	11-1FIL-0		1	0.53	1	1	2

GREENHECK

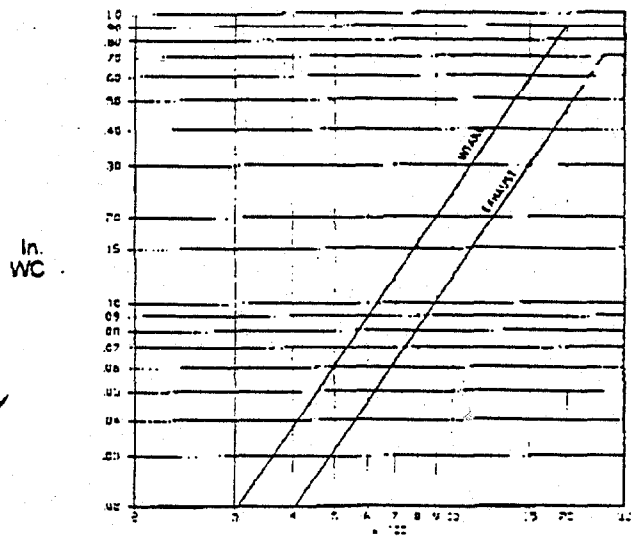
Symbol: LVR

amca CERTIFIED RATINGS WATER PENETRATION AIR PERFORMANCE

EAD-401 Louver Performance Data

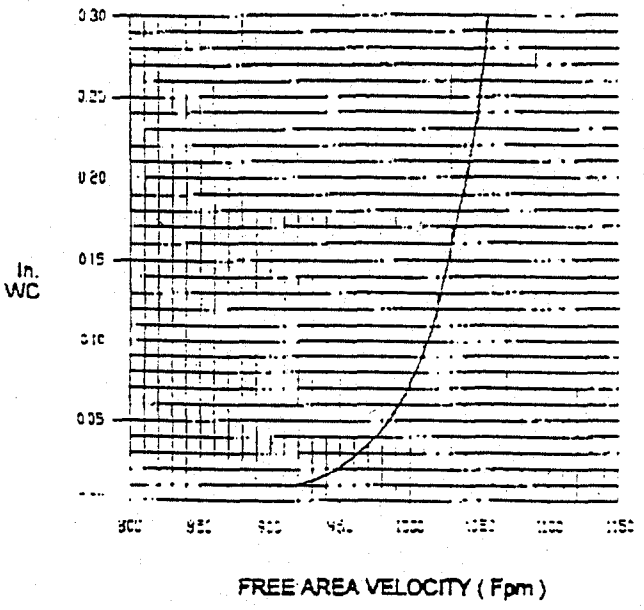
Greenheck certifies that the EAD-401 louvers shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to air performance and water penetration ratings.

Airflow Resistance (Standard Air - 0.075 lb/ft3)



Model EAD-401 resistance to airflow varies depending on louver application (air intake or air exhaust). Free area velocities (shown) are higher than the average velocity through the overall louver size.

Water Penetration (Standard Air - 0.075 lb/ft3)



The AMCA Water Penetration Test provides a method for comparing various louver models and designs as to their efficiency in resisting and penetration of rainfall under specific laboratory test conditions. The beginning point of water penetration is defined as that velocity where the water penetration curve projects through 0.01 oz. of water (penetration) per sq. foot of louver free area. The beginning point of water penetration for model EAD-401 is 920 FPM free area velocity. These performance ratings do not guarantee a louver to be weatherproof or stormproof and should be used in combination with other factors including good engineering judgement in selecting louvers.

READ AND SAVE THESE INSTRUCTIONS

Part # 455103

GREENHECK
P.O. BOX 410 SCHOFIELD, WISCONSIN 54476-0410
PH. 715-359-6171

Sidewall Propeller Fans Belt Drive and Direct Drive

Installation, Operating and Maintenance Manual

Upon receiving the unit, check for any damage and report it immediately to the shipper. Also assure all accessory items are accounted for.

Move fan to the desired location and determine the method by which the fan is to be mounted as shown below in figures 1, 2 and 3. Optional wall mount housings (Fig. 1) and wall mount collars (Fig. 2) provide a convenient means of mounting sidewall fans while maintaining the proper distance between propeller and damper.

Attach the fan by inserting a suitable fastener through each of the pre-punched mounting holes in the fan panel. Care should be taken not to bend or distort the fan panel or drive components during installation.

The motor voltage and amperage rating must be checked for compatibility with the electrical supply. Supply wiring to the fan must be properly fused and conform to local and national electrical codes.

TYPICAL INSTALLATIONS

Wall opening size and propeller-to-damper distance are two important dimensions for fan installation. Fans mounted to the wall require a different opening (W.O.) size than those mounted in collars or wall housings. Propeller-to-damper distance (M) is important to reduce turbulence and damper flutter which may lead to premature damper failure.

Figs. #1 and #2 , show the wall opening (W.O.) required for installations with either a wall housing or collar.

Fig. #3 shows the recommended wall opening (W.O.) and the minimum distance (M) suggested between the fan and damper for direct to wall installations.

Wall Opening Requirements

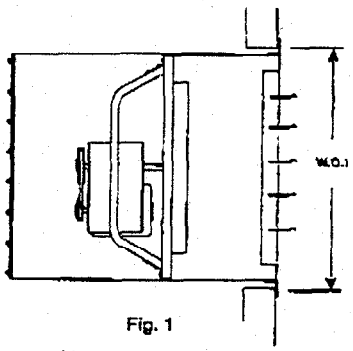


Fig. 1
Wall Housing Installation

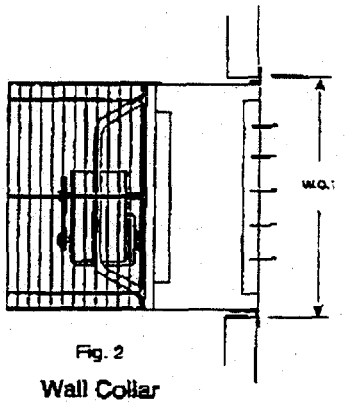


Fig. 2
Wall Collar Installation

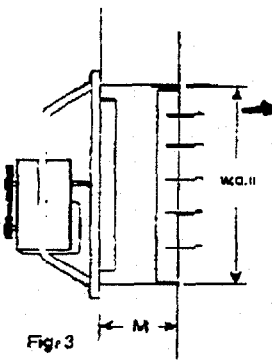


Fig. 3
Direct to Wall Installation

Fan Size	D Damper Size	WO-I Sq.	WO-II Sq.	M Min.
8	10x10	14 1/4	10 1/2	13
10	12x12	16 1/4	12 1/2	13
12	14x14	19 1/4	14 1/2	13
14	16x16	21 1/4	16 1/2	13
16	18x18	23 1/4	18 1/2	13
18	20x20	25 1/4	20 1/2	13
20	22x22	27 1/4	22 1/2	13
24	26x26	33 3/4	26 1/2	13
30	32x32	39 3/4	32 1/2	13
36	38x38	45 3/4	38 1/2	14
42	44x44	51 3/4	45 1/2	15
48	50x50	57 3/4	50 1/2	16
54	56x56	63 3/4	56 1/2	17
60	62x62	69 3/4	62 1/2	18
72	74x74	83 3/4	74 1/2	19

PRESTARTING CHECKS

Check all fasteners and set screws for tightness. This is especially important for bearing set screws.

The propeller should rotate freely and not rub on the fan panel venturi. Rotation direction of the propeller should be checked by momentarily turning the unit on. Rotation should be in the same direction as the rotation decal affixed to the unit or as shown in Fig. 4. For 3-phase installations, fan rotation can be reversed by simply interchanging any two of the three electrical leads. For single phase installations follow the wiring diagram located on the motor.

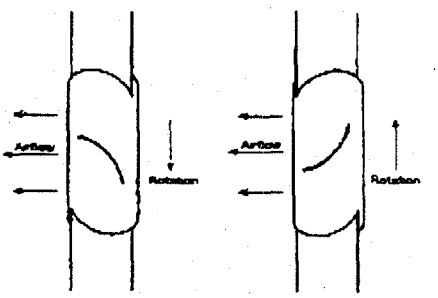


Fig. 4

FOR BELT DRIVE FANS

The adjustable motor pulley is preset at the factory for the specified fan RPM. Fan speed can be increased by closing or decreased by opening the adjustable pulley. Two or three groove variable pitch pulleys must be adjusted an equal number of turns open. Any increase in fan speed represents a substantial increase in horsepower required from the motor. Always check motor load amperage and compare to name plate rating when changing fan speed.

ROUTINE MAINTENANCE

WARNING

DISCONNECT AND SECURE TO THE "OFF" POSITION ALL ELECTRICAL POWER TO THE FAN PRIOR TO INSPECTION OR SERVICING. FAILURE TO COMPLY WITH THIS SAFETY PRECAUTION COULD RESULT IN SERIOUS INJURY OR DEATH.

Once the fan has been put into operation, a periodic maintenance program should be set up to preserve the reliability and performance of the fan. Items to be included in this program are:

- **BELTS**
- **BEARINGS**
- **FASTENERS**
- **SET SCREWS**
- **LUBRICATION**
- **REMOVAL OF DUST/DIRT**

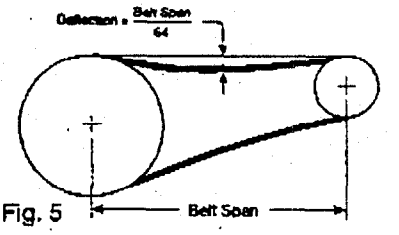


Fig. 5

BELTS

Premature belt failures are frequently caused by improper belt tension (either too tight or too loose) or misaligned pulleys. The proper tension for operating a V-belt is the lowest tension at which the belts will not slip at peak load conditions. For initial tensioning, the proper belt deflection half way between pulley centers is 1/64" for each inch of belt span. For example, if the belt span is 64 inches, the belt deflection should be one inch using moderate thumb pressure at midpoint of the drive (Fig. 5).

Check belt tension two times during the first 24 hours of operation and periodically thereafter. To adjust belt tension, simply loosen four fasteners (two on each side of the motor plate) and slide the motor plate away from the fan shaft until proper belt tension is attained. On some fans, fasteners attaching the motor to the motor plate must be loosened in order to adjust the belt.

It is very important that the drive pulleys remain in proper alignment after adjustments are made. Misalignment of pulleys will result in premature belt wear noise, vibration and power loss. See Fig. 6.

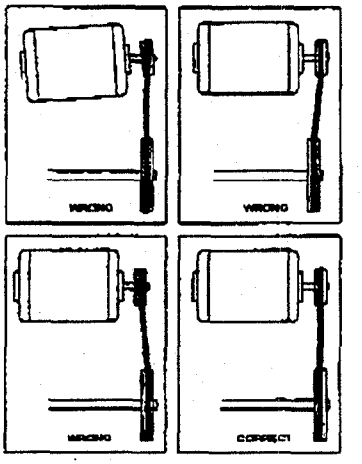


Fig. 6

BEARINGS (For belt drive fans only)

Bearings are the most critical moving part of the fan and should be inspected at periodic intervals. Locking collars and set screws, in addition to fasteners attaching the bearings to the bearing plate, must be checked for tightness. In a clean environment and temperatures above 32°F./below 200° F., fan shaft bearings with grease fittings should be lubricated semi-annually using a high quality lithium based grease. If unusual environmental conditions exist temperatures below 32°F./above 200°F., moisture or contaminants, more frequent lubrication is required.

With the unit running, add grease very slowly with a manual grease gun until a slight bead of grease forms at the seal. Be careful not to unseat the seal by over lubricating or using excessive pressure. Bearings without grease fittings are lubricated for life.

FASTENERS AND SET SCREWS

Any fan vibration has a tendency to loosen mechanical fasteners. A periodic inspection should include checking all fasteners and set screws for tightness. Particular attention should be paid to set screws attaching the propeller to the shaft and the shaft to the bearings. Loose bearing set screws will lead to premature failure of the fan shaft.

LUBRICATION

Refer to the paragraph on bearings for bearing lubrication. Many fractional horsepower motors installed on the smaller fans are lubricated for life and require no further attention. Motors equipped with oil holes should be oiled in accordance with the manufacturer's instructions printed on the motor. Use a high grade SAE 20 machine oil and use caution not to over lubricate. Motors supplied with grease fittings should be greased according to directions printed on the motor.

REMOVAL OF DUST AND DIRT

Dirt clogs cooling openings on the motor housing, contaminates bearing lubricant and collects on propeller blades causing severe imbalance if left unchecked. The exterior surface of the motor, fan panel and entire propeller should be thoroughly cleaned periodically. Use caution and do not allow water or solvents to enter the motor or bearings. Under no circumstances should motors or bearings be sprayed with steam or water.

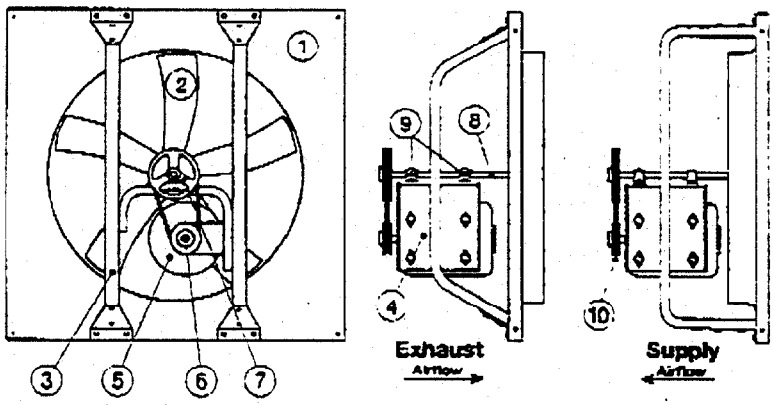
TROUBLESHOOTING

PROBLEM	CAUSE	CORRECTIVE ACTION
Reduced airflow	System resistance is too high.	Check backdraft dampers for proper operation. Remove obstructions in ductwork. Clean dirty filters. Check for adequate supply air for exhaust fans or exhaust air for supply fans.
	Fan too close to damper.	Increase distance between fan and damper.
	Unit running backwards.	See pre-starting checks.
	Fan speed too low.	Increase fan speed.
	Excessive dirt on propeller.	Clean propeller.
Excessive Noise	Bearings	Tighten bearing collars and set screws Lubricate bearings. Replace defective bearings.
	V-Belt drive	Tighten pulleys on motor and fan shaft. Adjust belt tension. Align pulleys. Replace worn belts or pulleys. See "Routine Maintenance".
	Excessive vibration	Clean dirt build-up from propeller. Check all set screws and fasteners for tightness. Check for worn bearing. Correct propeller imbalance. Check for loose dampers. guards or ductwork.
	Defective Motor	Replace motor.

Motor load amperage must be checked and compared to nameplate rating to avoid serious damage to motor when speed is increased.

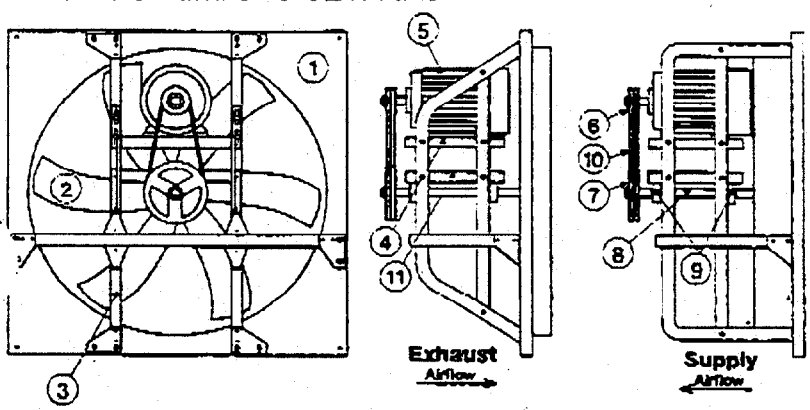
Belt Drive Fans Parts List

For SB-1L/H and SBC-2L/H Fans



1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor/Bearing Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt

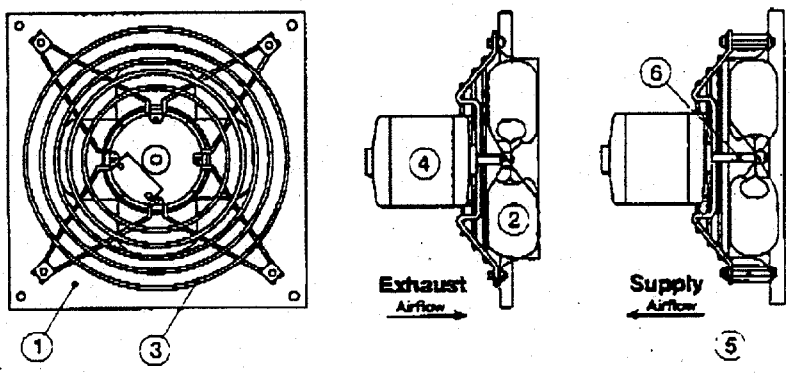
For SB-3L/H and SBC-3L/H Fans



1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt
11. Bearing Plate

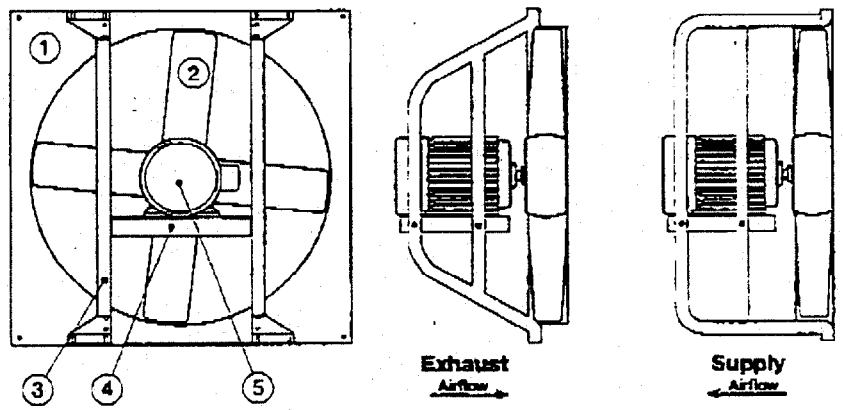
Direct Drive Fans Parts List

For S1 Fans



1. Fan Panel
2. Propeller
3. Drive Frame/Motor Support
4. Motor
5. Riser Blocks (4) - supply fan only
6. Shaft Extension- supply fan only

For S2 and SC3 Fans



1. Fan Panel
2. Propeller
3. Drive Frame Channels (2)
4. Motor Plate
5. Motor

Replacement Parts

Always provide the unit serial number when requesting parts or information.

JOB _____

MODEL _____ SERIAL NO. _____

GREENHECK PRODUCTION ORDER NO. _____

SALES OFFICE _____ CITY _____

SELECT ONE:

❑ BELT DRIVE ❑ DIRECT DRIVE

Part Description	Quantity	Remarks

1-800-928-8471

Metering Sales *and* Service
The right meter the first time - GUARANTEED
1930 Pioneer Road
Huntingdon Valley, PA 19006
1-215-675-5117
1-215-675-4960 FAX

QUOTATION

The quotation number must appear on all related correspondence, inquiries and purchase orders:

QUOTATION NUMBER:98-021702

To:
Wayne Underhill
Bethel Env.
Tad Nobles

Ship To:
Same

Phone: 423-220-2245 Fax: 423-220-2108 -2123

QUOTE DATE	QUOTED BY	SHIP VIA	F.O.B. POINT	TERMS
2/18/98	John C. Burgess	UPS - Grd	MS & S	Net 30

QTY	UNIT	DESCRIPTION / CATALOG	UNIT PRICE	TOTAL
1	each	G.E. WH Type kV meter, 3Ø 4W 208V, CL200 FM16S.	$445.93	$ 445.93
1	each	Meter board,7 jaw with lever. Mfg. Anchor[T&B]	$126.83	$ 126.83

Special Notes / Terms:

*Shipping and handling Pre-paid and added MS&S.

G.E. kV meter is in stock.

Meter socket, 7 jaw is in stock.

SUBTOTAL	$ 572.76
SHIPPING & HANDLING	*
OTHER	
SALES TAX	
TOTAL	$ 572.76

Please reference quotation number on any Purchase Orders-Thank You

1. Enter order in accordance with the prices, terms, delivery method, and specifications listed above.
2. Partial Shipments : OK / Not ACCEPTED

John C. Burgess

John C. Burgess 2-18-98
Authorized by Date

METERING SALES & SERVICE, INC.
Distributors of Metering Equipment & Systems
1930 Pioneer Road
HUNTINGDON VALLEY, PENNSYLVANIA 19006

1771

(215) 675-5117

BECHTEL ENVIRONMENTAL, INC
151 LAFAYETTE DRIVE
PO BOX 350
OAK RIDGE, TN 37831-0350

SALESPERSON	DATE OF INVOICE
	MARCH 2, 1998

SHIP TO: SAME

COUNT NO.	DATE SHIPPED	SHIPPED VIA	COL	P.P.	F.O.B. POINT	TERMS	YOUR ORDER NUMBER
	03/02/98	UPS			SHIPPING	MC	

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
1	GENERAL ELECTRIC kV WATTHOUR METER, 3Ø, 4W, C1-200	$445.93	$445.93
1	7 TERMINAL METER SOCKET	126.83	126.83
	SHIPPING CHARGES		11.58
	TOTAL		$584.43

PAID
DATE 03-09-98
CASH ☐
CHECK NO. M/C ☑
AMOUNT $ 584.43

RECEIVED
MAR 13 1998
CONTROLLER ORO

Thank You

A555A

Bechtel Environmental Inc
151 Lafayette Drive
PO Box 350
Oak Ridge, TN 37831-0350
Kent J. Parish
5405 9200 0198 4441
0899

SIGN HERE
X Telephone Sale

The issuer of the card identified on this item is authorized to pay the amount shown as TOTAL upon proper presentation. I promise to pay such TOTAL (together with any other charges due thereon) subject to and in accordance with the agreement governing the use of such card.

QTY.	CLASS	DESCRIPTION	PRICE	AMOUNT
1		GE kV meter	445.93	445 93
1		7T. socket	126.83	126 83
		Shipping & Ins		11 58

DATE 03.09.98 | AUTHORIZATION | SUB TOTAL
REFERENCE NO. 015786 | SERVER | TAX
ID-FOLIO / CHECK NO. / LIC. NO. STATE | REG./DEPT. | CLERK | TIP / MISC.
VISA MasterCard 5021225 | TOTAL | 584 34

SALES SLIP CUSTOMER COPY

CUSTOMER: RETAIN THIS COPY FOR YOUR RECORDS

HAYWARD CONTROLS
INSTRUCTION MANUAL
for
EVR-SERIES (Reversing) ELECTRIC ACTUATORS

MODEL NO. EVR2 115 VAC .4 AMPS 25% DUTY

This instruction manual contains important information regarding the installation and operation of the EVR-Series Electric Actuators. Please read these instructions carefully and save them for future reference.

CYCLE = 4.5

DESCRIPTION

Hayward Controls's EVR-Series Electric Actuators are designed to provide reliable and efficient operation of 1/4 turn valves. The supported torque range for actuation is between 100 and 600 inch pounds. EVR-Series actuators are available in AC models with a 25% duty cycle and DC models with a 100% duty cycle. Note: If the actuator will be mounted on a butterfly valve, ensure that the actuator is equipped with a Motor Brake. This factory installed option is shown by a "K" in the model number on the actuator nameplate.

PARTS LIST

1 - Limit Switch
2 - Cams
3 - Override/ Cam Shaft
4 - O-Ring

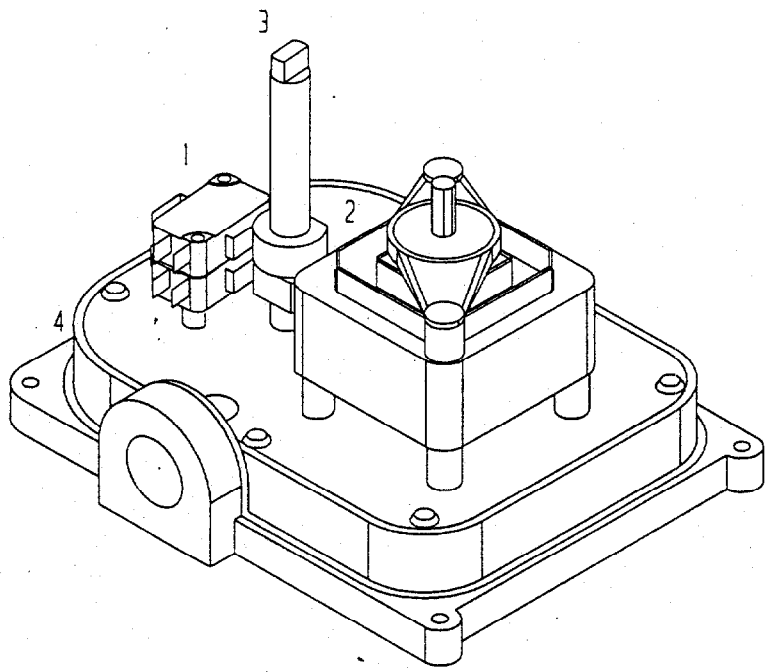


Figure 1 *Parts Identification*

INSTALLATION

CAUTION: Dangerous voltages are present inside the actuator unless the power supply to the actuator has been shut off or disconnected. Use extreme caution whenever working on the actuator with the cover removed.

Temperature Limits

Low ambient temperatures: The minimum recommended ambient temperature without the optional heater and thermostat is approximately 30°F (although it varies with the frequency of use). With the optional heater and thermostat installed, the recommended minimum ambient temperature is -40°F.

High ambient temperatures: The maximum recommended ambient temperature is 160°F.

High media temperatures: For media temperatures up to 200°F, additional precautions are not typically required. For media temperatures between 200°F and 300°F, a shielding plate about one inch larger than the actuator in each dimension should be placed between the actuator and the mounting bracket. In addition, the actuator should be mounted at the 3 o'clock or 9 o'clock position relative to the pipe. For media temperatures above 300°F, a valve with an extended shaft mounting arrangement should be used.

Mounting the Actuator

First verify that the output torque of the actuator is appropriate for the torque requirements of the valve and that the actuator duty cycle is appropriate for the intended application.

NOTE: A 25% duty cycle means that for every operating cycle that the actuator is ON (to open or close the valve), the actuator must be OFF for a time equal to three operating cycles. For example, if the operating cycle time is 5 seconds, for every operating cycle that the actuator is ON, it must be OFF for 15 seconds. **Exceeding the actuator's duty cycle may cause the thermal overload switch to temporarily shut off power to the motor.**

Actuator Drive Output Requirements: Hayward Controls's EVR-Series actuators have a male drive output with 0.375" flats. Two industry standard bolt hole circle configurations are provided (see Figure 2).

Bracket requirements: **It is mandatory that the actuator be firmly secured to a sturdy mounting bracket.** A minimum of four bolts must be used to secure the actuator to the bracket. There can be no flexibility in the bracket, and backlash ("play") in the coupling should be minimized. In addition, the actuator output shaft must be in line (centered) with the valve shaft. This avoids side-loading the shafts.

MANUAL OVERRIDE

To operate the actuator manually, remove the position indicator. Then push the override shaft down fully (approximately 1/4"), and use a 5/16" wrench on the flats of the shaft to rotate the actuator. Pushing the override shaft down disengages the gear train and directly rotates the output shaft. Note: It is also possible

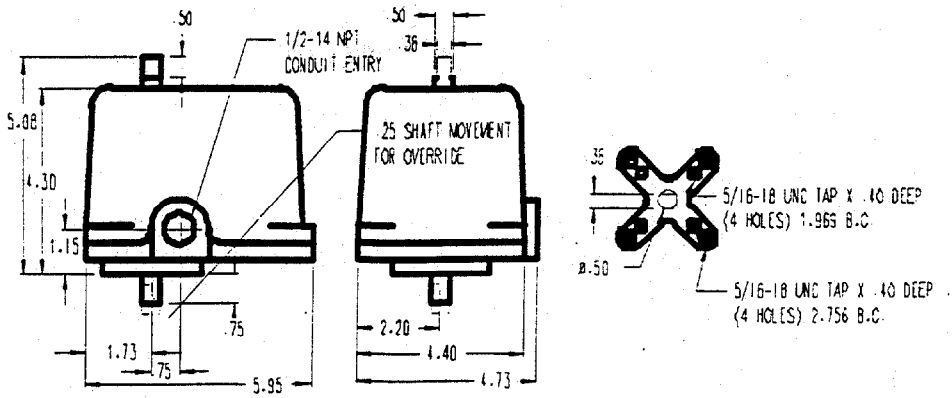


Figure 2 *Dimensions*

to turn the override shaft without pushing it down. The gear train is then still engaged and the override shaft must work through the gear train to rotate the actuator.

WIRING

Note: Be sure to follow local wiring codes.

The identification label on each actuator specifies the voltage and current requirements for the actuator. Figure 3 shows the standard power and control wiring connections for AC and DC actuators. To operate the EVR actuator, the user supplies power to the actuator's motor through two limit switches. The limit switches control the actuator's mechanical travel limits and are factory set at 90 degrees.

VAC

To drive the actuator counterclockwise (CCW), apply power to terminals 1 and 3. To drive the actuator clockwise (CW), apply power to terminals 1 and 4. The actuator can be driven fully open (CCW) or closed (CW) by maintaining power to the motor until the actuator trips the internal limit switches. Power can also be disconnected at any point during the travel to position the actuator.

VDC

DC voltage actuators require a reversing of the power polarity. To drive the actuator CW, apply power so that terminal 1 is negative and terminal 4 is positive. To drive the actuator CCW, apply power so that terminal 1 is positive and terminal 3 is negative.

ADJUSTMENT OF THE LIMIT SWITCH

The limit switch is actuated by the cam on the output shaft and sets the 0°, 90°, 180° and 270° positions where the actuator will stop at the end of each cycle. If adjustment of the open or closed position is required, proceed as follows:

A. Remove the Actuator Cover

Remove the actuator cover by removing the screws securing the cover to the base.

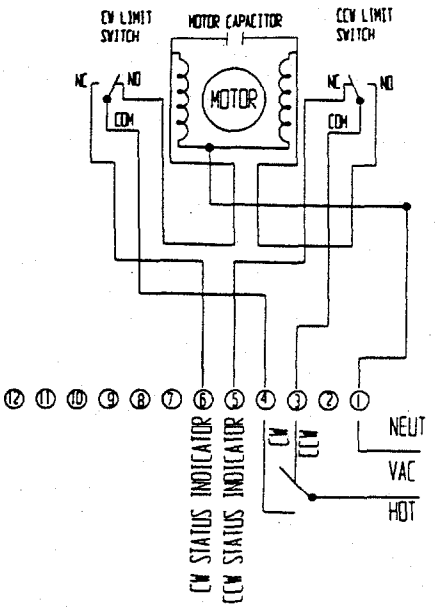


Figure 3A *Wiring Diagram VAC*

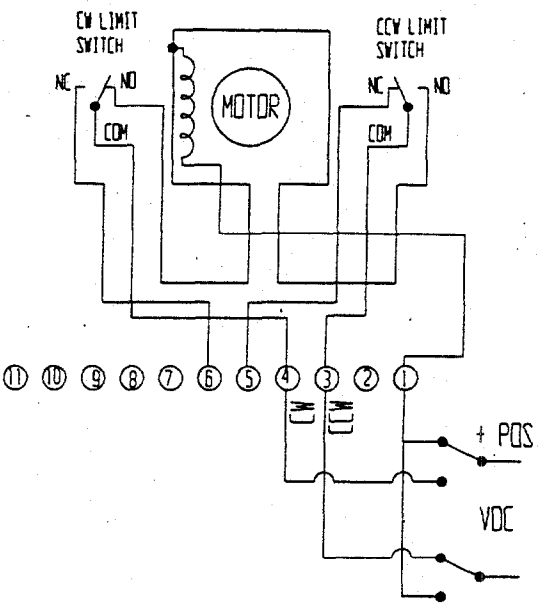


Figure 3B *Wiring Diagram VDC*

B. Adjust the Cam

1. Operate the actuator and observe where it stops in the open and closed positions. Note whether the actuator is stopping **short** of the desired open and closed positions or traveling **beyond** the desired open and closed position.
2. Continue to cycle the actuator from closed to open positions until the cam stops at a position where you can reach the cam set screw with the hex wrench.
3. Remove power from the actuator.
4. Using the 1/16 inch hex wrench, loosen the set screw in the cam.
5. If the actuator is stopping short of the desired stopping positions, rotate the cam slightly toward the limit switch arm (Counterclockwise). Note: Cam adjustments affect both the open and closed stopping positions equally.
6. If the actuator is traveling beyond the desired stopping positions, rotate the cam slightly away from the limit switch arm (Clockwise). Note: Cam adjustments affect both the open and closed stopping positions equally.
7. Re-tighten the set screw in the cam (be careful not to over-tighten the screw).

C. Replace the Actuator Cover

NOTE: When reinstalling the cover, follow the normal practice of tightening the cover screws in a cross pattern to insure that the cover is pulled down flat without over-stressing a corner.

Options

Additional Limit Switches:	Two field-installable additional limit switches are available.
Heater and Thermostat:	A field-installable heater and thermostat is available for low temperature or high humidity applications.
Timer Board:	An optional timer board is available but must be factory installed in the actuator.

Hayward Industrial Products Incorporated

900 Fairmount Avenue, Elizabeth, NJ 07207
Phone: (908)351-5400, Fax: (908)351-7706
A Hayward Industries Company

HAYWARD INDUSTRIAL PRODUCTS, INC.
900 FAIRMOUNT AVENUE . P.O. BOX 18. ELIZABETH NEW JERSEY 07207, U.S.A. Phone: (908) 351-5400
FAX : (908) 351-7706

Most Common Electric Actuator Misusage

Exceeding Rated Duty Cycle (Burned-out motor)

AC powered motors have "Duty Cycle" limitations. Hayward Controls offers a standard duty cycle motor (25%) and an extended duty cycle motor (75%). The definition of duty cycle is the amount of time a motor can run relative to the amount of time it needs to be at rest.

Causes of excessive duty cycle:

1) Actuators on butterfly valves with no motor brakes. Solution: Install motor brake.
2) Standard duty motors in modulating applications. Solution: Use an extended duty motor.
3) Unstable control systems (constant modulation). Solution: Use DC motor (100%).
4) Multiple actuators wired in parallel. Solution: Use independent relays or Valvcon relay boards.
5) High Temperature Exposure. Solution: Shield actuator from heat.

Exceeding Rated Torque (Stripped motor gearbox)

The gear trains in Hayward Controls actuators use rugged hardened steel spur gears. Under normal conditions, a gear failure is unlikely.

Causes of stripped gears in motor gearbox:

1) Manual override is not used correctly ("Push Down to Override"), thereby not declutching from the motor gearbox. Solution: Ensure proper usage
2) Overtorque due to external influence or continuous stalling (gear fatigue). Verify actuator is sized correctly to the valve. Check Valve torque as it may have risen beyond published specifications and beyond actuator rating.

Miswiring

Miswiring can simply cause an actuator not to run, or be as extensive as causing circuit board damage. Each actuator is supplied from the factory with an I.O.M. manual containing wiring information, as well as a built-in schematic on the "motherboard". In addition, miswiring can also be caused by working with the actuator's internal connections (i.e. motor plugged into the board in the wrong spot, limit switches reversed, Potentiometer plugged into wrong spot).

Out of Calibration/Out of "quadrant"

The manual override has the capability to put the actuator in any position relative to 360 degrees. If the actuator is turned such that it leaves the 90 degree quadrant it was set up for, it will lose it's capability of positioning (many times the valve will not allow more than 90 degrees of travel). In addition, if the actuator is removed from the valve, and installed 90 degrees offset, this could cause "stalling" on butterfly valves or reverse logic on continuous rotation ball valves (what was open is now close and vice versa). Hayward Controls actuators are marked on the output drive for position orientation. Position feedback potentiometer damage could occur outside the 90 degree quadrant.

Improper Environmental Protection (Moisture and Corrosion Damage)

There are three possible entries for moisture:

1) Override shaft - The override shaft incorporates an o-ring seal.
2) Cover flange - All Hayward Controls actuators are provides a gasket or an O-ring and are NEMA4 rated.
3) Conduit entries - The conduit holes come factory plugged (plastic plug).

If the actuator is installed correctly (override shaft has O-ring, flange gasket/o-ring is in place, all cover bolts are tight, and conduit entries have been sealed), the actuator will be protected from splashing or hose directed water. For high humidity areas, we recommend installing the heater thermostat option (T).

Voltage Spikes (Burned-out Board, Burned-out Capacitor)

Voltage spikes caused by lightening or power surges can damage the electronic board circuitry. Install power conditioning and surge protection if required

Old Age (Component Failure)

Components will fail due to old age and high use (over 100,000 cycles).

Quality

Hayward performs multiple steps during manufacturing to ensure the product you have received is of the highest standards. Each actuator, in addition to manufacturing QC, is tested for rated torque capability and smooth electrical operation.

Hayward Controls warrants it's electric actuators to be free from defects in material, design, and workmanship under proper and normal use and service for which the products are recommended for a period commencing on the date of purchase and ending, with respect to mechanical components of a product, two (2) years after the date of purchase.

INSTALLATION, OPERATION AND MAINTENANCE
HAYWARD ELECTRIC ACTUATORS
ALL MODELS

WITH THE HAYWARD PRE-MOUNTED AND FACTORY TESTED, ELECTRIC ACTUATOR, MOUNTING KIT AND VALVE ASSEMBLY, THE FIRST REQUIREMENT FOR PROPER INSTALLATION IS TO:

1.DISCONNECT POWER SUPPLY !

2.REMOVE THE ACTUATOR COVER.

INSIDE THE COVER YOU WILL FIND ALL OF THE APPROPRIATE WIRING DIAGRAM INFORMATION TO ALLOW YOU TO PROPERLY INSTALL EACH ACTUATOR. ON THOSE MODELS REQUIRING MORE THAN FOUR (4) COVER SCREWS, THE ADDITIONAL SCREWS ARE PACKAGED IN A POLYBAG INSIDE THE ACTUATOR.

THE INSTALLATION WIRING DOCUMENTATION HAS BEEN PLACED INSIDE THE ACTUATOR IN THE FORM OF A LABEL AFFIXED TO THE INSIDE OF THE TOP COVER OR PRINTED ON A FOLDED INSTALLATION, OPERATION SHEET.

SHOULD YOU HAVE PURCHASED AN ACTUATOR WITH MULTIPLE OPTIONS, WE MAY HAVE PLACED THE ADDITIONAL INSTALLATION OPERATION DOCUMENTATION INTO A HEAT SEALED POLYBAG PLACED WITHIN THE SHIPPING CARTON. LOOK CAREFULLY INSIDE THE CARTON TO BE SURE THAT YOU DO NOT ACCIDENTLY DISCARD THESE IMPORTANT DOCUMENTS.

COMPLIANCE OF LOCAL BUILDING/ELECTRICAL CODES:

THE ELECTRICAL CONNECTIONS TO THE ACTUATOR MUST BE PROPERLY CONNECTED CONSISTANT WITH THE INSTALLATION SCHEMATIC(S) TO THE TERMINAL STRIP(S) AFFIXED WITHIN THE ACTUATOR, OR IN CASES WHERE MULTIPLE ADDITIONAL LIMIT SWITCHES HAVE BEEN INSTALLED, TO THE WIRE LEADS WITH PROPERLY SIZED WIRE CONNECTORS AS REQUIRED BY CODE.

ALL HAYWARD ELECTRIC ACTUATORS CARRY A TWO (2) YEAR WARRANTY FOR MATERIAL DEFECTS AND WORKMANSHIP.

ACTUATOR COUPLING

DO NOT USE COUPLINGS OTHER THAN THAT SUPPLIED WITH THIS VALVE/ACTUATOR COMBINATION FOR INTERFACE BETWEEN THE ACTUATOR AND THE VALVE.

IMPORTANT TORQUE NOTICE

WHEN ATTACHING HAYWARD PLASTIC MOUNTING BRACKETS TO HAYWARD VALVES, THE FOLLOWING TORQUE SPECIFICATIONS FOR TIGHTENING OF ACTUATOR MOUNTING BRACKET BOLTS TO VALVES SHOULD BE FOLLOWED:

BALL VALVES:

BOLT SIZE	VALVE SIZE	TORQUE SPECIFICATION
1/4" THREAD	1/4" THRU 2"	25 TO 30 INCH POUNDS
3/8" THREAD	2 1/2" THRU 6"	70 TO 90 INCH POUNDS

BUTTERFLY VALVES:

3/8" THREAD	1/2" THRU 12"	100 TO 140 INCH POUNDS

HAYWARD INDUSTRIAL PRODUCTS
INSTALLATION OPERATION & MAINTENANCE OF TRUE UNION BALL VALVES

SOCKET CONNECTION:

Socket end connections are manufactured to ASTM D2467-87A. Solvent cementing of socket end connections to pipe should be performed per ASTM specifications D2855-87. Cut pipe square. Chamfer and deburr pipe. Surfaces must be cleaned and free of dirt, moisture, oil and other foreign material. Remove assembly nuts and end connectors from valve body. Slide assembly nuts, with threads facing valve, onto pipe to which the end connector is to be cemented. Apply primer to inside socket surface of end connector. Never allow primer or cement to contact valve ball or end connector o-ring sealing surfaces, as leaking may result. Use a scrubbing motion. Repeat applications may be necessary to soften the surface of the socket. Next, liberally apply primer to the male end of the pipe to the length of the socket depth. Again apply to the socket, without delay apply cement to the pipe while the surface is still wet with primer. Next apply cement lightly, but uniformly to the inside of the socket. Apply a second coat of cement to the pipe, and assemble the end connector to the pipe, rotating the end connector 1/4 turn in one direction as it is slipped to full depth on to the pipe. The end connector should be held in position for approx. 30 seconds to allow the connection to "set". After assembly wipe off excess cement. Full set time is a minimum of 30 minutes at 60 to 100 F. Full cure time should be based on the chart below.

JOINT CURE SCHEDULE:

The cure schedules are suggested as guides. They are based on laboratory test data, and should not be taken to be the recommendations of all cement manufacturers. Individual manufacturer's recommendations for their particular cement should be followed.

Temperature Range During Cure Period(B) °F(°C)	Test Pressures for Pipe Sizes 1/2 to 1-1/4 In.		Test Pressures for Pipe Sizes 1-1/2 to 3 In.		Test Pressures for Pipe Sizes 4 to 5 In.		Test Pressures for Pipe Sizes 6 to 8 In.	
	Up to 180 PSI (1240 kPa)	Above 180 to 370 PSI (1240 to 2550 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI 1240) to 2170 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2170 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2170 kPa)
60 to 100 (15 to 40)	1 h	6 h	2 h	12 h	6 h	18 h	8 h	24 h
40 to 60 (5 to 15)	2 h	12 h	4 h	24 h	12 h	36 h	16 h	48 h
20 to 40 (-7 to 5)	6 h	36 h	12 h	72 h	36 h A	4 days A	3 days A	9 days A
10 to 20) (-15 to 7)	8 h	48 h	16 h	96 h	72 h A	8 days A	4 days A	12 days A
Colder than 10 (-15)	Extreme care should be exercised on all joints made where pipe, fittings or cement is below 10°F.							

A: It is important to note that at temperatures colder than 20°F on sizes that exceed 3 in., test results indicate that many variables exist in the actual cure rate of the joint. The data expressed in these categories represent only estimated averages. In some cases, cure will be achieved in less time, but isolated test results indicate that even longer periods of cure may be required.
B: These cure schedules are based on laboratory test data obtained on Net Fit Joints (NET FIT=in a dry fit the pipe bottoms snugly in the fitting socket without meeting interference).

THREADED CONNECTION:

Threaded end connections are manufactured to ASTM specifications D2464-88. F437-88 and ANSI B2.1. Wrap threads of pipe with Teflon tape of 3 to 3-1/2 mil thickness. The tape should be wrapped in a clockwise direction starting at the first or second full thread. Overlap each wrap by, 1/2 the width of the tape. The wrap should be applied with sufficient tension to allow the threads of a single wrapped area to show through without cutting the tape. The wrap should continue for the full effective length of the thread. Pipe sizes 2" and greater will not benefit with more than a second wrap, due to the greater thread depth. To provide a leak proof joint, the pipe should be threaded into the end connection "hand tight". Using a strap wrench only. (Never use a stillson type wrench) tighten the joint an additional 1/2 to 1-1/2 turns past hand tight. Tightening beyond this point may induce excessive stress that could cause failure.

FLANGED CONNECTION:

Flange bolts should be tight enough to slightly compress the gasket and make a good seal, without distorting or putting excessive stress on the flanges. Suitable washers should be used between the bolt head and flange and the nut and flange. Bolts should be tightened in alternating sequence.

RECOMMENDED FLANGE BOLT TORQUE

FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.	FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.
1/2	1/2	10-15	2	5/8	15-25
3/4	1./2	10-15	2-1/2	5/8	20-25
1	1/2	10-15	3	5/8	20-25
1-1/4	1/2	10-15	4	5/8	20-25
1-1/2	1/2	10-15	6	3/4	30-40

NOTE: USE WELL LUBRICATED METAL BOLTS AND NUTS. USE SOFT RUBBER GASKETS.

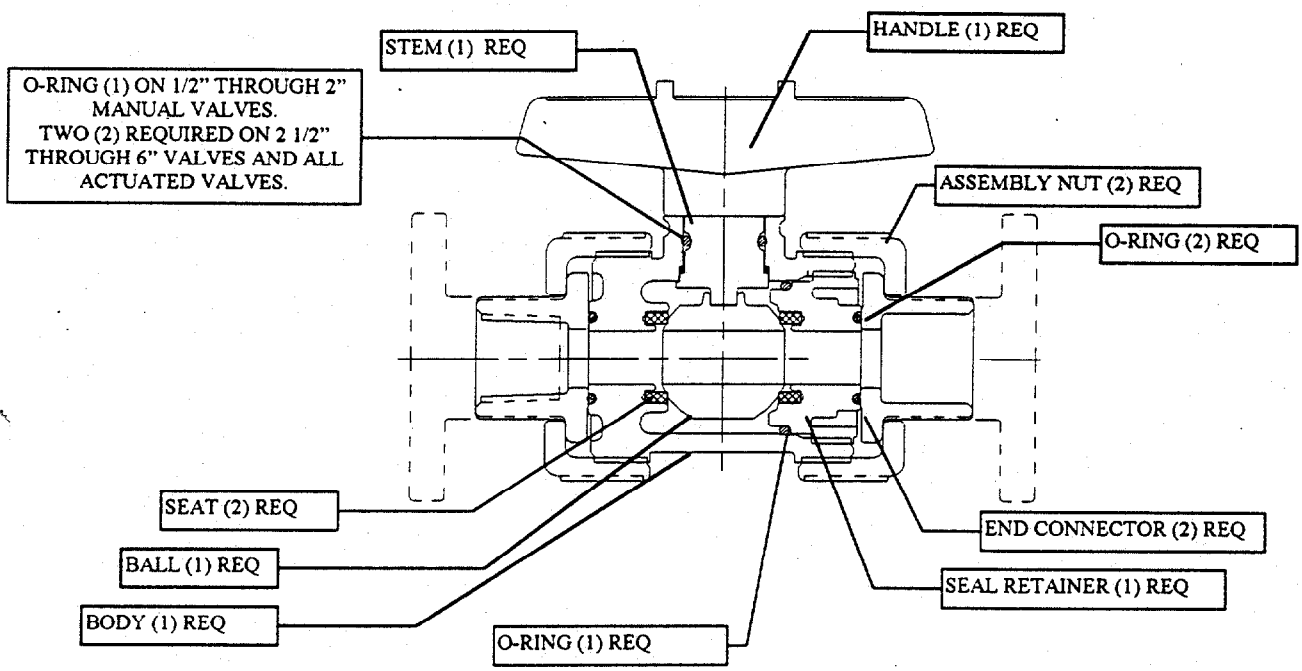
ADJUSTMENT:

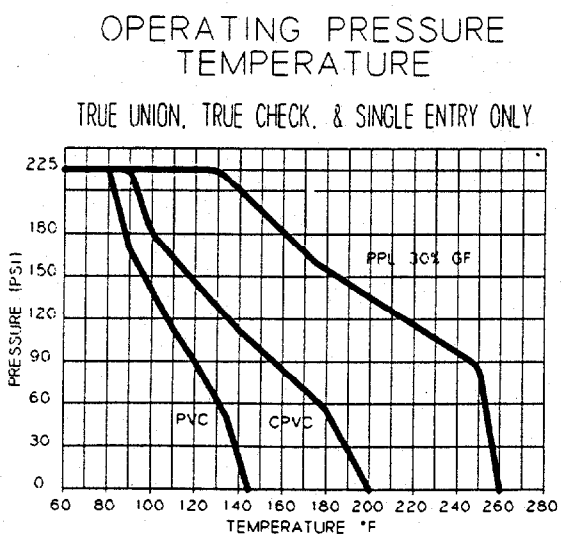
EXTREME CAUTION MUST BE TAKEN WHEN WORKING ON THIS VALVE.
THE PIPING SYSTEM MUST BE DEPRESSURIZED AND DRAINED. PROPER CARE MUST BE TAKEN. CONSULT M.S.D.S. (MATERIAL SAFETY DATA SHEETS) INFORMATION REGARDING YOUR SPECIFIC APPLICATION.

Remove the assembly nut and end connector from the "adjust" end of the body, or the complete valve body from the piping system. The front face of the seal retainer indicates which direction of rotation tightens or loosens the seal retainer, with the word "tighten" and a directional arrow, and the word "loosen" and a directional arrow. Direction of rotation may vary depending on date of manufacture. The Assembly nut should be installed on the valve "hand tight". Using a strap wrench only the joint may be tightened 1/2 to 3/4 of a turn past hand tight.

REPAIR:

Follow the adjustment sequence and information above, but rotating the seal retainer completely in the "loosen" direction and remove it from valve body. The o-rings and seals are now accessible for replacement using a "seal" repair kit. Carefully remove the o-rings from their respective locations taking care not to scratch their sealing surfaces. Use a non-petroleum base lubricant to lubricate the o-rings, and re-assemble the valve. See table below.





Recommended valve stem torque to rotate the ball 360° when valve is reassembled.

VALVE SIZE	TORQUE IN*LB
1/2"	30
3/4"	40
1"	50
1 1/4"	60
1 1/2"	60
2"	80
3" & 2 1/2"	140
4" & 6"	170

FAX

Date 03/12/98

Number of pages including cover sheet 2

TO: Jerry Lotz

Phone 757-488-7653
Fax Phone 757-465-5593

FROM: Bill Zulliger
Bechtel Environmental
151 Lafayette Drive
Oak Ridge, TN 37830

Phone 423-220-2210
Fax Phone 423-220-2123

CC:

REMARKS: ☐ Urgent ☐ For your review ☐ Reply ASAP ☐ Please Comment

I received your fax of the building layout for our Parris Island job. All looks good, however, I need to adjust the location of the intake louvers. Attached is a marked-up version of your sketch showing the revised position for the intake louvers. They should be mounted at the bottom of the doors instead of at the top as shown.

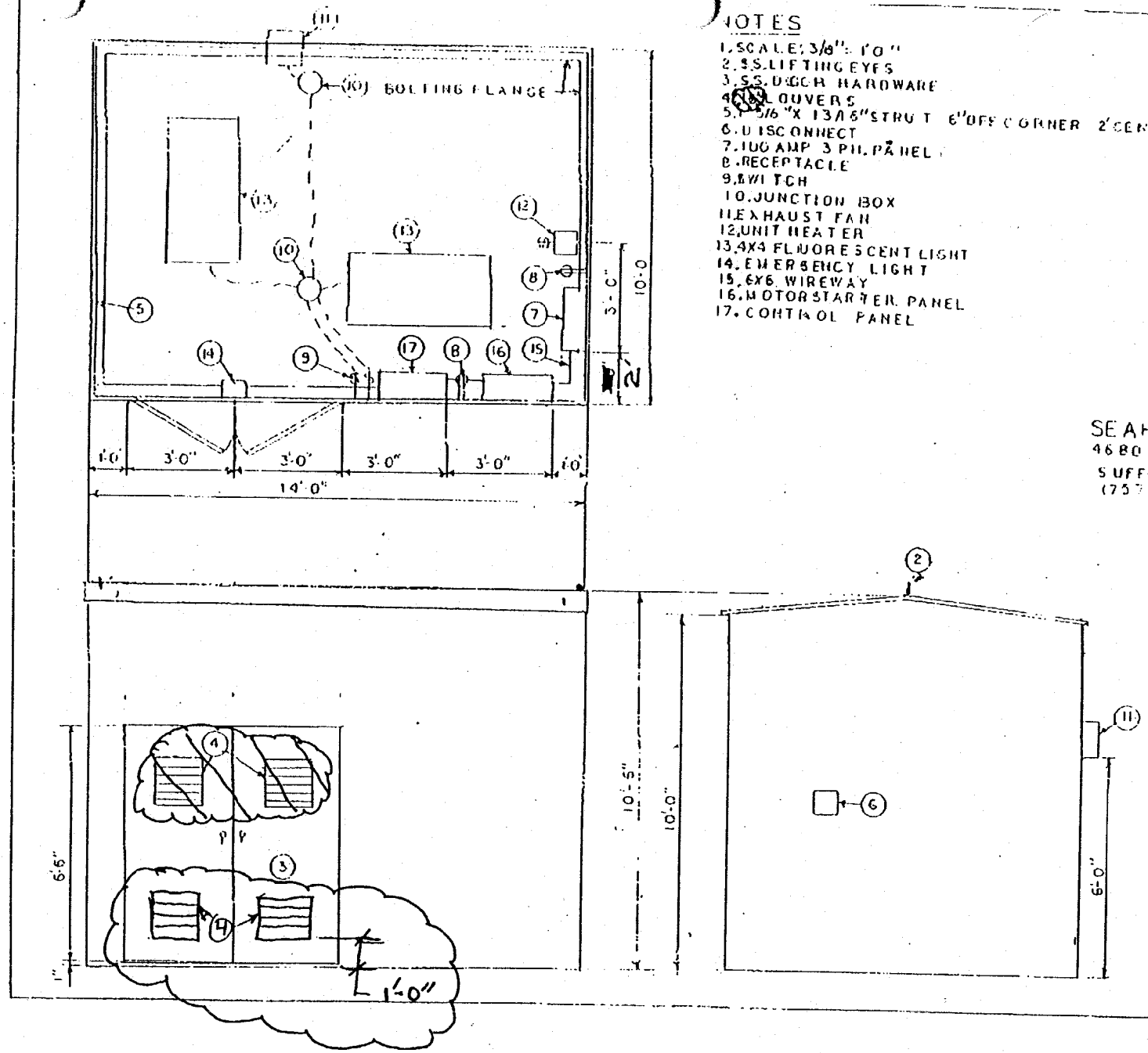
Please call me at the number above if you have any questions

Thank You,

Bill Zulliger WR Zulliger

WEIGHT OF BLDG = 1 lb/SF

LONG SIDE = 10' x 14' = 140 SF
SHORT SIDE = 10' x 10' = 100 SF
EAVE = 5' x 1' = 5 SF
ROOF = 6' x 10' = 60 SF
(1 #/SF)(2)(305 SF) = 610 #
MISC. EQPT = 500 #
1110 #

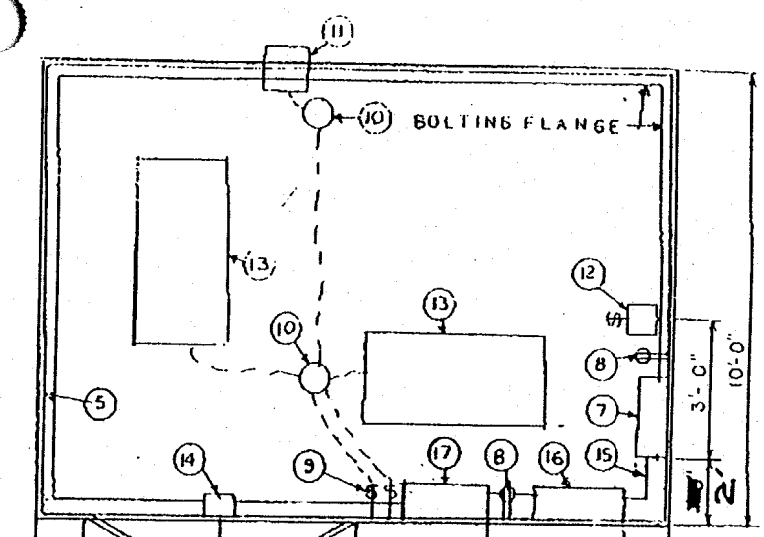


NOTES

1. SCALE: 3/8" = 1'0"
2. S.S. LIFTING EYES
3. S.S. DOOR HARDWARE
4. LOUVERS
5. 5/16" X 1 3/8" STRUT 6" OFF CORNER 2' CENTERS
6. DISCONNECT
7. 100 AMP 3 PH. PANEL
8. RECEPTACLE
9. SWITCH
10. JUNCTION BOX
11. EXHAUST FAN
12. UNIT HEATER
13. 4X4 FLUORESCENT LIGHT
14. EMERGENCY LIGHT
15. 6X6 WIREWAY
16. MOTOR STARTER PANEL
17. CONTROL PANEL

SEAHORSE PLASTICS CORP
4680 SHOULDERS HILL RD.
SUFFOLK VA. 23435
(757) 488-7653

SER. NO.	
MODEL NO. 101410	
DATE 3/10/96	WAC



NOTES

1. SCALE; 3/8" = 1'-0"
2. S.S. LIFTING EYES
3. S.S. DOOR HARDWARE
4. 16" LOUVERS
5. 1 5/6" X 1 3/8" STRUT 6" OFF CORNER 2' CENTERS
6. DISCONNECT
7. 100 AMP 3 PH. PANEL
8. RECEPTACLE
9. SWITCH
10. JUNCTION BOX
11. EXHAUST FAN
12. UNIT HEATER
13. 4X4 FLUORESCENT LIGHT
14. EMERGENCY LIGHT
15. 6X6 WIREWAY
16. MOTOR STARTER PANEL
17. CONTROL PANEL

SEAHORSE PLASTICS CORP
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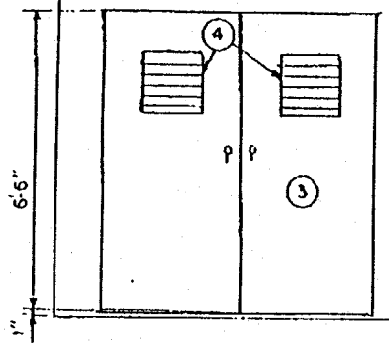

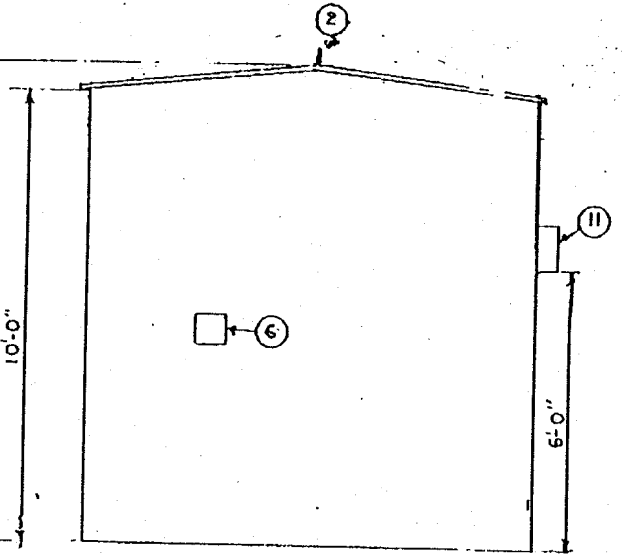

SER. NO.	
MODEL NO. 101410	
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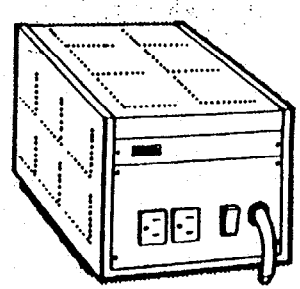
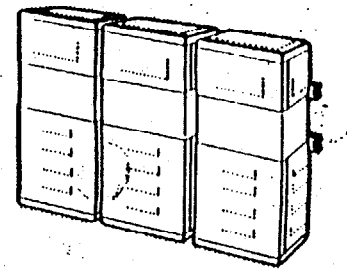
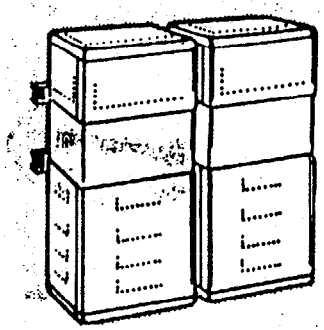
POWER CONDITIONER

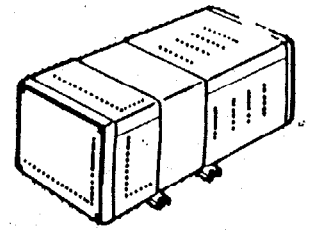
MICRO/MINICOMPUTER REGULATORS

OPERATING AND SERVICE MANUAL









GS

SOLA

OPERATING & SERVICE INSTRUCTIONS
SOLA MICRO/MINICOMPUTER REGULATORS

U.L. WE CARD LISTED — POWER SUPPLY CLASSIFICATION[1]

C.S.A. CERTIFIED — TRANSFORMER CLASSIFICATION[2]

GENERAL DESCRIPTION & SPECIFICATIONS

The Sola Micro/Minicomputer Regulator provides virtually instantaneous voltage regulation, and isolation from both transverse and common mode noise for any type of load. It also suppresses transients, protects against overloads and serves as a portable dedicated line. It is the ultimate in AC power conditioning equipment.

The portable 70 to 3000 VA models are designed for office type environments and have a low acoustical sound level of 43 dB. Also available are rack mounted models in the 500 to 2000 VA range and hard-wired models for heavy-duty applications in the 120 to 15000 VA range.

Operating Temperature Range:	-20° to +50°C.
Phase:	Single
Input Voltage:	
Portable models: 180-260 Vac (50Hz)	95-130 Vac (60Hz)
Rack Mount models:	95-130 Vac (60Hz)
Hard-Wired models:	Refer to Table 5
Output Voltage:	
Portable models: 220/240 Vac (50Hz)	120 Vac (60Hz)
Rack-Mount:	120 Vac
Hard-Wired:	120, 208, or 240 Vac
Output Voltage Regulation:	
±3% for an input line variation of ±15%.	
Output Harmonic Distortion: content at full load.	Less than 3% total rms

Efficiency: 85% @full load. No loss of output for line loss of 3 msec.
Common mode noise rejection exceeds 120 dB.
Transverse noise rejection exceeds 60 dB.
Output will remain within NEMA voltage specifications for input voltages as low as 65% of nominal.

---

[1] 50Hz models are not U.L. listed.
[2] 60 Hz portable models 70-2000 VA, and rack-mount models 500-2000 VA are C.S.A certified. Consult factory for additional certified models.

INSTALLATION

All regulators generate considerable heat and depend on the natural draft air circulation for adequate cooling. It is important that ventilation openings not be obstructed. Mounting in a confined or poorly ventilated space should be avoided unless special provisions have been made for ventilation.

PORTABLE REGULATORS

Portable regulators (3 kVA and smaller) are equipped with one input off-on switch, one 3-wire grounding type input cord/plug and two or more 3-wire grounding output receptacles. No additional connections are required except for customer's output cable(s). The neutral side of the output voltage is grounded to the regulator chassis, as are the input cord and output receptacle ground connections. Figure 1, in conjunction with Tables 1 and 2 details the dimensions of the portable regulators. A schematic diagram is presented in Figure 2a for 60-Hz Models and Figure 2b for 50-Hz Models.

Caution

50-Hz portable models are factory-wired for 220 Vac output. To convert regulator to 240 Vac output, be sure the unit is not connected to input power, and perform the following procedure.

To change the output voltage of 50-Hz portable regulators: 1). remove the small Sola logo strip across the front panel, 2). remove the front panel to expose a terminal block, 3). disconnect the lead to the front panel outlets and connect it to the appropriate terminal, 4). replace panel and logo strip. Refer to Figure 2b.

RACK-MOUNT REGULATORS

Rack-mounted models may be connected to input power by a three prong plug or by flexible conduit. Wiring kits (999-745 or 999-746) are available and have instruction enclosed. Wiring access is gained through the knockout on the rear panel.

Caution

Do not attempt to connect rack-mount regulators with rigid or semi rigid wire. Be sure to connect chassis ground!

Figure 3, used in conjunction with Table 3 details the dimensions of the rack-mounted regulators. Figure 4 is a schematic diagram for the rack mount units.

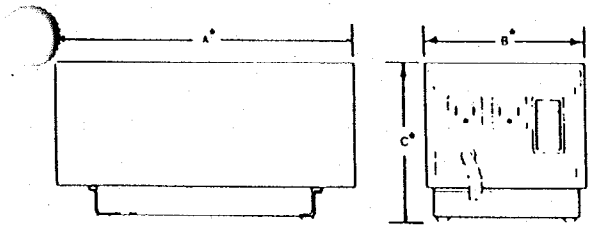


Figure 1. Outline Drawing, Portable Micro/Minicomputer Regulators

Table 1. Portable Micro/Minicomputer Regulators — 60Hz Models

Catalog Number	Output VA	Ship Wt	Dimensions (Inches)			Receptacle		Plug
			A	B	C	NEMA	Qty	NEMA
63-13-070	70	16	12.06	6.00	5.94	5-15R	2	5-15P
63-13-114	140	20	12.06	6.00	5.94	5-15R	2	5-15P
63-13-125	250	34	13.62	8.12	7.25	5-15R	2	5-15P
63-13-150	500	44	16.62	8.88	8.44	5-15R	2	5-15P
63-13-175	750	53	16.62	8.88	8.44	5-15R	2	5-15P
63-13-210	1000	63	16.62	8.88	8.44	5-15R	4	5-15P
63-13-220	2000	117	16.88	11.38	10.62	L5-30R	2	L5-30P
63-13-230	3000	150	16.88	11.38	10.62	L5-30R 5-15R	2 2	5-50P

Table 2. Portable Micro/Minicomputer Regulators — 50Hz Models

Catalog Number	Output VA	Ship Wt	Dimensions * (Inches)			Receptacle		Plug
			A	B	C	NEMA	Qty	NEMA
63-13-570-2	70	24	12.06	6.00	5.94	6-15R	2	6-15P
63-13-614-2	140	28	13.62	8.12	7.25	6-15R	2	6-15P
63-13-625-2	250	38	13.62	8.12	7.25	6-15R	2	6-15P
63-13-650-2	500	46	16.62	8.88	8.44	6-15R	2	6-15P
63-13-710-2	1000	72	16.62	8.88	8.44	6-15R	2	6-15P
63-13-720-2	2000	122	16.88	11.38	10.62	6-15R	2	6-15P

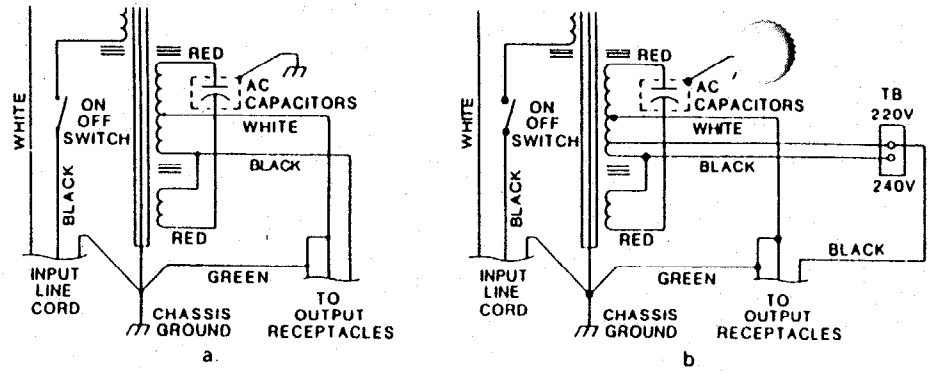


Figure 2. Portable Regulator Schematic Diagrams

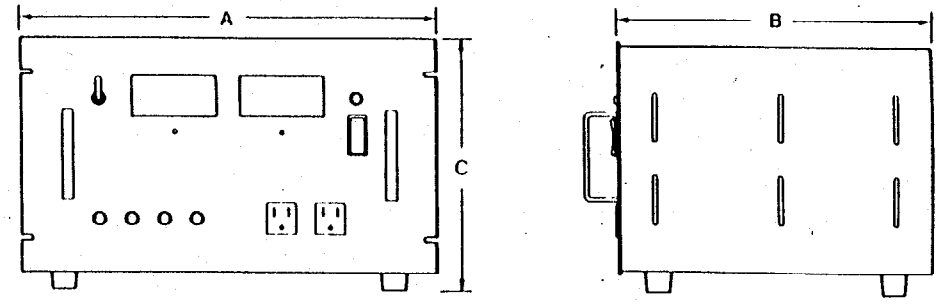


Figure 3. Rack Mount Regulator Outline Drawing

Table 3. 60Hz Rack-Mount Regulator Specifications

Catalog Number	Output VA	Input VA	Ship Wt	Dimensions (Inches)			Receptacle		Plug
				A	B	C	NEMA	Qty	NEMA
93-13-150	500	95-130	59	19.00	10.46	14.25	5-15R	4	5-15P
93-13-210	1000	95-130	81	19.00	10.46	14.25	5-15R	4	5-15P
93-13-220	2000	95-130	117	19.00	10.46	14.25	5-15R	4	L5-30P

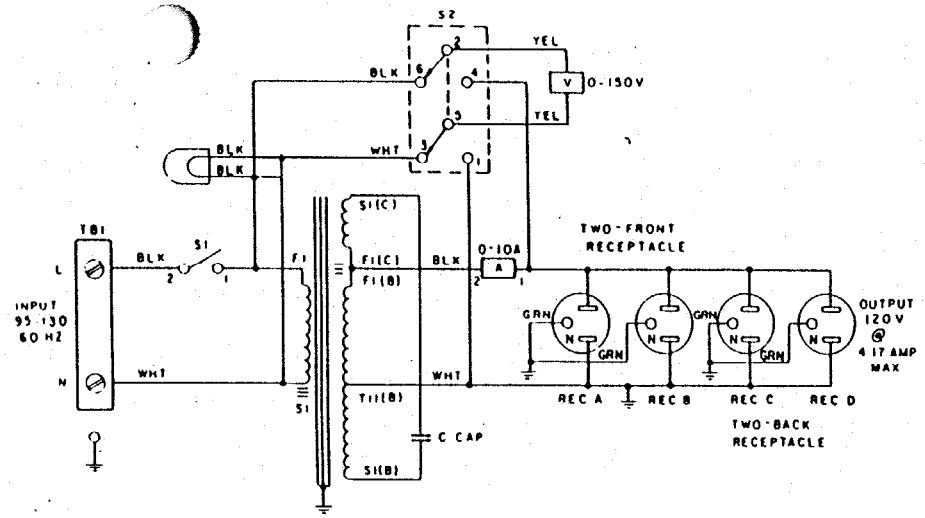


Figure 4. 500, 100VA Rack Mount Regulator Schematic Diagram

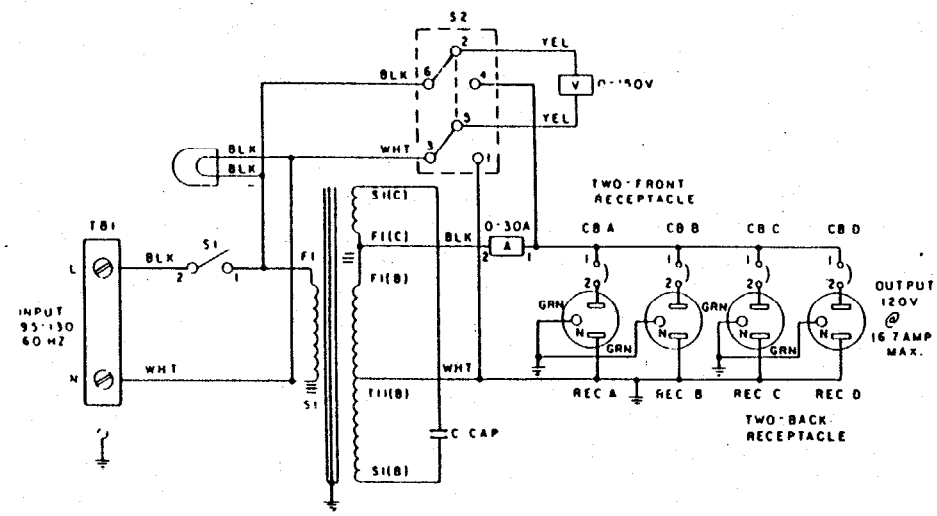


Figure 4A. 2 KVA Rack Mount Regulator Schematic Diagram

Hard-wired regulators vary in size acccording to the outpu ver and may be mounted in either a horizontal or vertical position. It mounted in a vertical position (on a wall, for example), steel mounting hardware must be selected in accordance with Table 4 for a secure installation. The wiring compartment should be at the top. Regardless of position, the regulator should be located where contact with the hot surface of the transformer is unlikely.

For proper ventilation, allow a minimum of 12 inches of clearance above the unit and a minimum of 6 inches of clearance on each side. Dimensions of the regulators and the mounting brackets are presented in Figures 5, 6, 7 and 8. The specifications for the figures are listed in Table 5.

Table 4. Hard-Wired Mounting Hardware Recommendations

Rated VA of Unit	Minimum Size of Steel Mounting Hardware
30 to 120	#10 Machine Screws
250	1/4" Diameter Bolts
500 to 1000	5/16" Diameter Bolts
1500 to 10000	3/8" Diameter Bolts
15000	1/2" Diameter Bolts

Hard-wired regulators must be connected to a branch circuit in accordance with local and national electrical codes. Electrical connections are diagrammed in Figures 9, 10, and 11. Proper wiring is determined by the Figure indicated from the regulator specifications (Table 5).

If operation from a 3-phase source is required, three hard-wired regulators may be wired in delta as shown in Figure 12. Table 6 defines the regulator connections in relation to the points diagrammed in Figure 12. Fusing and wire gauge sizes are detailed in Table 7.

NOTE

Branch circuit protection must be located in the primary of each transformer! **Not** in the three-phase line. The outputs must supply three, independent, single-phase loads of the same voltage rating.

Use U.L. Class RK1 Type fuses only. When three units are used together for three-phase operation, fuses must be connected in the primary of each unit, not in the three-phase lines.

On 7.5 and 10 kVA models, the terminal block is located in the right unit. Use only the front or right side knockouts of the right unit for conduit connections. On 15 kVA models, the terminal block is located in the middle unit. Use only the front knockouts of the middle unit for conduit connections.

Two or more models of the same rating may be connected with their input and output in parallel. However, on models smaller than 5 kVA, do not parallel both 208 V (X4-X5) and 240 VCT (X1-X2-X3). This may damage the output windings.

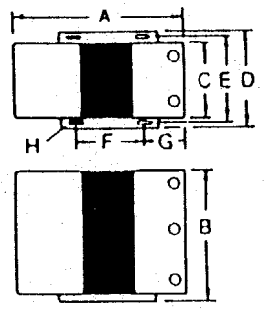


Figure 5. Outline Drawing - 120 thru 1000 VA Regulators

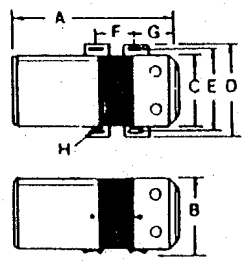
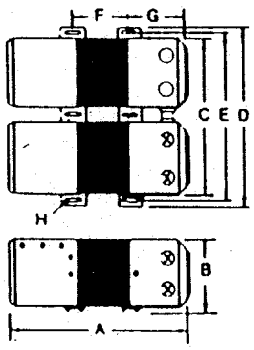
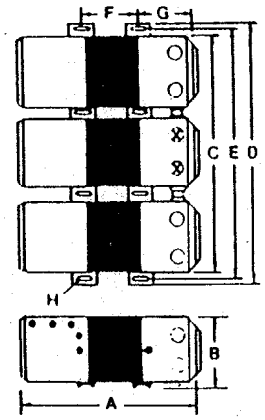


Figure 6. Outline Drawing - 1500 thru 5000 VA Regulators



NOTE: Terminal Block is located in right unit. Use only the knockouts marked with X in Figure 7.

Figure 7. Outline Drawing - 7.5kVA thru 10 kVA Regulators



NOTE: Terminal Block is located in center unit. Use only the knockouts marked with X in Figure 8.

Figure 8. Outline Drawing - 15 kVA Regulators

Table 5. Hard-Wired Micro/Minicomputer Regulators

Voltage Ratings		VA	Catalog Number	Outline Drawing	Wiring Diagram	Dimensions (Inches)								Approximate Shipping Wt. (lbs)
Reg. Outputs VAC	Input Ranges VAC					A	B	C	D	E	F	G	H	
120	95-130	120	63-23-112-4	Fig.5	Fig.9	8.62	5.19	3.31	4.00	3.50	3.00	2.44	.22x.59	15
		250	63-23-125-4	Fig.5	Fig.9	9.88	7.44	4.50	5.38	4.75	4.12	2.19	.31x.69	27
120 208 240	175-235 190-260 380-520	500	63-23-150-8	Fig.5	Fig.10	12.69	6.44	7.78	8.00	8.12	5.62	3.06	.38x.81	37
		750	63-23-175-8	Fig.5	Fig.10	13.69	6.44	7.78	9.00	8.12	5.62	3.06	.38x.81	52
		1000	63-23-210-8	Fig.5	Fig.10	16.75	6.44	7.78	9.00	8.12	5.62	5.25	.38x.81	62
		1500	63-23-215-8	Fig.6	Fig.10	16.44	9.03	10.56	12.75	11.75	3.00	5.19	.44x.69	95
		2000	63-23-220-8	Fig.6	Fig.10	17.31	9.03	10.56	12.75	11.75	3.88	5.19	.44x.69	109
		3000	63-23-230-8	Fig.6	Fig.10	18.69	9.03	10.56	12.75	11.75	5.25	5.19	.44x.69	142
		5000	63-23-250-8	Fig.6	Fig.10	28.19	9.03	10.56	12.75	11.75	8.25	8.88	.44x.69	222
	175-235 190-260 380-520	7500	63-28-275-8	Fig.7	Fig.11	26.56	9.03	22.81	25.81	24.81	6.62	8.88	.44x.69	362
		10000	63-28-310-8	Fig.7	Fig.11	28.19	9.03	22.81	25.81	24.81	8.25	8.88	.44x.69	446
		15000	63-28-315-8	Fig.8	Fig.11	28.19	9.38	35.56	38.25	37.22	8.25	8.88	.56x.69	710

Table 6. Connection Terminal for Three Phase Line

Regulator kVA	Line Voltage	Figure 10 Label					
		A	B	C	D	E	F
120 VA thru 5 kVA	208	H1	H3	H1	H3	H1	H3
	240	H1	H4	H1	H4	H1	H4
	480	H1	H5	H1	H5	H1	H5
7.5 kVA thru 15 kVA	208	H2	H3	H2	H3	H2	H3
	240	H2	H4	H2	H4	H2	H4
	480	H1	H4	H1	H4	H1	H4

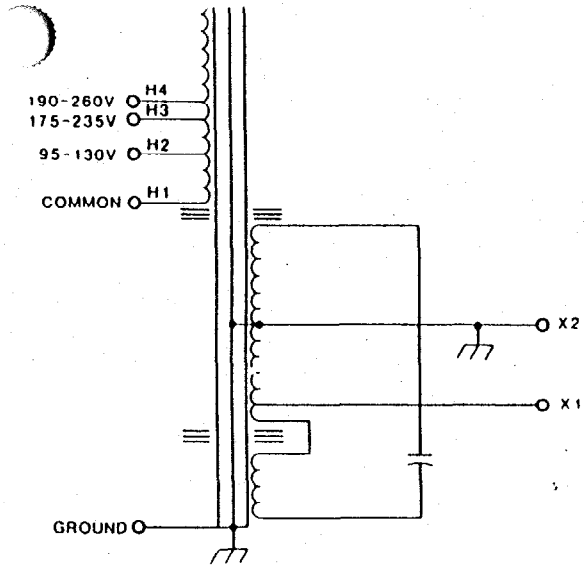
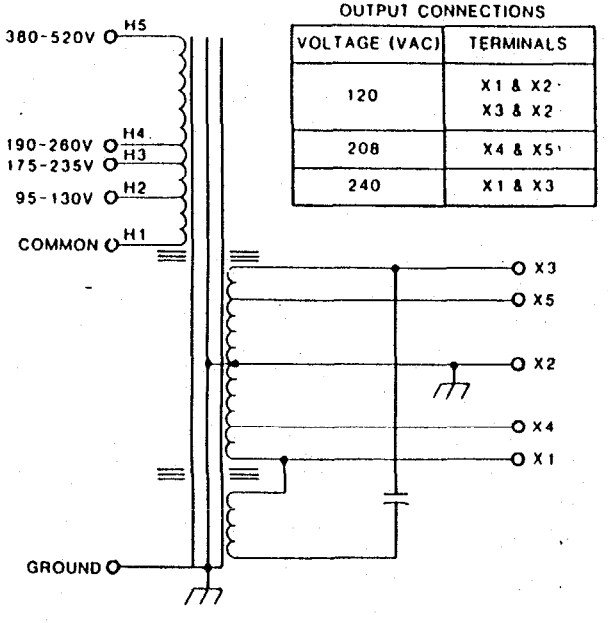


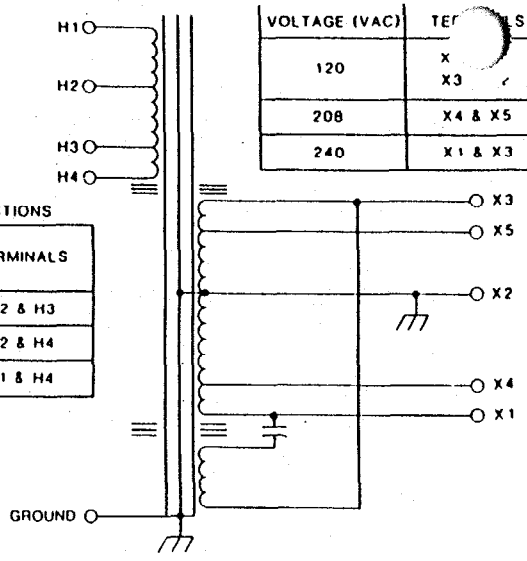
Figure 9. Wiring Diagram - 120 and 250 VA Regulators



OUTPUT CONNECTIONS

VOLTAGE (VAC)	TERMINALS
120	X1 & X2 X3 & X2
208	X4 & X5
240	X1 & X3

Figure 10. Wiring Diagram - 500 thru 5000 VA Regulators

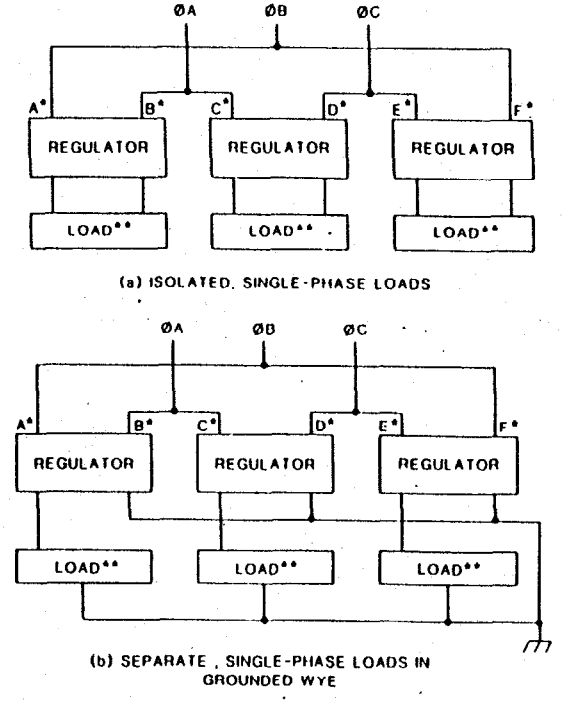


VOLTAGE (VAC)	TERMINALS
120	X X3
208	X4 & X5
240	X1 & X3

PRIMARY CONNECTIONS

INPUT VOLTAGE (VAC)	TERMINALS
175-235	H2 & H3
190-260	H2 & H4
380-520	H1 & H4

Figure 11. Wiring Diagram - 7.5, 10, 15kVA Regulators



* CONNECT PER TABLE 8

** CONNECT PER FIG. 9 (120 & 250 VA). FIG. 10 (500 THRU 5000 VA) OR FIG. 11 (7500 THRU 15000 VA)

Figure 12. 3-Phase Connections

Table 7. Circuit Protection/Wire Guage

Sola Catalog Number	Input			Output	
	Rated Volts	Required Circuit Protection(A)	Minimum Gauge 90°C Wire	Rated Volts	Minimum Gauge 90°C Wire
63-23-112-4	95-130	3	14	120	14
	175-235	3	14		
	190-260	3	14		
	380-520	1	14		
63-23-125-4	95-130	6	14	120	14
	175-235	3	14		
	190-260	3	14		
	380-520	1	14		
63-23-150-8	95-130	10	14	120	14
	175-235	6	14	208	14
	190-260	6	14	240	14
	380-520	3	14		
63-23-175-8	95-130	15	14	120	14
	175-235	10	14	208	14
	190-260	6	14	240	14
	380-520	3	14		
63-23-210-8	95-130	15	14	120	14
	175-235	10	14	208	14
	190-260	10	14	240	14
	380-520	6	14		
63-23-215-8	95-130	25	10	120	12
	175-235	15	14	208	14
	190-260	15	14	240	14
	380-520	10	14		
63-23-220-8	95-130	30	10	120	10
	175-235	20	12	208	14
	190-260	15	14	240	14
	380-520	10	14		
63-23-230-8	95-130	45	8	120	8
	175-235	25	10	208	12
	190-260	25	10	240	12
	300-520	15	14		
63-23-250-8	95-130	80	4	120	8
	175-235	40	8	208	10
	190-260	40	8	240	10
	380-520	20	12		
63-28-275-8	175-235	60	6	120	4
	190-260	60	6	208	8
	380-520	30	10	240	8
63-28-310-8	175-235	80	3	120	3
	190-260	80	4	208	6
	380-520	40	8	240	8
63-28-315-8	175-235	125	1	120	0
	190-260	110	2	208	4
	380-520	60	4	240	4
93-13-150	95-130	10	14	120	-
93-13-210	95-130	15	14	120	-
93-13-220	95-130	30	10	120	-

OPERATING NOTES AND DATA

Safety Notice

High voltages are present inside the regulator. Do not reach inside the unit while it is energized. To measure voltage, de-energize the unit, connect the meter, and then re-energize the unit.

Checking With Voltmeters

All input and output voltage measurements should be made with a true rms-responding voltmeter. A reasonably close measurement can also be obtained with those iron-vane types which are rated for "25-500 Hertz" or broader frequency range. A certain amount of harmonics in the output may cause other types — particularly rectifier types — to give inaccurate indications.

Ratings and Characteristics

Micro/Minicomputer Regulators come in various input and output voltages, input and output VA ratings and frequencies. See the nameplate attached to each regulator for appropriate data.

Load Regulation

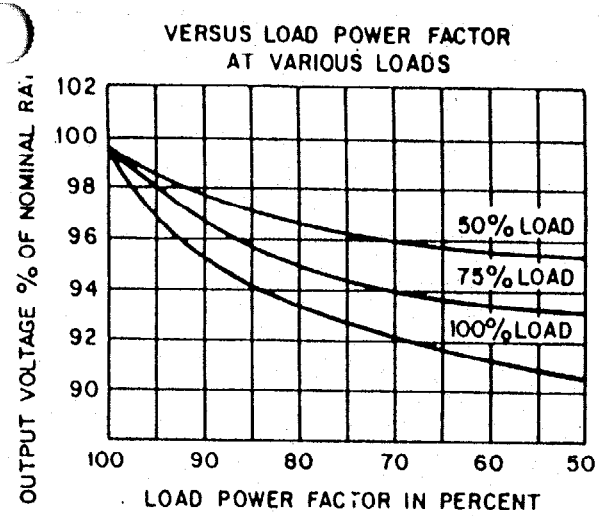
Changes in output voltage resulting from changes in resistive loads from no load to full load (100% P.F.) are approximately four percent.

Effect of Load Power Factor

"Median" value of output of voltage will vary from nameplate rating if the load has a power factor other than that for which the transformer was designed. Load regulation will also be greater as the inductive load power factor is decreased (see adjacent chart of average values). However, the resulting median values of output voltage will be regulated against supply line changes at any reasonable load or load power factor.

Operation With Switchmode Power Supplies

If a CVS transformer is used as a source for a switchmode power supply, a slight amount of ringing may be noticed on the sine wave output of the CVS at half cycle intervals for a short duration. This ringing occurs at the point when the switchmode power supply current demand drops to zero. The ringing need not be a cause for concern since it is of relatively low magnitude and frequency. The CVS has been tested with a variety of switchmode power supplies and it has been determined that the ringing never affects the DC outputs, nor has it been found to degrade the components of any switchmode power supply.



Effect of Frequency

Changes in the frequency of the supply voltage will be directly reflected in the output voltage. A change of about 1.8% in output voltage will occur for every 1% change in input frequency, and in the same direction as the frequency change.

Response Time

An important advantage of the Sola principle of static magnetic regulation is its exceedingly fast response time, compared with other types of AC regulators. Transient changes in supply voltage are usually corrected within 1-1/2 cycles or less; the output voltage will not fluctuate more than a few percent.

Input Characteristics

The regulator transformer includes a resonant circuit which is energized whether it is serving load or not. Therefore, the input current at no load is approximately 35% of the full-load primary current. As a result, the temperature of the unit may rise to substantially full-load level, even at light or no load. Input power factor will average 90-100% at full load, but may drop to about 75% at half load and 25% at no load. In any case, it is always leading.

Current Limitation

When the load is increased beyond the regulator's rated value, a point is reached where the output voltage suddenly collapses and will not regain its normal value until the load is partially released. Under short circuit conditions, the load current is limited to approximately 150% of the rated full-load value, and the input power to less than 10% of normal. The Micro/Minicomputer Regulator will protect both itself and its load against damage from excessive fault currents. Fusing of load circuits is not necessary.

Operation on Motor Loads

Because of the current-limiting effect described above, special attention should be given to motor applications. In general, the regulator must have a load rating nearly equal to the maximum power drawn during the starting cycle. This may run from two to eight times the normal (running) rating of the motor. In doubtful cases, it is advisable to measure the actual starting current.

Multiple Operation

Two or more hard-wired models of the same rating may be connected with their input and output in parallel. However, on models smaller than 5kVA, do not parallel both 208V (X4-X5) and 240VCT (X1-X2-X3). This may damage the output windings.

Operating Temperature

Standard units are designed to operate in ambient temperatures of minus 20°C to plus 50°C. In operation, a temperature rise will occur whether or not the transformer is serving load. Normally, this rise may fall anywhere in the range of 45°C to 110°C, depending on the regulator type and rating. In any case, the maximum operating temperature at an ambient of 50°C is always within safe operating limits for the class of insulating material used.

Effect of Temperature

The output voltage will show a small change as the unit warms up to stable operating temperatures at a constant ambient temperature. This change may be about one or two percent, depending on the unit's VA rating. At a stable operating temperature, the output voltage will change slightly with varying ambient temperature. This shift is approximately one percent for each 40°C of temperature change.

No Routine Maintenance Necessary

Because the Sola Micro/Minicomputer Regulator is a simple, rugged device without moving parts or manual adjustments, no routine servicing or maintenance is needed. In case of apparent poor performance, the user is urged to check the following points immediately:

Checklist of Factors Affecting Performance

A. Nominal Voltage Too High

1. The load may be considerably less than full rating. (See note on "Load Regulation".)
2. The load may have a leading power factor.

B. Nominal Voltage Too Low

1. Load power factor may be lagging.
2. Unit may be slightly overloaded. (See note on "Current Limitation".)

C. Does Not Regulate Closely

1. Unit may be slightly overloaded. (See note on "Current Limitation".)
2. Actual line voltage swings may be outside the rated range of unit, particularly on low side.
3. On varying loads, a certain amount of load regulation may be mixed with the line voltage regulating action. (See note on "Load Regulation".)

D. Output Voltage Very Low (20-60V)

1. Unsuspected or unplanned overloads of substantial size may occur intermittently (motor-starting currents, solenoid inrush currents, etc.). See note on "Current Limitation".)
2. One or more capacitor units in the regulator may be defective.

E. No Output Voltage

1. Check power source breakers or fuses.
2. Check input switch (on portable units).
3. Check continuity between input terminals, and also between output terminals.

F. Transformer Operating Temperature

1. The transformer used in these regulators is designed to operate at high flux density, and hence, relatively high temperatures.

   After connection to line for a half hour or so, the transformer core structure may be too hot to touch with bare hand. This is normal and need give no concern.

NOTE: In case regulator is operating but does not appear to have correct output, IT IS VERY HELPFUL TO APPLY THE FOLLOWING TEST:

1. Disconnect the working load.
2. Connect a dummy load of lamps, heaters, or other resistive load substantially equal to the full-load rating of regulator, directly across its output terminals.
3. Measure the output voltage of the regulator using a true rms type voltmeter directly across its output terminals.

This test will usually establish whether the apparent poor performance is due to a fault in the regulator or to some peculiarity of the working load.

Field Replacement of Capacitors

Capacitors used in all regulators are the highest commercial grade. Each one is given a rigid acceptance test upon receipt. Nevertheless, as with all capacitors, there is a certain small percentage of failure. The Sola guarantee includes free replacement at the factory of any capacitor unit which fails within one year of sale. Older units can be replaced at moderate charge.

Where competent technical help is available, it may be possible to test and identify defective capacitors in the field, and to make field replacement with new capacitors shipped from the factory. In all such cases, factory advice and cooperation must be requested in advance.

WARRANTY

The Micro/Minic ter is warranted against failure due to faulty materials or workmanship for a period of one year from the date of purchase. The warranty covers repair or replacement of defective parts by authorized repair centers, provided the unit has been returned by the user, via prepaid motor freight, under a Return Authorization Number formally obtained from the factory or field representative.

The above warranty is void if the Micro/-Minicomputer has been modified by the customer, or if it has been abused or operated outside its electrical or environmental specifications.

If customer conducted field tests suggest that the Micro/Minicomputer may be faulty whether in or out of the warranty period, a full report of the difficulty should be sent to the place of purchase. The office may then suggest further helpful field tests, or have return authorized for evaluation at the factory.

Units for factory inspection should be shipped via prepaid motor freight direct to the Sola factory at Elk Grove Village, Illinois. The Return Authorization Number must appear on the outside of the shipping container, otherwise the unit will not be accepted.

NOTE

Freight collect shipments will be refused. When the unit has been received, inspected and tested, you will receive a report on the findings along with a quotation on any recommended repairs falling outside our standard warranty.

Units returned for in-warranty repairs which are found to be not defective will be subject to an inspection and handling charge of $50.00 plus transportation charges.

In-warranty units found to be the responsibility of Sola will be repaired and returned via prepaid motor freight. Also, at that time, credit will be issued for in-coming motor freight charges.

Defective out-of-warranty units require a purchase order and will be invoiced for parts, labor and transportation charges.

Components used in all Micro/Minicomputers are the highest commercial grade available. Each one is given a rigid acceptance test upon receipt. Nevertheless, as with all components, there is a certain percentage of failure. Sola's warranty includes free replacement by authorized repair centers of any component which fails within one year of the date of shipment.

Where competent technical help is available, it may be possible to test and identify defective components in the field, and to make field replacement with new parts shipped from the factory. This procedure is not recommended, but may be suggested by the factory in some cases to save valuable time, packing, or transportation charges. In all such cases, factory advice and cooperation must be requested in advance. Sola will not be liable for any costs associated with the replacement of defective, in-warranty material incurred by the user, installing contractor or wholesaler as a direct or indirect result of a failure unless prior approval has been received in writing, by the Marketing Manager.

When ordering replacement parts, always specify the following:

1. Serial number or date code of Micro/Minicomputer
2. Catalog Number
3. Part number, description and quantity needed
4. Date of purchase
5. Any special shipping instructions

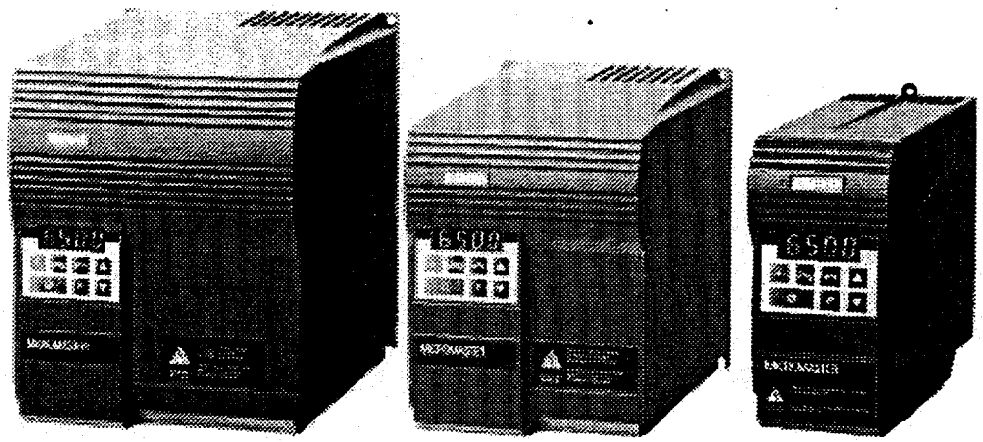
Parts ordered and all correspondence concerning repairs and performance under the warranty should be addressed to the place of purchase.

FREQUENCY INVERTER

SIEMENS

MICROMASTER

Operating Instructions



TAG. DATA.

MICRO MASTER 6SE9216-8CB40
INPUT 230V ±15% 1 OR (3)Ø 14.4 (8.3)A 47-63 Hz
OUTPUT 0-INPUT V 3Ø 7.4A 0-400 Hz
MOTOR 2.00 HP / 1500W
Wgt 1.75 Kg
PROTECTION IEC 536/VDE 0106 CLASS I IP20
TEMPERATURE RANGE: 0-50°C DUTY CLASS II
SN XAK146MM416B
ISSUE B.3.1
MADE IN EU

Contents

Safety Instructions....2
1. OVERVIEW....3
2. INSTALLATION....4
3. FRONT PANEL CONTROLS & BASIC OPERATION....14
4. OPERATING MODES....17
5. SYSTEM PARAMETERS....20
6. FAULT CODES....34
7. SPECIFICATIONS....35
8. SUPPLEMENTARY INFORMATION....37

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G85139-H1750-U049-B
09/16/97

Safety Instructions

Before installing and putting this equipment into operation, please read these safety instructions and 'arnings carefully and all the warning labels attached to the equipment. Make sure that the warning labels e kept in a legible condition and replace missing or damaged labels.

WARNING

This equipment contains dangerous voltages and controls dangerous rotating mechanical parts. Loss of life, severe personal injury or property damage can result if the instructions contained in this manual are not followed.

Only suitable qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon its proper handling, installation, operation and maintenance.

- MICROMASTERS operate at high voltages.
- Only permanently-wired input power connections are allowed. This equipment must be grounded (IEC 536 Class 1, NEC and other applicable standards).
- If a Residual Current-operated protective Device (RCD) is to be used, it must be an RCD type B.
- Machines with a three phase power supply, fitted with EMC filters, must not be connected to a supply via an ELCB (Earth Leakage Circuit-Breaker - see DIN VDE 0160, section 6.5).
- The following terminals can carry dangerous voltages even if the inverter is inoperative:
  - the power supply terminals L/L1, N/L2, L3.
  - the motor terminals U, V, W.
- Only qualified personnel may connect, start the system up and repair faults. These personnel must be thoroughly acquainted with all the warnings and operating procedures contained in this manual.
- Certain parameter settings may cause the inverter to restart automatically after an input power failure.
- This equipment must not be used as an 'emergency stop' mechanism *(see EN 60204, 9.2.5.4)*
- If motor thermal protection is required, then an external PTC must be used. *(Refer to Section 2.3.5.)*
- Lowering the fan tray on Frame Size C MICROMASTER exposes rotating parts. Power must be isolated prior to this operation.

CAUTION

- Children and the general public must be prevented from accessing or approaching the equipment!
- This equipment may only be used for the purpose specified by the manufacturer. Unauthorised modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the equipment can cause fires, electric shocks and injuries.
- Keep these operating instructions within easy reach and give them to all users!

CE

European Low Voltage Directive

The MICROMASTER product range complies with the requirements of the Low Voltage Directive 73/23/EEC as amended by Directive 98/68/EEC. The units are certified for compliance with the following standards:

EN 60146-1-1	Semiconductor converters - General requirements and line commutated converters
EN 60204-1	Safety of machinery - Electrical equipment of machines

European Machinery Directive

The MICROMASTER inverter series does not fall under the scope of the Machinery Directive. However, the products have been fully evaluated for compliance with the essential Health & Safety requirements of the directive when used in a typical machine application. A Declaration of Incorporation is available on request.

European EMC Directive

When installed according to the recommendations described in this manual, the MICROMASTER fulfills all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN61800-3.

UL and CUL listed.

ISO 9001

Siemens plc operates a quality management system which complies with the requirements of ISO 9001.

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1. OVERVIEW

The MICROMASTERS are a range of frequency inverters for controlling the speed of three phase AC motors. Various models are available, ranging from the compact 120 W single phase input MICROMASTER up to the 7.5 kW three phase input MICROMASTER.

The inverters are microprocessor-controlled and use state of the art IGBT technology for reliability and flexibility. A special pulse-width modulation method with selectable ultrasonic pulse frequency permits extremely quiet motor operation. Inverter and motor protection is provided by comprehensive protective functions.

Features:

- Easy to install, program and commission.
- Closed loop control using a Proportional, Integral (PI) control loop function.
- High starting torque with automatic starting boost.
- Remote control capability via RS485 serial link using the USS protocol with the ability to control up to 31 inverters.
- A comprehensive range of parameters is provided to enable the inverters to be configured for use in almost any application.
- Membrane-type front panel controls for simple operation.
- Built-in non-volatile memory for storing parameter settings.
- Factory default parameter settings pre-programmed for European and North American requirements.
- Output frequency (and hence motor speed) can be controlled by one of five methods:
  (1) Frequency setpoint using the keypad.
  (2) High resolution analogue setpoint (voltage input).
  (3) External potentiometer to control motor speed.
  (4) Fixed frequencies via binary inputs.
  (5) Serial interface.
- Built-in DC injection brake with special COMPOUND BRAKING.
- Integral RFI filter on single phase input inverters (MM12 - MM300).
- Acceleration/deceleration times with programmable smoothing.
- Fully programmable single relay output incorporated.
- External Options connector for optional multi-language Clear Text Display (OPm2) or optional PROFIBUS module.
- Automatic recognition of 2, 4, 6 or 8-pole motors by software.
- Integral software-controlled cooling fan.
- Fast Current Limit (FCL) for reliable trip-free operation.
- Compact design and the ability to mount inverters side by side provides greater space saving.

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2. INSTALLATION

2.1 Wiring Guidelines to Minimise the Effects of EMI

The inverters are designed to operate in an industrial environment where a high level of Electro-Magnetic Interference (EMI) can be expected. Usually, good installation practices will ensure safe and trouble-free operation. However, if problems are encountered, the following guidelines may prove useful. In particular, grounding of the system 0V at the inverter, as described below, may prove effective. Figure 1 illustrates how an RFI suppression filter should be installed.

(1) Ensure that all equipment in the cubicle is well earthed using short, thick earthing cable connected to a common star point or busbar. It is particularly important that any control equipment that is connected to the inverter (such as a PLC) is connected to the same earth or star point as the inverter via a short, thick link. Flat conductors (e.g. braids or metal brackets) are preferred as they have lower impedance at high frequencies.

The return earth from motors controlled by the inverters should be connected directly to the earth connection (PE) on the associated inverter.

(2) Wherever possible, use screened leads for connections to the control circuitry. Terminate the ends of the cable neatly, ensuring that unscreened wires are as short as possible. Use cable glands whenever possible.

(3) Separate the control cables from the power connections as much as possible, using separate trunking, etc. If control and power cables cross, arrange the cables so that they cross at 90° if possible.

(4) Ensure that contactors in the cubicle are suppressed, either with R-C suppressors for AC contactors or 'flywheel' diodes for DC contactors, **fitted to the coils**. Varistor suppressors are also effective. This is particularly important if the contactors are controlled from the relay on the inverter.

(5) Use screened or armoured cables for the motor connections and ground the screen at both ends via the cable glands.

(6) If the drive is to be operated in an Electro-magnetic noise-sensitive environment, the RFI footprint filter kit should be used to reduce the conducted and radiated interference from the inverter. For optimum performance, there should be a good conductive bond between filter and metal mounting plate.

On no account must safety regulations be compromised when installing inverters!

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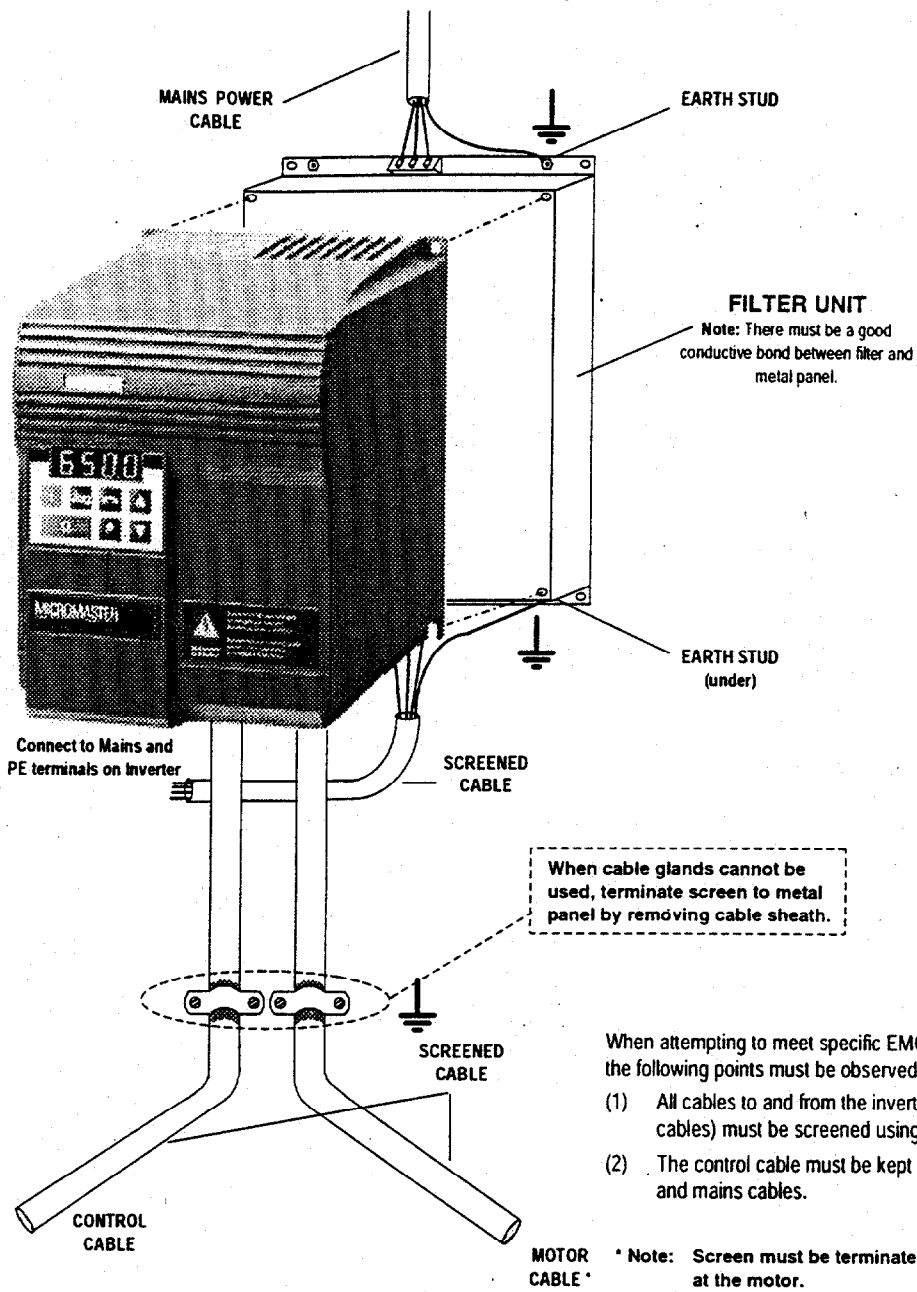

When attempting to meet specific EMC limits by using a filter, the following points must be observed:

(1) All cables to and from the inverter (including control cables) must be screened using suitable glands.

(2) The control cable must be kept separate from the motor and mains cables.

Figure 1: Example of an RFI Suppression Filter Installation

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2.2 Mechanical Installation

WARNING

THIS EQUIPMENT MUST BE EARTHED.

To guarantee the safe operation of the equipment it must be installed and commissioned properly by qualified personnel in compliance with the warnings laid down in these operating instructions.

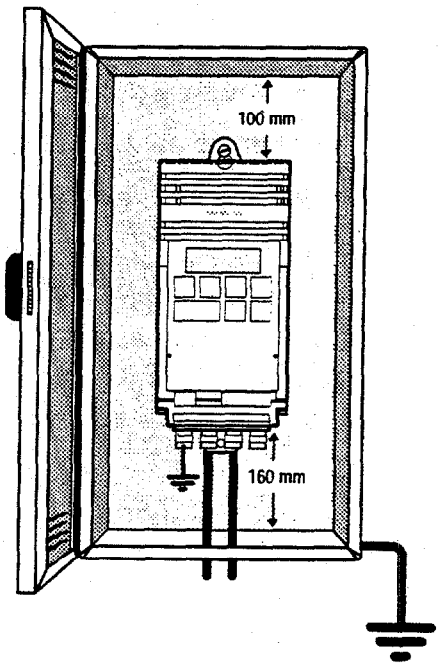
Take particular note of the general and regional installation and safety regulations regarding work on dangerous voltage installations (e.g. VDE), as well as the relevant regulations regarding the correct use of tools and personal protective gear.

The mains input and motor terminals can carry dangerous voltages even if the inverter is inoperative. Use insulated screwdrivers only on these terminal blocks.

Environmental Requirements

Hazard	Notes
Temperature	Min. = 0°C Max. = 50°C
Altitude	If the Inverter is to be installed at an altitude > 1000 m, derating will be required.(Refer to DA 64 Catalogue).
Shock	Do not drop the inverter or expose to sudden shock.
Vibration	Do not install the inverter in an area where it is likely to be exposed to constant vibration.
Electro-Magnetic Radiation	Do not install the inverter near sources of electro-magnetic radiation.
Atmospheric Pollution	Do not install the inverter in an environment which contains atmospheric pollutants such as dust, corrosive gases, etc.
Water	Take care to site the inverter away from potential water hazards. e.g. Do not install the inverter beneath pipes that are subject to condensation.
Overheating	Ensure that the inverter's air vents are not obstructed. Make sure that there is an adequate air-flow through the cabinet, as follows: 1. Using the formula below, calculate the airflow required. Air-flow (m^3/ hr) = (Dissipated Watts / ΔT) x 3.1 2. Install cabinet cooling fan(s) if necessary. **Note:** Typical dissipation (Watts) = 3% of inverter rating. ΔT = Allowable temperature rise within cabinet in °C. 3.1 = Specific heat of air at sea level.

Ideal Installation



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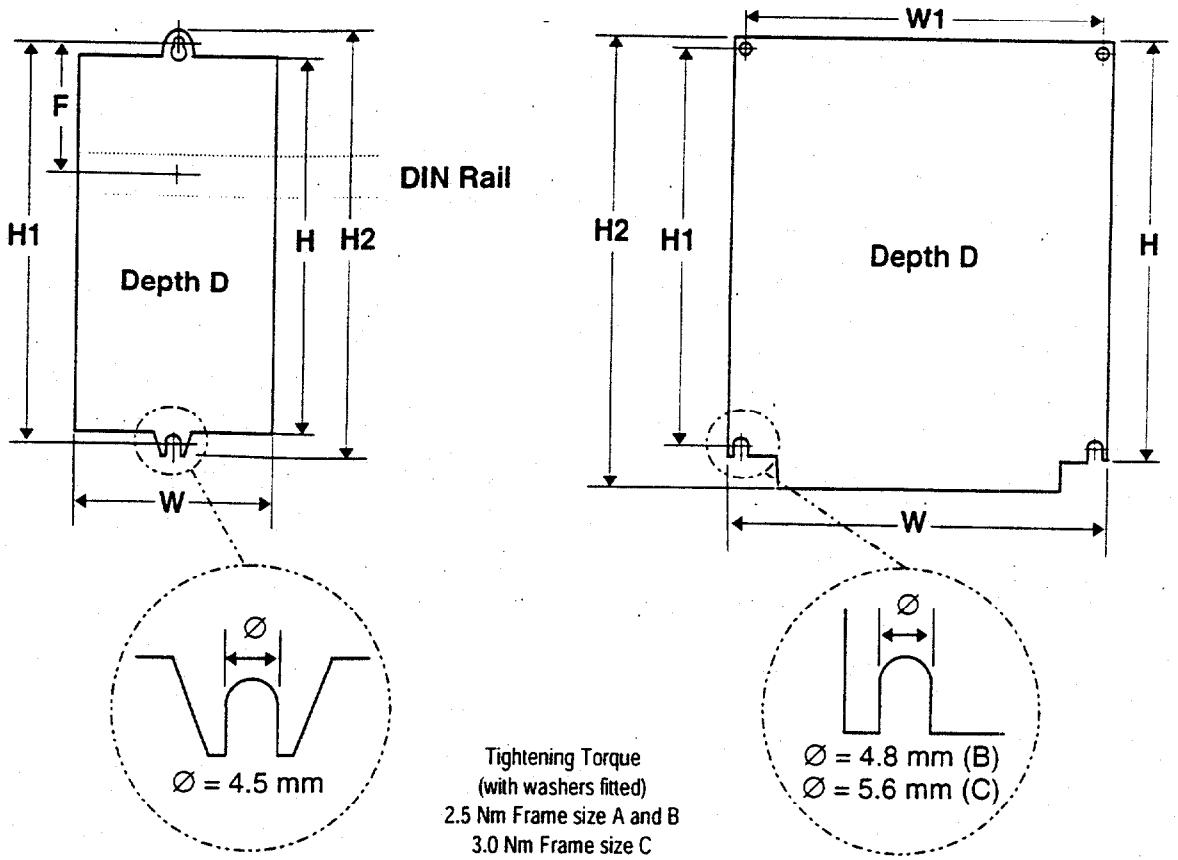

Tightening Torque
(with washers fitted)
2.5 Nm Frame size A and B
3.0 Nm Frame size C

2 bolts M4
2 nuts M4
2 washers M4

Frame size B:
4 bolts M4
4 nuts M4
4 washers M4

Frame size C:
4 bolts M5
4 nuts M5
4 washers M5

Frame Size A

Frame Sizes B and C

Model	MMxxx 1 AC 230 V Class A Filter	MMxxx/2 1/3 AC 230 V Without Filter	MMxxx/3 3 AC 380 - 500 V Without Filter	Frame Sizes (all measurements in mm)
MM12	A	A	-	
MM25	A	A	-	
MM37	A	A	A	
MM55	A	A	A	
MM75	A	A	A	
MM110	B	B	A	
MM150	B	B	A	
MM220	C	C	B	
MM300	C	C	B	
MM400	-	C	C	
MM550	-	-	C	
MM750	-	-	C	

	H		W		D	H1	H2	W1	F
A =	147	x	73	x	141	160	175	-	55
B =	184	x	149	x	172	174	184	138	-
C =	215	x	185	x	195	204	232	174	-

Figure 2: Mechanical Installation Diagram

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2.3 Electrical Installation

The electrical connectors on the MICROMASTER are shown in Figure 3. Connect the cables to the power and control terminal blocks in accordance with the information supplied in sections 2.3.1 - 2.3.4. Ensure that the leads are connected correctly and the equipment is properly earthed as shown in Figure 3.

CAUTION

The control, power supply and motor leads must be laid separately. They must not be fed through the same cable conduit/trunking.

Use screened cable for the control lead. Use Class 1 60/75°C copper wire only (for UL compliance). Tightening torque for the power (mains input and motor) terminals is 1.1 Nm.

To tighten up the power/motor terminal screws use a 4 - 5 mm cross-tip screwdriver.

2.3.1 Power and Motor Connections - Frame Size A

Ensure that the power source supplies the correct voltage and is designed for the necessary current *(see section 7)*. Ensure that the appropriate circuit-breakers/fuses with the specified current rating are connected between the power supply and inverter *(see section 7)*.

Connect the power and motor connections as shown in Figure 3.

WARNING

Isolate the supply before making or changing connections.

Ensure that the motor is configured for the correct supply voltage. **Single/three phase 230 V MICROMASTERS must not be connected to a 400 V three phase supply.**

When synchronous machines are connected or when coupling several motors in parallel, the inverter must be operated with voltage/frequency control characteristic (P077= 0 or 2).

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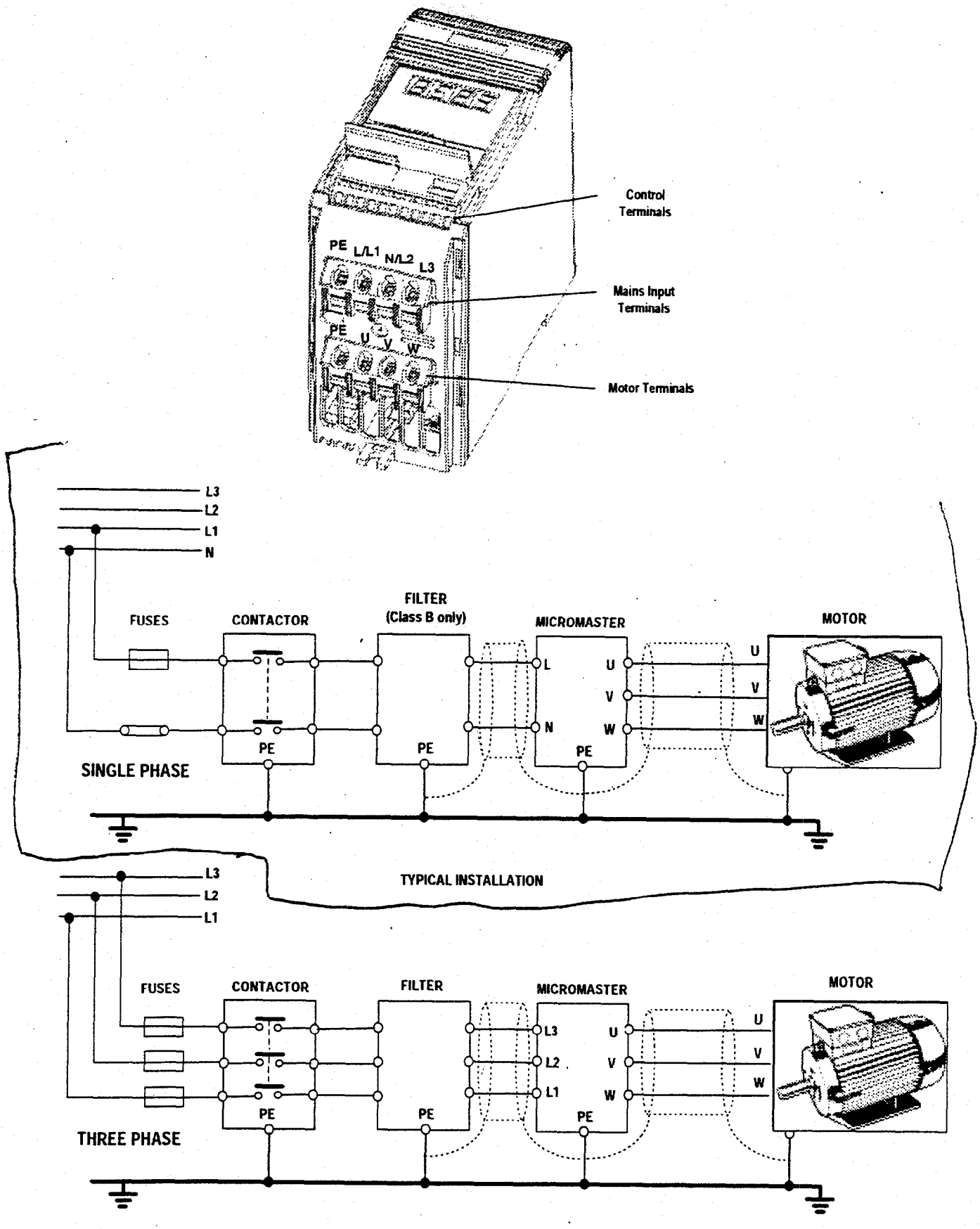

Figure 3: Power Connections

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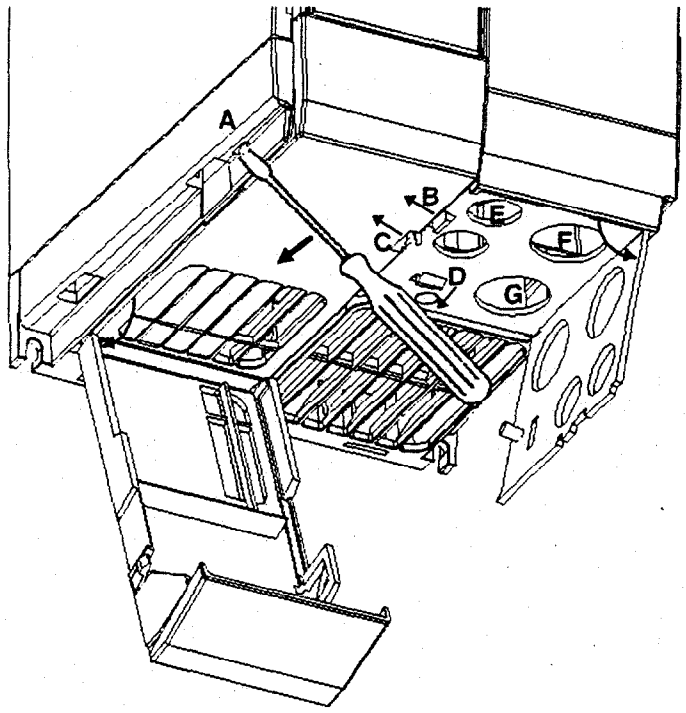
2.3.2 Power and Motor Connections - Frame Size B

The terminal arrangement for frame size B is identical to frame size A *(see Figure 3)*. However, before the wires can be connected to the terminal blocks, you must lower the terminal access panel and secure the cables to the gland plate.

Refer to Figures 3 and 4. Proceed as follows:

1. Insert the blade of a small screwdriver into slot A on the side of the inverter and press in the direction of the arrow. At the same time, apply finger pressure to clip B on the other side of the access panel and press in the direction of the arrow.

   This will release the access panel, which will then swing down on its rear-mounted hinges.
2. Remove the gland plate by applying pressure to release clips C and D in the direction of the arrows.
3. Secure each cable to the correct hole in the gland plate, ensuring that the exposed wires are long enough to reach the terminal blocks.
4. Before refitting the gland plate, feed the control wires (if used) through hole 1 and the mains input and motor wires through hole 2. IT IS MOST IMPORTANT THAT THE MOTOR AND CONTROL WIRES ARE KEPT APART.
5. Refit the gland plate. Ensure that the release clips snap into position.
6. Connect the wires to the terminal blocks as shown in Figure 3. (See section 2.3.4 for information about connecting the control wires.)
7. Close the terminal access panel.



A & B: Terminal cover release tabs
C & D: Gland plate release tabs
E: Control cable input (16.2 mm diameter; accepts cables up to 10 mm diameter)
F: Mains cable input (22.8 mm diameter; accepts cables up to 14.5 mm diameter)
G: Motor cable input (22.8 mm diameter; accepts cables up to 14.5 mm diameter)

Figure 4: Power Connections Access Diagram - Frame Size B

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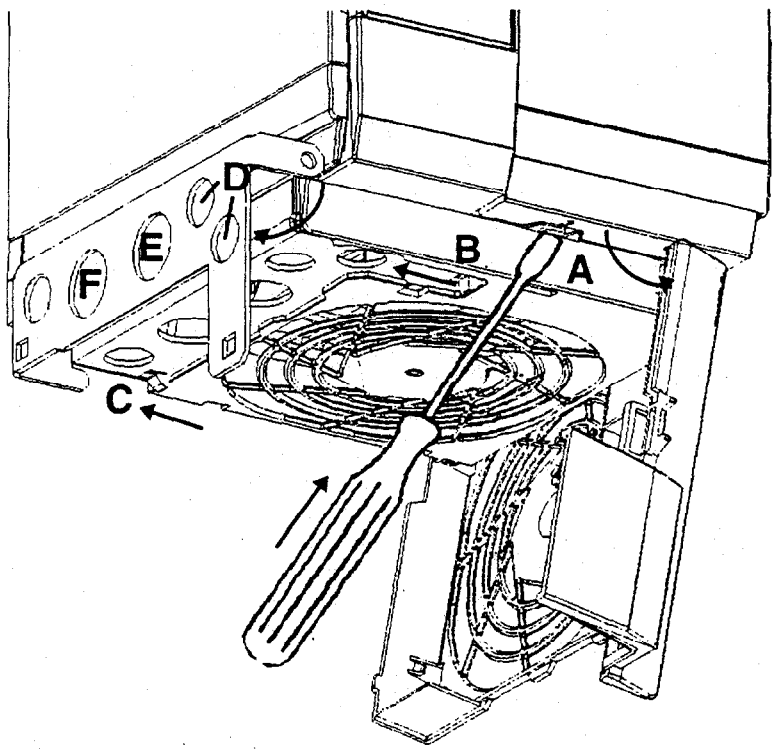
2.3.3 Power and Motor Connections - Frame Size C

The terminal arrangement for frame size C is identical to frame size A *(see Figure 3)*. However, before the wires can be connected to the terminal blocks, you must lower the fan housing and secure the cables to the gland plate.

Refer to Figure 5 and proceed as follows:

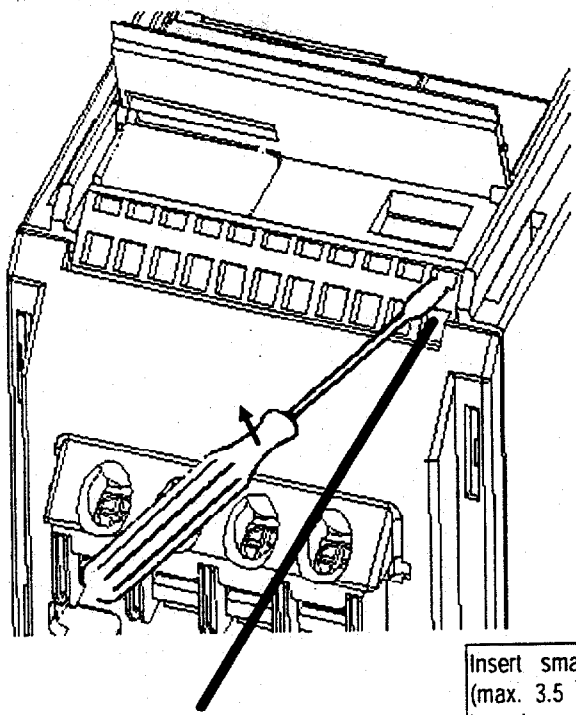
1. While supporting the fan housing with one hand, insert the blade of a screwdriver into slot A on the underside of the inverter and press upwards to release the securing tab. Lower the fan housing, allowing it to swing out to the right on its side-mounted hinges.
2. Applying pressure to the gland plate release clips B and C in the direction of the arrows. Swing the plate out to the left on its side-mounted hinges,
3. Secure each cable to the correct hole in the gland plate, ensuring that the exposed wires are long enough to reach the terminal blocks.
4. Connect the wires to the terminal blocks as shown in Figure 3. (See section 2.3.4 for information about connecting the control wires.) IT IS MOST IMPORTANT THAT THE MOTOR AND CONTROL WIRES ARE KEPT APART.
5. Swing the gland plate back into the base of the inverter. Ensure that the release clips snap into position.
6. Swing the fan housing back into the base of the inverter.



A:	**Fan housing release tab**
B & C:	**Gland plate release tabs**
D:	**Control cable input (16.2 mm diameter; accepts cables up to 10 mm diameter)**
E:	**Mains cable input (22.8 mm diameter; accepts cables up to 14.5 mm diameter)**
F:	**Motor cable input (22.8 mm diameter; accepts cables up to 14.5 mm diameter)**

Figure 5: Power Connections Access Diagram - Frame Size C

2.3.4 Control Connections



Insert small blade screwdriver (max. 3.5 mm) as shown while inserting control wire from below.

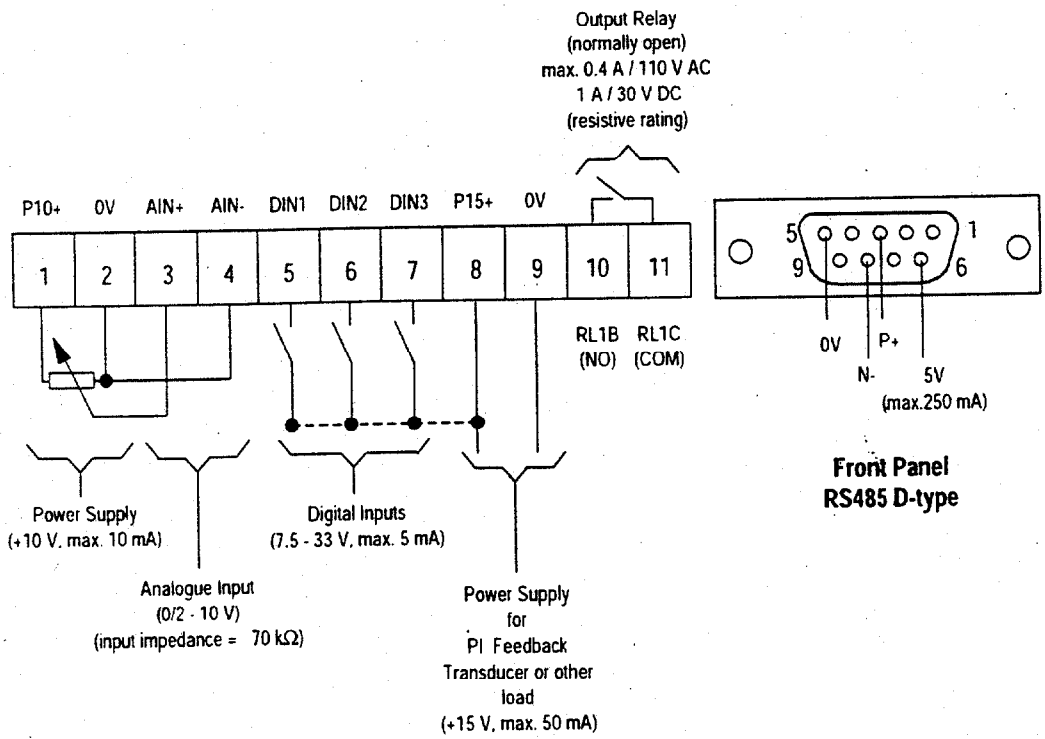


Figure 6: Control Connections

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2.3.5 Motor Overload Protection

When operated below rated speed, the cooling effect of fans fitted to the motor shaft is reduced. Consequentially, most motors require de-rating for continuous operation at low frequencies. To ensure that motors are protected against overheating under these conditions, a PTC temperature sensor must be fitted to the motor and connected to the inverter control terminals as shown in Figure 7.

Note: To enable the trip function, set parameter P051, P052 or P053 =19.

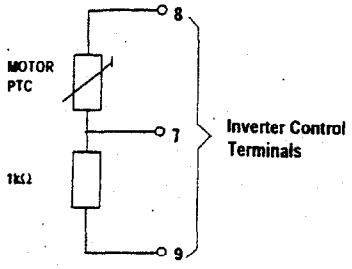


Figure 7: Motor Overload PTC Connection

2.3.6 Block Diagram

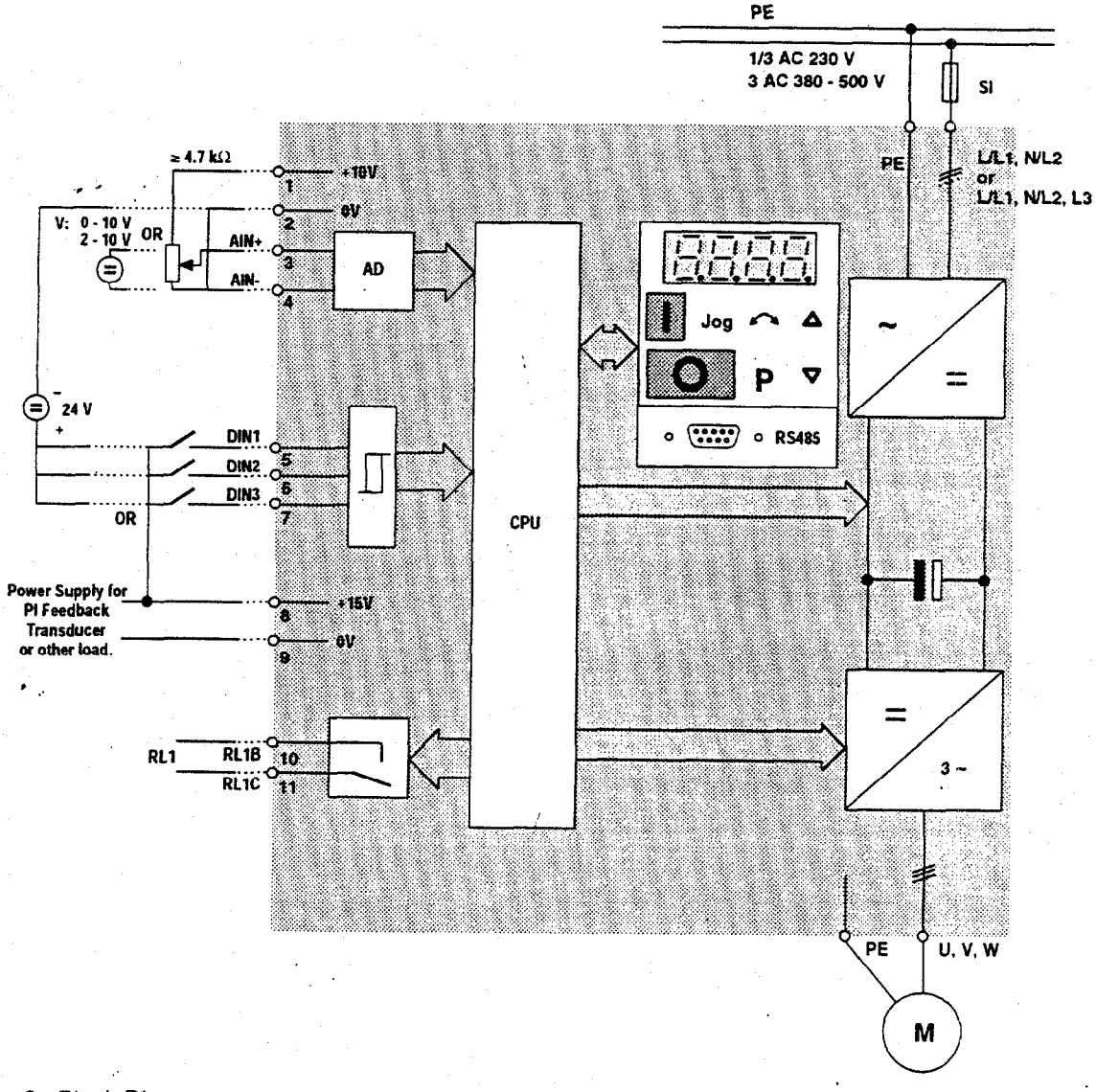


Figure 8: Block Diagram

3. FRONT PANEL CONTROLS & BASIC OPERATION

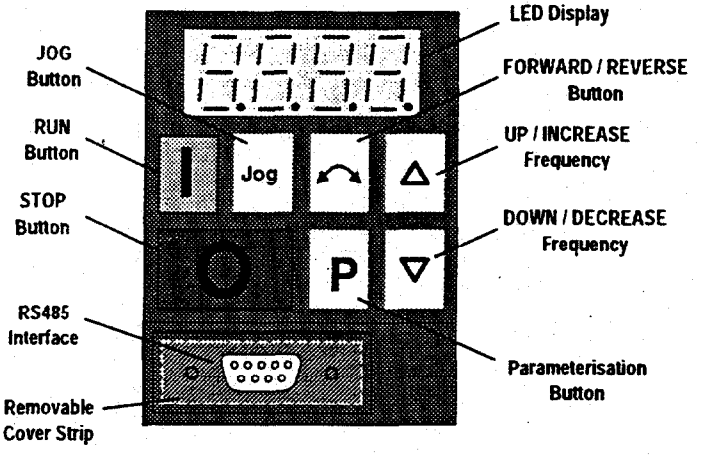
3.1 Front Panel Controls

CAUTION

The digital frequency setpoint has been set at 5.00 Hz in the factory. This means that, it is not necessary to enter a frequency setpoint via the Δ button or parameter P005 in order to test that the motor turns following a RUN command.

All settings must only be entered by qualified personnel, paying particular attention to the safety precautions and warnings.

The parameter settings required can be entered using the three parameterisation buttons (P, Δ and ∇) on the front panel of the inverter. The parameter numbers and values are indicated on the four digit LED display.



Jog	Pressing this button while the inverter is stopped causes it to start and run at the preset jog frequency. The inverter stops as soon as the button is released. Pressing this button while the inverter is running has no effect. Disabled if P123 = 0.
I	Press to start the inverter. Disabled if P121 = 0.
O	Press to stop the inverter.
LED Display	Displays frequency (default), parameter numbers or parameter values (when P is pressed) or fault codes.
↶	Press to change the direction of rotation of the motor. REVERSE is indicated by a minus sign (values < 100) or a flashing decimal point (values > 100). Disabled if P122 = 0
Δ	Press to INCREASE frequency. Used to change parameter numbers or values to higher settings during the parameterisation procedure. Disabled if P124 = 0.
∇	Press to DECREASE frequency. Used to change parameter numbers or values to lower settings during the parameterisation procedure. Disabled if P124 = 0.
P	Press to access parameters. Disabled if P051 - P053 = 14 when using digital inputs.

Figure 9: Front Panel

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3.2 Basic Operation

Refer to section 5 for a full description of each parameter.

3.2.1 General

(1) The inverter does not have a main power switch and is live when the mains supply is connected. It waits, with the output disabled, until the RUN button is pressed or for the presence of a digital ON signal at terminal 5 (rotate right) or terminal 6 (rotate left) - *see parameters P051 - P053.*

(2) If output frequency is selected to be displayed (P001 = 0), the corresponding setpoint is displayed approximately every 1.5 seconds while the inverter is stopped.

(3) The inverter is programmed at the factory for standard applications on Siemens four-pole standard motors. When using other motors it is necessary to enter the specifications from the motor's rating plate into parameters P081 to P085 *(see Figure 10).* **Note: Access to these parameters is not possible unless P009 has been set to 002 or 003.**

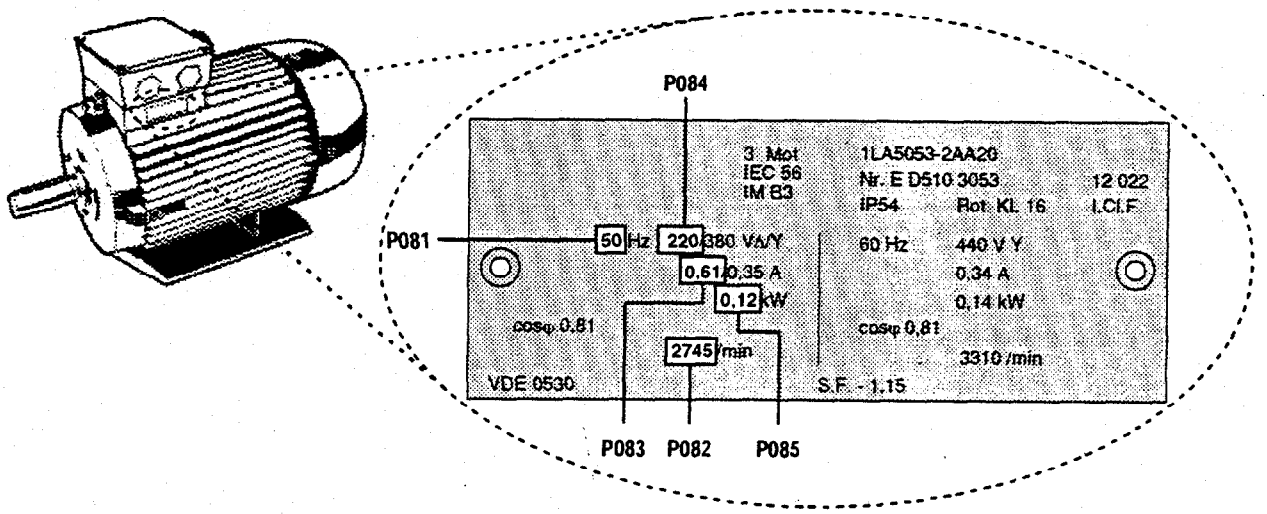

Figure 10: Typical Motor Rating Plate Example

Note: Ensure that the inverter is configured correctly to the motor, i.e. in the above example delta terminal connection is for 220 V.

3.2.2 Initial Testing

(1) Check that all cables have been connected correctly *(section 2)* and that all relevant product and plant/location safety precautions have been complied with.

(2) Apply mains power to the inverter.

(3) Ensure that it is safe to start the motor. Press the RUN button on the inverter. The display will change to **5.0** and the motor shaft will begin to turn. It will take one second for the inverter to ramp up to 5 Hz.

(4) Press the STOP button. The display will change to **0.0** and the motor slow to a complete stop within one second.

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3.2.3 Basic Operation - 10 Step Guide

The basic method of setting up the inverter for use is described below. This method uses a digital frequency setpoint and requires only the minimum number of parameters to be changed from their default settings. It assumes that a standard Siemens four-pole motor is connected to the inverter *(see section 3.2.1 if a different motor type is being used).*

Step /Action	Button	Display
1. Apply mains power to the inverter. The display will alternate between the actual frequency (0.0 Hz) and the requested frequency setpoint (5.0 Hz default).		0.0 ⇕ 5.0
2. Press the parameterisation button.	P	P000
3. Press the Δ button until parameter P005 is displayed.	Δ	P005
4. Press P to display the current frequency setpoint (5 Hz is the factory default setting).	P	005.0
5. Press the Δ button to set the desired frequency setpoint (e.g. 35 Hz).	Δ	035.0
6. Press P to lock the setting into memory.	P	P005
7, Press the ∇ button to return to P000.	∇	P000
8. Press P to exit the parameterisation procedure. The display will alternate between the current frequency and the requested frequency setpoint.	P	0.0 ⇕ 35.0
9. Start the inverter by pressing the RUN button. The motor shaft will start to turn and the display will show that the inverter is ramping up to the setpoint of 35 Hz. **Note** The setpoint will be achieved after 7 seconds (35 Hz/50 Hz x 10 s *). If required, the motor's speed (i.e. frequency) can be varied directly by using the Δ ∇ buttons. (Set P011 to 001 to enable the new frequency setting to be retained in memory during periods when the inverter is not running.)		0.0 ↓ 35.0
10. Switch the inverter off by pressing the STOP button. The motor will slow down and come to a controlled stop (takes 7 s **).		↓ 0.0

* Default ramp-up time is 10 s to reach 50 Hz (defined by P002 and P013).

** Default ramp-down time is 10 s from 50 Hz (defined by P003 and P013).

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4. OPERATING MODES

4.1 Digital Control

For a basic startup configuration using digital control, proceed as follows:

(1) Connect control terminal 5 to terminal 8 via a simple on/off switch. This sets up the motor for clockwise rotation (default).

(2) Apply mains power to the inverter. Set parameter P009 to 002 or 003 to enable all parameters to be adjusted.

(3) Check that parameter P006 is set to 000 to specify digital setpoint.

(4) Set parameter P007 to 000 to specify digital input (i.e. DIN1 (terminal 5) in this case) and disable the front panel controls.

(5) Set parameter P005 to the desired frequency setpoint.

(6) Set parameters P081 to P085 in accordance with the rating plate on the motor *(see Figure 10).*

Note: In many cases, when default factory parameters are used, the default stator resistance set in P089 will generally suit the default power rating set in P085. Should the inverter and motor ratings differ greatly, it is recommended that the stator resistance of the motor is measured and entered manually into P089. Continuous Boost (P078) and Starting Boost (P079) are dependent on the value of Stator Resistance - too high a value may cause overcurrent trips

(7) Set the external on/off switch to ON. The inverter will now drive the motor at the frequency set by P005.

4.2 Analogue Control

For a basic startup configuration using analogue voltage control, proceed as follows:

(1) Connect control terminal 5 to terminal 8 via a simple on/off switch. This sets up the motor for clockwise rotation (default).

(2) Connect a 4.7 kΩ potentiometer to the control terminals as shown in Figure 6 or connect pin 2 (0V) to pin 4 and a 0 - 10 V signal between pin 2 (0V) and pin 3 (AIN+).

(3) Apply mains power to the inverter. Set parameter P009 to 002 or 003 to enable all parameters to be adjusted.

(4) Set parameter P006 to 001 to specify analogue setpoint.

(5) Set parameter P007 to 000 to specify digital input (i.e. DIN1 (terminal 5) in this case) and disable the front panel controls.

(6) Set parameters P021 and P022 to specify the minimum and maximum output frequency settings.

(7) Set parameters P081 to P085 in accordance with the rating plate on the motor *(see Figure 10).*

Note: In many cases, when default factory parameters are used, the default stator resistance set in P089 will generally suit the default power rating set in P085. Should the inverter and motor ratings differ greatly, it is recommended that the stator resistance of the motor is measured and entered manually into P089. Continuous Boost (P078) and Starting Boost (P079) are dependent on the value of Stator Resistance - too high a value may cause overcurrent trips

(8) Set the external on/off switch to ON. Turn the potentiometer (or adjust the analogue control voltage) until the desired frequency is displayed on the inverter.

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4.3 Stopping the Motor

Stopping can be achieved in several ways:

- Cancelling the ON command or pressing the OFF button (**O**) on the front panel causes the inverter to ramp down at the selected ramp down rate *(see P003).*
- OFF2 - operation causes the motor to coast to a standstill *(see parameters P051 to P053).*
- OFF3 - operation causes rapid braking *(see parameters P051 to P053).*
- DC injection braking up to 250% causes a rapid stop *(see P073).*

4.4 If the Motor Does Not Start Up

If the display shows a fault code, refer to Section 6.

If the motor does not start up when the ON command has been given, check that the ON command is valid, check if a frequency setpoint has been entered in P005 and check that the motor specifications have been entered correctly under parameters P081 to P085.

If the inverter is configured for operation via the front panel (P007 = 001) and the motor does not start when the RUN button is pressed, check that P121 = 001 (RUN button enabled).

If the motor does not run after parameters have been changed accidentally, reset the inverter to the factory default parameter values by setting parameter **P944** to **001** and then pressing **P**.

4.5 Local and Remote Control

The inverter can be controlled either locally (default), or remotely via a USS data line connected to the RS485 D-type connector on the front panel. (Refer to parameter P910 in section 5 for the available remote control options.)

When local control is used, the inverter can only be controlled via the front panel or the control terminals. Control commands, setpoints or parameter changes received via the RS485 interface have no effect.

When operating via remote control the inverter will not accept control commands from the terminals. *Exception: OFF2 or OFF3 can be activated via parameters P051 to P053 (refer to parameters P051 to P053 in section 5).*

Several inverters can be connected to an external control unit at the same time. The inverters can be addressed individually.

For further information, refer to the following documents *(available from your local Siemens office).*

E20125-B0001-S302-A1	Application of the USS Protocol in SIMOVERT Units 6SE21 and MICROMASTER (German)
E20125-B0001-S302-A1-7600	Application of the USS Protocol in SIMOVERT Units 6SE21 and MICROMASTER (English)

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4.6 Closed Loop Control

4.6.1 General Description

The MICROMASTER provides a PI control function for closed loop control *(see Figure 11)*. PI control is ideal for temperature or pressure control, or other applications where the controlled variable changes slowly or where transient errors are not critical. This control loop is **not** suitable for use in systems where fast response times are required.

Note: The closed loop function is not designed for speed control, but can be used for this provided that fast response times are not required.

When closed loop PI control is enabled (P201 = 002), all setpoints are calibrated between zero and 100%, i.e. a setpoint of 50.0 = 50%. This allows general purpose control of any process variable that is actuated by motor speed and for which a suitable transducer is available.

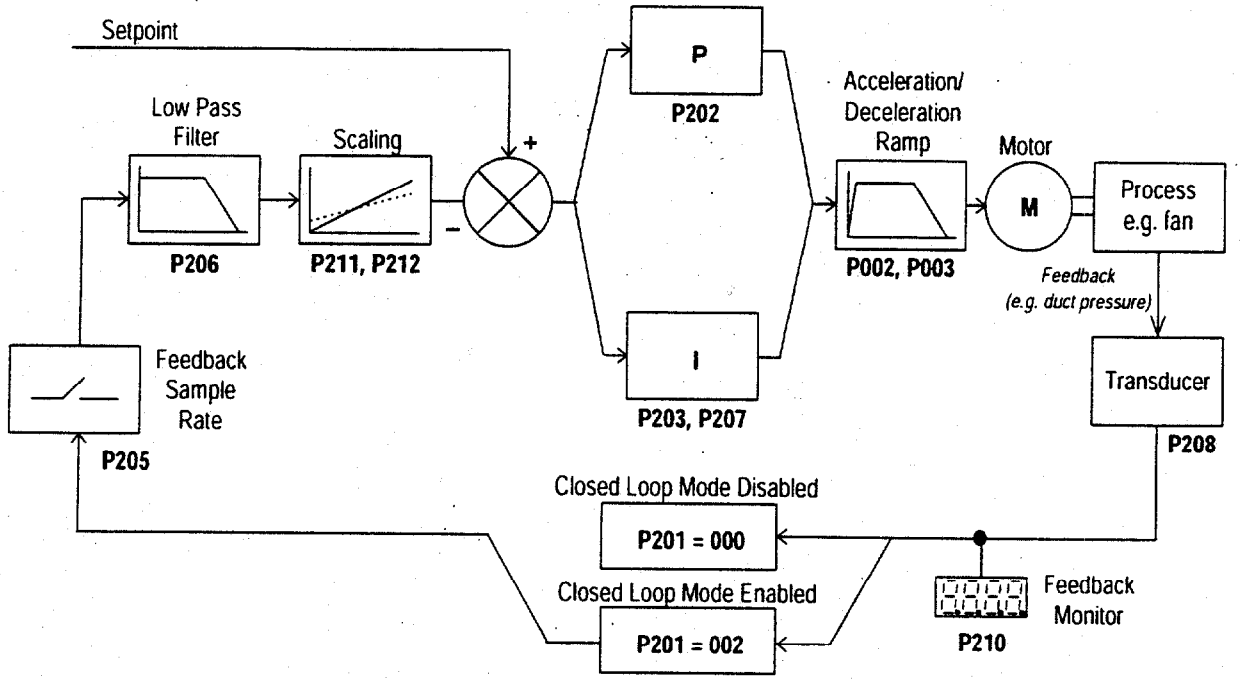

Figure 11: Closed Loop Control

4.6.2 Hardware Setup

Connect the outputs from the external feedback transducer to control terminals 3 and 4. This analogue input accepts a 0/2 - 10 V signal, has 10-bit resolution and permits a differential (floating) voltage. Ensure that the values of parameters P023 and P024 are set to 000 and that P006 is set to 000 or 002.

15 V dc power for the feedback transducer can be supplied from terminals 8 and 9 on the control block.

4.6.3 Parameter Settings

Closed loop control cannot be used unless P201 is first set to 002. Most of the parameters associated with closed loop control are shown in Figure 11. Other parameters which are also associated with closed loop control are as follows:

P001 (value = 007)
P061 (value = 012 or 013)
P210
P220

Descriptions of all closed loop control parameters are provided in section 5. For further detailed information about PI operation refer to the Siemens DA 64 Catalogue.

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5. SYSTEM PARAMETERS

Parameters can be changed and set using the membrane-type buttons to adjust the desired properties of the inverter, such as ramp times, minimum and maximum frequencies etc. The parameter numbers selected and the setting of the parameter values are indicated in the four digit LED display.

Note: If you press the Δ or ∇ button momentarily, the values change step by step. If you keep the buttons pressed for a longer time, the values scroll through rapidly.

Access to parameters is determined by the value set in P009. Check that the key parameters necessary for your application have been programmed.

Note: In the following parameter table:

'•' Indicates parameters that can be changed during operation.

'☆☆☆' Indicates that the value of this factory setting depends on the rating of the inverter.

To increase the resolution to 0.01 when changing frequency parameters, instead of pressing P momentarily to return to the parameter display, keep the button pressed until the display changes to '- -.n0' (n = the current tenths value, e.g. if the parameter value = '055.8' then n = 8). Press Δ or ∇ to change the value (all values between .00 and .99 are valid) and then press P twice to return to the parameter display.

If parameters are changed accidentally, all parameters can be reset to their default values by setting parameter **P944** to **1** and then pressing **P**.

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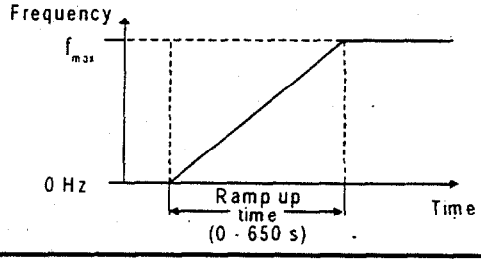
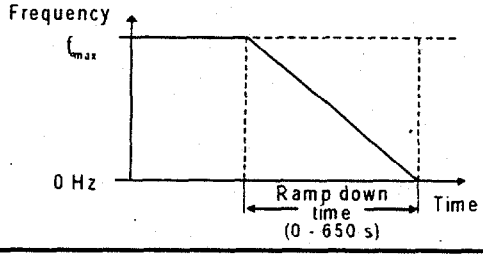
Parameter	Function	Range [Default]	Description / Notes
P000	Operating display	-	This displays the output selected in P001. In the event of a fault, the relevant fault code (Fxxx) is displayed *(see section 6)*. In the event of a warning the display flashes. If output frequency has been selected (P001 = 0) and the inverter is OFF, the display alternates between the selected frequency and the actual frequency.
P001 •	Display mode	0 - 8 [0]	Display selection: **0** = Output frequency (Hz) **1** = Frequency setpoint (i.e. speed at which inverter is set to run) (Hz) **2** = Motor current (A) **3** = DC-link voltage (V) **4** = *Not used* **5** = Motor RPM **6** = USS status *(see section 8.2)* **7** = Closed loop control setpoint (% of full scale) **8** = Output voltage
P002 •	Ramp up time (seconds)	0 - 650.00 [10.00]	This is the time taken for the motor to accelerate from standstill to the maximum frequency as set in P013. Setting the ramp up time too short can cause the inverter to trip (fault code F002 - overcurrent). 
P003 •	Ramp down time (seconds)	0 - 650.00 [10.00]	This is the time taken for the motor to decelerate from maximum frequency (P013) to standstill. Setting the ramp down time too short can cause the inverter to trip (fault code F001 - overvoltage). This is also the period for which DC injection braking is applied *(see P073)* 

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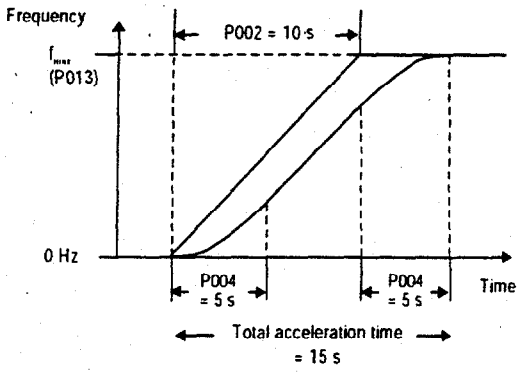
Parameter	Function	Range [Default]	Description / Notes
P004 •	Smoothing (seconds)	0 - 40.0 [0.0]	Used to smooth the acceleration/deceleration of the motor (useful in applications where it is important to avoid 'jerking', e.g. conveyor systems, textiles, etc.). Smoothing is only effective if the ramp up/down time exceeds 0.3 s.  **Note:** The smoothing curve for deceleration is based on the ramp up gradient (P002) and is added to the ramp down time set by P003. Therefore, the ramp down time is affected by changes to P002.
P005 •	Digital frequency setpoint (Hz)	0 - 400.00 [5.00]	Sets the frequency that the inverter will run at when operated in digital mode. Only effective if P006 set to '0'.
P006	Frequency setpoint source selection	0 - 2 [0]	Sets the control mode of the inverter. **0** = Digital. The inverter runs at the frequency set in P005. Alternatively, if P007 is set to zero, the frequency may be controlled by setting any two of binary inputs P051 - P053 to values of 11 and 12. **1** = Analogue. Control via analogue input signal. **2** = Fixed frequency or motor potentiometer. Fixed frequency is only selected if the value of at least one binary input (P051 - P053) = 6, 17 or 18. **Notes:** (1) If P006 = 1 and the inverter is set up for remote control operation, the analogue inputs remain active. (2) Motor potentiometer setpoints via digital inputs are stored when P011 = 1.
P007	Keypad control	0 - 1 [1]	**0** = Front panel buttons disabled (except STOP, Δ and ∇). Control is via digital inputs *(see parameters P051 - P053)*. Δ and ∇ may still be used to control frequency provided that P124 = 1 and a digital input has not been selected to perform this function. **1** = Front panel buttons enabled (can be individually disabled depending on the setting of parameters P121 - P124). **Note:** The digital inputs for RUN, REVERSE, JOG and increase/decrease frequency are disabled.
P009 •	Parameter protection setting	0 - 3 [0]	Determines which parameters can be adjusted: **0** = Only parameters from P001 to P009 can be read/set. **1** = Parameters from P001 to P009 can be set and all other parameters can only be read. **2** = All parameters can be read/set but P009 automatically resets to 0 when power is removed. **3** = All parameters can be read/set.

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Parameter	Function	Range [Default]	Description / Notes
P011	Frequency setpoint memory	0 - 1 [0]	**0** = Disabled **1** = Enabled after switch-off. i.e. The setpoint alterations made with the Δ / ∇ buttons or digital inputs are stored even when power has been removed from the inverter.
P012 •	Minimum motor frequency (Hz)	0 - 400.00 [0.00]	Sets the minimum motor frequency (must be less than the value of P013).
P013 •	Maximum motor frequency (Hz)	0 - 400.00 [50.00]	Sets the maximum motor frequency.
P014 •	Skip frequency 1 (Hz)	0 - 400.00 [0.00]	A skip frequency can be set with this parameter to avoid the effects of mechanical resonance. Frequencies within +/-(value of P019) of this setting are suppressed. Stationary operation is not possible within the suppressed frequency range - the range is just passed through.
P015 •	Automatic restart after mains failure.	0 - 1 [0]	Setting this parameter to '1' enables the inverter to restart automatically after a mains break or 'brownout', provided the run/stop switch is still closed, P007 = 0 and P910 = 0, 2 or 4. **0** = Disabled **1** = Automatic restart
P016 •	Start on the fly	0 - 2 [0]	Allows the inverter to start onto a spinning motor. Under normal circumstances the inverter runs the motor up from 0 Hz. However, if the motor is still spinning or is being driven by the load, it will undergo braking before running back up to the setpoint - this can cause an overcurrent trip. By using a flying restart, the inverter 'homes in' on the motor's speed and runs it up from that speed to the setpoint. **Note:** If the motor has stopped or is rotating slowly, some 'rocking' may occur as the inverter senses the direction of rotation prior to restarting. *(See also P020)* **0** = Normal restart **1** = Flying restart after power up, fault or OFF2 (if P018 = 1). **2** = Flying restart every time (useful in circumstances where the motor can be driven by the load).
P017 •	Smoothing type	1 - 2 [1]	**1** = Continuous smoothing (as defined by P004). **2** = Discontinuous smoothing. This provides a fast unsmoothed response to STOP commands and requests to reduce frequency. **Note:** P004 must be set to a value > 0.0 for this parameter to have any effect.
P018 •	Automatic restart after fault	0 - 1 [0]	Automatic restart after fault: **0** = Disabled **1** = The inverter will attempt to restart up to 5 times after a fault. If the fault is not cleared after the 5th attempt, the inverter will remain in the fault state until reset. **WARNING: While waiting to re-start, the display will flash. This means that a start is pending and may happen at any time. Fault codes can be observed in P930.**
P019 •	Skip frequency bandwidth (Hz)	0 - 10.00 [2.00]	Frequencies set by P014, P027, P028 or P029 that are within +/- the value of P019 are suppressed.
P020	Flying start ramp time (seconds)	0.50 - 25.0 [5.0]	Used in conjunction with P016 (set longer times if persistent F002 trips occur).
P021 •	Minimum analogue frequency (Hz)	0 - 400.00 [0.00]	Frequency corresponding to the lowest analogue input value, i.e. 0 V or 2 V. This can be set to a higher value than P022 to give an inverse relationship between analogue input and frequency output *(see diagram in P022)*.

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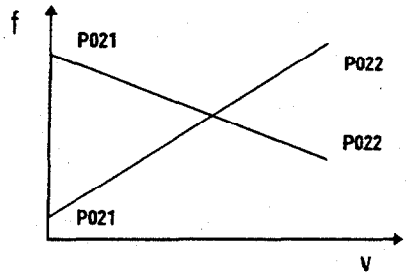
Parameter	Function	Range [Default]	Description / Notes
P022 •	Maximum analogue frequency (Hz)	0 - 400.00 [50.00]	Frequency corresponding to the highest analogue input value, i.e. 10 V, determined by P023. This can be set to a lower value than P021 to give an inverse relationship between analogue input and frequency output. i.e.  **Note:** The output frequency is limited by values entered for P012/P013.
P023 •	Analogue input function	0 - 2 [0]	**0** = 0 V to 10 V **1** = 2 V to 10 V **2** = 2 V* to 10 V * The inverter will come to a controlled stop if V < 1 V. **WARNING: The motor can automatically run without a potentiometer or voltage source connected between pins 3 and 4.** **WARNING: With P023=2, the inverter will automatically start when V goes above 1 V. This equally applies to analogue and digital control (i.e. P006 = 0 or 1).**
P024 •	Analogue setpoint addition	0 - 2 [0]	If the inverter is not in analogue mode (P006 = 0 or 2), setting this parameter to '1' causes the analogue input value to be added. **0** = No addition. **1** = Addition of the analogue setpoint (defined by P023) to the fixed frequency or the motor potentiometer frequency. **2** = Scaling of digital/fixed setpoint by analogue input (P023) in the range 0 - 100%. **Note:** By selecting a combination of reversed negative fixed frequency settings and analogue setpoint addition, it is possible to configure the inverter for 'centre zero' operation with a +/-5 V supply or a 0 - 10 V potentiometer so that the output frequency can be 0 Hz at any position, including the centre position.
P027 •	Skip frequency 2 (Hz)	0 - 400.00 [0.00]	*See P014.*
P028 •	Skip frequency 3 (Hz)	0 - 400.00 [0.00]	*See P014.*
P029 •	Skip frequency 4 (Hz)	0 - 400.00 [0.00]	*See P014.*
P031 •	Jog frequency right (Hz)	0 - 400.00 [5.00]	Jogging is used to advance the motor by small amounts. It is controlled via the JOG button or with a non-latching switch on one of the digital inputs (P051 to P053). If jog right is enabled (DINn = 7), this parameter controls the frequency at which the inverter will run when the switch is closed. Unlike other setpoints, it can be set lower than the minimum frequency.
P032 •	Jog frequency left (Hz)	0 - 400.00 [5.00]	If jog left is enabled (DINn = 8), this parameter controls the frequency at which the inverter will run when the switch is closed. Unlike other setpoints, it can be set lower than the minimum frequency.

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Parameter	Function	Range [Default]	Description / Notes
P041 •	Fixed frequency 1 (Hz)	0 - 400.00 [5.00]	Valid if P006 = 2 and P053 = 6 or 18.
P042 •	Fixed frequency 2 (Hz)	0 - 400.00 [10.00]	Valid if P006 = 2 and P052 = 6 or 18.
P043 •	Fixed frequency 3 (Hz)	0 - 400.00 [15.00]	Valid if P006 = 2 and P051 = 6 or 18.
P044 •	Fixed frequency 4 (Hz)	0 - 400.00 [20.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17.
P045	Inversion fixed setpoints for fixed frequencies 1 - 4	0 - 7 [0]	Sets the direction of rotation for the fixed frequency:

	FF 1	FF 2	FF 3	FF4
P045 = 0	⇒	⇒	⇒	⇒
P045 = 1	⇐	⇒	⇒	⇒
P045 = 2	⇒	⇐	⇒	⇒
P045 = 3	⇒	⇒	⇐	⇒
P045 = 4	⇒	⇒	⇒	⇐
P045 = 5	⇐	⇐	⇒	⇒
P045 = 6	⇐	⇐	⇐	⇒
P045 = 7	⇐	⇐	⇐	⇐

⇒ Fixed setpoints not inverted.
⇐ Fixed setpoints inverted.

P046 •	Fixed frequency 5 (Hz)	0 - 400.00 [25.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17.
P047 •	Fixed frequency 6 (Hz)	0 - 400.00 [30.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17.
P048 •	Fixed frequency 7(Hz)	0 - 400.00 [35.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17.
P050	Inversion fixed setpoints for fixed frequencies 5 - 7	0 - 7 [0]	Sets the direction of rotation for the fixed frequency:

	FF 5	FF 6	FF 7
P050 = 0	⇒	⇒	⇒
P050 = 1	⇐	⇒	⇒
P050 = 2	⇒	⇐	⇒
P050 = 3	⇒	⇒	⇐
P050 = 4	⇒	⇒	⇒
P050 = 5	⇐	⇐	⇒
P050 = 6 or 7	⇐	⇐	⇐

⇒ Fixed setpoints not inverted.
⇐ Fixed setpoints inverted.

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Parameter	Function	Range [Default]	Description / Notes
P051	Selection control function, DIN1 (terminal 5), fixed frequency 3 or binary fixed frequency bit 0.	0 - 19 [1]	
P052	Selection control function, DIN2 (terminal 6), fixed frequency 2. or binary fixed frequency bit 1.	0 - 19 [2]	
P053	Selection control function, DIN3 (terminal 7), fixed frequency 1 or binary fixed frequency bit 2.	0 - 19 [6]	

Value	Function of P051 to P053	Function, low state	Function, high state
0	Input disabled	-	-
1	ON right	Off	On right
2	ON left	Off	On left
3	Reverse	Normal	Reverse
4	OFF2 **	OFF2	On
5	OFF3 **	OFF3	On
6	Fixed frequencies 1 - 3	Off	On
7	Jog right	Off	Jog right
8	Jog left	Off	Jog left
9	Remote operation	Local	Remote
10	Fault code reset	Off	Reset on rising edge
11	Increase frequency *	Off	Increase
12	Decrease frequency *	Off	Decrease
13	Disable analogue input (setpoint is 0.0 Hz)	Analogue on	Analogue disabled
14	Disable the ability to change parameters	enabled	disabled
15	Enable dc brake	Off	Brake on
16	*Do not use*	-	-
17	Binary fixed frequency control (fixed frequencies 1 - 7)	Off	On
18	As 6, but input high will also request RUN *	Off	On
19	External trip/PTC	Yes (F012)	No

* Only effective when P007 = 0.

** *See section 4.3.*

Binary Coded Fixed Frequency Mapping

(P051, P052, P053 = 17)

	DIN3 (P053)	DIN2 (P052)	DIN1 (P051)
STOP	0	0	0
RUN to FF1 (P041)	0	0	1
RUN to FF2 (P042)	0	1	0
RUN to FF3 (P043)	0	1	1
RUN to FF4 (P044)	1	0	0
RUN to FF5 (P046)	1	0	1
RUN to FF6 (P047)	1	1	0
RUN to FF7 (P048)	1	1	1

P056	Digital input debounce time	0 - 2 [0]	**0** = 12.5 ms **1** = 7.5 ms **2** = 2.5 ms

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Parameter	Function	Range [Default]	Description / Notes

P061 Selection relay output RL1 — 0 - 13 [6]

Value	Relay function	Active [3]
0	No function assigned (relay not active)	Low
1	Inverter is running	High
2	Inverter frequency 0.0 Hz	Low
3	Motor run right has been selected	High
4	External brake on (see parameters P063/P064)	Low
5	Inverter frequency less than or equal to minimum frequency	Low
6	Fault indication [1]	Low
7	Inverter frequency greater than or equal to setpoint	High
8	Warning active [2]	Low
9	Output current greater than or equal to P065	High
10	Motor current limit (warning) [2]	Low
11	Motor over temperature (warning) [2]	Low
12	Closed loop motor LOW speed limit	High
13	Closed loop motor HIGH speed limit	High

[1] Inverter switches off *(see parameter P930 and section 6).*
[2] Inverter does not switch off *(see parameter P931).*
[3] 'Active low' = relay OPEN. 'Active high' = relay CLOSED.

P062 Electro-mechanical brake option control — 0 - 4 [0]

This operates in the same manner as the external brake control (described in P063/P064), except that the relay is not activated.

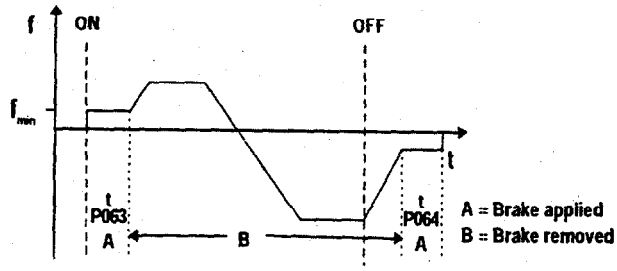
0 = Normal stop mode
1 - 3 = *Do not use*
4 = Combination stop mode

P063 External brake release delay (seconds) — 0 - 20.0 [1.0]

Only effective if the relay output is set to control an external brake (P061 = 4). In this case when the inverter is switched on, it will run at the minimum frequency for the time set by this parameter before releasing the brake control relay and ramping *up (see illustration in P064).*

P064 External brake stopping time (seconds) — 0 - 20.0 [1.0]

As P063, only effective if the relay output is set to control an external brake. This defines the period for which the inverter continues to run at the minimum frequency after ramping down and while the external brake is applied.



Notes: (1) Settings for P063 and P064 should be slightly longer than the actual time taken for the external brake to apply and release respectively.
(2) Setting P063 or P064 to too high a value, especially with P012 set to a high value, can cause an overcurrent warning or trip as the inverter attempts to move a locked motor shaft.

P065 Current threshold for relay (A) — 0 - 99.9 [1.0]

This parameter is used when P061 = 9. The relay switches on when the motor current is greater than the value of P065 and switches off when the current falls to 90% of the value of P065 (hysteresis).

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Parameter	Function	Range [Default]	Description / Notes
P066	Compound braking	0 - 1 [1]	**0** = Off **1** = On. Permits faster ramp-down times and enhances stopping capability.
P073 •	DC injection braking (%)	0 - 250 [0]	This stops the motor by applying a DC current. This causes heat to be generated in the motor rather than the inverter and holds the shaft stationary until the end of the braking period. Braking is effective for the period of time set by P003. The DC brake can be activated using DIN1 - DIN3 *(braking is active for as long as the DIN is high - see P051 - P053).* **WARNING: Frequent use of long periods of dc injection braking can cause the motor to overheat.** **If DC injection braking is enabled via a digital input then DC current is applied for as long as the digital input is high. This causes heat in the motor.**
P074 •	I^2t motor derating	0 - 1 [1]	**0** = Disabled **1** = Enabled. Causes an F074 trip if the motor exceeds the I^2t calculation. The time taken to trip is dependent on the difference between the overload current and the nominal motor current rating stored in P083 - typically a 150% overload will result in a switch-off in 1 - 2 minutes. **WARNING: Where motor thermal protection is required, an external PTC must be used.**
P076 •	Pulse frequency	0 - 7 [0 or 4]	Sets the pulse frequency (from 2 to 16 kHz) and the PWM mode. If silent operation is not absolutely necessary, the losses in the inverter as well as the RFI emissions can be reduced by selecting lower pulse frequencies. **0/1** = 16 kHz (230 V default) **2/3** = 8 kHz **4/5** = 4 kHz (400 V default) **6/7** = 2 kHz **Note:** When P076 = 0/1, the display of the current at frequencies below 10 Hz is less accurate. 400V inverters require the continuous current rating reduced for operation below 5Hz, when operating at switching frequencies greater than 4kHz and with boost values greater than 100% (P078 + P079). These are typically as follows:

Model	P076 =	
	0 or **1**	**2** or **3**
MM37/3- MM750/3	50%xP083	80%xP083

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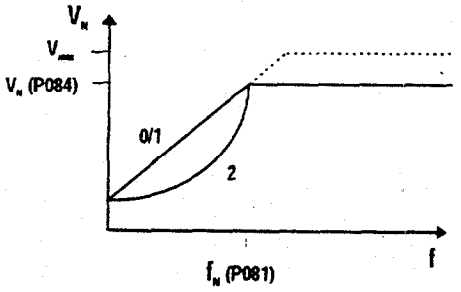
Parameter	Function	Range [Default]	Description / Notes
P077	Control mode	0 - 2 [1]	Controls the relationship between the speed of the motor and the voltage supplied by the inverter. One of two modes can be selected: **0/1** = Linear voltage/frequency Use this curve for synchronous motors or motors connected in parallel. **2** = Quadratic voltage/frequency relationship This is suitable for centrifugal pumps and fans. 
P078 •	Continuous boost (%)	0 - 250 [100]	Operates continuously over the whole frequency range. For many applications it is necessary to increase low frequency torque. This parameter sets the start-up voltage at 0 Hz to adjust the available torque for low frequency operation. 100% setting will produce rated motor current at low frequencies. **WARNING: If P078 is set too high, overheating of the motor and/or an overcurrent trip (F002) can occur.**
P079 •	Starting boost (%)	0 - 250 [0]	For drives which require a high initial starting torque, it is possible to set an additional current (added to the setting in P078) during ramping. This is only effective during initial start up and until the frequency setpoint is reached. **Note:** This increase is in addition to P078.
P081	Nominal frequency for motor (Hz)	0 - 400.00 [50.00]	These parameters must be set for the motor used. Read the specifications on the motor's rating plate *(see Figure 10 in section 3.2.1)*. **Note:** The inverter's default setting vary according to the power rating.
P082	Nominal speed for motor (RPM)	0 - 9999 [☆☆☆]	
P083	Nominal current for motor (A)	0.1 - 99.9 [☆☆☆]	
P084	Nominal voltage for motor (V)	0 - 1000 [☆☆☆]	
P085	Nominal power for motor (kW/hp)	0 - 100.0 [☆☆☆]	
P089 •	Stator resistance (Ω)	0.01-100.00 [☆☆☆]	The stator resistance of the motor should be entered in this parameter. The value entered should be the resistance between any two phases with the motor connected. **The measurement should be made at the inverter output terminals with power off.** **Note:** If the value of P089 is too high then an overcurrent trip (F002) may occur.
P091 •	Serial link slave address	0 - 30 [0]	Up to 31 inverters can be connected via the serial link and controlled by a computer or PLC using the USS protocol. This parameter sets a unique address for the inverter.

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Parameter	Function	Range [Default]	Description / Notes
P092 •	Serial link baud rate	3 - 7 [6]	Sets the baud rate of the RS485 serial interface (USS protocol): **3** = 1200 baud **4** = 2400 baud **5** = 4800 baud **6** = 9600 baud **7** = 19200 baud **Note:** Some RS232 to RS485 converters are not capable of baud rates higher than 4800.
P093 •	Serial link timeout (seconds)	0 - 240 [0]	This is the maximum permissible period between two incoming data telegrams. This feature is used to turn off the inverter in the event of a communications failure. Timing starts after a valid data telegram has been received and if a further data telegram is not received within the specified time period, the inverter will trip and display fault code F008. Setting the value to zero switches off the control.
P094 •	Serial link nominal system setpoint (Hz)	0 - 400.00 [50.00]	Setpoints are transmitted to the inverter via the serial link as percentages. The value entered in this parameter represents 100% (HSW = 4000H).
P095 •	USS compatibility	0 - 2 [0]	**0** = Compatible with 0.1 Hz resolution **1** = Enable 0.01 Hz resolution **2** = HSW is not scaled but represents the actual frequency value to a resolution of 0.01 Hz (e.g. 5000 = 50 Hz).
P099 •	Option module type	0 - 1 [0]	**0** = Option module not present **1** = PROFIBUS module (enables parameters relating to PROFIBUS)
P101 •	Operation for Europe or USA	0 - 1 [0]	This sets the inverter for European or USA supply and motor frequency: **0** = Europe (50 Hz) **1** = USA (60 Hz) **Note:** After setting P101 = 1 the inverter must be re-set to factory defaults. i.e. P944 = 1 to automatically set P013 = 60 Hz, P081 = 60 Hz, P082 = 1680 rpm and P085 will be displayed in hp.
P111	Inverter power rating (kW/hp)	0.0 - 50.00 [☆☆☆]	Read-only parameter that indicates the power rating of the inverter in kW. e.g. 0.55 = 550 W **Note:** If P101 = 1 then the rating is displayed in hp.
P112	Inverter type (model)	1 - 7 [☆☆☆]	Read-only parameter. **1** = MICROMASTER series 2 (MM2) **2** = COMBIMASTER **3** = MIDIMASTER **4** = MICROMASTER Junior (MMJ) → **5** = MICROMASTER series 3 (MM3) **6** = MICROMASTER Vector (MMV) **7** = MIDIMASTER Vector (MDV)
P113	Inverter type (power rating)	0 - 29 [☆☆☆]	Read-only parameter. **0** = MM12 / **10** = MM12/2 / **20** = MM37/3 **1** = MM25 / **11** = MM25/2 / **21** = MM55/3 **2** = MM37 / **12** = MM37/2 / **22** = MM75/3 **3** = MM55 / **13** = MM55/2 / **23** = MM110/3 **4** = MM75 / **14** = MM75/2 / **24** = MM150/3 **5** = MM110 / **15** = MM110/2 / **25** = MM220/3 **6** = MM150 / → **16** = MM150/2 / **26** = MM300/3 **7** = MM220 / **17** = MM220/2 / **27** = MM400/3 **8** = MM300 / **18** = MM300/2 / **28** = MM550/3 **19** = MM400/2 / **29** = MM750/3

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Parameter	Function	Range [Default]	Description / Notes
P121	Enable/disable RUN button	0 - 1 [1]	**0** = RUN button disabled. **1** = RUN button enabled (only possible if P007 = 1).
P122	Enable/disable FORWARD/REVERSE button	0 - 1 [1]	**0** = FORWARD/REVERSE button disabled. **1** = FORWARD/REVERSE button enabled (only possible if P007 = 1).
P123	Enable/disable JOG button	0 - 1 [1]	**0** = JOG button disabled. **1** = JOG button enabled (only possible if P007 = 1).
P124	Enable/disable Δ and ∇ buttons	0 - 1 [1]	**0** = Δ and ∇ buttons disabled. **1** = Δ and ∇ buttons enabled (only possible if P007 = 1). **Note:** This applies for frequency adjustment only. The buttons can still be used to change parameter values.
P125	Reverse direction inhibit	0 - 1 [1]	**0** = Reverse direction disabled. Inhibits reverse commands from ALL sources (reverse RUN commands result in forward rotation) **1** = Normal operation (FORWARD/REVERSE operation allowed)
P131	Frequency setpoint (Hz)	0.00-400.00 [-]	Read-only parameters. These are copies of the values stored in P001 but can be accessed directly via the serial link.
P132	Motor current (A)	0.0 - 99.9 [-]	
P134	DC link voltage (V)	0 - 1000 [-]	
P135	Motor RPM	0 - 9999 [-]	
P137	Output voltage (V)	0 - 1000 [-]	
P140	Most recent fault code	0 - 9999 [-]	The last recorded fault code *(see section 6)* is stored in this parameter. This is a copy of the code stored in P930.
P141	Most recent fault code -1	0 - 9999 [-]	This parameter stores the last recorded fault code prior to that stored in P140/P930.
P142	Most recent fault code -2	0 - 9999 [-]	This parameter stores the last recorded fault code prior to that stored in P141.
P143	Most recent fault code -3	0 - 9999 [-]	This parameter stores the last recorded fault code prior to that stored in P142.
P201	Closed loop mode	0 - 2 [0]	**0** = Normal operation (closed loop control disabled). **1** = *Not used.* **2** = Closed loop control using analogue input for transducer feedback input.
P202 •	P gain (%)	0.0 - 999.9 [1.0]	Proportional gain.
P203 •	I gain (%)	0.00 - 99.99 [0.00]	Integral gain. 0.01% corresponds to the longest integral action time.
P205 •	Sample interval (x 25 ms)	1 - 2400 [1]	Sampling interval of feedback sensor.
P206 •	Transducer filtering	0 - 255 [0]	**0** = Filter off. **1 - 255** = Low pass filtering applied to sensor.
P207 •	Integral capture range (%)	0 - 100 [100]	Percentage error above which integral term is reset to zero.
P208	Transducer type	0 - 1 [0]	**0** = An increase in motor speed causes an increase in sensor voltage/current output. **1** = An increase in motor speed causes a decrease in sensor voltage/current output.

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Parameter	Function	Range [Default]	Description / Notes
P210	Transducer reading (%)	0.0 - 100.0 [-]	Read only. Value is a percentage of full scale of the selected input.
P211 •	0% setpoint	0.00-100.00 [0.00]	Value of P210 to be maintained for 0% setpoint.
P212 •	100% setpoint	0.00-100.00 [100.00]	Value of P210 to be maintained for 100% setpoint.
P220	PI frequency cut-off	0 - 1 [0]	**0** = Normal operation **1** = Switch off inverter output at or below minimum frequency.
P700			*Specific to PROFIBUS-DP. See PROFIBUS Handbook for further details.* *Access only possible with P099 = 1*
P701 •			
P702			
P880			
P910 •	Local/Remote mode	0 - 4 [0]	Sets the inverter for local control or remote control over the serial link: **0** = Local control **1** = Remote control (and setting of parameter values) **2** = Local control (but remote control of frequency) **3** = Remote control (but local control of frequency) **4** = Local control (but remote read and write access to parameters and facility to reset trips) **Note:** When operating the inverter via remote control (P910 = 1 or 3), the analogue input remains active when P006 = 1 and is added to the setpoint.
P918 •			*Specific to PROFIBUS-DP. See PROFIBUS Handbook for further details. Access only possible with P099 = 1*
P922	Software version	0.00 - 99.99 [-]	Contains the software version number and cannot be changed.
P923 •	Equipment system number	0 - 255 [0]	You can use this parameter to allocate a unique reference number to the inverter. It has no operational effect.
P927 •			*Specific to PROFIBUS-DP. See PROFIBUS Handbook for further details.* *Access only possible with P099 = 1*
P928 •			
P930	Most recent fault code	0 - 9999 [-]	The last recorded fault code *(see section 6)* is stored in this parameter. This parameter can be cleared using the Δ and ∇ buttons.
P931	Most recent warning type	0 - 9999 [-]	The last recorded warning is stored in this parameter until power is removed from the inverter: **002** = Current limit active **003** = Voltage limit active **005** = Inverter over-temperature (Internal PTC)
P944	Reset to factory default settings	0 - 1 [0]	Set to '1' and then press **P** to reset all parameters except P101 to the factory default settings.

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Parameter	Function	Range [Default]	Description / Notes
P947			
P958			
P963			*Specific to PROFIBUS-DP. See PROFIBUS Handbook for further details.*
P967			
P968			*Access only possible with P099 = 1*
P970			
P971 •	EEPROM storage control	0 - 1 [1]	**0** = Changes to parameter settings (including P971) are lost when power is removed. **1** = Changes to parameter settings are retained during periods when power is removed. **WARNING: When using the serial link to update the parameter set held in EEPROM, care must be taken not to exceed the maximum number of write cycles to this EEPROM - this is approximately 50,000 write cycles. Exceeding this number of write cycles would result in corruption of the stored data and subsequent data loss. The number of read cycles are unlimited.**

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6. FAULT CODES

In the event of a failure, the inverter switches off and a fault code appears on the display. The last fault that occurred is stored in parameter P930. e.g. '0003' indicates that the last error was F003.

Fault Code	Cause	Corrective Action
F001	Overvoltage	Check whether supply voltage is within the limits indicated on the rating plate. Increase the ramp down time (P003). Check whether the required braking power is within the specified limits.
F002	Overcurrent	Check whether the motor power corresponds to the inverter power. Check that the cable length limits have not been exceeded. Check motor lead and motor for short-circuits and earth faults. Check whether the motor parameters (P081 - P086) correspond with the motor being used. Check the stator resistance (P089). Increase the ramp-up time (P002). Reduce the boost set in P078 and P079. Check whether the motor is obstructed or overloaded.
F003	Overload	Check whether the motor is overloaded. Increase the maximum motor frequency if a motor with high slip is used.
F005	Inverter overtemperature (internal PTC)	Check that the ambient temperature is not too high. Check that the air inlet and outlet are not obstructed. Check that the integral fan is working.
F008	USS protocol timeout	Check the serial interface. Check the settings of the bus master and P091 - P093. Check whether the timeout interval is too short (P093).
F010	Initialisation fault / Parameter loss *	Check the entire parameter set. Set P009 to '0000' before power down.
F011	Internal interface fault *	Switch off power and switch on again.
F012	External trip (PTC)	Check if motor is overloaded.
F013	Programme fault *	Switch off power and switch on again.
F018	Auto-restart after fault.	Automatic re-start after fault (P018) is pending. **WARNING: The inverter may start at any time.**
F030	PROFIBUS link failure	Check the integrity of the link.
F031	Option module to link failure	Check the integrity of the link.
F033	PROFIBUS configuration error	Check the PROFIBUS configuration.
F036	PROFIBUS module watchdog trip	Replace PROFIBUS module
F074	Motor overtemperature by I^2t calculation	Check that the motor current does not exceed the value set in P083.
F106	Parameter fault P006	Parameterise fixed frequency(ies) and/or motor potentiometer on the digital inputs.
F112	Parameter fault P012/P013	Set parameter P012 < P013.
F151 - F153	Digital input parameter fault	Check the settings of digital inputs P051 to P053.
F188	Automatic calibration failure	Motor not connected to inverter - connect motor. If the fault persists, set P088 = 0 and then enter the stator resistance of the motor into P089 manually.
F201	P006 = 1 while P201 = 2	Change parameter P006 and/or P201.
F212	Parameter fault P211/P212	Set parameter P211 < P212.

* *Ensure that the wiring guidelines described in section 2.1 have been complied with.*

When the fault has been corrected the inverter can be reset. To do this press button P twice (once to display P000 and the second time to reset the fault), or erase the fault via a binary input *(see parameters P051 - P053 in section 5)* or via the serial interface.

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7. SPECIFICATIONS

230 V Single Phase MICROMASTER Inverters									
Order No. (6SE92 ..)	10-7BA40	11-5BA40	12-1BA40	12-8BA40	13-6BA40	15-2BB40	16-8BB40	21-0BC40	21-3BC40
Inverter model	MM12	MM25	MM37	MM55	MM75	MM110	MM150	MM220	MM300[c]
Input voltage range	1 AC 230 V +/-15% 2 AC 208 V +/-10%								
Motor output rating[a] (kW / hp)	0.12 / 1/6	0.25 / 1/3	0.37 / 1/2	0.55 / 3/4	0.75 / 1	1.1 / 1 1/2	1.5 / 2	2.2 / 3	3.0 / 4
Continuous output	350 VA	660 VA	920 VA	1.14 kVA	1.5 kVA	2.1 kVA	2.8 kVA	4.0 kVA	5.2 kVA
Output current (nom.)[a]	0.75 A	1.5 A	2.1 A	2.6 A	3.5 A	4.8 A	6.6 A	9.0 A	11.8 A
Output current (max. continuous)	0.8 A	1.7 A	2.3 A	3.0 A	3.9 A	5.5 A	7.4 A	10.4 A	13.6 A
Input current (I rms)	1.8 A	3.2 A	4.6 A	6.2 A	8.2 A	11.0 A	14.4 A	20.2 A	28.3 A
Recommended mains fuse	10 A				16 A	20 A		25 A	32 A
Recommended lead cross-section (min.) Input	1.0 mm²				1.5 mm²	2.5 mm²			4.0 mm²
Recommended lead cross-section (min.) Output	1.0 mm²					1.5 mm²			2.5 mm²
Dimensions (mm) (w x h x d)	73 x 175 x 141					149 x 184 x 172		185 x 215 x 195	
Weight (kg / lb)	0.85 / 1.9					2.6 / 5.7		5.0 / 11.0	

All 1 AC 230 V MICROMASTERS include integrated Class A filters. Optional external Class B filters are available (see section 8.3).

230 V 3 Phase MICROMASTER Inverters										
Order No. (6SE92 ..)	10-7CA40	11-5CA40	12-1CA40	12-8CA40	13-6CA40	15-2CB40	16-8CB40	21-0CC40	21-3CC40	21-8CC13
Inverter model	MM12/2	MM25/2	MM37/2	MM55/2	MM75/2	MM110/2	MM150/2	MM220/2	MM300/2[c]	MM400/2
Input voltage range	1 - 3 AC 230 V +/-15%									3 AC
Motor output rating[a] (kW / hp)	0.12 / 1/6	0.25 / 1/3	0.37 / 1/2	0.55 / 3/4	0.75 / 1	1.1 / 1 1/2	1.5 / 2	2.2 / 3	3.0 / 4	4.0 / 5
Continuous output	350 VA	660 VA	920 VA	1.14 kVA	1.5 kVA	2.1 kVA	2.8 kVA	4.0 kVA	5.2 kVA	7.0 kVA
Output current (nom.)[a]	0.75 A	1.5 A	2.1 A	2.6 A	3.5 A	4.8 A	6.4A	9.0 A	11.8 A	15.9 A
Output current (max. continuous)	0.8 A	1.7 A	2.3 A	3.0 A	3.9 A	5.5 A	7.0 A	10.4 A	13.6 A	17.5 A
Input current (I rms) (1 AC / 3 AC)	1.8 / 1.1 A	3.2 / 1.9 A	4.6 / 2.7 A	6.2 / 3.6 A	8.2 / 4.7 A	11.0 / 6.4 A	14.4 / 8.3 A	20.2 / 11.7 A	28.3 / 16.3 A	- / 21.1 A
Recommended mains fuse[b]	10 A					16 A		20 A		25 A
Recommended lead cross-section (min.) Input	1.0 mm²					1.5 mm²		2.5 mm²		4.0 mm²
Recommended lead cross-section (min.) Output	1.0 mm²					1.5 mm²			2.5 mm²	
Dimensions (mm) (w x h x d)	73 x 175 x 141					149 x 184 x 172		185 x 215 x 195		
Weight (kg / lb)	0.75 / 1.7					2.4 / 5.3		4.8 / 10.5		

All 1 AC and 3 AC 230 V MICROMASTERS (excluding MM400/2) are suitable for 208 V operation.
All 3 AC 230 V MICROMASTERS can operate on 1 AC 230 V (MM300/2 requires an external line choke, e.g. 4EM6100-3CB).

380 V - 500 V Three Phase MICROMASTER Inverters										
Order No. (6SE92 ..)	11-1DA40	11-4DA40	12-0DA40	12-7DA40	14-0DA40	15-8DB40	17-3DB40	21-0DC40	21-3DC40	21-5DC40
Inverter model	MM37/3	MM55/3	MM75/3	MM110/3	MM150/3	MM220/3	MM300/3	MM400/3	MM550/3	MM750/3
Input voltage range	3 AC 380 V - 500 V +/-10%									
Motor output rating[a] (kW / hp)	0.37 / 1/2	0.55 / 3/4	0.75 / 1	1.1 / 1 1/2	1.5 / 2	2.2 / 3	3.0 / 4	4.0 / 5	5.5 / 7 1/2	7.5 / 10
Continuous output	930 VA	1.15 kVA	1.5 kVA	2.1 kVA	2.8 kVA	4.0 kVA	5.2 kVA	7.0 kVA	9.0 kVA	12.0 kVA
Output current (nom.) (400 V / 500 V)[a]	1.05/0.95A	1.5 / 1.3 A	2.0 / 1.8 A	2.8 / 2.5 A	3.7 / 3.3 A	5.2 / 4.6 A	6.8 / 6.0 A	9.2 / 8.1 A	11.8 / 10.4 A	15.8 / 13.9 A
Output current (max. continuous)	1.2 / 1.06 A	1.6 / 1.45 A	2.1 / 1.9 A	3.0 / 2.7 A	4.0 / 3.6 A	5.9 / 5.3 A	7.7 / 6.9 A	10.2 / 9.1 A	13.2 / 11.8 A	17.0 / 15.2 A
Input current (I rms)	2.2 A	2.8 A	3.7 A	4.9 A	5.9 A	8.8 A	11.1 A	13.6 A	17.1 A	22.1 A
Recommended mains fuse	10 A					16 A		20 A		25 A
Recommended lead cross-section (min.) Input	1.0 mm²					1.5 mm²		2.5 mm²		4.0 mm²
Recommended lead cross-section (min.) Output	1.0 mm²					1.5 mm²			2.5 mm²	
Dimensions (mm) (w x h x d)	73 x 175 x 141					149 x 184 x 172		185 x 215 x 195		
Weight (kg / lb)	0.75 / 1.7					2.4 / 5.3		4.8 / 10.5		

Optional external Class A and Class B filters are available (see section 8.3).

Notes

[a] Siemens 4 pole-motor, 1LA5 series or equivalent.

[b] Assumes 3-phase supply. If a single phase supply is used, the input current ratings, wire sizes and fuses for single phase MICROMASTERS will apply.

[c] MM300 and MM300/2 require an external choke (e.g. 4EM6100-3CB) and a 30 A mains fuse to operate on a single phase supply.

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Input frequency:	47 Hz to 63 Hz
Power factor:	$\lambda \geq 0.7$
Output frequency range:	0 Hz to 400 Hz
Resolution:	0.01 Hz
Overload capability:	150% for 60 s, related to nominal current
Protection against:	Inverter overtemperature Motor overtemperature Overvoltage and undervoltage
Additional protection:	Against short-circuits and earth/ground faults pull-out protection. Protection against running with no load (open-circuit)
Operating mode:	4 quadrants possible
Regulation and control:	Voltage/frequency curve
Analogue setpoint / PI Input:	0 - 10 V/2 - 10 V (recommended potentiometer 4.7 kΩ)
Analogue setpoint resolution:	10-bit
Setpoint stability:	Analogue < 1% Digital < 0.02%
Motor temperature monitoring:	I^2t control
Ramp times:	0 - 650 s
Control outputs:	1 relay 110 V AC / 0.4 A; 30 V DC / 1 A **WARNING:** External inductive loads must be suppressed in an appropriate manner *(see section 2.1 (5))*.
Interface:	RS485
Inverter efficiency:	97% (typically)
Operating temperature:	0°C to +50°C
Storage/transport temperature:	-40°C to +70°C
Ventilation:	Fan-cooled
Humidity:	90% non-condensing
Installation height above sea level:	< 1000 m **Note:** If the inverter is to be installed at an altitude >1000m, derating will be required.(Refer to DA 64 Catalogue)
Degree of protection:	Frame size A: IP20 (NEMA 1 using accessory kit - *see options*) Frame sizes B & C: IP20 (NEMA 1) (National Electrical Manufacturers' Association)
Protective separation of circuits:	Double insulation or protective screening
Electro-magnetic compatibility (EMC):	*See section 8.3*

Options / Accessories

Additional RFI suppression filter Clear Text Display (OPm2) PROFIBUS module (CB15) SIMOVIS software for control via PC Output chokes and line chokes Output filters IP20 (NEMA 1) Accessory Kit	*Please contact your local Siemens sales office for further details*

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8. SUPPLEMENTARY INFORMATION

8.1 Application Example

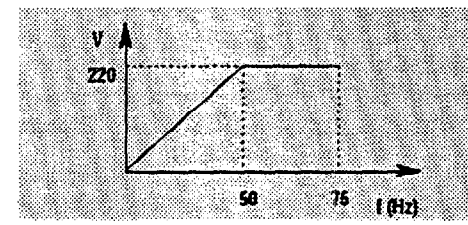
Setup procedure for a simple application

Motor:	220 V 1.5 kW output power
Application requirements:	Setpoint adjustable via potentiometer 0 - 50 Hz Ramp up from 0 to 50 Hz in 15 seconds Ramp down from 50 to 0 Hz in 20 seconds
Inverter used:	MM150 (6SE9216-8BB40)
Settings:	P009 = 2 (all parameters can be altered) P081 - P085 = values given on motor rating plate P006 = 1 (analogue input) P002 = 15 (ramp up time) P003 = 20 (ramp down time)

This application is now to be modified as follows:

Operation of motor up to 75 Hz
(voltage/frequency curve is linear up to 50 Hz).
Motor potentiometer setpoint in addition to analogue setpoint .
Use of analogue setpoint at maximum 10 Hz.
Ramp times to remain the same.

i.e.



Parameter adjustments:	P009 = 2 (all parameters can be altered) P013 = 75 (maximum motor frequency in Hz) P006 = 2 (setpoint via motor potentiometer or fixed setpoint) P024 = 1 (analogue setpoint is added) P022 = 10 (maximum analogue setpoint at 10 V = 10 Hz)

8.2 USS Status Codes

The following list gives the meaning of status codes displayed on the front panel of the inverter when the serial link is in use and parameter P001 is set to 006:

001	Message OK
002	Slave address received
100	Invalid start character
101	Timeout
102	Checksum error
103	Incorrect message length
104	Parity fail

Notes

(1) The display flashes whenever a byte is received, thus giving a basic indication that a serial link connection is established.

(2) If '**100**' flashes on the display continuously, this usually indicates a bus termination fault.

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8.3 Electro-Magnetic Compatibility (EMC)

All manufacturers / assemblers of electrical apparatus which performs a complete intrinsic function which is placed on the market as a single unit intended for the end user must comply with the EMC directive EEC/89/336 after January 1996. There are three routes by which the manufacturer/assembler can demonstrate compliance:

1. *Self-Certification*

   This is a manufacturer's declaration that the European standards applicable to the electrical environment for which the apparatus is intended have been met. Only standards which have been officially published in the Official Journal of the European Community can be cited in the manufacturer's declaration.

2. *Technical Construction File*

   A technical construction file can be prepared for the apparatus describing its EMC characteristics. This file must be approved by a 'Competent Body' appointed by the appropriate European government organisation. This approach allows the use of standards which are still in preparation.

3. *EC Type-Examination Certificate*

   This approach is only applicable to radio communication transmitting apparatus.

The MICROMASTER units do not have an intrinsic function until connected with other components (e.g. a motor). Therefore, the basic units are not allowed to be CE marked for compliance with the EMC directive. However, full details are provided below of the EMC performance characteristics of the products when they are installed in accordance with the wiring recommendations in section 2.1.

Three classes of EMC performance are available as detailed below. Note that these levels of performance are only achieved when using the default switching frequency (or less) and a maximum motor cable length of 25 m.

Class 1: General Industrial

Compliance with the EMC Product Standard for Power Drive Systems EN 68100-3 for use in **Second Environment (Industrial)** and **Restricted Distribution**.

EMC Phenomenon	Standard	Level
Emissions:		
Radiated Emissions	EN 55011	Level A1 *
Conducted Emissions	EN 68100-3	*
Immunity:		
Electrostatic Discharge	EN 61000-4-2	8 kV air discharge
Burst Interference	EN 61000-4-4	2 kV power cables, 1 kV control
Radio Frequency Electromagnetic Field	IEC 1000-4-3	26-1000 MHz, 10 V/m

* *Limits not required inside a plant where no other consumers are connected to the same electricity supply transformer.*

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Class 2: Filtered Industrial

This level of performance will allow the manufacturer/assembler to self-certify their apparatus for compliance with the EMC directive for the industrial environment as regards the EMC performance characteristics of the power drive system. Performance limits are as specified in the Generic Industrial Emissions and Immunity standards EN 50081-2 and EN 50082-2.

EMC Phenomenon	Standard	Level
Emissions:		
Radiated Emissions	EN 55011	Level A1
Conducted Emissions	EN 55011	Level A1
Immunity:		
Supply Voltage Distortion	IEC 1000-2-4 (1993)	
Voltage Fluctuations, Dips, Unbalance, Frequency Variations	IEC 1000-2-1	
Magnetic Fields	EN 61000-4-8	50 Hz, 30 A/m
Electrostatic Discharge	EN 61000-4-2	8 kV air discharge
Burst Interference	EN 61000-4-4	2 kV power cables, 2 kV control
Radio Frequency Electromagnetic Field, amplitude modulated	ENV 50 140	80-1000 MHz, 10 V/m, 80% AM, power and signal lines
Radio-frequency Electromagnetic Field, pulse modulated	ENV 50 204	900 MHz, 10 V/m 50% duty cycle, 200 Hz repetition rate

Class 3: Filtered - for residential, commercial and light industry

This level of performance will allow the manufacturer / assembler to self-certify compliance of their apparatus with the EMC directive for the residential, commercial and light industrial environment as regards the EMC performance characteristics of the power drive system. Performance limits are as specified in the generic emission and immunity standards EN 50081-1 and EN 50082-1.

EMC Phenomenon	Standard	Level
Emissions:		
Radiated Emissions	EN 55022	Level B1
Conducted Emissions	EN 55022	Level B1
Immunity:		
Electrostatic Discharge	EN 61000-4-2	8 kV air discharge
Burst Interference	EN 61000-4-4	1 kV power cables, 0.5 kV control

Note:
The MICROMASTERS are intended **exclusively for professional applications**. Therefore, they do not fall within the scope of the harmonics emissions specification EN 61000-3-2.

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Compliance Table:

Model No.	EMC Class
MM12 - MM220	Class 2
MM12/2 - MM300/2	Class 1
MM12/2 - MM220/2 with external filter (see table) *1 phase input only*	Class 2*
MM150/3 - MM750/3	Class 1
MM150/3 - MM750/3 with external filter (see table)	Class 2*

* If the installation of the inverter reduces the radio frequency field emissions (e.g. by installation in a steel enclosure), Class 3 limits will typically be met.

External Filters:

Model No.	Filter Class	Filter Part No.	Standard
MM12/2 & MM25/2	B	6SE3290-0BA87-0FB0*	EN 55011 / EN 55022
MM37/2 - MM75/2	B	6SE3290-0BA87-0FB2*	EN 55011 / EN 55022
MM110/2 & MM150/2	B	6SE3290-0BB87-0FB4*	EN 55011 / EN 55022
MM220/2 & MM300/2	B	6SE3290-0BC87-0FB4*	EN 55011 / EN 55022
MM400/2	-	*Not available*	-
MM37/3 - MM150/3	A B	6SE3290-0DA87-0FA1 6SE3290-0DA87-0FB1	EN 55011 / EN 55022
MM220/3 & MM300/3	A B	6SE3290-0DB87-0FA3 6SE3290-0DB87-0FB3	EN 55011 / EN 55022
MM400/3 - MM750/3	A B	6SE3290-0DC87-0FA4 6SE3290-0DC87-0FB4	EN 55011 / EN 55022

*Class B filters are for use with 1/3 AC 230V unfiltered units.

8.4 Environmental Aspects

Transport and Storage

Protect the inverter against physical shocks and vibration during transport and storage. The unit must also be protected against water (rainfall) and excessive temperatures *(see section 7).*

The inverter's packaging is re-usable. Retain the packaging or return it to the manufacturer for future use.

If the unit has been in storage (non-operational) for more than one year, you must re-form the DC-link capacitors before use. Refer to your local Siemens sales office for advice on the procedure.

Dismantling and Disposal

The unit can be broken-down to its component parts by means of easily-released screw and snap connectors.

The component parts can be re-cycled, disposed of in accordance with local requirements or returned to the manufacturer.

Documentation

This handbook is printed on chlorine-free paper which has been produced from managed sustainable forests. No solvents have been used in the printing or binding process.

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8.5 User's Parameter Settings

Record your own parameter settings in the table below:

Parameter	Your setting	Default	Parameter	Your setting	Default	Parameter	Your setting	Default
P000		-	P065		1.0	P210		-
P001		0	P066		1	P211		0.0
P002		10.0	P073		0	P212		100.00
P003		10.0	P074		1	P220		0
P004		0.0	P076		0/4	P700		-
P005		5.00	P077		1	P701		0
P006		0	P078		100	P702		-
P007		1	P079		0	P880		-
P009		0	P081		50.00	P910		0
P011		0	P082		☆☆☆	P918		-
P012		0.00	P083		☆☆☆	P922		-
P013		50.00	P084		☆☆☆	P923		0
P014		0.00	P085		☆☆☆	P927		0
P015		0	P089		☆☆☆	P928		0
P016		0	P091		0	P930		-
P017		1	P092		6	P931		-
P018		0	P093		0	P944		0
P019		2.00	P094		50.00	P947		-
P020		5.0	P095		0	P958		-
P021		0.00	P099		0	P963		-
P022		50.00	P101		0	P967		-
P023		0	P111		☆☆☆	P968		-
P024		0	P112		☆☆☆	P970		1
P027		0.00	P113		☆☆☆	P971		1
P028		0.00	P121		1			
P029		0.00	P122		1			
P031		5.00	P123		1			
P032		5.00	P124		1			
P041		5.00	P125		1			
P042		10.00	P131		-			
P043		15.00	P132		-			
P044		20.00	P134		-			
P045		0	P135		-			
P046		25.00	P137		-			
P047		30.00	P140		-			
P048		35.00	P141		-			
P050		0	P142		-			
P051		1	P143		-			
P052		2	P201		0			
P053		6	P202		1.0			
P056		0	P203		0.00			
P061		6	P205		1			
P062		0	P206		0			
P063		1.0	P207		100			
P064		1.0	P208		0			

☆☆☆ = *Value depends on the rating of the inverter*

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Änderungen vorbehalten
Specification subject to change without prior notice

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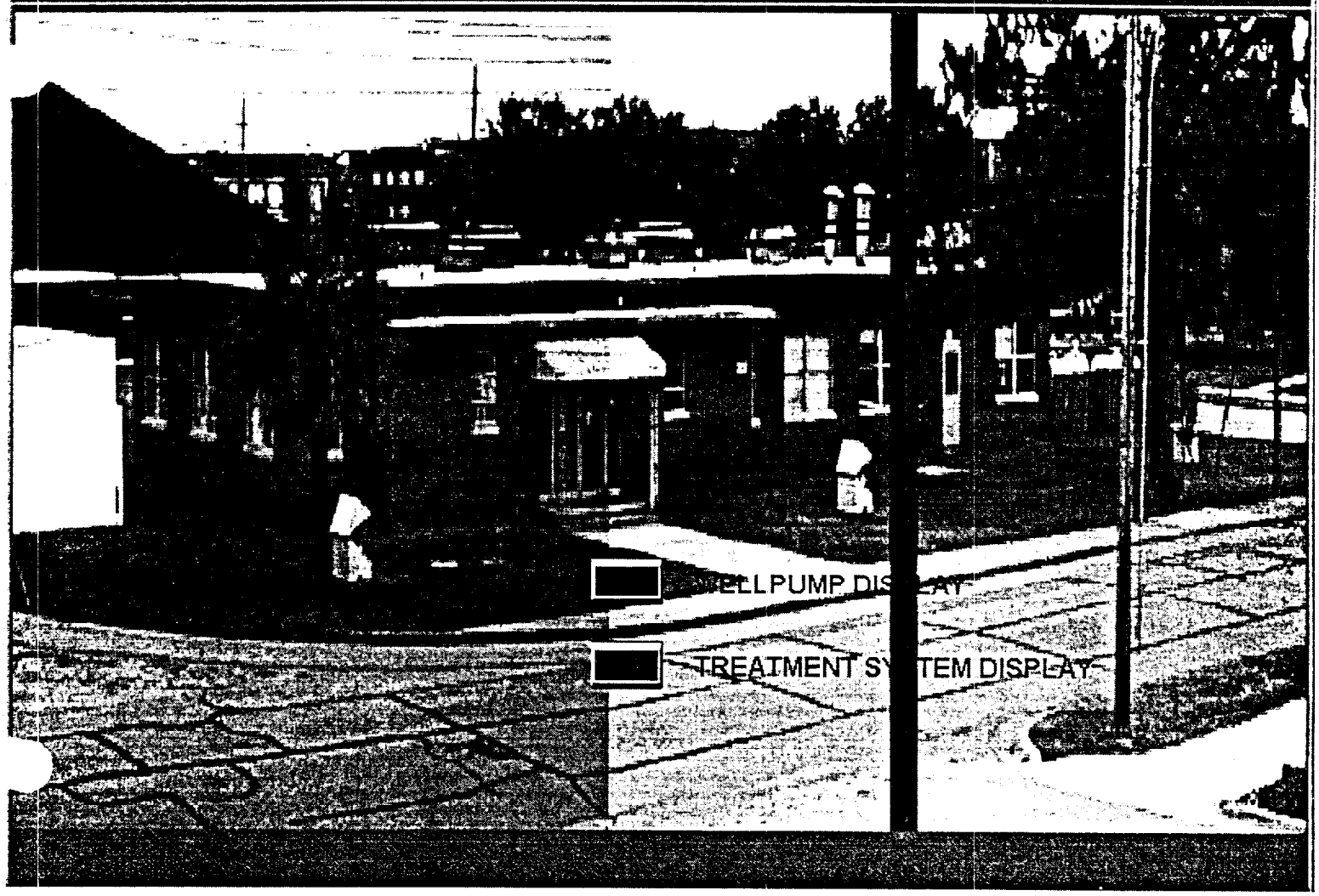
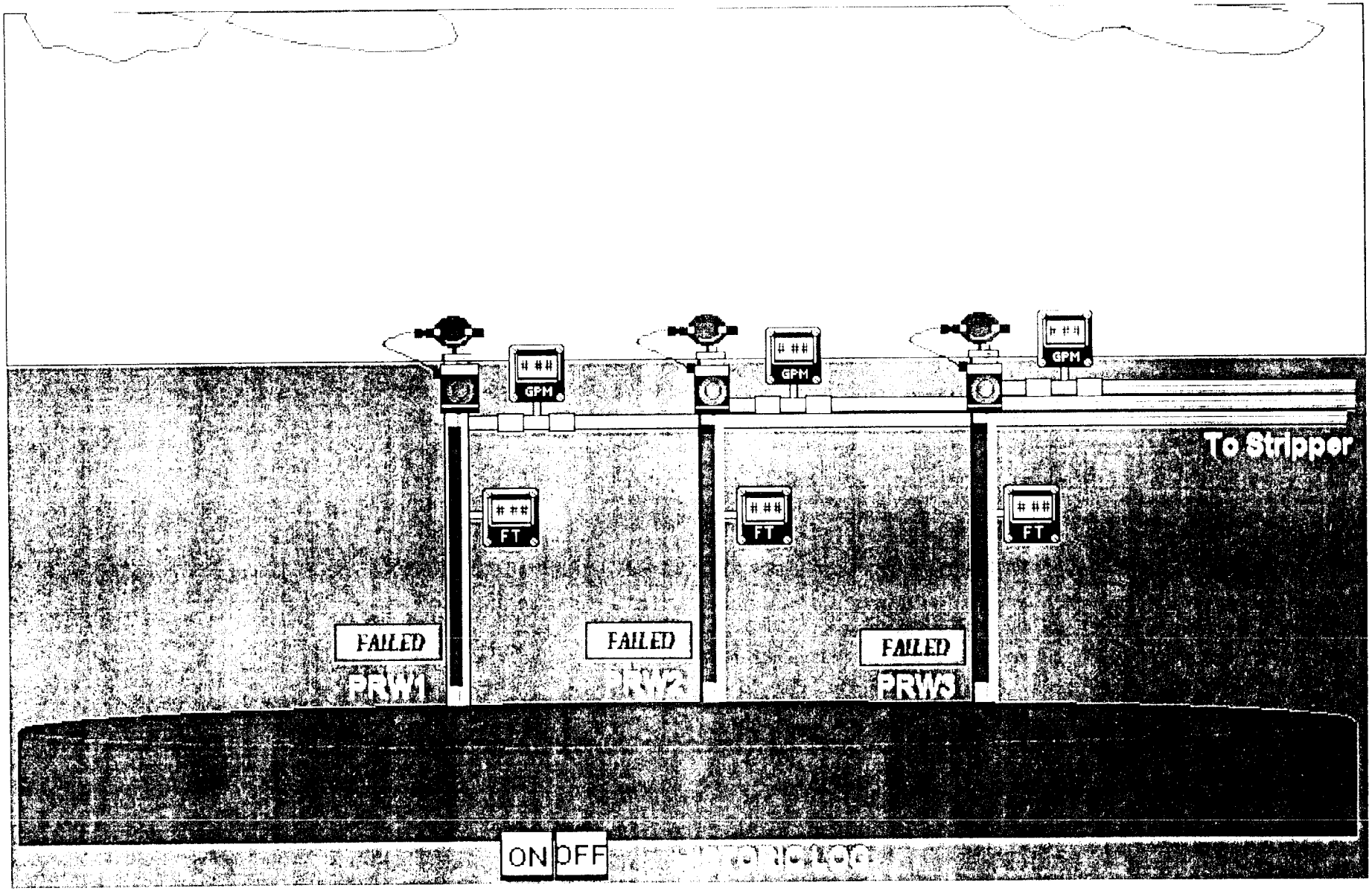
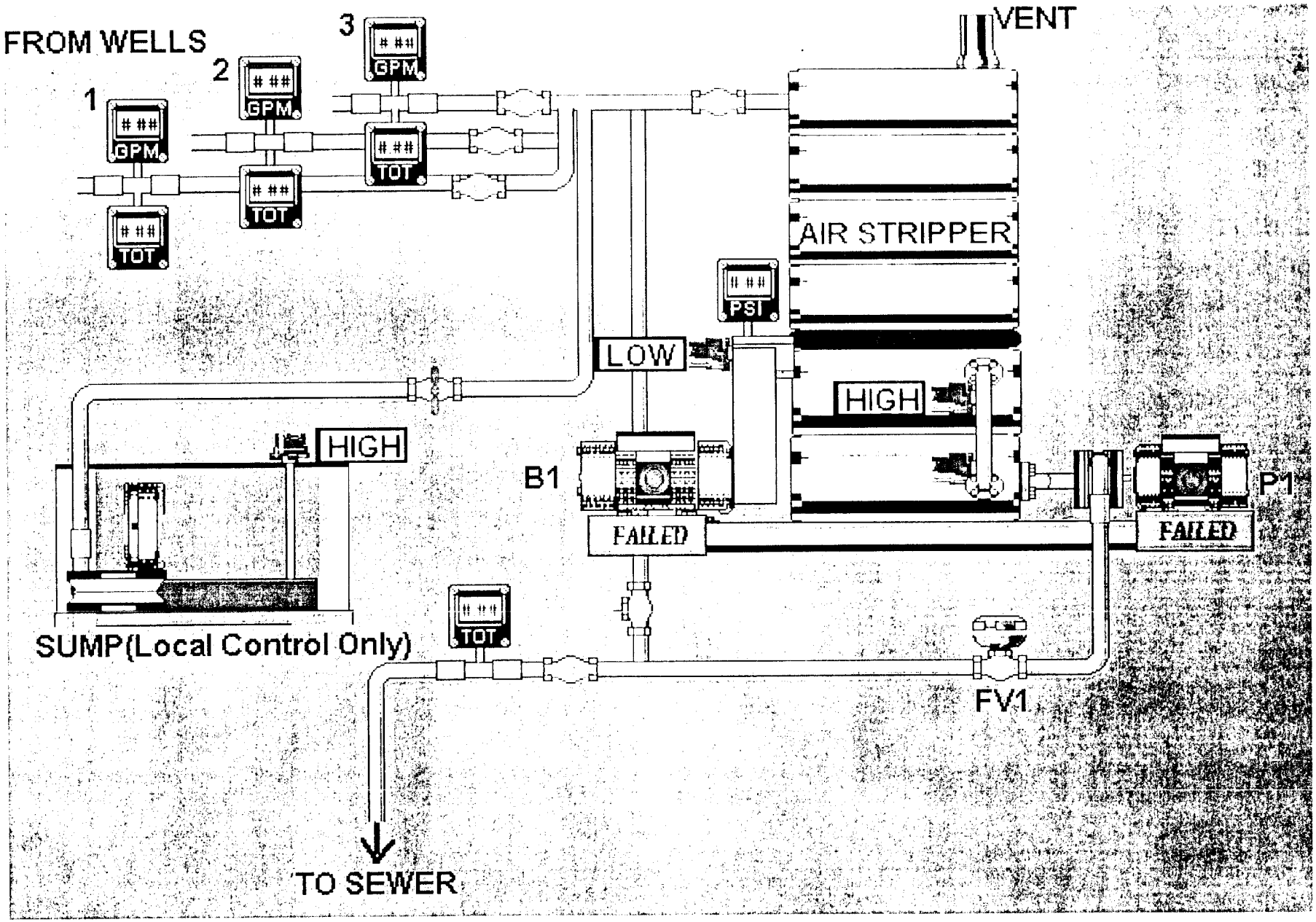
OptoDisplay Runtime - C:\Opto22\OptoDisp\Navy1\Parris\Site45.MMI

File View Alarm Window Help

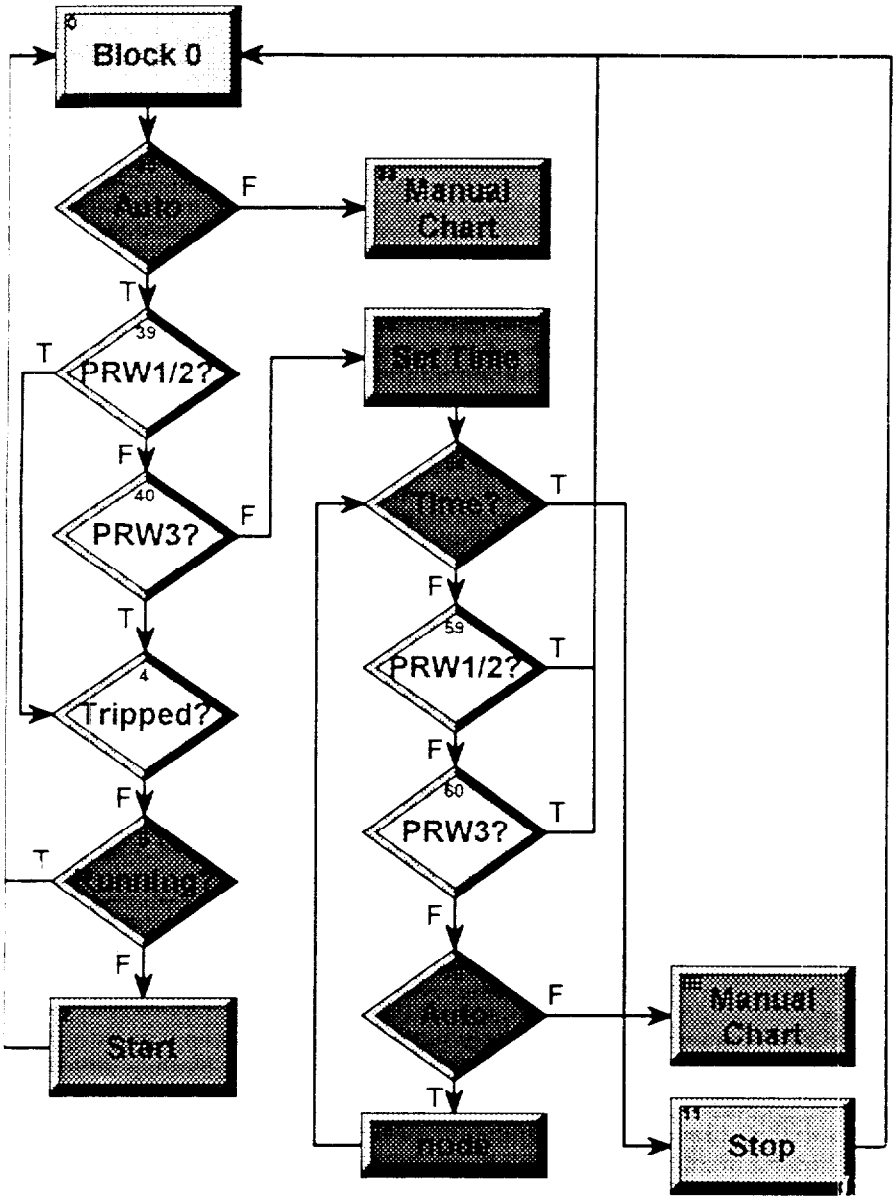
Parris Island Site45




GPM
GPM
GPM
To Stripper
FT
FT
FT
FAILED
FAILED
FAILED
PRW1
PRW3
ON
OFF


FROM WELLS
1
2
3
GPM
TOT
VENT
AIR STRIPPER
PSI
LOW
HIGH
B1
FAILED
P1
FAILED
HIGH
SUMP(Local Control Only)
TOT
FV1
TO SEWER

STRATEGY: Parris45
CHART: Blower_B1_Auto
DATE: 05/13/98 TIME: 10:23:12 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris46
CHART: Blower_B1_Auto
DATE: 05/13/98 **TIME:** 10:13:18

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Auto (Id: 30)

There are no instructions in this action block.

Action Block: Manual Chart (Id: 33)
This action block has no exit.

Move to Table Element

From	B1_run
To Index	4
Of Table	Manual_Outputs

Starts the Manual Mode of Operation of the Blower B1
Start Chart

Chart	Blower_B1_Manual
Put Status In	B1_Manual_Chart

Clears the Blower B1 Auto chart status
Move

From	0
To	B1_Auto_Chart

Action Block: Manual Chart (Id: 69)
This action block has no exit.

Starts the Manual Mode of Operation of the Blower B1
Start Chart

Chart	Blower_B1_Manual
Put Status In	B1_Manual_Chart

Clears the Blower B1 Auto chart status
Move

From	0
To	B1_Auto_Chart

Action Block: node (Id: 75)
Exit to: Time? (Id: 54)

There are no instructions in this action block.

Action Block: Set Time (Id: 53)
Exit to: Time? (Id: 54)

Move

From	300
To	Stop_Timer

Action Block: Start (Id: 2)
Exit to: Block 0 (Id: 0)

Start Command
Turn On

B1_start

Action Block: Stop (Id: 11)
Exit to: Block 0 (Id: 0)

Stop Command

Turn Off
B1_start

CONDITIONS

Condition Block: Auto (Id: 30)
TRUE Exit to: PRW1/2? (Id: 39)
FALSE Exit to: Manual Chart (Id: 33)

Blower B1 Automatic
Is -1
Equal to Table Element?
At Index 4
Of Table AM_Status

Condition Block: Auto (Id: 70)
TRUE Exit to: node (Id: 75)
FALSE Exit to: Manual Chart (Id: 69)

Blower B1 Automatic
Is -1
Equal to Table Element?
At Index 4
Of Table AM_Status

Condition Block: PRW1/2? (Id: 39)
TRUE Exit to: Tripped? (Id: 4)
FALSE Exit to: PRW3? (Id: 40)

PRW1 or PRW2 Running?
Is PRW1_run
OR?
PRW2_run

Condition Block: PRW1/2? (Id: 59)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: PRW3? (Id: 60)

PRW1 or PRW2 Running?
Is PRW1_run
OR?
PRW2_run

Condition Block: PRW3? (Id: 40)
TRUE Exit to: Tripped? (Id: 4)
FALSE Exit to: Set Time (Id: 53)

Is PRW3_Run
On?

Condition Block: PRW3? (Id: 60)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Auto (Id: 70)

Is PRW3_Run
On?

Condition Block: Running? (Id: 5)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 2)

Blower Running?
Is B1_run

On?

Condition Block: Time? (Id: 54)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: PRW1/2? (Id: 59)

Is Stop_Timer
Timer Expired?

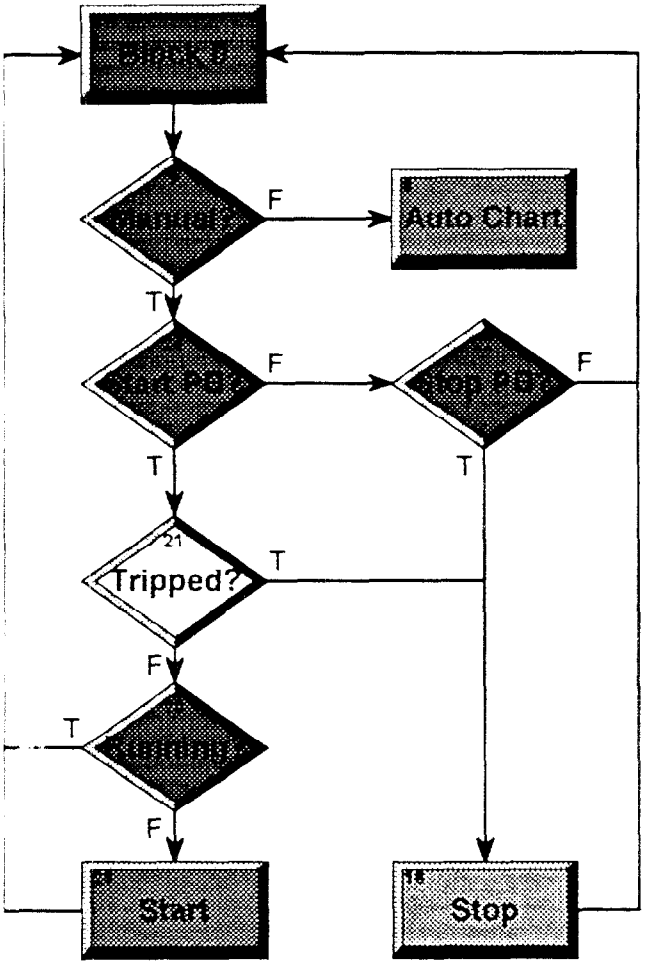
Condition Block: Tripped? (Id: 4)
This condition block has no TRUE exit.
FALSE Exit to: Running? (Id: 5)

Motor Overload Tripped
Is Bi_trip
On?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Blower_B1_Manual
DATE: 05/13/98 TIME: 10:23:59 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Blower_B1_Manual
DATE: 05/13/98 **TIME:** 10:24:06

ACTIONS

Action Block: Auto Chart (Id: 6)
This action block has no exit.

Starts the Automatic Mode of Operation of Blower B1
Start Chart
Chart Blower_B1_Auto
Put Status In B1_Auto_Chart

Clears the Blower B1 Manual chart status
Move
From 0
To B1_Manual_Chart

Action Block: Block 0 (Id: 0)
Exit to: Manual? (Id: 9)

There are no instructions in this action block.

Action Block: Start (Id: 23)
Exit to: Block 0 (Id: 0)

Start Command
Turn On
B1_start

Action Block: Stop (Id: 16)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
B1_start

CONDITIONS

Condition Block: Manual? (Id: 9)
TRUE Exit to: Start PB? (Id: 24)
FALSE Exit to: Auto Chart (Id: 6)

Blower B1 Manual
Is 0
Equal to Table Element?
At Index 4
Of Table AM_Status

Condition Block: Running? (Id: 20)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 23)

Blower B1 Running?
Is B1_run
On?

Condition Block: Start PB? (Id: 24)
TRUE Exit to: Tripped? (Id: 21)
FALSE Exit to: Stop PB? (Id: 22)

Manual Start
Is -1

Equal to Table Element?
At Index 4
Of Table Manual_Outputs

Condition Block: Stop PB? (Id: 22)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Block 0 (Id: 0)

Manual Stop
Is 0
Equal to Table Element?
At Index 4
Of Table Manual_Outputs

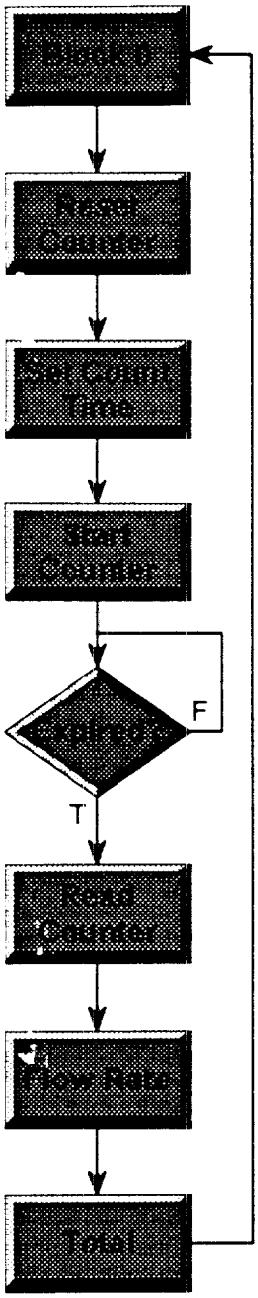
Condition Block: Tripped? (Id: 21)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Running? (Id: 20)

Motor Overload Tripped
Is B1_trip
On?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Discharge_Totalizer
DATE: 05/13/98 TIME: 10:29:33 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Discharge_Totalizer
DATE: 05/13/98 **TIME:** 10:29:39

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Reset Counter (Id: 1)

There are no instructions in this action block.

Action Block: Flow Rate (Id: 6)
Exit to: Total (Id: 7)

Multiply

	Discharge_Counter
Times	5
Put Result in	Discharge_Flowrate

Action Block: Read Counter (Id: 5)
Exit to: Flow Rate (Id: 6)

Get Counter

From Point	FQIT3
Put in	Discharge_Counter

Action Block: Reset Counter (Id: 1)
Exit to: Set Count Time (Id: 2)

Clear Counter

On Point	FQIT3

Action Block: Set Count Time (Id: 2)
Exit to: Start Counter (Id: 3)

Move

From	60
To	Discharge_Timer

Action Block: Start Counter (Id: 3)
Exit to: Expired? (Id: 4)

Turns On Counter for 60s
Start Counter

On Point	FQIT3

Action Block: Total (Id: 7)
Exit to: Block 0 (Id: 0)

Counter Running Totals
Add

	Discharge_Counter
Plus	Total_Discharge_Counts
Put Result in	Total_Discharge_Counts

Multiply

	Total_Discharge_Counts
Times	.005
Put Result in	Total_Discharge_Flow

CONDITIONS

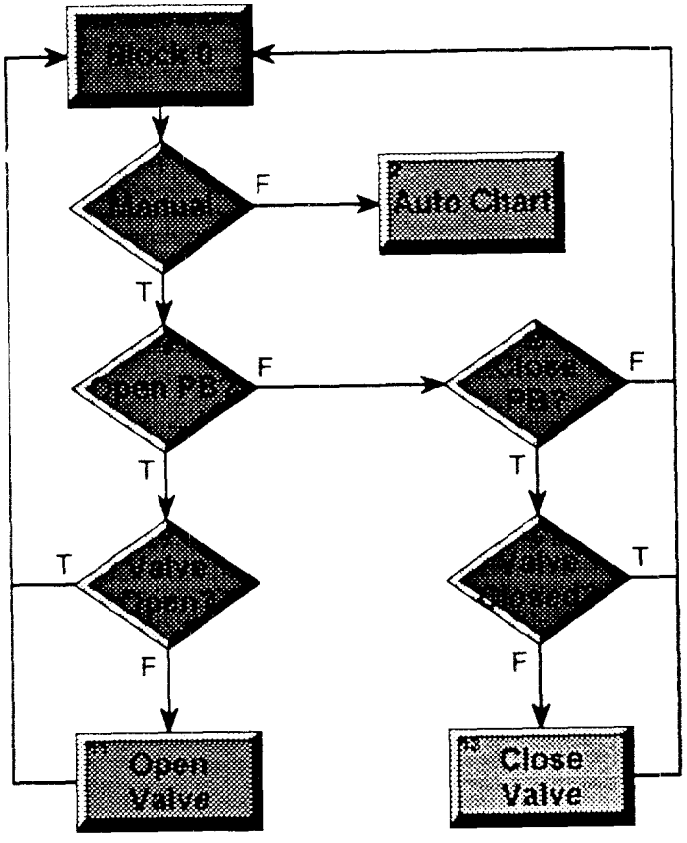
Condition Block: Expired? (Id: 4)
TRUE Exit to: Read Counter (Id: 5)
FALSE Exit to: Expired? (Id: 4)

Checks Timer Status
Is Discharge_Timer
Timer Expired?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: FV1_Manual
DATE: 05/13/98 TIME: 11:25:49 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: FV1_Manual
DATE: 05/13/98 **TIME:** 11:16:04

ACTIONS

Action Block: Auto Chart (Id: 2)
This action block has no exit.

Go To Automatic Mode
Start Chart
Chart FV1_Auto
Put Status In FV1_Auto_Chart

Clears the FV1 Manual chart status
Move
From 0
To FV1_Manual_Chart

Action Block: Block 0 (Id: 0)
Exit to: Manual (Id: 1)

There are no instructions in this action block.

Action Block: Close Valve (Id: 13)
Exit to: Block 0 (Id: 0)

Close Command
Turn On
FV1B

Clear Open
Turn Off
FV1A

Action Block: Open Valve (Id: 11)
Exit to: Block 0 (Id: 0)

Open Command
Turn On
FV1A

Clear Close
Turn Off
FV1B

CONDITIONS

Condition Block: Close PB? (Id: 20)
TRUE Exit to: Valve Closed? (Id: 8)
FALSE Exit to: Block 0 (Id: 0)

Close Pushbutton
Is 0
Equal to Table Element?
At Index 5
Of Table Manual_Outputs

Condition Block: Manual (Id: 1)
TRUE Exit to: Open PB? (Id: 19)
FALSE Exit to: Auto Chart (Id: 2)

FV1 Automatic Mode
Is 0
Equal to Table Element?

At Index 5
Of Table AM_Status

Condition Block: Open PB? (Id: 19)
TRUE Exit to: Valve Open? (Id: 7)
FALSE Exit to: Close PB? (Id: 20)

Is -1
Equal to Table Element?
At Index 5
Of Table Manual_Outputs

Condition Block: Valve Closed? (Id: 8)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Close Valve (Id: 13)

FV1 Closed State
Is ZS1B
On?

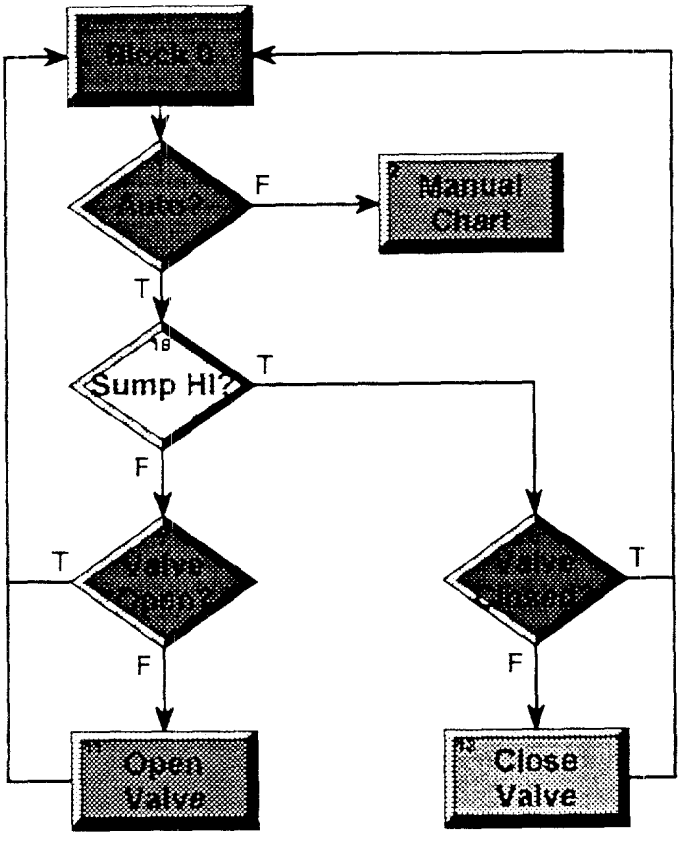
Condition Block: Valve Open? (Id: 7)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Open Valve (Id: 11)

FV1 Open State
Is ZS1A
On?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: FV1_Auto
DATE: 05/13/98 TIME: 11:26:45 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: FV1_Auto
DATE: 05/13/98 **TIME:** 11:26:53

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Auto? (Id: 1)

There are no instructions in this action block.

Action Block: Close Valve (Id: 13)
Exit to: Block 0 (Id: 0)

Close Command
Turn On
FV1B

Clear Open
Turn Off
FV1A

Action Block: Manual Chart (Id: 2)
This action block has no exit.

Go To Manual Mode
Start Chart
Chart FV1_Manual
Put Status In FV1_Manual_Chart

Clears the FV1 Auto chart status
Move
From 0
To FV1_Auto_Chart

Action Block: Open Valve (Id: 11)
Exit to: Block 0 (Id: 0)

Open Command
Turn On
FV1A

Clear Close
Turn Off
FV1B

CONDITIONS

Condition Block: Auto? (Id: 1)
TRUE Exit to: Sump HI? (Id: 19)
FALSE Exit to: Manual Chart (Id: 2)

FV1 Automatic Mode
Is -1
Equal to Table Element?
At Index 5
Of Table AM_Status

Condition Block: Sump HI? (Id: 19)
TRUE Exit to: Valve Closed? (Id: 8)
FALSE Exit to: Valve Open? (Id: 7)

Is -1.0
Equal?

T: Sump_Hi

Condition Block: Valve Closed? (Id: 8)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Close Valve (Id: 13)

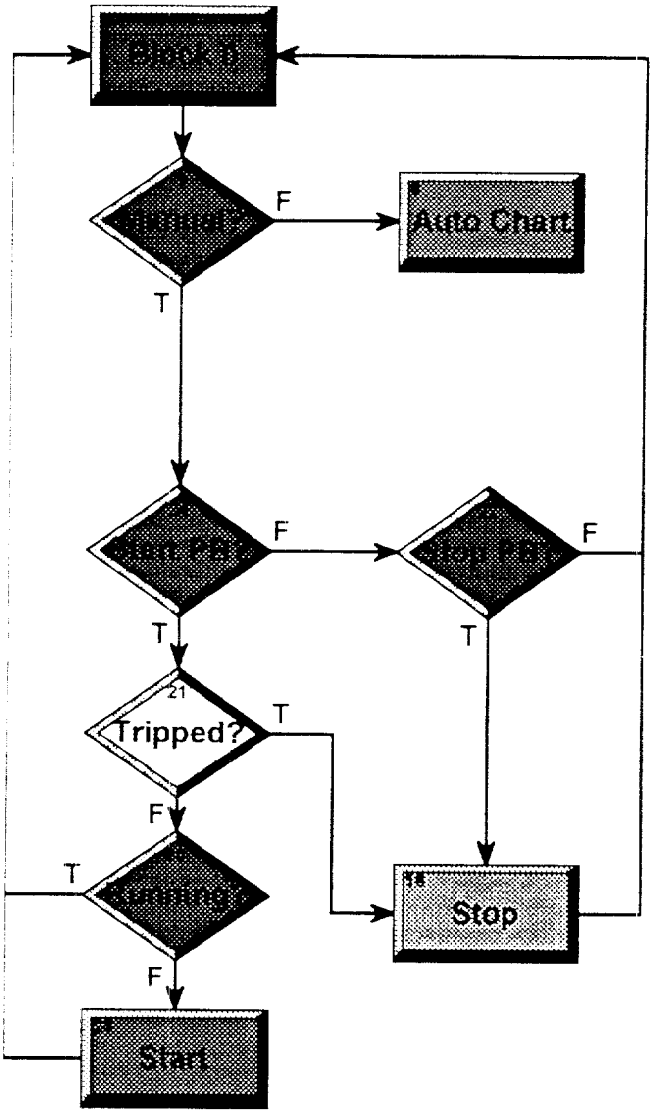
FV1 Closed State
Is ZS1B
On?

Condition Block: Valve Open? (Id: 7)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Open Valve (Id: 11)

FV1 Open State
Is ZS1A
On?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.


Block 0
Manual?
F
Auto Chart
T
Start PB?
F
Stop PB?
F
T
T
21
Tripped?
T
F
T
Running?
Stop
F
Start

TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Pump_P1_Manual
DATE: 05/13/98 **TIME:** 12:25:51

ACTIONS

Action Block: Auto Chart (Id: 6)
This action block has no exit.

Starts the Automatic Mode of Operation of Pump P1
Start Chart
Chart Pump_P1_Auto
Put Status In P1_Auto_Chart

Clears the Pump P1 Manual chart status
Move
From 0
To P1_Manual_Chart

Action Block: Block 0 (Id: 0)
Exit to: Manual? (Id: 9)

There are no instructions in this action block.

Action Block: Start (Id: 23)
Exit to: Block 0 (Id: 0)

Start Command
Turn On
P1_start

Action Block: Stop (Id: 16)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
P1_start

CONDITIONS

Condition Block: Manual? (Id: 9)
TRUE Exit to: Start PB? (Id: 24)
FALSE Exit to: Auto Chart (Id: 6)

Pump P1 Manual
Is 0
Equal to Table Element?
At Index 3
Of Table AM_Status

Condition Block: Running? (Id: 20)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 23)

Pump P1 Running?
Is P1_run
On?

Condition Block: Start PB? (Id: 24)
TRUE Exit to: Tripped? (Id: 21)
FALSE Exit to: Stop PB? (Id: 22)

Manual Start
Is -1

Equal to Table Element?
At Index 3
Of Table Manual_Outputs

Condition Block: Stop PB? (Id: 22)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Block 0 (Id: 0)

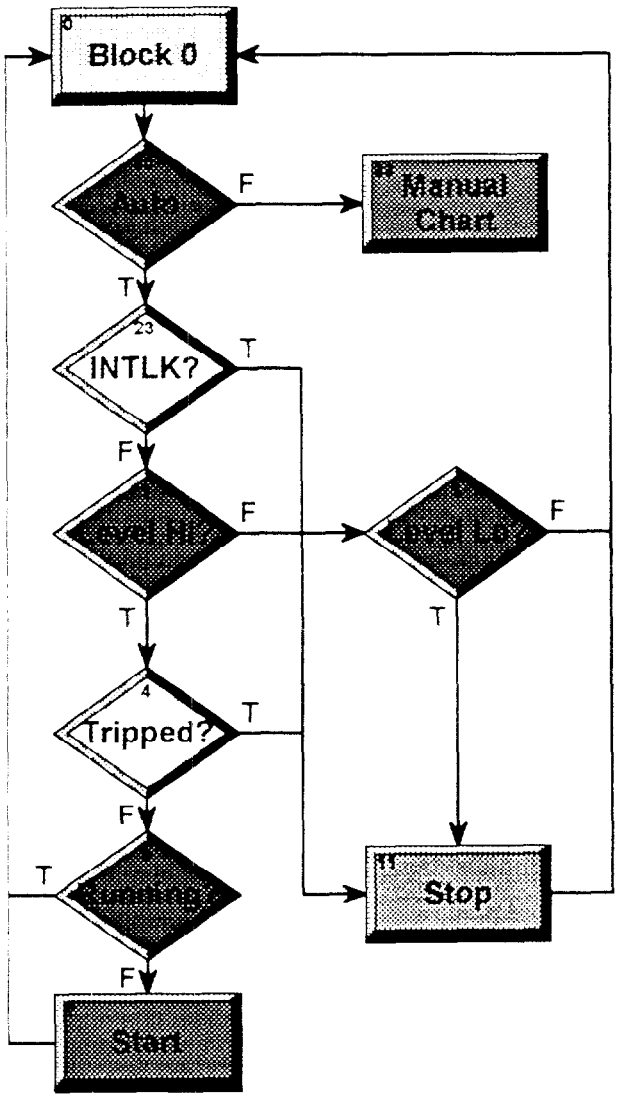
Manual Stop
Is 0
Equal to Table Element?
At Index 3
Of Table Manual_Outputs

Condition Block: Tripped? (Id: 21)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Running? (Id: 20)

Motor Overload Tripped
Is P1_Trip
On?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.


Block 0
Auto
F
Manual Chart
T
INTLK?
T
F
Level Hi?
F
Speed Lo?
F
T
T
Tripped?
T
F
Running?
T
Stop
F
Start

TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Wellpump_1_Auto
DATE: 05/13/98 **TIME:** 13:08:09

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Auto (Id: 30)

There are no instructions in this action block.

Action Block: Manual Chart (Id: 33)
This action block has no exit.

Move to Table Element

From	PRW1_run
To Index	0
Of Table	Manual_Outputs

Starts the Manual Mode of Operation of the Wellpump
Start Chart

Chart	Wellpump_1_Manual
Put Status In	Wellpump_1_Manual_Chart

Clears the Wellpump 1 Auto chart status
Move

From	0
To	Wellpump_1_Auto_Chart

Action Block: Start (Id: 2)
Exit to: Block 0 (Id: 0)

Set Stop 'on' Latch
Turn On
PRW1_Stop

Start Command
Turn On
PRW1_start

Delay (Sec)
1.0

Turn Off
PRW1_start

Action Block: Stop (Id: 11)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
PRW1_Stop

CONDITIONS

Condition Block: Auto (Id: 30)
TRUE Exit to: INTLK? (Id: 23)
FALSE Exit to: Manual Chart (Id: 33)

Wellpump PRW1 Automatic

Is	-1

Equal to Table Element?

At Index	0
Of Table	AM_Status

Condition Block: INTLKT (Id: 23)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Level Hi? (Id: 1)

Is Sump or Stripper Hi-Hi Level?

Is	Stripper_Hi
OR?	
	Sump_Hi

Condition Block: Level Hi? (Id: 1)
TRUE Exit to: Tripped? (Id: 4)
FALSE Exit to: Level Lo? (Id: 3)

LT1>setpoint

Is	LT1
Greater Than or Equal?	
To	-1.0

Condition Block: Level Lo? (Id: 3)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Block 0 (Id: 0)

LT1<setpoint

Is	LT1
Less Than or Equal?	
To	-6.0

Condition Block: Running? (Id: 5)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 2)

Wellpump Running?

Is	PRW1_run
On?	

Condition Block: Tripped? (Id: 4)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Running? (Id: 5)

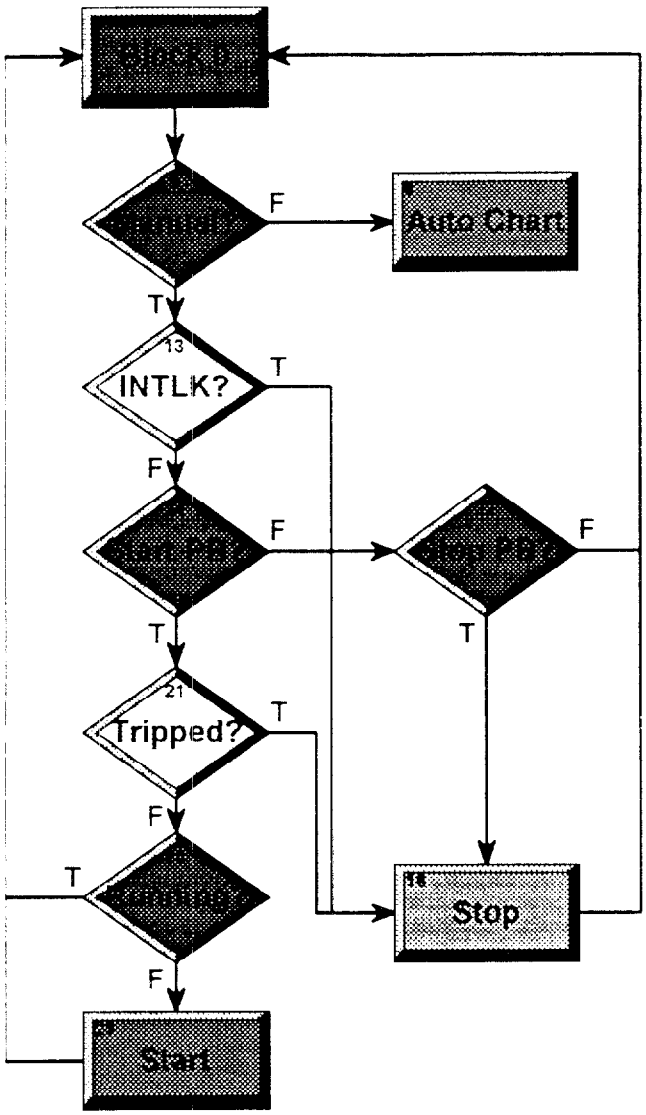
Motor Overload Tripped

Is	PRW1_trip
OR?	
	B1_trip

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Wellpump_1_Manual
DATE: 05/13/98 TIME: 13:05:57 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Wellpump_1_Manual
DATE: 05/13/98 **TIME:** 13:06:02

ACTIONS

Action Block: Auto Chart (Id: 6)
This action block has no exit.

Starts the Automatic Mode of Operation of the Wellpump
Start Chart
Chart Wellpump_1_Auto
Put Status In Wellpump_1_Auto_Chart

Clears the Wellpump 1 Manual chart status
Move
From 0
To Wellpump_1_Manual_Chart

Action Block: Block 0 (Id: 0)
Exit to: Manual? (Id: 9)

There are no instructions in this action block.

Action Block: Start (Id: 23)
Exit to: Block 0 (Id: 0)

Set Stop 'on' Latch
Turn On
PRW1_Stop

Start Command
Turn On
PRW1_start

Delay (Sec)
1.0

Turn Off
PRW1_start

Action Block: Stop (Id: 16)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
PRW1_Stop

CONDITIONS

Condition Block: INTLK? (Id: 13)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Start PB? (Id: 24)

Is Sump or Stripper Hi-Hi Level?
Is Stripper_Hi
OR?
Sump_Hi

Condition Block: Manual? (Id: 9)
TRUE Exit to: INTLK? (Id: 13)
FALSE Exit to: Auto Chart (Id: 6)

Wellpump PRW1 Manual
Is 0
Equal to Table Element?
At Index 0
Of Table AM_Status

Condition Block: Running? (Id: 20)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 23)

Wellpump Running?
Is PRW1_run
On?

Condition Block: Start PB? (Id: 24)
TRUE Exit to: Tripped? (Id: 21)
FALSE Exit to: Stop PB? (Id: 22)

Manual Start
Is -1
Equal to Table Element?
At Index 0
Of Table Manual_Outputs

Condition Block: Stop PB? (Id: 22)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Block 0 (Id: 0)

Manual Stop
Is 0
Equal to Table Element?
At Index 0
Of Table Manual_Outputs

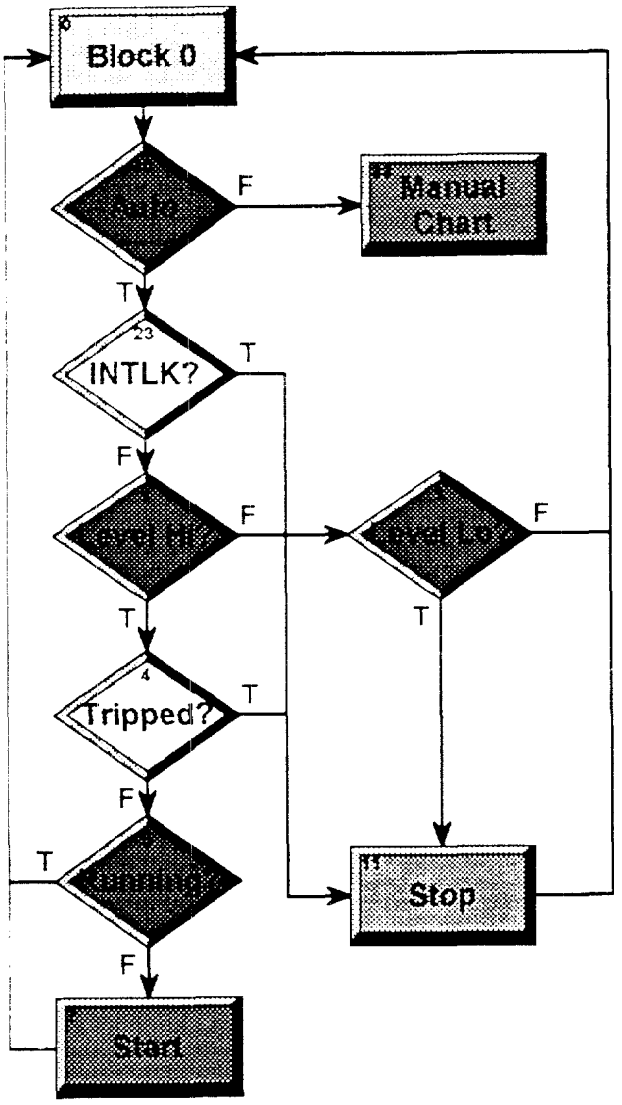
Condition Block: Tripped? (Id: 21)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Running? (Id: 20)

Motor Overload Tripped
Is PRW1_trip
OR?
B1_trip

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Wellpump_2_Auto
DATE: 05/13/98 TIME: 13:08:33 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Wellpump_2_Auto
DATE: 05/13/98 **TIME:** 13:08:36

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Auto (Id: 30)

There are no instructions in this action block.

Action Block: Manual Chart (Id: 33)
This action block has no exit.

Move to Table Element

From	PRW2_run
To Index	1
Of Table	Manual_Outputs

Starts the Manual Mode of Operation of the Wellpump
Start Chart

Chart	Wellpump_2_Manual
Put Status In	Wellpump_2_Manual_Chart

Clears the Wellpump 2 Auto chart status
Move

From	0
To	Wellpump_2_Auto_Chart

Action Block: Start (Id: 2)
Exit to: Block 0 (Id: 0)

Set Stop 'on' Latch
Turn On
PRW2_stop

Start Command
Turn On
PRW2_start

Delay (Sec)
1.0

Turn Off
PRW2_start

Action Block: Stop (Id: 11)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
PRW2_stop

CONDITIONS

Condition Block: Auto (Id: 30)
TRUE Exit to: INTLKT (Id: 23)
FALSE Exit to: Manual Chart (Id: 33)

Wellpump PRW2 Automatic

Is	-1

Equal to Table Element?

At Index	1
Of Table	AM_Status

Condition Block: INTLK? (Id: 23)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Level Hi? (Id: 1)

Is Sump or Stripper Hi-Hi Level?
Is Stripper_Hi
OR?
Sump_Hi

Condition Block: Level Hi? (Id: 1)
TRUE Exit to: Tripped? (Id: 4)
FALSE Exit to: Level Lo? (Id: 3)

LT2>setpoint
Is LT2
Greater Than or Equal?
To -1.5

Condition Block: Level Lo? (Id: 3)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Block 0 (Id: 0)

LT2<setpoint
Is LT2
Less Than or Equal?
To -6.5

Condition Block: Running? (Id: 5)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 2)

Wellpump Running?
Is PRW2_run
On?

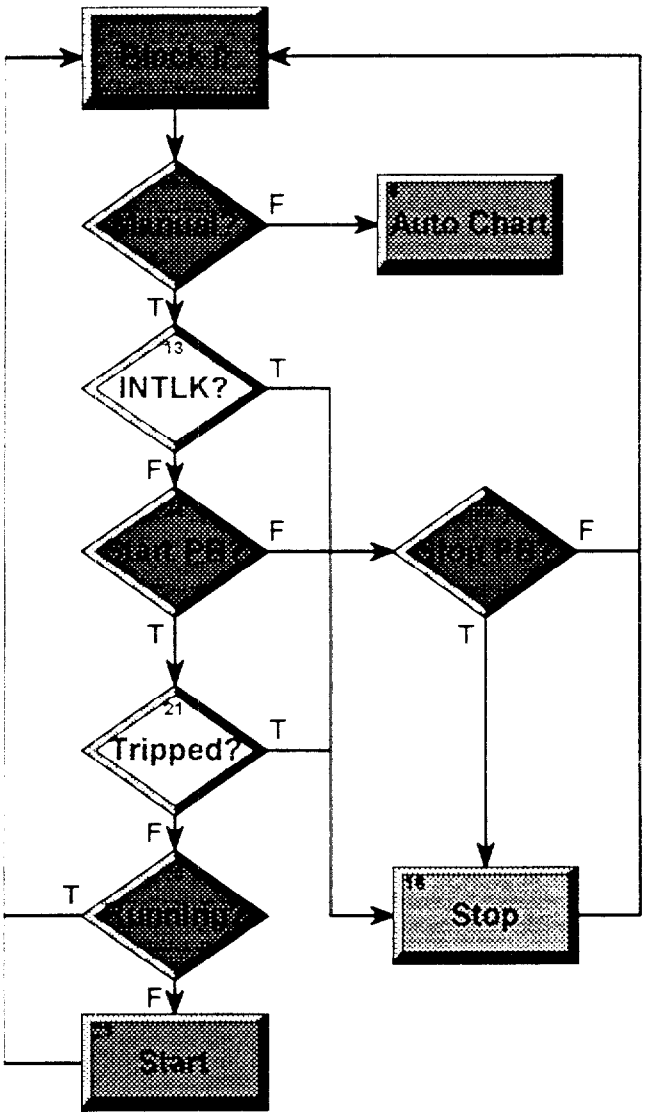
Condition Block: Tripped? (Id: 4)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Running? (Id: 5)

Motor Overload Tripped
Is PRW2_trip
OR?
B1_trip

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Wellpump_2_Manual
DATE: 05/13/98 TIME: 13:09:51 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Wellpump_2_Manual
DATE: 05/13/98 **TIME:** 13:09:56

ACTIONS

Action Block: Auto Chart (Id: 6)
This action block has no exit.

Starts the Automatic Mode of Operation of the Wellpump
Start Chart
Chart Wellpump_2_Auto
Put Status In Wellpump_2_Auto_Chart

Clears the Wellpump 2 Manual chart status
Move
From 0
To Wellpump_2_Manual_Chart

Action Block: Block 0 (Id: 0)
Exit to: Manual? (Id: 9)

There are no instructions in this action block.

Action Block: Start (Id: 23)
Exit to: Block 0 (Id: 0)

Set Stop 'on' Latch
Turn On
PRW2_stop

Start Command
Turn On
PRW2_start

Delay (Sec)
1.0

Turn Off
PRW2_start

Action Block: Stop (Id: 16)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
PRW2_stop

CONDITIONS

Condition Block: INTLK? (Id: 13)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Start PB? (Id: 24)

Is Sump or Stripper Hi-Hi Level?
Is Stripper_Hi
OR?
Sump_Hi

Condition Block: Manual? (Id: 9)
TRUE Exit to: INTLK? (Id: 13)
FALSE Exit to: Auto Chart (Id: 6)

Wellpump PRW2 Manual
Is 0
Equal to Table Element?
At Index 1
Of Table AM_Status

Condition Block: Running? (Id: 20)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 23)

Wellpump Running?
Is PRW2_run
On?

Condition Block: Start PB? (Id: 24)
TRUE Exit to: Tripped? (Id: 21)
FALSE Exit to: Stop PB? (Id: 22)

Manual Start
Is -1
Equal to Table Element?
At Index 1
Of Table Manual_Outputs

Condition Block: Stop PB? (Id: 22)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Block 0 (Id: 0)

Manual Stop
Is 0
Equal to Table Element?
At Index 1
Of Table Manual_Outputs

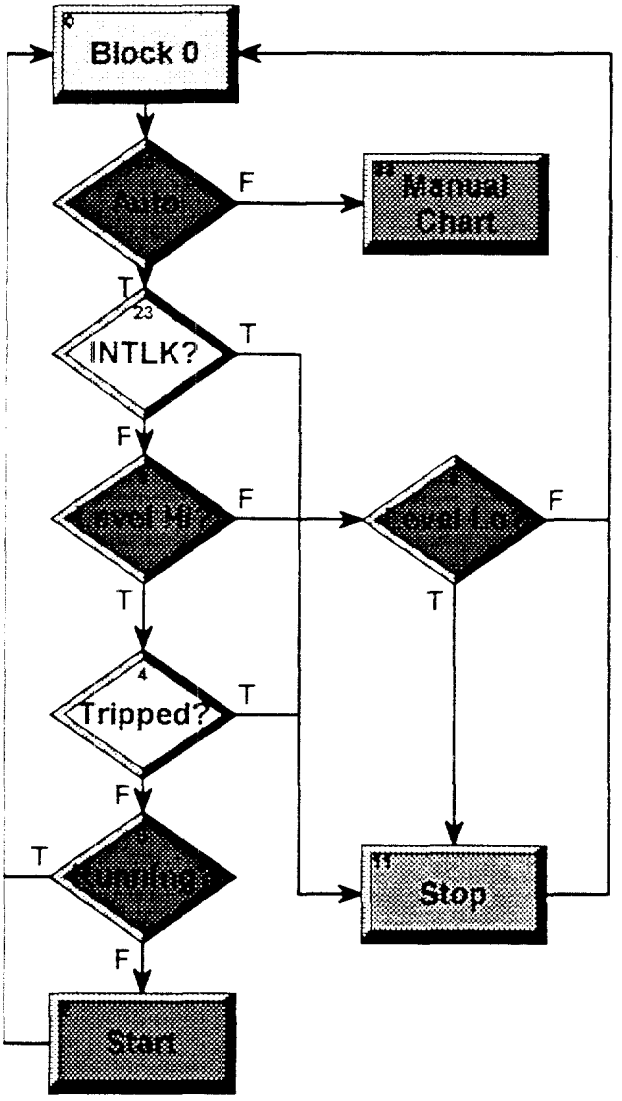
Condition Block: Tripped? (Id: 21)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Running? (Id: 20)

Motor Overload Tripped
Is PRW2_trip
OR?
B1_trip

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Wellpump_3_Auto
DATE: 05/13/98 TIME: 13:10:18 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Wellpump_3_Auto
DATE: 05/13/98 **TIME:** 13:10:24

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Auto (Id: 30)

There are no instructions in this action block.

Action Block: Manual Chart (Id: 33
This action block has no exit.

Move to Table Element

From	PRW3_Run
To Index	2
Of Table	Manual_Outputs

Starts the Manual Mode of Operation of the Wellpump
Start Chart

Chart	Wellpump_3_Manual
Put Status In	Wellpump_3_Manual_Chart

Clears the Wellpump 1 Auto chart status
Move

From	0
To	Wellpump_3_Auto_Chart

Action Block: Start (Id: 2)
Exit to: Block 0 (Id: 0)

Set Stop 'on' Latch
Turn On
PRW3_Stop

Start Command
Turn On
PRW3_Start

Delay (Sec)
1.0

Turn Off
PRW3_Start

Action Block: Stop (Id: 11)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
PRW3_Stop

CONDITIONS

Condition Block: Auto (Id: 30)
TRUE Exit to: INTLK? (Id: 23)
FALSE Exit to: Manual Chart (Id: 33)

Wellpump PRW3 Automatic

Is	-1

Equal to Table Element?

At Index	2
Of Table	AM_Status

Condition Block: INTLK? (Id: 23)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Level Hi? (Id: 1)

Is Sump or Stripper Hi-Hi Level?

Is	Stripper_Hi
OR?	
	Sump_Hi

Condition Block: Level Hi? (Id: 1)
TRUE Exit to: Tripped? (Id: 4)
FALSE Exit to: Level Lo? (Id: 3)

LT3>setpoint

Is	LT3
Greater Than or Equal?	
To	-1.0

Condition Block: Level Lo? (Id: 3)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Block 0 (Id: 0)

LT3<setpoint

Is	LT3
Less Than or Equal?	
To	-6.0

Condition Block: Running? (Id: 5)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 2)

Wellpump Running?

Is	PRW3_Run
On?	

Condition Block: Tripped? (Id: 4)
TRUE Exit to: Stop (Id: 11)
FALSE Exit to: Running? (Id: 5)

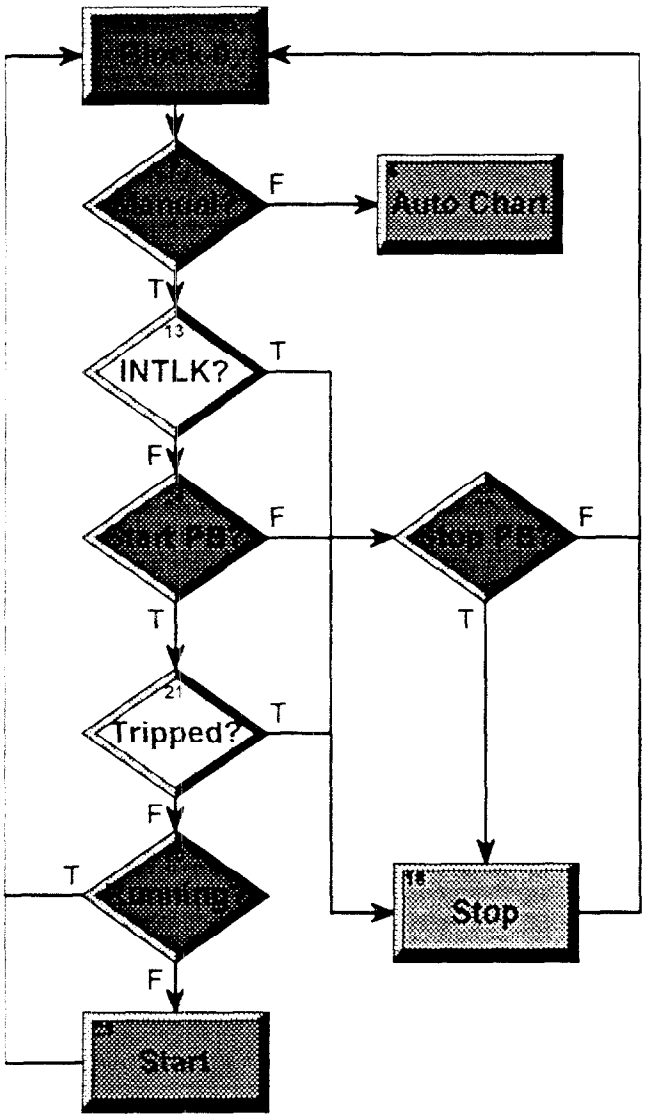
Motor Overload Tripped

Is	PRW3_Trip
OR?	
	B1_trip

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Wellpump_3_Manual
DATE: 05/13/98 TIME: 13:10:51 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Wellpump_3_Manual
DATE: 05/13/98 **TIME:** 13:10:57

ACTIONS

Action Block: Auto Chart (Id: 6)
This action block has no exit.

Starts the Automatic Mode of Operation of the Wellpump
Start Chart
Chart Wellpump_3_Auto
Put Status In Wellpump_3_Auto_Chart

Clears the Wellpump 3 Manual chart status
Move
From 0
To Wellpump_3_Manual_Chart

Action Block: Block 0 (Id: 0)
Exit to: Manual? (Id: 9)

There are no instructions in this action block.

Action Block: Start (Id: 23)
Exit to: Block 0 (Id: 0)

Set Stop 'on' Latch
Turn On
PRW3_Stop

Start Command
Turn On
PRW3_Start

Delay (Sec)
1.0

Turn Off
PRW3_Start

Action Block: Stop (Id: 16)
Exit to: Block 0 (Id: 0)

Stop Command
Turn Off
PRW3_Stop

CONDITIONS

Condition Block: INTLK? (Id: 13)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Start PB? (Id: 24)

Is Sump or Stripper Hi-Hi Level?
Is Stripper_Hi
OR?
Sump_Hi

Condition Block: Manual? (Id: 9)
TRUE Exit to: INTLK? (Id: 13)
FALSE Exit to: Auto Chart (Id: 6)

Wellpump PRW3 Manual
Is 0
Equal to Table Element?
At Index 2
Of Table AM_Status

Condition Block: Running? (Id: 20)
TRUE Exit to: Block 0 (Id: 0)
FALSE Exit to: Start (Id: 23)

Wellpump Running?
Is PRW3_Run
On?

Condition Block: Start PB? (Id: 24)
TRUE Exit to: Tripped? (Id: 21)
FALSE Exit to: Stop PB? (Id: 22)

Manual Start
Is -1
Equal to Table Element?
At Index 2
Of Table Manual_Outputs

Condition Block: Stop PB? (Id: 22)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Block 0 (Id: 0)

Manual Stop
Is 0
Equal to Table Element?
At Index 2
Of Table Manual_Outputs

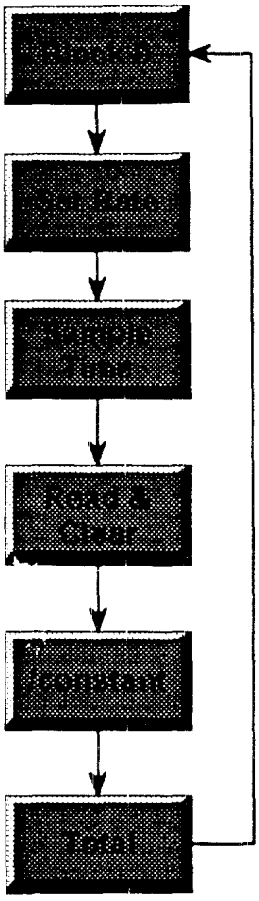
Condition Block: Tripped? (Id: 21)
TRUE Exit to: Stop (Id: 16)
FALSE Exit to: Running? (Id: 20)

Motor Overload Tripped
Is PRW3_Trip
OR?
B1_trip

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Well_Flow_Totalizer
DATE: 05/13/98 TIME: 12:34:02 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Well_Flow_Totalizer
DATE: 05/13/98 **TIME:** 12:34:10

ACTIONS

Action Block: /constant (Id: 4)
Exit to: Total (Id: 5)

Divide by constant
Divide

	Total1
By	60000
Put Result in	Total1a

Divide

	Total2
By	60000
Put Result in	Total2a

Divide

	Total3
By	60000
Put Result in	Total3a

Action Block: Block 0 (Id: 0)
Exit to: Set Rate (Id: 1)

There are no instructions in this action block.

Action Block: Read & Clear (Id: 3)
Exit to: /constant (Id: 4)

Reads the 60s sample and clears totalizer
Get & Clear Analog Totalizer Value

From	FIT1
Put in	Total1

Get & Clear Analog Totalizer Value

From	FIT3
Put in	Total3

Get & Clear Analog Totalizer Value

From	FIT2
Put in	Total2

Action Block: Sample Time (Id: 2)
Exit to: Read & Clear (Id: 3)

Totalizer Sample Time
Delay (Sec)

60.0

Action Block: Set Rate (Id: 1)
Exit to: Sample Time (Id: 2)

Set Analog Totalizer Rate

To (Seconds)	1
On Point	FIT1

Set Analog Totalizer Rate

To (Seconds)	1

On Point FIT2

Set Analog Totalizer Rate
To (Seconds) 1
On Point FIT3

Action Block: Total (Id: 5)
Exit to: Block 0 (Id: 0)

Running Flow Totalizers For Wells

Add
Total1a
Plus FIT1_Total
Put Result in FIT1_Total

Add
Total3a
Plus FIT3_Total
Put Result in FIT3_Total

Add
Total2a
Plus FIT2_Total
Put Result in FIT2_Total

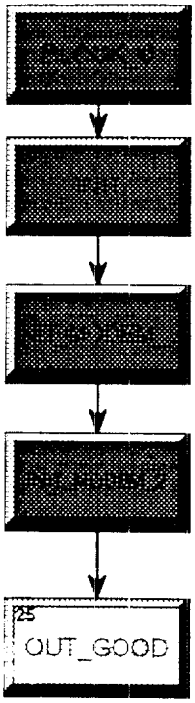
CONDITIONS

There are no condition blocks in this flowchart.

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Initialize_Modem
DATE: 05/13/98 TIME: 12:25:06 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Initialize_Modem
DATE: 05/13/98 **TIME:** 12:25:11

ACTIONS

Action Block: BLOCK_0 (Id: 0)
Exit to: INIT (Id: 16)

There are no instructions in this action block.

Action Block: INIT (Id: 16)
Exit to: INIT_MODEM_1 (Id: 1)

Comment (Single Line)
"INIT FOR ZYPCOM Z32 SLAVE RTU MODEM"

Move String
From "AT&F0"
To MODEM_INIT_1

Move String
From "AT&E0&C1S0=1S10=50"
To MODEM_INIT_2

Configure Port
Configuration "COM2:115200,N,8,1,CTS"
Put Status in PORT_STATUS

Configure Port Timeout Delay
Delay (Seconds) 5
On Port MODEM_PORT

Action Block: INIT_MODEM_1 (Id: 1)
Exit to: INIT_MODEM_2 (Id: 24)

Transmit String via Serial Port
From MODEM_INIT_1
On Port MODEM_PORT
Put Status in PORT_STATUS

Transmit Character via Serial Port
From 13
On Port MODEM_PORT
Put Status in PORT_STATUS

Delay (Sec)
1.0

Move String
From "INIT1"
To SLAVE_STEP

Action Block: INIT_MODEM_2 (Id: 24)
Exit to: OUT_GOOD (Id: 25)

Transmit String via Serial Port
From MODEM_INIT_2
On Port MODEM_PORT

Put Status in PORT_STATUS

Transmit Character via Serial Port
From 13
On Port MODEM_PORT
Put Status in PORT_STATUS

Move String
From "INIT2"
To SLAVE_STEP

Action Block: OUT_GOOD (Id: 25)
This action block has no exit.

Set Variable True
MODEM_ONLINE

Clear Receive Buffer
On Port MODEM_PORT
Put Result in PORT_STATUS

Start Host Task (ASCII)
On Port 2
Put Status in SCRAP

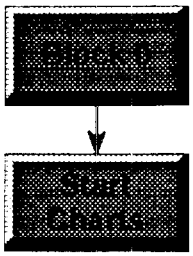
CONDITIONS

There are no condition blocks in this flowchart.

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Powerup
DATE: 05/13/98 TIME: 12:22:30 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Powerup
DATE: 05/13/98 **TIME:** 12:22:37

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Start Charts (Id: 1)

There are no instructions in this action block.

Action Block: Start Charts (Id: 1)
This action block has no exit.

Start Chart
Chart: Initialize_Modem
Put Status In: SCRAP

Start Misc. Chart
Start Chart
Chart: Miscellaneous
Put Status In: Miscellaneous

Start Chart
Chart: Blower_B1_Auto
Put Status In: B1_Auto_Chart

Start Chart
Chart: Discharge_Totalizer
Put Status In: Discharge_Totalizer_Chart

Start Chart
Chart: FV1_Auto
Put Status In: FV1_Auto_Chart

Start Chart
Chart: Pump_P1_Auto
Put Status In: P1_Auto_Chart

Start Chart
Chart: Well_Flow_Totalizer
Put Status In: Well_Flow_Totalizer_Chart

Start Chart
Chart: Wellpump_1_Auto
Put Status In: Wellpump_1_Auto_Chart

Start Chart
Chart: Wellpump_2_Auto
Put Status In: Wellpump_2_Auto_Chart

Start Chart
Chart: Wellpump_3_Auto
Put Status In: Wellpump_3_Auto_Chart

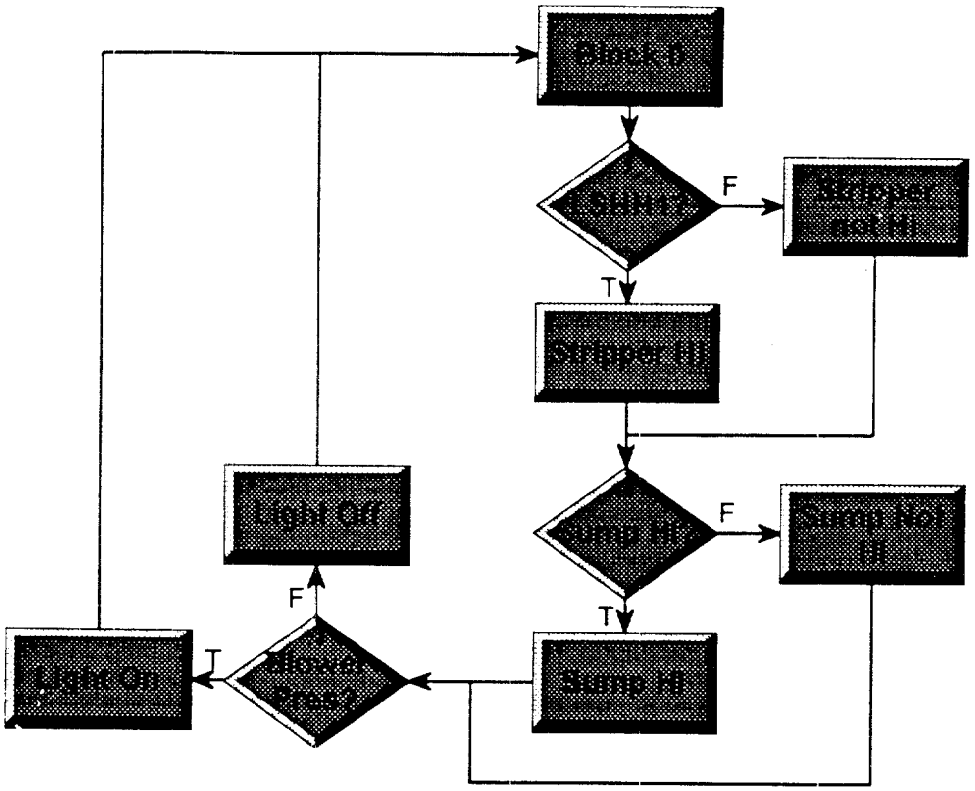
CONDITIONS

There are no condition blocks in this flowchart.

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

STRATEGY: Parris45
CHART: Miscellaneous
DATE: 05/13/98 TIME: 12:22:59 PAGE: 1 of 1 COLUMN: 1 ROW: 1



TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Miscellaneous
DATE: 05/13/98 **TIME:** 12:23:05

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: LSHH1? (Id: 1)

There are no instructions in this action block.

Action Block: Light Off (Id: 26)
Exit to: Block 0 (Id: 0)

Turn Off
Low_Air_Press_Alarm_Light

Action Block: Light On (Id: 25)
Exit to: Block 0 (Id: 0)

Turn On
Low_Air_Press_Alarm_Light

Action Block: Stripper Hi (Id: 2)
Exit to: Sump Hi? (Id: 15)

Turn On
Stripper_High_Level_Alarm_Light

If LSHH1 is off Level Is Hi
Move
From -1
To Stripper_Hi

Action Block: Stripper not Hi (Id: 3)
Exit to: Sump Hi? (Id: 15)

Turn Off
Stripper_High_Level_Alarm_Light

If LSHH1 is ON Stripper Level Is Normal
Move
From 0
To Stripper_Hi

Action Block: Sump Hi (Id: 16)
Exit to: Blower Pres? (Id: 24)

If LSHH2 is off Level Is Hi
Move
From -1
To Sump_Hi

Action Block: Sump Not Hi (Id: 17)
Exit to: Blower Pres? (Id: 24)

If LSHH2 iis ON Sump Level Is Normal
Move
From 0
To Sump_Hi

CONDITIONS

Condition Block: Blower Press? (Id: 14)
TRUE Exit to: Light On (Id: 25)
FALSE Exit to: Light Off (Id: 26)

Is PSL1
On?

Condition Block: LSHH1? (Id: 1)
TRUE Exit to: Stripper Hi (Id: 2)
FALSE Exit to: Stripper not Hi (Id: 3)

LSHH1 moved to Variable Stripper Hi
Is LSHH1
Off?

Condition Block: Sump Hi? (Id: 15)
TRUE Exit to: Sump Hi (Id: 16)
FALSE Exit to: Sump Not Hi (Id: 17)

LSHH2 moved to Variable Sump Hi
Is LSHH2
Off?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

Block 1

TITLE: Chart Block Instructions
STRATEGY: Parris45
CHART: Interrupt
DATE: 05/13/98 **TIME:** 12:23:31

ACTIONS

Action Block: Block 0 (Id: 0)
This action block has no exit.

There are no instructions in this action block.

CONDITIONS

There are no condition blocks in this flowchart.

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

TITLE: Strategy Database
STRATEGY: Parris45
DATE: 05/13/98 **TIME:** 08:45:20

NUMERIC VARIABLES

NAME	TYPE	INIT.	VALUE	SECURITY	REF. COUNT
A__DELAY	INT	RUN	10	0	0
B1_Auto_Chart Auto Chart Status	INT	RUN	0	0	4
B1_Manual_Chart Manual Chart Status	INT	RUN	0	0	3
Discharge_Counter 60s counter reading	INT	RUN	0	0	3
Discharge_Flowrate Calculated discharge flowrate	INT	RUN		0	1
Discharge_Timer 60s Flow Calc. Timer	TIMER	RUN		0	1
Discharge_Totalizer_Chart	INT	RUN	0	0	1
Dsch_Totalizer	INT	RUN	0	0	0
FIT1_Total Running Total For Well 1 Discharge Flow	FLOAT	DWNLD	0	0	2
FIT2_Total Running Total For Well 2 Discharge Flow	FLOAT	DWNLD	0	0	2
FIT3_Total Running Total For Well 3 Discharge Flow	FLOAT	DWNLD	0	0	2
FV1_Auto_Chart Automatic Mode	INT	RUN	0	0	3
FV1_Manual_Chart Manual Mode	INT	RUN	0	0	2
Historic_Log_On Trigger to run MMI log	INT	RUN	0	0	0
INIT_COUNT	INT	RUN	0	0	0
Initialize_Cycle_Timer Runs Initialize Modem Chart every 30 minutes if not online	TIMER	RUN		0	0
Miscellaneous Chart Status	INT	RUN	0	0	1
MODEM_ONLINE	INT	RUN	0	0	1
MODEM_PORT	INT	RUN	2	0	6
MODEM_TIMER	TIMER	RUN		0	0
P1_Auto_Chart Pump P1 Auto Status	INT	RUN	0	0	3
P1_Manual_Chart Manual Chart Status	INT	RUN	0	0	2
Passcheck	INT	RUN	0	0	0
PORT_STATUS	INT	RUN	0	0	6
SCRAP	INT	RUN	0	0	2
Stop_Timer	TIMER	RUN		0	2

Stripper_Hi Variable representing LSHH1	INT	RUN	0	0	9
Sump_Hi	INT	RUN	0	0	10
Total1 60 sec FIT1 reading	FLOAT	RUN		0	2
Total1a 60s reading / 60000	FLOAT	RUN	0	0	2
Total2 60s FIT2 reading	FLOAT	RUN	0	0	2
Total2a	FLOAT	RUN	0	0	2
Total3 60s FIT3 Reading	FLOAT	RUN	0	0	2
Total3a	FLOAT	RUN	0	0	2
Total_Discharge_Counts Running Discharge count Total	INT	DWNLD		0	3
Total_Discharge_Flow	FLOAT	DWNLD		0	1
Well_Flow_Totalizer_Chart	INT	RUN	0	0	1
Wellpump_1_Auto_Chart Auto Chart Status	INT	RUN	0	0	3
Wellpump_1_Manual_Chart Manual Chart Status	INT	RUN	0	0	2
Wellpump_2_Auto_Chart Auto Chart status	INT	RUN	0	0	3
Wellpump_2_Manual_Chart Manual Chart Status	INT	RUN	0	0	2
Wellpump_3_Auto_Chart Auto Chart Status	INT	RUN	0	0	3
Wellpump_3_Manual_Chart Manual Chart Status	INT	RUN	0	0	2

STRING VARIABLES

NAME	INIT.	WIDTH	SECURITY	REF. COUNT
MODEM_INIT_1	RUN	20	0	2
MODEM_INIT_2	RUN	20	0	2
MODEM_RESPONSE_	RUN	126	0	0
SLAVE_STEP	RUN	20	0	2
NUE_	RUN	126	0	0

NUMERIC TABLES

NAME	TYPE	LENGTH	INIT.	SECURITY	REF. COUNT
AM_Status Auto Or Manual Mode of Operation	INT	10	RUN	0	13
Manual_Outputs Start/Stop/Open/Close Manual Commands	INT	10	RUN	0	17

I/O UNITS

NAME: *Digi16A*
DESCRIPTION: 16 Point Remote Digital
TYPE: G4 Digital Multifunction
PORT: Remote 1
ADDRESS: 0
WATCHDOG: Enabled
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 17

CHANNEL #: 0
NAME: *ZS1A*
DESCRIPTION: FV1 Open Limit Switch
TYPE: Input
MODULE: G4IAC5: 90 - 140 VDC/VAC
FEATURES: None
DEFAULT: Last
WATCHDOG: Disabled
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 2

CHANNEL #: 1
NAME: *ZS1B*
DESCRIPTION: FV1 Closed Limit Switch
TYPE: Input
MODULE: G4IAC5: 90 - 140 VDC/VAC
FEATURES: None
DEFAULT: Last
WATCHDOG: Disabled
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 2

CHANNEL #: 2
NAME: *FV1A*
DESCRIPTION: FV1 Open Command
TYPE: Output
MODULE: G4OAC5MA: 11 - 140 VAC
FEATURES: None
DEFAULT: Off
WATCHDOG: Off
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 5

CHANNEL #: 3
NAME: *FV1B*
DESCRIPTION: FV1 Close Command
TYPE: Output
MODULE: G4OAC5MA: 1 - 140 VAC
FEATURES: None
DEFAULT: Off
WATCHDOG: On
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 5

CHANNEL #: 4
NAME: *PRW3_Run*
DESCRIPTION: Running Status Contact
TYPE: Input
MODULE: G4IAC5: 90 - 140 VDC/VAC
FEATURES: None
DEFAULT: Last
WATCHDOG: Disabled
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 2

CHANNEL #: 5
NAME: *PRW3_Trip*
DESCRIPTION: Overload Status Contact
TYPE: Input
MODULE: G4IAC5: 90 - 140 VDC/VAC
FEATURES: None
DEFAULT: Last
WATCHDOG: Disabled
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 2

CHANNEL #: 6
NAME: *PRW3_Start*
DESCRIPTION: Start Command
TYPE: Output
MODULE: G4OAC5MA: 11 - 140 VAC
FEATURES: None
DEFAULT: Off
WATCHDOG: Off
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 5

CHANNEL #: 7
NAME: *PRW3_Stop*
DESCRIPTION: Stop Command
TYPE: Output
MODULE: G4OAC5MA: 12 - 140 VAC
FEATURES: None
DEFAULT: Off
WATCHDOG: Off
ENABLE: Enabled
SECURITY: 0
REFERENCE COUNT: 5

CHANNEL #: 8
NAME: *PRW2_run*
DESCRIPTION: Running Status Contact
TYPE: Input **MODULE:** G4IAC5: 90 - 140 VDC/VAC
FEATURES: None **DEFAULT:** Last
WATCHDOG: Disabled **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 5

CHANNEL #: 9
NAME: *PRW2_trip*
DESCRIPTION: Overload Status Contact
TYPE: Input **MODULE:** G4IAC5: 90 - 140 VDC/VAC
FEATURES: None **DEFAULT:** Last
WATCHDOG: Disabled **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 2

CHANNEL #: 10
NAME: *PRW2_start*
DESCRIPTION: Start Command
TYPE: Output **MODULE:** G4OAC5MA: 12 - 140 VAC
FEATURES: None **DEFAULT:** Off
WATCHDOG: Off **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 5

CHANNEL #: 11
NAME: *PRW2_stop*
DESCRIPTION: Stop Command
TYPE: Output **MODULE:** G4OAC5MA: 12 - 140 VAC
FEATURES: None **DEFAULT:** Off
WATCHDOG: Off **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 5

CHANNEL #: 12
NAME: *PRW1_run*
DESCRIPTION: Running Status Contact
TYPE: Input **MODULE:** G4IAC5: 90 - 140 VDC/VAC
FEATURES: None **DEFAULT:** Last
WATCHDOG: Disabled **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 5

CHANNEL #: 13
NAME: *PRW1_trip*
DESCRIPTION: Overload Status Contact
TYPE: Input **MODULE:** G4IAC5: 90 - 140 VDC/VAC
FEATURES: None **DEFAULT:** Last
WATCHDOG: Disabled **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 2

CHANNEL #: 14
NAME: *PRW1_start*
DESCRIPTION: Start Command
TYPE: Output **MODULE:** G4OAC5MA: 12 - 140 VAC
FEATURES: None **DEFAULT:** Off
WATCHDOG: Off **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 5

CHANNEL #: 15
NAME: *PRW1_Stop*
DESCRIPTION: Stop Command
TYPE: Output **MODULE:** G4OAC5MA: 12 - 140 VAC
FEATURES: None **DEFAULT:** Off
WATCHDOG: Off **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 5

NAME: *RTU*
DESCRIPTION: Controller Digital
TYPE: G4 Digital Multifunction **PORT:** Local
ADDRESS: 0 **WATCHDOG:** Enabled
ENABLE: Enabled **SECURITY:** 0
REFERENCE COUNT: 14

CHANNEL #: 0
NAME: *P1_run*
DESCRIPTION: Run Status Contact
TYPE: Input **MODULE:** G4IAC5: 90 - 140 VDC/VAC

FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	3

CHANNEL #:	1		
NAME:	*P1_trip*		
DESCRIPTION:	Overload Status Contact		
TYPE:	Input	**MODULE:**	G4IAC5: 90 - 140 VDC/VAC
FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	1

CHANNEL #:	2		
NAME:	*P1_start*		
DESCRIPTION:	Start Command		
TYPE:	Output	**MODULE:**	G4OAC5MA: 12 - 140 VAC
FEATURES:	None	**DEFAULT:**	Off
WATCHDOG:	Off	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	5

CHANNEL #:	4		
NAME:	*B1_run*		
DESCRIPTION:	Run Status Contact		
TYPE:	Input	**MODULE:**	G4IAC5: 90 - 140 VDC/VAC
FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	3

CHANNEL #:	5		
NAME:	*B1_trip*		
DESCRIPTION:	Overload Status Contact		
TYPE:	Input	**MODULE:**	G4IAC5: 90 - 140 VDC/VAC
FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	8

CHANNEL #:	6		
NAME:	*B1_start*		
DESCRIPTION:	Start Command		
TYPE:	Output	**MODULE:**	G4OAC5MA: 12 - 140 VAC
FEATURES:	None	**DEFAULT:**	Off
WATCHDOG:	Off	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	5

CHANNEL #:	9		
NAME:	*LSHH1*		
DESCRIPTION:	Stripper Hi-Hi Level		
TYPE:	Input	**MODULE:**	G4IAC5: 90 - 140 VDC/VAC
FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	1

CHANNEL #:	10		
NAME:	*LSHH2*		
DESCRIPTION:	Sump Hi-Hi Level		
TYPE:	Input	**MODULE:**	G4IAC5: 90 - 140 VDC/VAC
FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	1

CHANNEL #:	11		
NAME:	*LSHL2*		
DESCRIPTION:	Stripper Control Levels HI-LO		
TYPE:	Input	**MODULE:**	G4IAC5: 90 - 140 VDC/VAC
FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	2

CHANNEL #:	12		
NAME:	*PSL1*		
DESCRIPTION:	B1 Discharge Pressure		
TYPE:	Input	**MODULE:**	G4IAC5: 90 - 140 VDC/VAC
FEATURES:	None	**DEFAULT:**	Last
WATCHDOG:	Disabled	**ENABLE:**	Enabled
SECURITY:	0	**REFERENCE COUNT:**	1

CHANNEL #: 13

NAME: Low_Air_Press_Alarm_Light
DESCRIPTION: Stripper Light
TYPE: Output **MODULE:** G4OAC5MA: 11 - 140 VAC
FEATURES: None **DEFAULT:** Off
WATCHDOG: Disabled **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 3

CHANNEL #: 14
NAME: *Stripper_High_Level_Alarm_Light*
DESCRIPTION: Stripper Light
TYPE: Output **MODULE:** G4OAC5MA: [illegible] - 140 VAC
FEATURES: None **DEFAULT:** Off
WATCHDOG: Disabled **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 3

CHANNEL #: 15
NAME: *FQIT3*
DESCRIPTION: System Discharge Flow & Totalizer Input
TYPE: Input **MODULE:** G4IAC5: 90 - 140 VDC/VAC
FEATURES: Counter **DEFAULT:** Last
WATCHDOG: Disabled **ENABLE:** Enabled
SECURITY: 0 **REFERENCE COUNT:** 3

NAME: *RTUX*
DESCRIPTION: Controller Analog
TYPE: G4 Analog Multifunction **PORT:** Local
ADDRESS: 1 **WATCHDOG:** Enabled
ENABLE: Enabled **SECURITY:** [illegible]
REFERENCE COUNT: 7

CHANNEL #: 0
NAME: *PT3*
DESCRIPTION: B1 Discharge Pressure
TYPE: Input **MODULE:** G4AD3: 4 - 20 mA
DEFAULT: No
UNITS: Psig **ENABLE:** Enabled
LOWER REAL READING: 4.000 **UPPER REAL READING:** 20.000
LOWER SCALED READING: 0.000 **UPPER SCALED READING:** 15.000
ZERO-SCALE VALUE: 0.000 **FULL-SCALE VALUE:** 15.000
WATCHDOG: Disabled
SECURITY: 0 **REFERENCE COUNT:** 0

CHANNEL #: 1
NAME: *LT1*
DESCRIPTION: Well RW1 Level
TYPE: Input **MODULE:** G4AD3: 4 - 20 mA
DEFAULT: No
UNITS: Feet **ENABLE:** Enabled
LOWER REAL READING: 4.000 **UPPER REAL READING:** 20.000
LOWER SCALED READING: -8.820 **UPPER SCALED READING:** 14.280
ZERO-SCALE VALUE: -8.820 **FULL-SCALE VALUE:** 14.280
WATCHDOG: Disabled
SECURITY: 0 **REFERENCE COUNT:** 2

CHANNEL #: 2
NAME: *LT2*
DESCRIPTION: Well RW2 Level
TYPE: Input **MODULE:** G4AD3: 4 - 20 mA
DEFAULT: No
UNITS: Feet **ENABLE:** Enabled
LOWER REAL READING: 4.000 **UPPER REAL READING:** 20.000
LOWER SCALED READING: -9.270 **UPPER SCALED READING:** 13.830
ZERO-SCALE VALUE: -9.270 **FULL-SCALE VALUE:** 13.830
WATCHDOG: Disabled
SECURITY: 0 **REFERENCE COUNT:** 2

CHANNEL #: 3
NAME: *LT3*
DESCRIPTION: Well RW3 Level
TYPE: Input **MODULE:** G4AD3: 4 - 20 mA
DEFAULT: No
UNITS: Feet **ENABLE:** Enabled
LOWER REAL READING: 4.000 **UPPER REAL READING:** 20.000
LOWER SCALED READING: -8.860 **UPPER SCALED READING:** 14.140
ZERO-SCALE VALUE: -8.860 **FULL-SCALE VALUE:** 14.140
WATCHDOG: Disabled

SECURITY:	0	**REFERENCE COUNT:**	2

CHANNEL #:	4		
NAME:	*FIT1*		
DESCRIPTION:	Well RW1 Flow		
TYPE:	Input	**MODULE:**	G4AD3: 4 - 20 mA
DEFAULT:	No		
UNITS:	GPM	**ENABLE:**	Enabled
LOWER REAL READING:	4.000	**UPPER REAL READING:**	20.000
LOWER SCALED READING:	0.000	**UPPER SCALED READING:**	7.000
ZERO-SCALE VALUE:	0.000	**FULL-SCALE VALUE:**	7.000
WATCHDOG:	Disabled		
SECURITY:	0	**REFERENCE COUNT:**	2

CHANNEL #:	5		
NAME:	*FIT2*		
DESCRIPTION:	Well RW2 Flow		
TYPE:	Input	**MODULE:**	G4AD3: 4 - 20 mA
DEFAULT:	No		
UNITS:	GPM	**ENABLE:**	Enabled
LOWER REAL READING:	4.000	**UPPER REAL READING:**	20.000
LOWER SCALED READING:	0.000	**UPPER SCALED READING:**	7.000
ZERO-SCALE VALUE:	0.000	**FULL-SCALE VALUE:**	7.000
WATCHDOG:	Disabled		
SECURITY:	0	**REFERENCE COUNT:**	2

CHANNEL #:	6		
NAME:	*FIT3*		
DESCRIPTION:	Well RW3 Flow		
TYPE:	Input	**MODULE:**	G4 D . 4 - 20 mA
DEFAULT:	No		
UNITS:	GPM	**ENABLE:**	Enabled
LOWER REAL READING:	4.000	**UPPER REAL READING:**	20.000
LOWER SCALED READING:	0.000	**UPPER SCALED READING:**	7.000
ZERO-SCALE VALUE:	0.000	**FULL-SCALE VALUE:**	7.000
WATCHDOG:	Disabled		
SECURITY:	0	**REFERENCE COUNT:**	2

EVENT/REACTIONS

NAME:	*Watchdog1*
DESCRIPTION:	Shutdown on communication loss
I/O UNIT:	Digi16A
SCAN ON RUN:	Yes
INTERRUPT ON EVENT:	No
EVENT TYPE:	Watchdog Timeout
REACTION TYPE:	Set MOMO Outputs
MUST ON MASK:	8
MUST OFF MASK:	52420
ENABLE:	Enabled
SECURITY:	0
REFERENCE COUNT:	0

NAME:	*Watchdog2*
DESCRIPTION:	Shutdown on communications loss
I/O UNIT:	RTU
SCAN ON RUN:	Yes
INTERRUPT ON EVENT:	No
EVENT TYPE:	Watchdog Timeout
REACTION TYPE:	Set MOMO Outputs
MUST ON MASK:	0
MUST OFF MASK:	68
ENABLE:	Enabled
SECURITY:	0
REFERENCE COUNT:	0

TITLE: Strategy Cross References
STRATEGY: Parris45
DATE: 05/13/98 **TIME:** 16:01:13

CHARTS

Blower_B1_Auto

Chart Referenced	Block Referenced	Instruction
Blower_B1_Manual	Auto Chart	Start Chart
Powerup	Start Charts	Start Chart

Blower_B1_Manual

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Manual Chart	Start Chart
Blower_B1_Auto	Manual Chart	Start Chart

Discharge_Totalizer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

FV1_Auto

Chart Referenced	Block Referenced	Instruction
FV1_Manual	Auto Chart	Start Chart
Powerup	Start Charts	Start Chart

FV1_Manual

Chart Referenced	Block Referenced	Instruction
FV1_Auto	Manual Chart	Start Chart

Initialize_Modem

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

Interrupt - Not referenced.

Miscellaneous

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

Powerup - Not referenced.

Pump_P1_Auto

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart
Pump_P1_Manual	Auto Chart	Start Chart

Pump_P1_Manual

Chart Referenced	Block Referenced	Instruction
Pump_P1_Auto	Manual Chart	Start Chart

Well_Flow_Totalizer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

Wellpump_1_Auto

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart
Wellpump_1_Manual	Auto Chart	Start Chart

Wellpump_1_Manual

Chart Referenced	Block Referenced	Instruction
Wellpump_1_Auto	Manual Chart	Start Chart

Wellpump_2_Auto

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart
Wellpump_2_Manual	Auto Chart	Start Chart

Wellpump_2_Manual

Chart Referenced	Block Referenced	Instruction
Wellpump_2_Auto	Manual Chart	Start Chart

Wellpump_3_Auto

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

Wellpump_3_Manual	Auto Chart	Start Chart

Wellpump_3_Manual

Chart Referenced	Block Referenced	Instruction
Wellpump_3_Auto	Manual Chart	Start Chart

EVENT/REACTIONS

Watchdog1 - Not referenced.

Watchdog2 - Not referenced.

ANALOG POINTS

FIT1

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Read & Clear	Get & Clear Analog
Totalizer Value		
Well_Flow_Totalizer	Set Rate	Set Analog Totalizer Rate

FIT2

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Read & Clear	Get & Clear Analog
Totalizer Value		
Well_Flow_Totalizer	Set Rate	Set Analog Totalizer Rate

FIT3

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Read & Clear	Get & Clear Analog
Totalizer Value		
Well_Flow_Totalizer	Set Rate	Set Analog Totalizer Rate

LT1

Chart Referenced	Block Referenced	Instruction
Wellpump_1_Auto	Level Lo?	Less Than or Equal?
Wellpump_1_Auto	Level Hi?	Greater Than or Equal?

LT2

Chart Referenced	Block Referenced	Instruction
Wellpump_2_Auto	Level Hi?	Greater Than or Equal?
Wellpump_2_Auto	Level Lo?	Less Than or Equal?

LT3

Chart Referenced	Block Referenced	Instruction
Wellpump_3_Auto	Level Lo?	Less Than or Equal?
Wellpump_3_Auto	Level Hi?	Greater Than or Equal?

PT3 - Not referenced.

DIGITAL POINTS

B1_run

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Manual Chart	Move to Table Element
Blower_B1_Auto	Running?	On?
Blower_B1_Manual	Running?	On?

B1_start

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Stop	Turn Off
Blower_B1_Auto	Start	Turn On
Blower_B1_Manual	Start	Turn On
Blower_B1_Manual	Stop	Turn Off

B1_trip

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Tripped?	On?
Blower_B1_Manual	Tripped?	On?
Wellpump_1_Auto	Tripped?	OR?

Well pump_1_Manual	Tripped?	OR?
Well pump_2_Auto	Tripped?	OR?
Wellpump_2_Manual	Tripped?	OR?
Wellpump_3_Auto	Tripped?	OR?
Wellpump_3_Manual	Tripped?	OR?

FQIT3

Chart Referenced	Block Referenced	Instruction
Discharge_Totalizer	Read Counter	Get Counter
Discharge_Totalizer	Start Counter	Start Counter
Discharge_Totalizer	Reset Counter	Clear Counter

FV1A

Chart Referenced	Block Referenced	Instruction
FV1_Auto	Close Valve	Turn Off
FV1_Auto	Open Valve	Turn On
FV1_Manual	Open Valve	Turn On
FV1_Manual	Close Valve	Turn Off

FV1B

Chart Referenced	Block Referenced	Instruction
FV1_Auto	Close Valve	Turn On
FV1_Auto	Open Valve	Turn Off
FV1_Manual	Open Valve	Turn Off
FV1_Manual	Close Valve	Turn On

Low_Air_Press_Alarm_Light

Chart Referenced	Block Referenced	Instruction
Miscellaneous	Light Off	Turn Off
Miscellaneous	Light On	Turn On

LSHH1

Chart Referenced	Block Referenced	Instruction
Miscellaneous	LSHH1?	Off?

LSHH2

Chart Referenced	Block Referenced	Instruction
Miscellaneous	Sump Hi?	Off?

LSHL2

Chart Referenced	Block Referenced	Instruction
Pump_P1_Auto	Level Hi?	On?
Pump_P1_Auto	Level Lo?	Off?

P1_run

Chart Referenced	Block Referenced	Instruction
Pump_P1_Auto	Running?	On?
Pump_P1_Auto	Manual Chart	Move to Table Element
Pump_P1_Manual	Running?	On?

P1_start

Chart Referenced	Block Referenced	Instruction
Pump_P1_Auto	Start	Turn On
Pump_P1_Auto	Stop	Turn Off
Pump_P1_Manual	Stop	Turn Off
Pump_P1_Manual	Start	Turn On

P1_Trip

Chart Referenced	Block Referenced	Instruction
Pump_P1_Auto	Tripped?	On?
Pump_P1_Manual	Tripped?	On?

PRW1_run

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	PRW1/2?	OR?
Blower_B1_Auto	PRW1/2?	OR?
Wellpump_1_Auto	Manual Chart	Move to Table Element
Wellpump_1_Auto	Running?	On?
Wellpump_1_Manual	Running?	On?

PRW1_start

Chart Referenced	Block Referenced	Instruction
Wellpump_1_Auto	Start	Turn On
Wellpump_1_Auto	Start	Turn Off
Wellpump_1_Manual	Start	Turn On
Wellpump_1_Manual	Start	Turn Off

PRW1_Stop

Chart Referenced	Block Referenced	Instruction
Wellpump_1_Auto	Stop	Turn Off
Wellpump_1_Auto	Start	Turn On
Wellpump_1_Manual	Start	Turn On
Wellpump_1_Manual	Stop	Turn Off

PRW1_trip

Chart Referenced	Block Referenced	Instruction
Wellpump_1_Auto	Tripped?	OR?
Wellpump_1_Manual	Tripped?	OR?

PRW2_run

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	PRW1/2?	OR?
Blower_B1_Auto	PRW1/2?	OR?
Wellpump_2_Auto	Running?	On?
Wellpump_2_Auto	Manual Chart	Move to Table Element
Wellpump_2_Manual	Running?	On?

PRW2_start

Chart Referenced	Block Referenced	Instruction
Wellpump_2_Auto	Start	Turn On
Wellpump_2_Auto	Start	Turn Off
Wellpump_2_Manual	Start	Turn On
Wellpump_2_Manual	Start	Turn Off

PRW2_stop

Chart Referenced	Block Referenced	Instruction
Wellpump_2_Auto	Start	Turn On
Wellpump_2_Auto	Stop	Turn Off
Wellpump_2_Manual	Stop	Turn Off
Wellpump_2_Manual	Start	Turn On

PRW2_trip

Chart Referenced	Block Referenced	Instruction
Wellpump_2_Auto	Tripped?	OR?
Wellpump_2_Manual	Tripped?	OR?

PRW3_Run

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	PRW3?	On?
Blower_B1_Auto	PRW3?	On?
Wellpump_3_Auto	Manual Chart	Move to Table Element
Wellpump_3_Auto	Running?	On?
Wellpump_3_Manual	Running?	On?

PRW3_Start

Chart Referenced	Block Referenced	Instruction
Wellpump_3_Auto	Start	Turn On
Wellpump_3_Auto	Start	Turn Off
Wellpump_3_Manual	Start	Turn On
Wellpump_3_Manual	Start	Turn Off

PRW3_Stop

Chart Referenced	Block Referenced	Instruction
Wellpump_3_Auto	Stop	Turn Off
Wellpump_3_Auto	Start	Turn On
Wellpump_3_Manual	Start	Turn On
Wellpump_3_Manual	Stop	Turn Off

PRW3_Trip

Chart Referenced	Block Referenced	Instruction
Wellpump_3_Auto	Tripped?	OR?
Wellpump_3_Manual	Tripped?	OR?

PSL1

Chart Referenced	Block Referenced	Instruction
Miscellaneous	Blower Pres?	On?

Stripper_High_Level_Alarm_Light

Chart Referenced	Block Referenced	Instruction
Miscellaneous	Stripper not Hi	Turn Off
Miscellaneous	Stripper Hi	Turn On

ZS1A

Chart Referenced	Block Referenced	Instruction
TV1_Auto	Valve Open?	On?
TV1_Manual	Valve Open?	On?

ZS1B

Chart Referenced	Block Referenced	Instruction
FV1_Auto	Valve Closed?	On?
FV1_Manual	Valve Closed?	On?

I/O UNITS

Digi16A - Not referenced.

RTU - Not referenced.

RTUX - Not referenced.

NUMERIC TABLES

AM_Status - Integer

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Auto	Equal to Table Element?
Blower_B1_Auto	Auto	Equal to Table Element?
Blower_B1_Manual	Manual?	Equal to Table Element?
FV1_Auto	Auto?	Equal to Table Element?
FV1_Manual	Manual	Equal to Table Element?
Pump_P1_Auto	Auto	Equal to Table Element?
Pump_P1_Manual	Manual?	Equal to Table Element?
Wellpump_1_Auto	Auto	Equal to Table Element?
Wellpump_1_Manual	Manual?	Equal to Table Element?
Wellpump_2_Auto	Auto	Equal to Table Element?
Wellpump_2_Manual	Manual?	Equal to Table Element?
Wellpump_3_Auto	Auto	Equal to Table Element?
Wellpump_3_Manual	Manual?	Equal to Table Element?

Manual_Outputs - Integer

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Manual Chart	Move to Table Element
Blower_B1_Manual	Start PB?	Equal to Table Element?
Blower_B1_Manual	Stop PB?	Equal to Table Element?
FV1_Manual	Close PB?	Equal to Table Element?
FV1_Manual	Open PB?	Equal to Table Element?
Pump_P1_Auto	Manual Chart	Move to Table Element
Pump_P1_Manual	Stop PB?	Equal to Table Element?
Pump_P1_Manual	Start PB?	Equal to Table Element?
Wellpump_1_Auto	Manual Chart	Move to Table Element
Wellpump_1_Manual	Start PB?	Equal to Table Element?
Wellpump_1_Manual	Stop PB?	Equal to Table Element?
Wellpump_2_Auto	Manual Chart	Move to Table Element
Wellpump_2_Manual	Stop PB?	Equal to Table Element?
Wellpump_2_Manual	Start PB?	Equal to Table Element?
Wellpump_3_Auto	Manual Chart	Move to Table Element
Wellpump_3_Manual	Start PB?	Equal to Table Element?
Wellpump_3_Manual	Stop PB?	Equal to Table Element?

STRING VARIABLES

MODEM_INIT_1

Chart Referenced	Block Referenced	Instruction
Initialize_Modem	INIT	Move String
Initialize_Modem	INIT_MODEM_1	Transmit String via Serial Port

MODEM_INIT_2

Chart Referenced	Block Referenced	Instruction
Initialize_Modem	INIT_MODEM_2	Transmit String via Serial Port
Initialize_Modem	INIT	Move String

MODEM_RESPONSE_ - Not referenced.

SLAVE_STEP

Chart Referenced	Block Referenced	Instruction
Initialize_Modem	INIT_MODEM_1	Move String
Initialize_Modem	INIT_MODEM_1	Move String

SUB_ - Not referenced.

NUMERIC VARIABLES

A__DELAY - Integer - Not referenced.

B1_Auto_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Manual Chart	Move
Blower_B1_Auto	Manual Chart	Move
Blower_B1_Manual	Auto Chart	Start Chart
Powerup	Start Charts	Start Chart

B1_Manual_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Manual Chart	Start Chart
Blower_B1_Auto	Manual Chart	Start Chart
Blower_B1_Manual	Auto Chart	Move

Discharge_Counter - Integer

Chart Referenced	Block Referenced	Instruction
Discharge_Totalizer	Total	Add
Discharge_Totalizer	Flow Rate	Multiply
Discharge_Totalizer	Read Counter	Get Counter

Discharge_Flowrate - Integer

Chart Referenced	Block Referenced	Instruction
Discharge_Totalizer	Flow Rate	Multiply

Discharge_Timer - Timer

Chart Referenced	Block Referenced	Instruction
Discharge_Totalizer	Expired?	Timer Expired?
Discharge_Totalizer	Set Count Time	Move

Discharge_Totalizer_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

Dsch_Totalizer - Integer - Not referenced.

FIT1_Total - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Total	Add
Well_Flow_Totalizer	Total	Add

FIT2_Total - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Total	Add
Well_Flow_Totalizer	Total	Add

FIT3_Total - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Total	Add
Well_Flow_Totalizer	Total	Add

FV1_Auto_Chart - Integer

Chart Referenced	Block Referenced	Instruction
FV1_Auto	Manual Chart	Move
FV1_Manual	Auto Chart	Start Chart
Powerup	Start Charts	Start Chart

FV1_Manual_Chart - Integer

Chart Referenced	Block Referenced	Instruction
FV1_Auto	Manual Chart	Start Chart
FV1_Manual	Auto Chart	Move

Historic_Log_On - Integer - Not referenced.

INIT_COUNT - Integer - Not referenced.

Initialize_Cycle_Timer - Timer - Not referenced.

Miscellaneous - Integer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

MODEM_ONLINE - Integer

Chart Referenced	Block Referenced	Instruction
Initialize_Modem	OUT_GOOD	Set Variable True

MODEM_PORT - Integer

Chart Referenced	Block Referenced	Instruction
Initialize_Modem	OUT_GOOD	Clear Receive Buffer
Initialize_Modem Port	INIT_MODEM_2	Transmit String via Serial
Initialize_Modem Serial Port	INIT_MODEM_2	Transmit Character via
Initialize_Modem	INIT	Configure Port Timeout
Initialize_Modem Port	INIT_MODEM_1	Transmit String via Serial
Initialize_Modem Serial Port	INIT_MODEM_1	Transmit Character via

MODEM_TIMER - Timer - Not referenced.

P1_Auto_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart
Pump_P1_Auto	Manual Chart	Move
Pump_P1_Manual	Auto Chart	Start Chart

P1_Manual_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Pump_P1_Auto	Manual Chart	Start Chart
Pump_P1_Manual	Auto Chart	Move

Passcheck - Integer - Not referenced.

PORT_STATUS - Integer

Chart Referenced	Block Referenced	Instruction
Initialize_Modem	OUT_GOOD	Clear Receive Buffer
Initialize_Modem Port	INIT_MODEM_2	Transmit String via Serial
Initialize_Modem Serial Port	INIT_MODEM_2	Transmit Character via
Initialize_Modem	INIT	Configure Port
Initialize_Modem Port	INIT_MODEM_1	Transmit String via Serial
Initialize_Modem Serial Port	INIT_MODEM_1	Transmit Character v.

SCPAP - Integer

Chart Referenced	Block Referenced	Instruction
Initialize_Modem	OUT_GOOD	Start Host Task (ASCII)
Powerup	Start Charts	Start Chart

Stop_Timer - Timer

Chart Referenced	Block Referenced	Instruction
Blower_B1_Auto	Time?	Timer Expired?
Blower_B1_Auto	Set Time	Move

Stripper_Hi - Integer

Chart Referenced	Block Referenced	Instruction
Miscellaneous	Stripper not Hi	Move
Miscellaneous	Stripper Hi	Move
Pump_P1_Auto	INTLK?	OR?
Wellpump_1_Auto	INTLK?	OR?
Wellpump_1_Manual	INTLK?	OR?
Wellpump_2_Auto	INTLK?	OR?
Wellpump_2_Manual	INTLK?	OR?
Wellpump_3_Auto	INTLK?	OR?
Wellpump_3_Manual	INTLK?	OR?

Sump_Hi - Integer

Chart Referenced	Block Referenced	Instruction
FV1_Auto	Sump HI?	Equal?
Miscellaneous	Sump Not Hi	Move
Miscellaneous	Sump Hi	Move

[illegible]_P1_Auto	INTLK?	OR?
Well[illegible]pump_1_Auto	INTLK?	OR?
Well[illegible]pump_1_Manual	INTLK?	OR?
Wellpump_2_Auto	INTLK?	OR?
Wellpump_2_Manual	INTLK?	OR?
wellpump_3_Auto	INTLK?	OR?
Wellpump_3_Manual	INTLK?	OR?

Total1 - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	/constant	Divide
Well_Flow_Totalizer	Read & Clear	Get & Clear Analog
Totalizer Value		

Total1a - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Total	Add
Well_Flow_Totalizer	/constant	Divide

Total2 - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	/constant	Divide
Well_Flow_Totalizer	Read & Clear	Get & Clear Analog
Totalizer Value		

Total2a - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Total	Add
Well_Flow_Totalizer	/constant	Divide

Total3 - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	/constant	Divide
Well_Flow_Totalizer	Read & Clear	Get & Clear Analog
Totalizer Value		

Total3a - Float

Chart Referenced	Block Referenced	Instruction
Well_Flow_Totalizer	Total	Add
Well_Flow_Totalizer	/constant	Divide

Total_Discharge_Counts - Integer

Chart Referenced	Block Referenced	Instruction
Discharge_Totalizer	Total	Add
Discharge_Totalizer	Total	Add
Discharge_Totalizer	Total	Multiply

Total_Discharge_Flow - Float

Chart Referenced	Block Referenced	Instruction
Discharge_Totalizer	Total	Multiply

Well_Flow_Totalizer_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart

Wellpump_1_Auto_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart
Wellpump_1_Auto	Manual Chart	Move
Wellpump_1_Manual	Auto Chart	Start Chart

Wellpump_1_Manual_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Wellpump_1_Auto	Manual Chart	Start Chart
Wellpump_1_Manual	Auto Chart	Move

Wellpump_2_Auto_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart
Wellpump_2_Auto	Manual Chart	Move
Wellpump_2_Manual	Auto Chart	Start Chart

Wellpump_2_Manual_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Wellpump_2_Auto	Manual Chart	Start Chart
Wellpump_2_Manual	Auto Chart	Move

Wellpump_3_Auto_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Powerup	Start Charts	Start Chart
Wellpump_3_Auto	Manual Chart	Move
Wellpump_3_Manual	Auto Chart	Start Chart

Wellpump_3_Manual_Chart - Integer

Chart Referenced	Block Referenced	Instruction
Wellpump_3_Auto	Manual Chart	Start Chart
Wellpump_3_Manual	Auto Chart	Move

1.0 SYSTEM STARTUP AND SHUTDOWN INSTRUCTIONS

1.1 GENERAL

There are site specific parameters and standard pre-startup, startup, normal operations, shutdown, and emergency shutdown procedures for the Parris Island Site 45 treatment system. The following subsections address all the site specific parameters and procedures.

1.2 SITE 45, DRY CLEANERS FACILITY

The Site 45 pump and treatment system consists of three wells and wellpumps, air stripper with positive displacement blower, discharge pump, floor sump with sump and various flow, pressure and level indicators and transmitters.

1.2.1 Design Parameters

Site 45 System Design Parameters	Value
Max. Well Flow	6 gpm
Min. Well Flow	0.75 gpm
Norm. Well Flow	1-3 gpm
Max. Blower Discharge Pressure	17 in. WC
Min. Blower Discharge Pressure	10 in. WC
Norm. Blower Discharge Pressure	12-14 in. WC
Max. Stripper Discharge Flow	25 gpm
Min. Stripper Discharge Flow	10 gpm
Norm. Stripper Discharge Flow	25 gpm

1.2.2 System Alarm Limits

Alarm limits for the system are electronically accessible through the OPTO 22 control system.
No present alarm limits are established :

Site 45 System Alarm Limits	Low Value	High Value	Units

1.2.3 Initial-Startup Procedures

Site 45 Initial-Startup Procedures	Expected Response/Remarks
1. Ensure proper personal protective equipment is available and worn correctly.	1. Hearing protection, hard hat, safety glasses and study work boots are required.
2. Obtain system startup approval.	2. Direction from Bechtel Project Engineer. The PE has key to building and well guards.
3. Verify that electrical power is **ON** and that the following circuit breakers located in panel LP1 are **ON** ; main, 1, 7, 9, 19, 23, 2, 14, & 26 and that 21, &25 are **OFF**	3. If room light will not turn on assume that power to the building is deenergized at the pole or that circuit breaker 26 in LP1 is tripped. CB 21 & 25 are for the control computer and in the off position the computer will not run the control program.
4. Visually inspect equipment.	4. None.
5. Visually inspect process lines for leaks or damage.	5. None.
6. Visually inspect position of system influent valves V1, V2, & V3	6. Valves should be open to their throttle position. If not, place valves approximately 25% open.
7. Visually inspect position of well head valves V11 , V12, & V13.	7. Valves should be open.
8. Verify cord connection to power outlet for well pumps PRW1, PRW2, & PRW3.	8. None.
9. Inspect position of valves V14 and V15 of air stripper.	9. Valves should be open.
10. Inspect position of valves V16 and V18	10. Valves should be open.
11. Inspect position of valves V17 and V19	11. Valves should be closed.
12. Inspect position of floor sump valve V4.	12. Valve should be closed.
13. Bump test sump pump.	13. Wall switch above sump pump operates the pump.
14. Inspect water level in the stripper sump.	14. If level in stripper sump is above high – high level switch, coordinate with Operations Manager to empty sump.
15. Inspect all gages.	15. None.

16. Verify that all motor starters are in the **AUTO** position.	16. None.
17. Verify that the following circuit breakers located in panel LP1 are **ON** ; 21 & 25.	17. Computer should initialize the program and system will operate.

procedure complete.

1.2.4 Startup Procedures

Site 45 Startup Procedures	Expected Response/Remarks
1. Perform Initial-Startup Procedures listed in Section 1.2.3.	1. Notify Bechtel Project Engineer of any non functioning equipment.
2. Establish computer communication as outlined in *2.0 System Control and Monitoring*	2. Start OPTO Display Runtime program for Site 45 and select Treatment System window.
3. Verify flow control valve FV-1 is 100% **OPEN**.	3a. FV-1 should already be open in response to the control system power-up. If Not perform 3b-3d. 3b. Locate FV-1 symbol and click on the actuator portion of the symbol. 3c. Select MANUAL mode by clicking on the MANUAL button. 3d. Click on the OPEN button to open the valve. 3e. Return FV-1 to Auto mode by clicking on the AUTO button.

IF the well flow rates have been previously set at the desired rate and downtime was minimal, no flow adjustments are needed; skip to step 5, otherwise proceed to step 4.

4. Manually adjust valves V-1 through V-3 to operating flowrates with well pump running.	4. Well 193-1-RW @ 1.0-2.0 gpm Well 193-2-RW @ 2.0-3.0 gpm Well 193-3-RW @ 1.5-2.5 gpm
5. Check treatment system screen for alarm indications.	5. Acknowledge alarms if any.

*Operator is responsible for responding to alarm conditions when operating valves, blower, and pumps, in **MANUAL** mode. In **MANUAL** mode, system alarms will not automatically generate the designed response.* ***SYSTEM MUST NEVER BE LEFT UNSUPERVISED IN MANUAL MODE.***

6. Verify Blower B1 is in **AUTO** mode.	6a. Locate Blower symbol and click on the motor to displa the mode pop-up window. The display should read "IN AUTO". If not perform step 6b. 6b. Click on the AUTO button . 6c. The display should read "IN AUTO".

7. Verify stripper drain Pump P1 is in **AUTO** mode.

7a. Locate Pump P1 symbol and click on the motor to display the mode pop-up window. The display should read "IN AUTO". If not perform step 7b.

7b. Click on the AUTO button .
7c. The display should read "IN AUTO".

8. Check wellpump system screen for alarm indications.

7. Acknowledge alarms if any.

9. Verify Wellpump PRW1 is in **AUTO** mode.

9a. Locate Wellpump PRW1 symbol and click on the moto to display the mode pop-up window. The display shoul read "IN AUTO". If not perform step 9b.

9b. Click on the AUTO button .
9c. The display should read "IN AUTO".

10. Verify Wellpump PRW1 is in **AUTO** mode.

10a. Locate Wellpump PRW1 symbol and click on the motor to display the mode pop-up window. The display should read "IN AUTO". If not perform step 10b.

10b. Click on the AUTO button .
10c. The display should read "IN AUTO".

11. Verify Wellpump PRW1 is in **AUTO** mode.

11a. Locate Wellpump PRW1 symbol and click on the motor to display the mode pop-up window. The display should read "IN AUTO". If not perform step 4b.

11b. Click on the AUTO button .
11c. The display should read "IN AUTO".

12. Remove laptop from control system

12a. Close open display windows.
12b. Exit OPTO Display Runtime.
12c. Disconnect communication cabling.
12d. Perform normal windows shutdown.

procedure complete.

1.2.5 Normal Local Operating Procedures

Site 45 Normal Local Operating Procedures	Expected Response/Remarks
1. Ensure proper personal protective equipment is available and worn correctly.	1. Hearing protection, hard hat, safety glasses and study work boots are required.
2. Visually inspect piping and equipment.	2. Look for leaks in piping or obstructions to equipment.
3. Establish computer communication as outlined in *2.0 System Control and Monitoring.*	3. Start OPTO Display Runtime program for Site 45 and select Treatment System window.
4. Verify blowers and pumps are operating in the AUTO mode.	4a. Locate device symbol and click on the motor to displa the mode pop-up window. The display should read "IN AUTO". If not perform step 4b. 4b. Click on the AUTO button . 4c. The display should read "IN AUTO".
5. Inspect system flow, pressure and levels.	5a. Parameters found on the treatment system screen and on the wellpump screen. 5b. Notify Bechtel Project Engineer of any unusually low/high flows .
6. Record data points	6a. Click the ON button for the historic log located at the bottom of the Wellpump System screen. 6b. Notify the Bechtel Project Engineer of any unusually low/high flows or trends in daily log.
7. Inspect water level in stripper sump and in floor sump.	13. If level in floor sump is close to floating the level sensor, coordinate with Bechtel Project Engineer to empty sump.
8. Conduct routine system sampling.	12. Samples to be taken at influent and effluent sampling ports SP1, SP2, SP3, & SP5 once a month.
9. Conduct a visual inspection of the site.	13. Note and report any damage to building or pump guards to the Bechtel Project Engineer.

10. Proceed with field sampling activities as required.	10. None
11. Secure premises prior to leaving.	11a. Lock doors and turn off lights. 11b. During winter months set unit heater ON at 40F.

procedure complete.

1.2.6 Shut Down Procedures With Laptop (Short Duration)

Site 45 Shut Down Procedures	Expected Response/Remarks
1. Inform Bechtel Project Engineer that the system is being shut down.	1. Record time of notification and shut down action.
2. Establish remote or local computer connection as stated in *2.0 System Control and Monitoring*.	2. Start OPTO Display Program for Site 45 and open the Wellpump system screen.
3. Stop Wellpump PRW1.	3a. Locate wellpump symbol and click on the mot to pop-up the Auto/Manual-Start/Stop window. 3b. Click on the MANUAL button 3c. Click on the STOP button.
4. Stop Wellpump PRW2.	4a. Locate wellpump symbol and click on the mot to pop-up the Auto/Manual-Start/Stop window. 4b. Click on the MANUAL button 4c. Click on the STOP button.
5. Stop Wellpump PRW3.	5a. Locate wellpump symbol and click on the mot to pop-up the Auto/Manual-Start/Stop window. 5b. Click on the MANUAL button 5c. Click on the STOP button.
6. Stop blower B-1.	6 Blower will automatically shutdown after five minutes wellpump delay.
7. Stop Stripper drain pump P-1	7. Allow drain pump to cycle automatically to remove water draining from trays.

*Operator is responsible in responding to alarm conditions when operating valves, blower,and pumps in **MANUAL** mode. In **MANUAL** mode, system alarms will not automatically generate the designed response. **SYSTEM MUST NEVER BE LEFT UNSUPERVISED IN MANUAL MODE. IF A POWER FAILURE OCCURS DURING THIS COMPUTER SHUTDOWN, THE RTU WILL REINITIALIZE IN THE AUTOMATIC MODE AND THE SYSTEM WILL START.***
procedure complete.

1.2.7 Local Shut Down Procedures(Short Duration)

Site 45 Emergency Shut Down Procedures	Expected Response/Remarks
1. Inform Bechtel Project Engineer that the system is being shut down.	1. Record time of notification and shut down action.
2. Locate the motor starter cabinet MSP for the wellpump.	2. Place starters 1, 2, and 3 in the **OFF** position.
3. Stripper Blower shutdown.	3. Allow blower to shutdown automatically following a five minute time-out.
4. Stripper Drain Pump P1 Shutdown.	4. Allow drain pump to cycle automatically to remove water from the trays.

procedure complete.
Note the RTU computer is still energized and running the automatic program. When the starters for the wellpumps are returned to normal they will run if called for by the program.

1.2.7 Emergency Shut Down Procedures (also Long Term Outage)

Site 45 Emergency Shut Down Procedures	Expected Response/Remarks
For Emergency	
1. Locate the main power supply disconnect switch on the utility pole outside of the building and turn the main disconnect **OFF.**	1. None
For Long term outage	
2. Locate the main power distribution panel LP1 inside the building and turn the main circuit breaker **OFF.**	2. None
3. Inform Bechtel Project Engineer and Operator who conducts normal operating rounds that the system is being shut down.	3. Record time of notification and shut down action.

procedure complete.

2.0 SYSTEM CONTROL AND MONITORING

The control and monitoring of Paris Island's Site45 treatment facility is accomplished through the supervisory control and data acquisition (SCADA) system. The SCADA system is an integrated concept using a remote telemetry unit (RTU), analog and digital input/output (I/O) modules, and a remote laptop personal computer (PC). The facility can be controlled and monitored from remote locations or locally at the treatment site.

2.1 SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

The SCADA system integrates the treatment facility by providing for local and remote control of treatment system equipment status, including start/stop and open/close control functions. The system also provides indication of operating parameters such as pressure, flow, and level. In addition the system allows for local and remote alarming, trending, and logging functions for treatment system equipment.

The treatment facility contains an OPTO 22 RTU and OPTO 22 digital and analog I/O hardware housed in a paneled enclosure equipped with a modem and telephone line.

Any Windows 95 based laptop computer having 16-megabytes of random access memory (RAM), loaded with the application software for the site, may be used for local control and local logging.

Remote control and logging may be performed using any Windows 95 based computer having a minimum of 16-megabytes of RAM, loaded with the application software for the site, equipped with internal modem, and with access to a standard voice telephone line.

2.1.1 System Attributes

The SCADA system consists of the following components:

- Laptop PC monitor for treatment site control and logging functions. The operator can access the sites one at a time for monitoring, logging, changing control set points, or changing modes of operation. The supervisor control computer (SCC) is connected to the site with modems using the alternate host port function of the site RTU. The connection can be maintained for as long as needed.

- The RTU is a modular electronic control device consisting of solid-state functional components. It addresses digital and analog inputs and consists of a central processing unit, an I/O processing unit, ports for expandable I/O unit, and operator interfaces. The RTU performs logical decision making for control application and control of field devices without the use of mechanical relays.

- The RTU processor uses a flow charting software called "OPTO Control" for visual control logic programming and point ID control and addressing. The operator graphical interface is accomplished with "OPTO Display " software. Both software operate in a Microsoft Windows 95 operating system.

The RTU programming provides the following functions:

- Scans inputs.

- Controls outputs.

- Responds to operator commands, local or remote.
- Maintains real time and accepts real time updates from the local operator interface or from the remote supervisory PC.
- Communicates with local or remote operator interfaces.

Programming the OPTO 22 control system is done by the Bechtel Project Engineer. Any programming modifications shall be referred to the Bechtel Project Engineer.

2.1.2 System Functions

The SCADA system performs the operations:

- The system provides remote and local graphical interfaces for an operator to change modes of operation, or monitoring of treatment system components.
- The system communicates directly to a locally connected laptop PC.
- The RTU analog input function monitors each analog input, performs analog/digital conversion on 4-20 MADC input signals, and holds the digital value in a buffer for RTU processing. Each analog input is capable of having high and low limits assignable for alarm initiation triggers. Setting of the analog point zero and span input levels is accomplished using OPTO Control software.
- The RTU analog output function accepts digital data, performs digital/analog conversion, and outputs a 4-20 MADC signal to field devices for each analog output. Setting of zero and span output levels is accomplished using OPTO Control software.
- The RTU digital input function monitors each digital input and processes two-state data from field contact sources.
- The RTU digital output function monitors digital outputs and provides equivalent contact (form A) output signals for momentary and maintained operation of field devices such as motor starters and motor operated valve. Each output module is equipped with a manual on/off/automatic switch to allow manual control of the output status.
- The RTU is provided with fault indication diagnostics that will allow the operator to rapidly recognize a system malfunction and localize the fault using a laptop PC.
- Interactive color graphic displays of the process or sections of the process have been prepared to resemble the system P&IDs for use on the laptop PC. The following features are available:
  - Indication of process variables, outputs, set points, and mode of operation are included in the displays.
  - Alarms are indicated on the displays by a flashing alarm symbol.
  - Motor status (running or stopped) is indicated on the displays by changing symbol color (red = running, green = stopped).

- Motor operated valve position (open or closed) are indicated on the displays by changing symbol color (red = open, green = closed).

- Displays are multicolored, interactive, and dynamic.

- OPTO Display software was used to build the displays and assign the various symbol attributes.

2.1.3 RTU and I/O System Components

The RTU is a microprocessor-based, completely solid-state unit capable of program storage and performing all logical functions and scanning sequences, with external and internal control functions for implementing the intended design. It uses two microprocessors, a 32-bit control and communication processor and a 16-bit I/O processor for I/O interfacing. The unit contains a clock/calendar real-time clock with a lithium battery capable of protecting memory data. The RTU includes power and watchdog timer monitoring functions. Other features include the following:

- The RTU, power supply, I/O modules, drivers, and interconnecting cabling are mounted on a single control panel installed in a NEMA 4x rated enclosure, Control Panel CP-1.

- Analog input modules accept standard 4-20 MADC input signals with input impedance of 250 ohms and have 12 bits of resolution. Loop current is supplied by the module. Modules are OPTO 22 Mystic 200, G4 series, installed on the RTU/RTUX in any of the 4-channel analog slots.

- Analog output modules output standard 4-20 MADC signals into a loop impedance of 600-ohms with 12 bits of resolution. Loop current is supplied by the module. Modules are OPTO 22 Mystic 200, G4 series, installed on the RTU/RTUX in any of the 4-channel analog slots.

- Digital input modules have externally powered switched 120 VAC input signals with input impedance of 2 K-ohms minimum. Each module provides 4,000 Vrms optical isolation. Input status is displayed on module front with a red LED (on = energized state). Modules are OPTO 22 Mystic 200, G4 series installed in any channel of a 16-channel brick, model G4D16RS or as part of the digital section of the RTU/RTUX units.

- Digital output modules are equivalent contact Form A output signals capable of 2-amp continuous loads supplied by an external 120 VAC source. Each module provides 4,000 Vrms optical isolation. Output status is displayed on module front with a red LED (on = energized). Each module is equipped with a manual on/off/automatic switch. Modules are OPTO 22 Mystic 200, G40AC5MA series installed in any channel of a 16-channel brick, model G4D16RS or as part of the digital section of the RTU/RTUX units.

- RTU programming software is capable of programming off-line, downloading off-line developed programs to the RTU processor, and on/off-line debugging. Software allows programming in flowchart format with control terminology expressed as state logic. Programming is accomplished using pull-down menus and text entry. Programming software is OPTO 22, model OPTO Control.

- The power supply for the RTU has an input voltage range of 100 to 135 VAC and a regulated output voltage range of 22.5 to 24.5 VDC. The power supply is capable of supplying the RTU processor and all I/O requiring 24 VDC loop power. Power supply is fully encased in metal and operable in a nonventilated hazardous environment.

- The modem has selectable line speeds in the range of .3 to 21.6 KBPS with adaptive connect speed monitoring that selects line speeds based on line quality. Modem protocols are Hayes AT with bi-directional flow control. Modem operates on 120 VAC, 60 Hz power with full surge protection on power and phone lines. Modem is a Zypcom model Z32t-SE.

2.2 REMOTE MONITORING AND CONTROL

2.2.1 Remote Control and Monitoring of Treatment Facility

The treatment facility is remotely controlled and monitored via the laptop PC. A modem is provided internal to the PC and configured to allow communication between the treatment site RTU and the PC. The PC provides the remote control, data acquisition, logging, and trending features of the SCADA system.

Data acquisition occurs whenever the site is connected to the PC. Data is transferred from the site RTU to the PC. The data transfer occurs approximately every 2 seconds until hang-up. The transfer rate will depend on the telephone line condition and noise.

Historical logging of each site's data is initiated by the operator by selection of the historic log "On" button on the site graphic display. The data is stored as a log file in the laptop PC for use with any third party database software for interrogation and reporting.

2.3 LOCAL MONITORING

Local control and monitoring of treatment facility are primarily via the laptop PC at the site location. Connection to the site must be established first (see Section 2.4).
Local gauges and meters are also provided to allow visual verification of process conditions and local switches provide a means of starting and stopping pumps should a computer fail or not be available.

2.4 COMMUNICATION

The first step in controlling and monitoring the treatment systems is to establish computer-to-RTU communication. The following subsections state how to locally and remotely connect the computer to each system.

2.4.1 Local Laptop Computer Communication

2.4.1.1 Setup at the Site

1. Position laptop securely on designated platform.

2. Insert the computer/RTU patch cable into the nine pen serial computer port COM 1 and connect the cannon plug to the RTU cabinet cannon bulkhead connector. The internal portion of the connection has already been made to the RTU communications port COM 0.

3. Turn the computer on and boot up computer.

4. The Windows 95 Program Manager screen should be displayed.

2.4.1.2 Setting Up Site-Specific Programs

To ensure the laptop is set to the specific site program, perform the following:

For OPTO CONTROL CONFIGURATOR:

1. Double click on the **OPTO 22 Program Group** icon.
2. Double click on the **OPTO Control** icon.
3. Pull down the **OPTO Control** menu option.
4. Highlight **Configurator** and click to access **OPTO Control Configurator**.
5. Pull down the **File** menu option.
6. Highlight **Load** and click.
7. Locate and click on **Directory**.
8. For local connection a site-specific folder is to be chosen. Highlight the **desired file** and click.
9. Highlight **Accept** and click.
10. Locate and click on the **File** menu option.
11. Highlight **Quit** and click to quit **OPTO Control Configurator**.
12. Highlight **Yes** and click.

For OPTO CONTROL DEBUGGER:

1. Pull down the **OPTO Control** menu option.
2. Highlight **Debugger** and click to access **OPTO Control Debugger**.
3. Pull down the **File** menu option.
4. Highlight **Load** and click.
5. Locate and click on **Directory**.
6. For local connection a site-specific folder is to be chosen. Highlight the **desired file** and click.
7. Highlight **Accept** and click.

At this time the laptop actually connects to the running logic program in the RTU. The screen will display the home page of the logic program. At the top of the screen the program status is displayed and should show "Running." This proves that the connection is good and that the laptop is communicating with the RTU. To exit debugger, perform the following:

1. Locate and click on the **File** menu option.
2. Highlight **Quit** and click to quit **OPTO Control Debugger**.
3. Highlight **Yes** and click.

The OPTO Control Debugger mode is the normal way to troubleshoot a logic problem of the system or monitor the I/O points for signal values or check the enable/disable status of the point. To exit OPTO Control, perform the following:

1. Locate and click on the **File** menu option.
2. Highlight **Quit** and click to quit **OPTO Control**.

For the graphic interface display **OPTO Display Configurator and OPTO Display Runtime:**

For OPTO DISPLAY CONFIGURATOR:

1. Double click on the **OPTO Display Configurator** icon.
2. At the new project screen click on **Cancel**.
3. Locate and click on the **File** menu option.
4. Highlight **Open Project** and click.
5. Highlight and click on the **desired folder (Site No.)**.
6. Click on **OK** to select the project folder.
7. Click on **OK** again to open the project file.
8. Locate and click on the **File** menu option.
9. Highlight **Quit** and click to quit **OPTO Display Configurator**.

For OPTO DISPLAY RUNTIME:

1. Double click on the **OPTO Display Configurator** icon.
2. At the new project screen click on **Cancel**.
3. Open the desired **Project File OPTO Display Runtime** screen.
4. Locate and click on the **File** menu option.
5. Highlight and click on the **desired folder (Site No.)**
6. Click on **OK**.
7. Click on **OK**.

At this time the laptop and the RTU will connect and assemble all the programmed attributes with the site logic control file. Upon connection or failure to connect an event log viewer will be displayed.

8. Click on **Cancel** at the **event log viewer** window upon successful attachment and writing of the **Site Historic Log File**.

The Event Log Viewer dialog window displays the Runtime system event log. This log contains errors and messages received during Runtime. Each message consists of a date and time stamp and message text. The message text describes events such as communications errors and I/O errors. Scroll bars may be used to view prior messages. This window should appear upon entrance into OPTO Display Runtime. The message "Attached to Scanner" indicates that there was successful attachment with the file and the RTU. Other messages may be displayed, such as the successful writing of a log file.

Click on the windows menu selection a list of windows that may be opened is displayed.

9. Highlight the Wellpump System window and while holding the shift button on the PC highlight the Treatment System window.
10. Click OK to open both windows (overlaid)

The Wellpump System screen will be visible and after 3-5 seconds the screen will actively attach to the RTU program and the display will be active with real time data.

11. Use the Windows menu selection to switch between the System screens.

2.4.2 Disconnecting Computer Communication

Once all local control and monitoring are complete and it is desired to disconnect the computer.

1. Close all system windows to get back to the blank project system **menu screen.**
2. Locate **File** on the menu bar; locate and click on **exit OPTO Display Runtime.**
3. Disconnect the cable from the PC and the bulkhead connector on the control cabinet.

2.4.3 Remote Computer Communication

2.4.3.1 Setup at a Remote Location

1. Insert the phone cable into the phone jack and connect the other end to the modem connector on the computer.
2. Turn the computer on and boot up computer.
3. The Windows 95 Program Manager screen should be displayed.

2.4.3.2 For OPTO Display Runtime

1. Select the **OptoDial** icon on the Windows 95 Program Manager screen. A pop-up window will appear.
2. Enter the project telephone number into the dial string "ATDT8435252519".
3. Enter COM port #2 into port selection.
4. Enter a baud rate of 115,200 BPS.
5. Select the **Dial button.**

This button will execute a Visual Basic file that initializes the modem, dials the selected site and will show a connection status in the message section of the window.

6. Minimize the OptoDial pop-up window.

For **OPTO DISPLAY RUNTIME**:

7. Double click on the **OPTO Display Configurator** icon.
8. At the new project screen click on **Cancel.**
9. Open the desired **Project File OPTO Display Runtime** screen.
10. Locate and click on the **File** menu option.
11. Highlight and click on the **desired folder (Site No.)**
12. Click on **OK.**
13. Click on **OK.**
14. Click on **Cancel** at the **event log viewer** window upon successful attachment and writing of the **Site Historic Log File.**

The Event Log Viewer dialog window displays the Runtime system event log. This log contains errors and messages received during Runtime. Each message consists of a date and time stamp and message text. The message text describes events such as communications errors and I/O errors. Scroll bars may be used to view prior messages. This window should appear upon entrance into OPTO Display Runtime. The message "Attached to Scanner" indicates that there was successful attachment with the file and the RTU. Other messages may be displayed, such as the successful writing of a log file.

Click on the windows menu selection a list of windows that may be opened is displayed.

15. Highlight the Wellpump System window and while holding the shift button on the PC highlight the Treatment System window.

16. Click OK to open both windows (overlaid)

The Wellpump System screen will be visible and after 5-10 seconds the screen will actively attach to the RTU program and the display will be active with real time data.

17. Use the Windows menu selection to switch between the System screens.

2.4.4 Disconnecting Remote Communication

Once all remote control and monitoring are complete and it is desired to disconnect the computer.

1. Close all system windows to get back to the blank project system **menu screen**.
2. Locate **File** on the menu bar; locate and click on **exit OPTO Display Runtime**.
3. Maximize the OptoDial window and click the Hang-up button.

*The operator may remain on the **OptoDial window** indefinitely or close out the batch file.*

4. Close the OptoDial window.
5. Disconnect the phone cable from the PC and the wall connector .

ATTACHMENT 5

3.0 RECOVERY WELL PUMP SERVICING

The following describes the sequence of tasks for removing and servicing submersible pumps from a recovery well.

1. Turn starter switch for subject well pump OFF at Motor Starter Panel (MSP-1).
2. Remove upper portion of the Hot Box cover at subject well head.
3. Unplug pump power cord from power outlet.
4. Remove well cap and close ball valve.
5. Carefully lift down well piping approximately 12" from well casing using support cable.
6. Unscrew bottom union at ball valve to separate down-well piping from the ball valve and ¾-inch discharge tubing. Care should be taken not to lose the 'O' ring from the union.
7. Carefully lift down-well piping from well casing using support cable.
8. Lift piping to union and disconnect union, allow for water within the pipe to drain into the well casing before complete disconnection. Care should be taken not to loose the 'O' ring from the union.
9. Place all down-well piping/materials on plastic sheeting.
10. Remove remainder of piping and pump from the well.
11. See Grundfos pump manual (Attachment 3) for disassembly and servicing the pump.
12. Reinstall pump and down well materials by reversing the sequence for removal.

MAINTENANCE SCHEDULE

ITEM DESCRIPTION	MAINTENANCE ACTIVITY	FREQUENCY			CATALOG PAGE	COMMENTS
		MONTHLY	QUARTERLY	AS REQUIRED		
GOULDS SUBMERSIBLE SUMP PUMP	ELECTRICAL BUMP TEST		X		--	
IN-SITU PRESSURE TRANSDUCER, RECOVERY WELLS	CLEAN NOSECONE & FILTER			X	15	
NEEP AIR STRIPPER ASSEMBLY	CLEAN TRAYS			X	4-1	
	CHECK TIGHTNESS OF BOLTS AND FITTINGS		X		7-4	
BLOWER	GREASE BLOWER BEARING	X			7-4	
DWYER PRESSURE SWITCH	REMOVE DEPOSITS FROM VENT DRAIN PLUG		X		E-57	
DWYER MAGNEHELIC GAGE	RE-ZERO GAGE		X		A-27	
MARLEY UNIT HEATER	CHECK SETTINGS FOR WINTER TEMPERATURE CONTROL			X	--	
HAYWARD BASKET STRAINER	CLEAN STRAINER BASKET			X	--	
GREENHECK EXHAUST FAN	CHECK FAN OPERATION FOR SUMMER TEMPERATURE CONTROL	X			--	
	CHECK LOUVER OPERATION FOR OBSTRUCTIONS	X			--	
GREENHECK ADJUSTABLE BLADE LOUVER	CHECK LOUVER SETTING FOR OBSTRUCTIONS	X			--	
SEAHORSE FIBERGLASS BUILDING	CHECK WATER LEVEL IN SUMP	X			--	
	VACUUM BUILDING FLOOR		X		--	
	CHECK BUILDING EXTERIOR FOR DAMAGE	X			--	

O&M LOGSHEET
MCRD PARRIS ISLAND, SC

Inspector's Name:		Date:
Time Arrived at Site:	Time Departed Site:	Weather Conditions:
Materials/Supplies Used:		

Item	Readings/Results
1.0 Recovery Pump House	Are conditions acceptable?
Open the cover and inspect the pump housing, pumps, piping, and electrical connections. Note any problem areas, leaks, etc.	RW 1 ☐ Yes ☐ No RW 2 ☐ Yes ☐ No RW 3 ☐ Yes ☐ No
1.1 Clean Transducer Nose Cone and Filter	RW 1 ☐ Yes ☐ No RW 2 ☐ Yes ☐ No RW 3 ☐ Yes ☐ No
1.2 Pump Control Elevations	RW 1 ☐ Yes ☐ No RW 2 ☐ Yes ☐ No RW 3 ☐ Yes ☐ No
2.0 Air Sample Readings	
PID reading from treatment building	ppm
3.0 Flow Readings	
3.1 FIT-1 reading	gpm
3.2 FIT-2 reading	gpm
3.3 FIT-3 reading	gpm
4.0 Air Stripper	
4.1 PI-5 reading	inches of water
4.2 FQIT 3 reading	gallons
4.3 Blower inspection/maintenance	
4.4 Blower grease bearing	☐ Yes ☐ No
4.5 Discharge pump inspection/maintenance	☐ Yes ☐ No
4.6 Inspect/clean air stripper trays and refill wiers	☐ Yes ☐ No
4.7 Check tightness of bolts and fittings	☐ Yes ☐ No
4.8 Remove deposits from vent drain plug on pressure switch	☐ Yes ☐ No
4.9 Re-zero magnehelic gauge	☐ Yes ☐ No
5.0 Building and Miscellaneous Equipment	☐ Yes ☐ No
5.1 Unit heater – check temperature setting	☐ Yes ☐ No
5.2 Clean strainer basket	☐ Yes ☐ No
5.3 Exhaust fan inspection and maintenance	☐ Yes ☐ No
5.4 Check/clean building door louvers	☐ Yes ☐ No
5.5 Clean sump and bump test pump	☐ Yes ☐ No
5.6 Clean building floor	☐ Yes ☐ No

Treatment System Water Sampling Log		
Collected by:	**Date:**	**SEIR No.:**

Sample Location			SP-1	SP-2	SP-3	SP-4
Analytes	**Container**	**Presv.**	**Cont. ID**	**Cont. ID**	**Cont. ID**	**Cont. ID**
VOCs	40 mL vials	HCl				
TOC	250 mL amber	H_2SO_4				NA
Alkalinity	1,000 mL amber	none				NA
Sulfate	250 mL poly	none				NA
Chloride	250 mL poly	none				NA
Nitrate	250 mL poly	none				NA
Iron	250 mL poly	HNO_3				NA
BOD 5-day	1,000 mL poly	none	NA	NA	NA	

Treatment System Water Field Data		
Collected by:	**Date:**	
Equipment used and Serial Numbers:		

Parameter	Sample Locations			
	SP-1	SP-2	SP-3	SP-4
pH				
Temperature				NA
Conductivity				NA
Dissolved O_2				NA
Turbidity				NA
Redox Potential				NA

Notes:

Parris Island Former Dry Cleaners Facility
Groundwater Sampling Schedule

Sample Event	Field Parameters						Chemical Analysis							
	Temp	PH	Cond	DO	Turbidity	Redox	VOCs	TOC	Alkalin.	Sulfate	Chloride	Nitrate	Iron	BOD
Baseline & Quarterly Groundwater Sampling at 16 Wells	X	X	X	X	X	X	X	X	X	X	X	X	X	
System Operation Monthly Sampling (Influent) from RW-1,2,3	X	X	X	X	X	X	X	X	X	X	X	X	X	
System Operation Monthly Sampling (Effluent) to FOTW		X			X		X							X

GROUNDWATER SAMPLING RECORD

Sampling Event:	Logbook ID:	Sheet 1 of 2

SAMPLING STATION

Station ID	Station Type *WELL*

SAMPLE

Sample ID	Sample Matrix *GWT*	Sample Type *ENV*	Collection Method	Date	Time	By

Weather Conditions:

Field Logbook(s) Pages	ES&H Jrnl(s) Pgs	SEIR No.:

Flush Mount Well Inspection

Is the concrete pad cracked or unstable? ☐ Yes ☐ No	Is the water-tight cover damaged? ☐ Yes ☐ No	Is water in the interior of the casing? ☐ Yes ☐ No	Is the bentonite seal cracked or damaged? ☐ Yes ☐ No

Remarks:

Instruments	Manufacturer/Mode	Serial No.	Func. Ck.	Calib. Due	Reference
pH/Eh					
Conductivity/Temp					
Dissolved Oxygen					
Turbidity					

Water LEVEL DATA (before purging)

Well Variables	Casing Volume Calculations
Depth of water = (TD - H) = h (ft) [H = depth to top of water]	V = $\pi(R)^2$ h×(7.48 gal/ft^3)
Inside diam. of casing = d(in.); 1/2(d) = r(in.)	V = _____ 3x _____
$\frac{r(in.)}{12(in.)} = R(ft)$; [7.48 gal/ft^3 constant]	V = _____ gal

WELL PURGE INFORMATION

Purge equipment:	S/N:	Purge method:	Pump type:

Prog Cyc	Date	Time	Temp (°C)	pH	Eh	Units	Cond.	Units	Turb ( )		D.O. ( )	VolPrdg (gal)	Purge rate (gpm)

Well purged to dryness: ☐ Yes ☐ No

GROUNDWATER SAMPLING RECORD

Sampling Event:	Logbook ID:	Sheet 2 of 2

Container Information				
Analytes	**Container**	**Preservative**	**Container ID**	**Comment**
VOCs	40 mL vials	HCL		
TOC	250 mL amber	H_2SO_4		
Alkalinity	1000 mL poly	none		
Sulfate	250 mL poly	none		
Chloride	250 mL poly	none		
Nitrate	250 mL poly	none		
Iron	250 ml poly	HNO_3		

Parameters during sampling (Record immediately before sampling and every 2 hours if sampling time exceeds 2 hours):

Date	Time	Temp	pH	Eh	Conductivity	Turb.	D.O.

Remarks:

Recorded by:	Date	Reviewed by	Date