FINAL

SWMU B-3 BIOREACTOR

OPERATION AND MAINTENANCE MANUAL

Prepared For:

Camp Stanley Storage Activity

Boerne, Texas

July 2008 Update

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

btoc	below top of casing
BTS	Bioreactor Trench Sump
CC	Cow Creek Formation
CSSA	Camp Stanley Storage Activity
DO	Dissolved oxygen
DOC	Dissolved organic carbon
ft	Feet
GAC	Granular activated carbon
gpm	Gallons per minute
HDPE	High density polyethylene
HOA	Hand off automatic
HSP	Health and Safety Plan
MPMW	Multi port monitoring well
MSL	Mean sea level
MW	Monitoring well
NTP	Notice to proceed
O&M	Operation and Maintenance
ORP	Oxidation reduction potential
Parsons	Parsons Infrastructure and Technology
psi	Pounds per square inch
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SWMU	Solid Waste Management Unit
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TOC	Total organic carbon
toc	top of casing
VOC	Volatile organic compound

SECTION 1
INTRODUCTION

The purpose of this O&M Plan is to describe the procedures to be followed during normal operation of the system. The Plan provides a detailed description of the injection system, including specifications of system components, data to be collected during normal system operation, system maintenance procedures, and general site maintenance to facilitate effective system operations. The Plan furthermore provides CSSA with a set of procedures for monitoring the equipment used for operating the SWMU B-3 bioreactor as well as monitoring the effectiveness of the bioreactor at reducing the concentrations of VOCs in the aquifer underlying SWMU B-3.

This Operations and Maintenance (O&M) Plan documents the necessary activities to be performed during operation and maintenance of the Solid Waste Management (SWMU) B-3 bioreactor and injection system installed at Camp Stanley Storage Activity (CSSA) in Boerne, Texas.

Section 2 provides a description of the pilot study remedial (bioreactor) system to be operated at the Site, including detailed description of the system components. Section 3 describes the system operation and monitoring requirements, Section 4 presents the system maintenance activities to be performed, and Section 5 discusses reporting requirements. The Texas Commission on Environmental Quality (TCEQ) Authorization Letter(s) for the underground injection of CS-MW16 groundwater is included in Appendix A. Product manuals and literature of system components are included in Appendix B through I. Field data forms to be used during O&M activities are included in Appendix J.

1.1 HEALTH AND SAFETY

CSSA and Parsons Infrastructure and Technology (Parsons) are committed to performing the O&M activities at the B-3 site in a safe manner. A Health and Safety Plan (HSP) has been prepared that addresses worker safety during performance of the O&M activities at the site. The HSP identifies potential safety hazards associated with the O&M work activities and describes safety procedures that must be implemented to ensure that the work can be completed without incident. A copy of the HSP is maintained at CSSA.

All personnel performing O&M activities at the site must read the HSP to become familiar with the potential work hazards and the safety procedures to be followed. After familiarizing themselves with the HSP, all employees must sign the HSP Acknowledgement Form maintained at CSSA. The procedures presented in the HSP must be followed by Parsons Employees and subcontractors at all times while on CSSA. The HSP will be updated as needed to address new site work hazards or incorporate work tasks as they are identified.

1.2 SITE DESCRIPTION

CSSA is located in northwestern Bexar County about 19 miles northwest of San Antonio, Texas. The installation consists of 4,004 acres immediately east of State Highway 3351 and approximately one-half mile from Interstate Highway 10. Additional background information regarding CSSA is located in CSSA's Environmental Encyclopedia (**Volume 1-1, Background Information Report**).

SWMU B-3 was a landfill area thought to have been used primarily for garbage disposal and trash burning from the 1950's through the 1980s. The trench areas were reportedly closed in 1990-1991. In 1991, chlorinated hydrocarbons were detected in groundwater from Well CS-16, approximately 500 feet north-northwest of SWMU B-3. The VOC concentrations, which were above drinking water standards, prompted several investigations aimed at identifying possible source areas that could be contributing to the contamination. SWMU B-3, along with nearby SWMU O-1 (oxidation pond), was identified as potential sources of groundwater contamination within the inner cantonment.

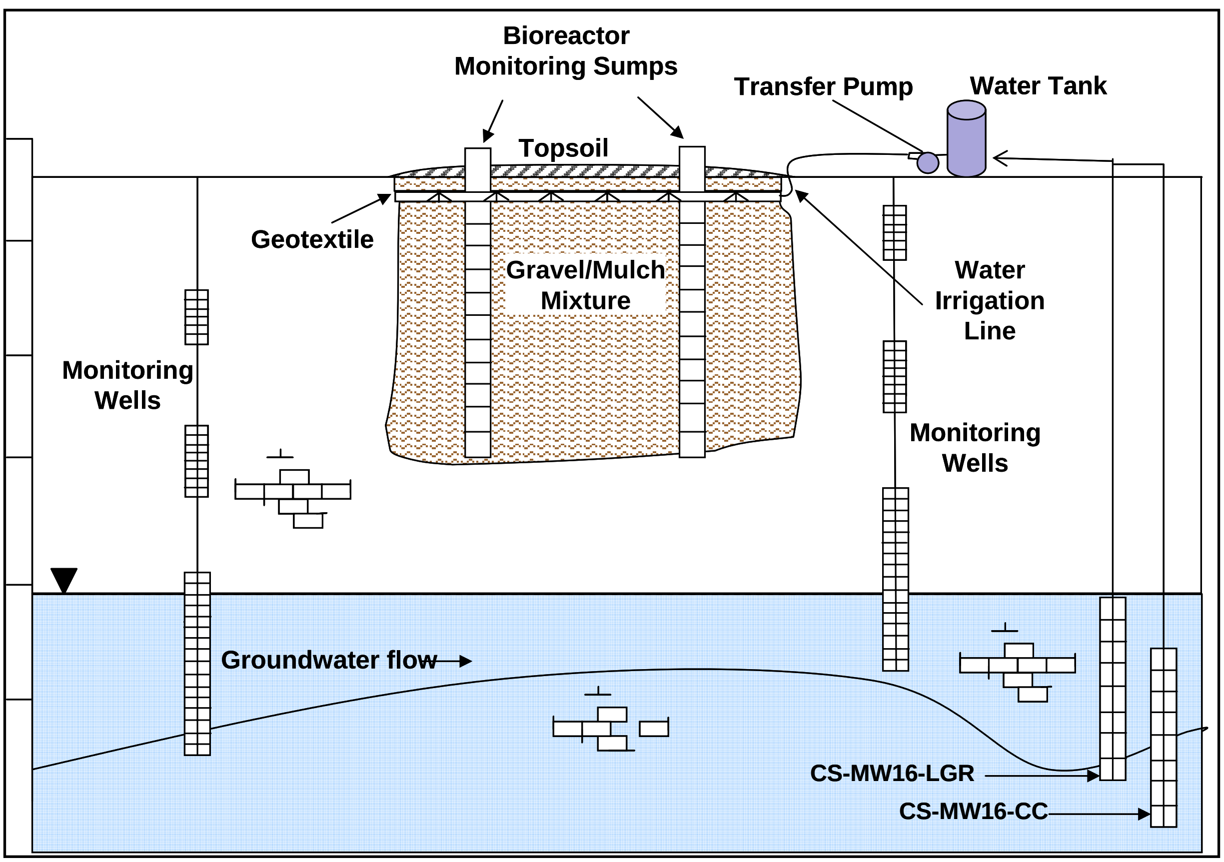
As part of the Resource Conservation and Recovery Act (RCRA) Administrative Consent Order, a pilot study using a bioreactor was conceptualized, designed, and constructed at SWMU B-3. The bioreactor is designed to remediate the affected groundwater and unsaturated zone underlying SWMU B-3. The design included excavation, removal, and offsite disposal of affected soil, debris, and waste contained within six trenches. The waste is believed to be a likely source of contaminants impacting the underlying fractured limestone (bedrock) and groundwater.

Based on the general design of the bioreactor, a request for a Class V Aquifer Remediation Injection Well was submitted to the Industrial and Hazardous Waste Permits Section of the Waste Permits Division at the Texas Commission on Environmental Quality (TCEQ) in May 2006. The permit application was approved July 20, 2006 and TCEQ Authorization Number 5X2600431; WWC 12002216; CN602728206/RN104431655 was assigned to the SWMU B-3 injection system. An amendment to CSSA's Class V Aquifer Remediation Injection permit was submitted November 26, 2006 to authorize the use of a sixth trench that was encountered during removal actions at SWMU B-3. A copy of the Class V Aquifer Remediation Injection Well permit authorization letter and correspondence related to amendments are presented in Appendix A.

SECTION 2
SYSTEM DESCRIPTION

The general concept (see Figure 2.1) is to pump water approximately 400 feet from recovery wells CS-MW16-LGR and CS-MW16-CC to a 5,000-gallon storage tank. Level switches within the storage tank will be set to communicate directly with the two water delivery wells to maintain an available water supply in the water tank for the bioreactor. A transfer pump is used to pump water from the storage tank to the network of pipes buried approximately 1.5 ft below a gravel surface which overlay's the SWMU B-3 gravel/mulch filled trenches. Water from the storage tank will be sprayed into the gravel/tree mulch mixture in each trench through downward-pointing discharge nozzles located at 10-foot centers along 1.5-inch flexible high density polyethylene (HDPE) pipe. In order to prevent overfilling of the bioreactor, a level switch is included in monitoring sump 1-1 (Trench 1 - sump 1) to control the application of water from the transfer pump. This sump, 1-1 is located in the deepest portion of Trench 1, which is west and downslope of all the other trenches. Additional transducers may be added to the other remaining trenches to provide simultaneous monitoring locations to assess subsurface flows within the bioreactor.

Figure 2.1 General Components of the Bioreactor



Water will be pumped into each trench to create saturated conditions within a portion of the gravel/tree mulch mixture. The capability of the bioreactor to reduce the concentrations of contaminants associated with CS-MW16-LGR and CS-MW16-CC as well as in the subsurface will be accessed through periodic sampling of groundwater monitoring wells located around SWMU B-3. To further enhance anaerobic degradation, possible future plans may call for amending the groundwater from the CS-16 wells with an organic substrate that would be added to the bioreactor via an eductor located between the transfer pump and the piping network over the trenches.

2.1 BIOREACTOR CONSTRUCTION

The details associated the construction of the bioreactor are provided in *"B-3 Bioreactor Construction Report"* (Parsons, February 2007).

2.2 MAJOR EQUIPMENT

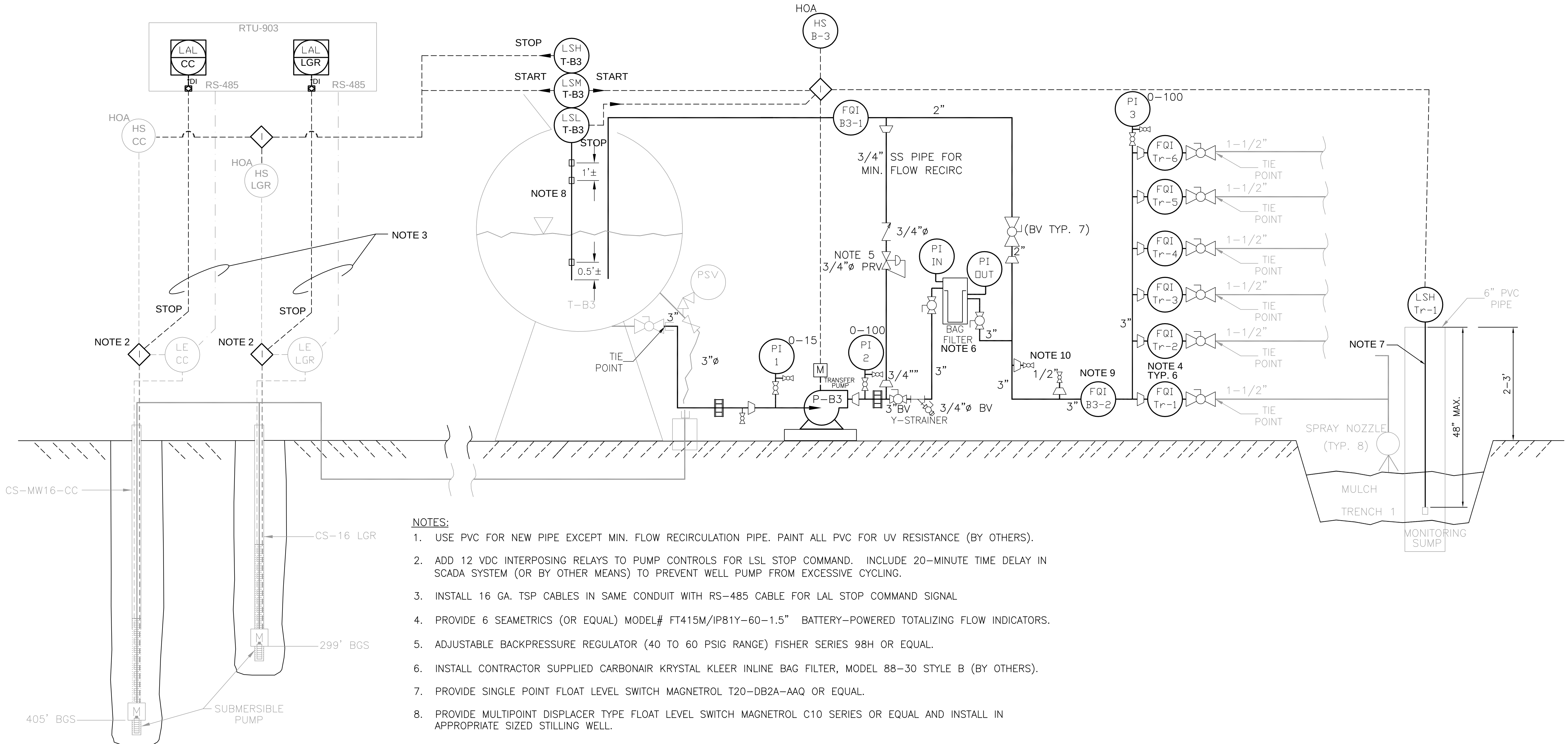
Equipment was installed to provide, control and maintain a flow of water from the two CS-MW-16 wells. The process diagram depicting the equipment and the controls regulating the flow of water through the system is shown in Figure 2.2.

2.2.1 Recovery Well Pumps

The existing submersible pumps on 2-inch pipe with electric cable were placed into CS-MW-16LGR and CS-MW-16CC wells in 2002. These pumps will be used to supply recovered groundwater for injection into SWMU B-3. A 1-inch diameter flex-pipe line was also installed to facilitate water level probe access along with QED low-flow pump (sampling) in CS-MW-16LGR and transducer in both CS-MW-16 wells. Pump details, including operations and maintenance instructions and parts listing is provided in Appendix B.

2.2.2 System Transfer Pump

An end suction centrifugal pump manufactured by Price® Pump Co. was installed to pump water from the storage tank to the bioreactor based upon the water level detected in the bioreactor. The pump is bolted to a site constructed concrete pad and is connected to the storage tank with a 2-inch suction hose and schedule 80 polyvinyl chloride (PVC) line. A 1.5-inch line installed from the pump to the bag filter and then from the bag filter to the 3-inch header connects the pump to the distribution system. Since portions of the line between the storage tank and the distribution line are above ground, precautions will be taken to prevent line damage during freezing weather conditions. Additional information about the pump is provided in Appendix C.



NOTES:

1. USE PVC FOR NEW PIPE EXCEPT MIN. FLOW RECIRCULATION PIPE. PAINT ALL PVC FOR UV RESISTANCE (BY OTHERS).
2. ADD 12 VDC INTERPOSING RELAYS TO PUMP CONTROLS FOR LSL STOP COMMAND. INCLUDE 20-MINUTE TIME DELAY IN SCADA SYSTEM (OR BY OTHER MEANS) TO PREVENT WELL PUMP FROM EXCESSIVE CYCLING.
3. INSTALL 16 GA. TSP CABLES IN SAME CONDUIT WITH RS-485 CABLE FOR LAL STOP COMMAND SIGNAL
4. PROVIDE 6 SEAMETRICS (OR EQUAL) MODEL# FT415M/IP81Y-60-1.5" BATTERY-POWERED TOTALIZING FLOW INDICATORS.
5. ADJUSTABLE BACKPRESSURE REGULATOR (40 TO 60 PSIG RANGE) FISHER SERIES 98H OR EQUAL.
6. INSTALL CONTRACTOR SUPPLIED CARBONAIR KRYSTAL KLEER INLINE BAG FILTER, MODEL 88-30 STYLE B (BY OTHERS).
7. PROVIDE SINGLE POINT FLOAT LEVEL SWITCH MAGNETROL T20-DB2A-AAQ OR EQUAL.
8. PROVIDE MULTIPOINT DISPLACER TYPE FLOAT LEVEL SWITCH MAGNETROL C10 SERIES OR EQUAL AND INSTALL IN APPROPRIATE SIZED STILLING WELL.
9. PROVIDE TWO SEAMETRICS (OR EQUAL) FLOWMETERS, ONE EACH OF THE FOLLOWING MODELS: FT415M/IP81Y-60-3" AND FT415M/IP81Y-60-2" BATTERY-POWERED TOTALIZING FLOW INDICATORS. (866) 542-9641.
10. INSTALL 1/2" ISOLATION VALVES FOR FUTURE AMENDMENT ADDITION (BY OTHERS).
11. LABEL TANK WITH STENCIL OR PLACARD "CS-16 NON-POTABLE WATER"
12. INSTALL CONTRACTOR SUPPLIED HORIZONTAL END-SUCTION CENTRIFUGAL, CLOSE-COUPLED PUMP P-B3 WITH A CAPACITY OF 120 GPM @ 145 FT (BY OTHERS).

Legend

—— (light line)	EXISTING
—— (heavy line)	NEW
▷	REDUCER
Y-strainer symbol	Y-STRAINER

744223.10 B3 P-10M.DWG

Figure 2.2

Bioreactor Pumping System Process Diagram
SWMU B-3
Camp Stanley Storage Activity

PARSONS

2.2.3 Storage Tank

A 5000-gallon former transport tanker was placed on the north side of the bioreactor and secured so that the tanker would not move. The former transport tank will serve as temporary storage for ground water from the two CS-MW-16 wells and is set to supply water on demand to the bioreactor. Monthly inspections will be conducted to monitor the condition of the tank and noted in the field logbook.

2.2.4 Bag Filter System

The sprayer openings are small, a 0.063-inch orifice for the 1.7 gallons per minute (gpm) spray nozzle and a 0.094-inch orifice for the 2.5 gpm spray nozzle; therefore, it is necessary to remove possible sediment from the water to reduce the potential for clogging of the spray heads. As shown in Figure 2.2, bag filter equipment was installed downstream of the transfer pump in between the pump and the distribution system. The bag filter equipment, manufactured by Krystil Klear Filtration® consists of a single chamber with a coarse mesh basket and a bag filter fitted inside the mesh basket. The replacement of the bag filters should follow the schedule recommended by the manufacturer, or more frequently as determined by use in the field. Additional information about the bag filter equipment is provided in Appendix D.

2.2.5 Eductor for Incorporation of Additive

An eductor system is designed to be located down stream of the bag filter equipment and will be used in the future if it is necessary to pump additional additive into the bioreactor. A container of oil or similar microbial enhancement amendment can be placed near the eductor and an intake pipe will be placed in the container. The additive will be drawn into the flow system via the eductor as water passes through the piping and will be subsequently distributed uniformly with the injected groundwater.

2.3 TRENCH AND INJECTION PIPING LAYOUT

The details associated with excavation trenches are provided in "*B-3 Bioreactor Construction Report*" (Parsons, February 2007). There are six trenches within SWMU B-3 which are to be utilized for injection of recovered groundwater. The injection piping from the transfer piping is constructed of 1.5-inch HDPE piping with pressure type fittings. Injection nozzles are located in each trench and are brass spray nozzles with orifice openings of 0.063-inch for the 1.7 gpm spray nozzle, and a 0.094-inch orifice for the 2.5 gpm spray nozzle. Nozzle specifications are provided in Appendix E.

2.4 INSTRUMENTS AND CONTROL

Two sets of controllers were installed to monitor and control the conveyance of water from the two CS-16 wells to the bioreactor. The first set of controllers maintains the flow of water between the storage tank and the two wells, CS-MW16-LGR and CS-MW16-CC. The storage tank is equipped with a high, medium, and low level switches set to communicate with each well, which is equipped with pressure transducers that are set to detect low water level (pump is turned off) and high water level (pump is restarted after well has recovered). The control equipment for these two wells is located in the GAC building and Hand or Manual, Off and Automatic (HOA) switches for each pump are located at the well heads. The second set of controllers maintains the flow of water between the storage tank and the bioreactor. The high, medium, and low level switches in the storage tank are set to also communicate with the transfer pump based on the water level detected in monitoring sump 1-1. The control equipment for the transfer pump includes an HOA switch located near the transfer pump. Product information for controllers and instruments are provided in Appendix F.

2.4.1 Pressure Gauges and Flow Meters

The monitoring and reporting of flow volumes discharged into the subsurface is required by TCEQ and must be reported in scheduled (monthly and/or quarterly) UIC authorization reports. Instruments to monitor line pressures and volume of injection water are provided for the B-3 bioreactor System. Pressure gauges are located at various locations between the storage tank and the main header as shown in the design drawings in *"B-3 Bioreactor Construction Report"* (Parsons, February 2007.). In addition, flow meters are installed to provide injection volumes in each of the six trenches, as well as extraction volumes from the extraction wells. A K factor of 98.0 is used for flow meters installed on 1.5" lines, and a K factor of 25.4 is used for flow meters installed on 3" lines. The lines that lead to injection nozzles in each trench are equipped with FT415 SeaMetrics flow meters to obtain discrete volumes injected into each trench. Product information for the FT415 SeaMetrics flow meters are provided in Appendix G**.**

2.4.2 Liquid Level Switches

Multiple sets of water level indicators are required for the automation system to operate effectively. One set is installed within the storage tank and is comprised of three Magnetrol, model C10, liquid level switches. These switches indicate high, medium, and low levels within the storage tank. One model T20, Magnetrol liquid level switch is installed in sump 1-1, to communicate the water level within the trench to the control system which, in turn, controls the transfer pump. Product information for the liquid level switches are provided in Appendix H.

SECTION 3
SYSTEM OPERATION AND MONITORING

3.1 SITE ACCESS

Camp Stanley is an active military installation. Security regulations mandate that the base be informed about any operation that are to take place inside the installation borders. Visitors and subcontractors need to contact the base 48 hours in advance with personal information to obtain entrance permit. Entry to the base occurs through the main gate situated in the south-west corner of the base, on FM 3351. Access related issues are coordinated through the CSSA Environmental Office.

3.2 NORMAL OPERATION PROCEDURES

During normal operation, the system will be pumping groundwater from two wells, CS-MW16-LGR and CS-MW16-CC. The extracted groundwater is pumped into the storage tank and subsequently through a bag filter to remove suspended solids that could cause fouling of the spray nozzles and ultimately into trenches filled with deciduous tree mulch/gravel mixture. The following sections outline the steps in the operation of the bioreactor. The intent of operating and controlling the groundwater recovery system (CS-MW16 wells) and the bioreactor transfer pumping system (5,000 gallon storage tank) is to maximize the throughput of water to the bioreactor.

3.2.1 Pumping water from CS-16 to Storage Tank

Submersible pumps in Wells CS-MW16-CC and CS-MW16-LGR are expected to pump water at a combined, sustainable flow rate of approximately 30 gpm to the 5,000-gallon storage tank located approximately 400 feet through a buried 2-inch PVC line. Note that the 30 gpm rate is an estimated average rate that may fluctuate depending on aquifer recharge resulting from rainfall events. Each well is equipped with a pressure transducer that is set to signal deactivation of the pump if the water level gets too low during the drawdown phase and will also signal the pump when the water level is high enough for the pump to restart after the recovery phase of the well. The different scenarios controlling the operation of the well pumps (water levels in recovery well and 5,000 gallon storage tank) are identified in Table 3.1.

In addition to the controller associated with the water level transducer for each of the CS-16 wells, there is a second controller connected to level switches located in the 5,000-gallon storage tank. The controllers for the transducers are located at the B-3 transfer tank control panel. There is an HOA switch at each pump that should be kept in the automatic mode where both the well transducer and the storage tank level switches control the activation of the pump.

Table 3.1 Scenarios Dictating Activation of the Submersible Pumps at CS-16

Water Level in Well	Water Level in 5000-gallon Storage Tank	Activation of Both or One CS-16 Well Based on Water Levels in Well and Storage Tank
1. During drawdown phase and above the low level turn-off depth.	Below the high level turn-off.	**On**
2. During drawdown phase and above the low level turn-off depth.	At the high level turn-off.	Off
3. During recovery phase and above the low level turn-off depth, but also below the high level restart.	Below the high level turn-off.	Off
4. During recovery phase and above the low level turnoff depth.	At the high level turn-off.	Off
5. High level is attained (*i.e.*, completion of recovery phase)	Below the high level turn-off.	**On**
6. High level is attained (*i.e.*, completion of recovery phase)	At the high level turn-off.	Off

Note: Controllers are switches that start or stop operations under certain conditions.

Generally, the controllers associated with the recovery wells will allow recovery well pumps to operate when there is sufficient water in the wells and sufficient volume capacity in the 5,000 gallon storage tank.

3.2.2 Pumping Water from Storage Tank to the Bioreactor

Water will enter the northern end of the tank and the stored water will be pumped from the tank with an end-suction centrifugal transfer pump located between the storage tank and the bioreactor. The operation of the transfer pump will be controlled by the water level indicated by a level switch in bioreactor trench sump 1-1 in Trench 1. This sump is located in the deepest portion of the bioreactor and should provide a representative water level elevation of the saturated conditions across the base of the bioreactor in Trenches 1 through 5. There is an HOA switch at the transfer pump that should be kept in the automatic mode where both the sump water level switch and the storage tank level switches control the activation of the transfer pump. The different scenarios controlling the operation of the transfer pump are identified in Table 3.2.

Table 3.2 Scenarios Dictating Activation/Deactivation of the Transfer Pump

Water Level in Bioreactor Sump	Water Level in 5000-Gallon Storage Tank	Response of Transfer Pump Based on Signal from a Sump or a Tank Level Switch
1. Below the high level turn-off switch and water level rising in Trench 1 with transfer pump operating.	Above the low level turn-off.	Continues operating
2. Below the high level turn-off switch and water level rising in Trench 1 with transfer pump operating.	Water level reaches the low level turn-off.	Turns off
3. Below the high level turn-off switch and water level dropping in Trench 1 with transfer pump off.	Water level rising in tank and reaches the medium-level turn-on (switch set just below the high level switch).	Turns on
4. Pump has been off and water level recedes below the sump level switch.	Water level at high-level switch.	Turns on
5. Pump has been on and water rises to the sump level switch.	Water level above low-level turn-off switch.	Turns off

Generally, the controllers at the 5,000 gallon storage tank will operate the transfer pump when there is sufficient volume of water in the 5,000 gallon storage tank and sufficient volume capacity within trench 1.

3.3 LOCKOUT/TAGOUT

When the system is being shut down to perform any electrical or piping service it is necessary to follow the lockout/tagout procedure to prevent potential injuries, prevent exposure to contaminated materials, and reduce the potential for spillage of contaminated groundwater. Maintenance and repair activities requiring lockout/tagout procedures include work on the submersible pumps, pressure transducers, storage tank, and bag filter system. Each time a lockout/tagout becomes necessary, the authorized person shall log the activity to be performed, the name of the person carrying out the activity, the date, and the time in the Logout/Tagout Log form included in Appendix I; after completing the maintenance activity the authorized person shall proceed to file the filled out tag used during the activities in the Lockout/Tagout folder, to be preserved as a safety record.

Phase I – Locking, Blocking or Releasing Energy:

- ♦ The authorized person notifies all affected people on site that a lockout/tagout procedure is ready to begin.

- The authorized person will turn off the power to the system and lockout the power switch.
- The authorized person releases or restrains all stored energy (*i.e.* venting residual pressure in the filter, or closing the valve upstream of the section of piping affected to isolate it before performing the necessary work)
- All locks and tags are checked for defects. If any are found, the lock or tag is discarded and replaced.
- The authorized person places a personalized lock or tag on the energy isolating device.
- The authorized person tries to start the system to ensure that it has been isolated from its energy source. The system is then de-energized again after this test. If the work to be performed is of an electrical nature, it will be necessary to test the affected components with a volt-meter to ensure that they are not energized.
- The system is now ready for service or maintenance.

Phase II – Returning the System to Normal Operation:

1. The authorized person checks the system to be certain no tools have been left behind.
2. All safety guards are checked to be certain that they have been replaced properly, if applicable.
3. All affected people on site are notified that the system is about to go back into normal operation.
4. The authorized person performs a secondary check of the area to ensure that no one is exposed to danger.
5. The authorized person removes the lock and/or tag from the energy isolating device and restores energy to the system.

3.4 SYSTEM MONITORING

Monitoring of the system operation will be performed to measure the effectiveness of the groundwater recovery and treatment processes and to assess performance and maintenance requirements for the system components. Data to be collected for compliance with UIC requirements of the groundwater recovery and bioreactor operations include:

- water elevation measurements;
- contaminant concentrations which include:
  - ✓ Volatile Organic Compounds (VOCs),
  - ✓ Total Dissolve Solids (TDS),
  - ✓ and pH;
- injection volumes; and
- system pressure readings.

Performance monitoring measurements include:

- Dissolved Organic Carbon (DOC),
- Methane, Ethane, Ethene,
- Dissolved Hydrogen,
- Temp, Specific Conductivity,
- Oxidation Reduction Potential (ORP),
- Dissolved Oxygen (DO),
- Dehalococcides populations, including vcrA reductase, TCE reductase, BAV1,
- Total Organic Carbon (TOC),
- Carbon Dioxide,
- Alkalinity,
- Nitrogen, Nitrate + Nitrite,
- Additional ions including Sulfate, Chloride, Ferrous Iron, Manganese,
- Soil gas monitoring for PCE, TCE, breakdown products, and
- rainfall totals.

The methods for collecting the data listed above and the end use of the data are described in the following sections.

Periodic monitoring and sampling will also be implemented to assess the effectiveness of the bioreactor to:

1) treat the contaminants in the groundwater being pumped to the trench, and
2) treat the contaminants present in the materials surrounding and underlying the excavation trenches.

3.4.1 Monitoring of Treatment within the Bioreactor

To evaluate the contaminant concentrations of the water pumped from the CS-MW-16 wells to the bioreactor, a water sample will be collected from a sampling port located prior to the injection nozzles. In addition, water samples will be collected from the bioreactor sumps periodically in accordance with this O&M plan's monitoring schedule. Water levels and water quality measurements will be recorded weekly for all the bioreactor sumps at least the first six months of operation and periodically thereafter. Transducers may be installed in at least one sump per trench to measure simultaneous fluctuating water levels in the bioreactor, A summary of the monitoring (both performance and regulatory monitoring) and sample collection schedule is presented in Table 3.3. Additional details such as proper sample collection methods are provided in the CSSA Sampling and Analysis Plan and associated amendments (Parsons, December 2005) which include additional details associated with the test methods such as container type(s) and preservative(s).

3.4.2 Monitoring the Treatment of Zones Underlying the Bioreactor

Four Multi-Port Monitoring Wells (MPMW) or Westbay® wells were installed around B-3 to monitor the groundwater percolating through the formation underlying B-

3. Through use of the multi-port system in each well, a representative sample can be collected from six to nine, discrete monitored zones that are each sealed at the top and bottom with permanent well packers to evaluate possible migration patterns of treated groundwater from the bioreactor to the underlying aquifer. Locations of the four MPMW wells are shown in Figure 3.1. A summary of the discrete intervals and the sample port depths relative to the top of casing (TOC) is provided in Table 3.4. The cross section in Figure 3.2 depicts the location of each sample port relative to elevation and within the rock formation. Water levels or elevation head can be recorded in each zone by lowering a device that can access each port one at a time. Through the following formula the pressure reading can be converted to a water level elevation:

$$Water\ Level = \frac{D-(P-A)}{0.4335}$$

Where D = depth of sample port below reference point
P = pressure of zone
A = Atm pressure at well head

A summary of the monitoring and samples to be collected is presented in Table 3.6. Appendix I provides a copy of the Westbay® monitoring well operations and repair manual.

3.4.3 Monitoring of Surrounding Monitor Wells

In addition to monitoring water levels and collecting samples from the MPMWs, samples will also be collected from four monitoring wells and all intervals of the four MPMWs that surround the site on a quarterly basis. The locations of these four wells and the MPMW's are shown in Figure 3.3. Figure 3.4 shows the topographical survey and the trench sump locations for the bioreactor. The list of these monitoring wells is identified in Table 3.5.

Table 3.3
Class V Aquifer Remediation Injection Well Permit #5X2600431
Sampling and Monitoring Schedule for the B3 Bioreactor Pilot Study
CSSA – Boerne, Texas

	Sampling or Monitoring Location	Parameter(s)	Sampling Frequency	Reporting Frequency
Current Regulatory Req.	Flow meters (6) for each trench on downstream side of the header and one flow meter on the upstream side of the header	Injection volume	Twice per month (record)	Monthly
	Pressure gages (4) on both sides of the transfer pump, at the bag filter and on the header	Pressure on the transfer pump	Twice per month (record)	Monthly
	Sampling port (1) on the upstream side of the distribution header	- pH (field) and TDS (lab) - VOCs (b)	Twice per month	Monthly
	Trench sumps (5) (b)	- pH (field) and TDS (lab) - VOCs (b)	Monthly	Quarterly
	MPMWs (4) (b)	- TDS (lab) - VOCs (b)	Quarterly	Quarterly
Proposed Regulatory Req.	Flow meters (6) for each trench on downstream side of the header and one flow meter on the upstream side of the header	Injection volume	Monthly (record)	Semi-Annual
	Pressure gages (4) on both sides of the transfer pump, at the bag filter and on the header	Pressure on the transfer pump	Monthly (record)	Semi-Annual
	Sampling port (1) on the upstream side of the distribution header	- pH (field) and TDS (lab) - VOCs (a)	Monthly	Semi-Annual
	Trench sumps (5) (b)	- pH (field) and TDS (lab) - VOCs (a)	Quarterly	Semi-Annual
	MPMWs (4) (b)	- pH (field) and TDS (lab) - VOCs (a)	Quarterly	Semi-Annual

Notes:

(a) Standard list of VOCs tested at CSSA
(b) Bioreactor trench sumps (BTS) include: Trench 1 – 1-1, 1-2 and 1-3; Trench 2 – 2-1 and 2-2; Trench 3 – 3-1 and 3-2; Trench 4 – 4-1; Trench 5 – 5-1 and 5-2; Trench 6 – 6-1 and 6-2. Samples are collected from all trench sumps which includes the injection of CS-MW16 groundwater.
Multi-port monitoring wells (MPMW) include: CS-WB05 (9 sampling ports), CS-WB06 (6 sampling ports), CS-WB07 (6 sampling ports) and CS-WB08 (6 sampling ports).
MPMW will be sampled quarterly and include only Zone LGR-03B for each MPMW.
Surrounding monitor wells includes: CS-MW1-LGR, CS-B3-MW01-LGR, CS-D-LGR, CS-MW16-LGR and CS-MW16-CC.

Table 3.4
List of Multi-Port Monitoring Wells

Well	Elevation (a) (Top of Casing)	Zone	Interval (Ft. BTOC)	Elevation (Ft MSL)		Sampling Port (b) (Ft BTOC)	
				Top of Interval	Base of Interval	Primary	Secondary
CS-WB05	1242.93	LGR-01	32 - 109	1210.93	1133.93	99	
		LGR-02	114 - 192	1128.93	1050.93	182	
		LGR-03	197 - 272	1045.93	970.93	216	262
		LGR-04A	277 - 286	965.93	956.93	277	
		LGR-04B	291 - 342	951.93	900.93	329	
		BS-01	347 - 390	895.93	852.93	362	
		CC-01	395 - 444	847.93	798.93	432	
		CC-02	449 - 482	793.93	760.93	460	
CS-WB06	1235.20	UGR-01	12 - 30	1223.20	1205.20	20	
		LGR-01	35 - 103	1200.20	1132.20	93	
		LGR-02	108 - 184	1127.20	1051.20	174	
		LGR-03	189 - 270	1046.20	965.20	207	260
		LGR-04	275 - 335.5	960.20	899.70	320	
CS-WB07	1235.13	UGR-01	9 - 24	1226.13	1211.13	14	
		LGR-01	29 - 100	1206.13	1135.13	90	
		LGR-02	105 -185	1130.13	1050.13	175	
		LGR-03	190 - 267	1045.13	968.13	208	257
		LGR-04	272 - 336.75	963.13	898.38	318	
CS-WB08	1253.26	UGR-01	12 - 48	1241.26	1205.26	38	
		LGR-01	53 - 125	1200.26	1128.26	115	
		LGR-02	130 - 203	1123.26	1050.26	193	
		LGR-03	208 - 283	1045.26	970.26	228	273
		LGR-04	288 - 357.5	965.26	895.76	341	

Notes:
BTOC - Below Top of Casing
(a) Top of Casing (TOC) elevations surveyed by Baker and Associates located in San Antonio, Texas.
(b) For each well there is one zone where both the upper (primary) and lower (secondary) portions are monitored.

Table 3.5
List of Surrounding Monitoring Wells

Well ID	TOC Elev. (Ft MSL)	Screen Interval Depth below TOC (Ft bgs)	Pump Depth (Ft bgs)	Pump Elevation (Ft MSL)	Depth to LGR/BS Contact (Ft bgs)	Planned Performance Monitoring Frequency
CS-MW1-LGR	1220.73	288 – 313	300	920.73	319	Baseline + Quarterly
CS-MW2-LGR	1237.08	318 – 343	330	907.08	347	Baseline + Quarterly
CS-MW-D-LGR	1257.27	296 – 321	283	974.27		Baseline + Quarterly
CS-B3-MW01	1242.84	277 - 287	284	958.84		Baseline + Quarterly

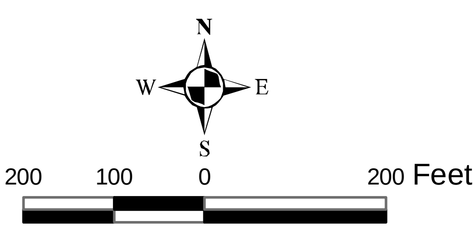
bgs = below ground surface
MSL = mean sea level

Table 3.6
B-3 O&M Monitoring Schedule

	Recurrence Interval	Activity
Performance Requirement	Weekly	Trench Sumps and MPMWs Water Level Measurements
	Monthly	Trench 1 Sumps, Uppermost Interval of WB-05, WB-07 Performance Sampling
	Quarterly	Trench Sumps, MPMWs, and Surrounding Wells Performance Sampling
Regulatory Requirement	Bi-Monthly	Headers and Flow Meter Measurements
	Bi-Monthly	Transfer Pump and Filter Pressure Readings
	Monthly	Sampling Port Monitoring (pH, TDS, VOCs)
	Monthly	Trench Sumps Sampling (ph, TDS, VOCs)
	Monthly	Uppermost Interval MPMWs Sampling (TDS, VOCs)

Activities begin on Week 53 of Bioreactor operations

Aerial Photo Date: 2003



Creeks (Dashed where intermittent)

Water Well Locations

SWMU Boundary

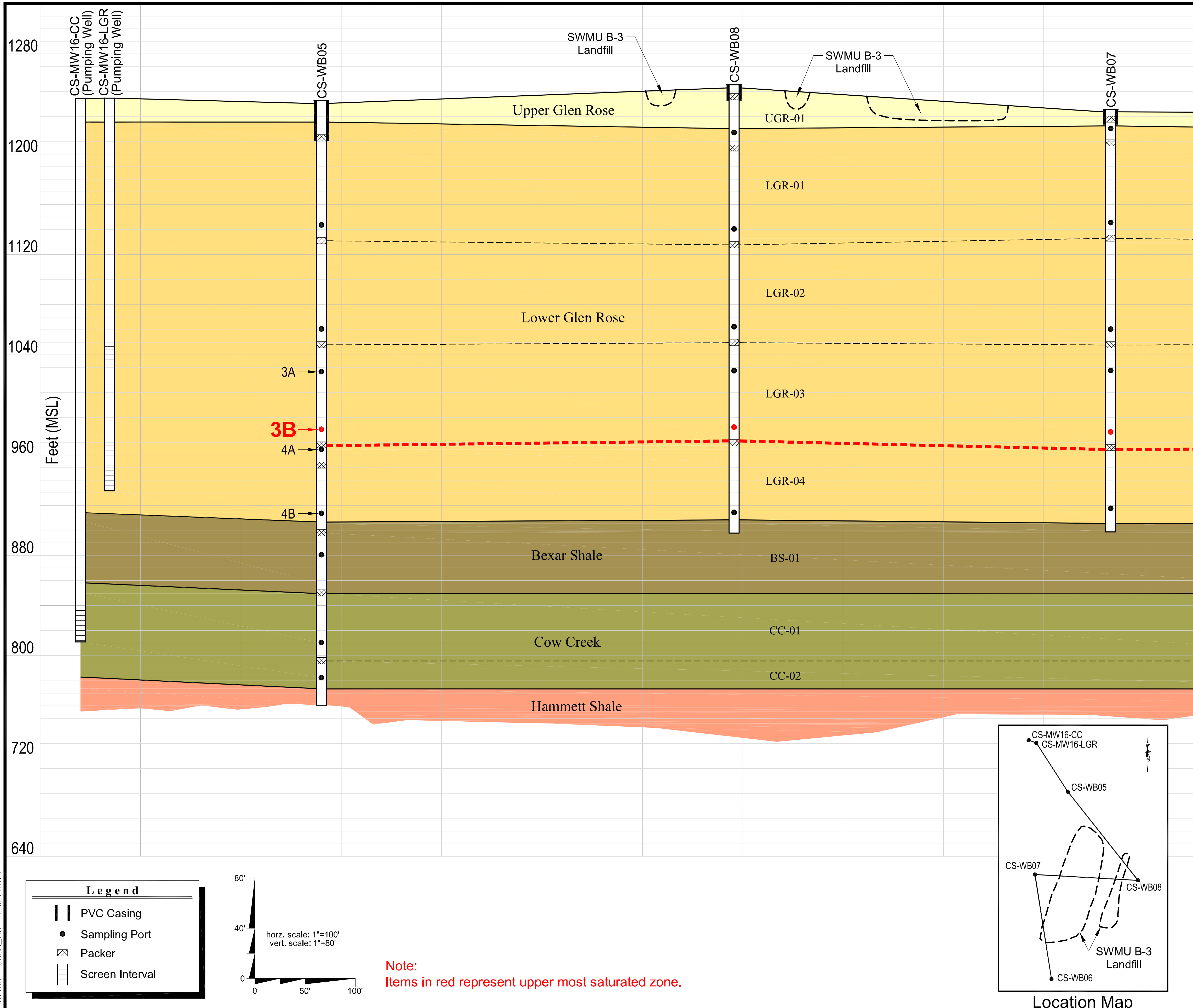
Westbay Wells

Figure 3.1

SWMU B-3
MPMW Locations
Camp Stanley Storage Activity

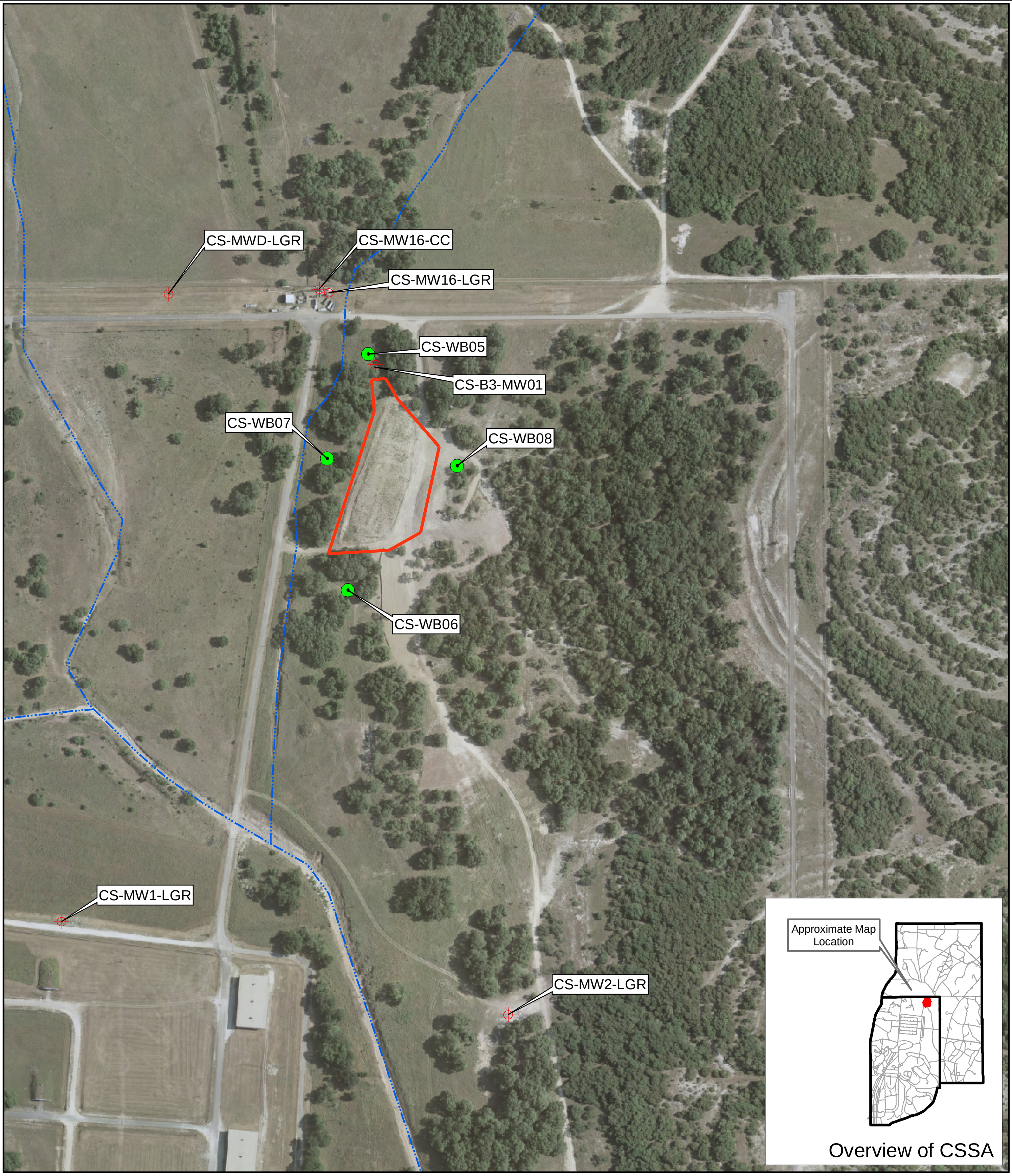
P a r s o n s

J:\744223\GIS\pilot_study_location_map.mxd



Pumping Zones and Monitored Zones SWMU B-3

745953 CSSA_B3-PZMZ2.DWG



Aerial Photo Date: 2003

N
W E
S

400 200 0 400
Feet

Creeks (Dashed where intermittent)
Monitoring Well Locations
SWMU Boundary
Westbay Wells

Figure 3.3

SWMU B-3
Area Monitoring Wells
Camp Stanley Storage Activity

P a r s o n s

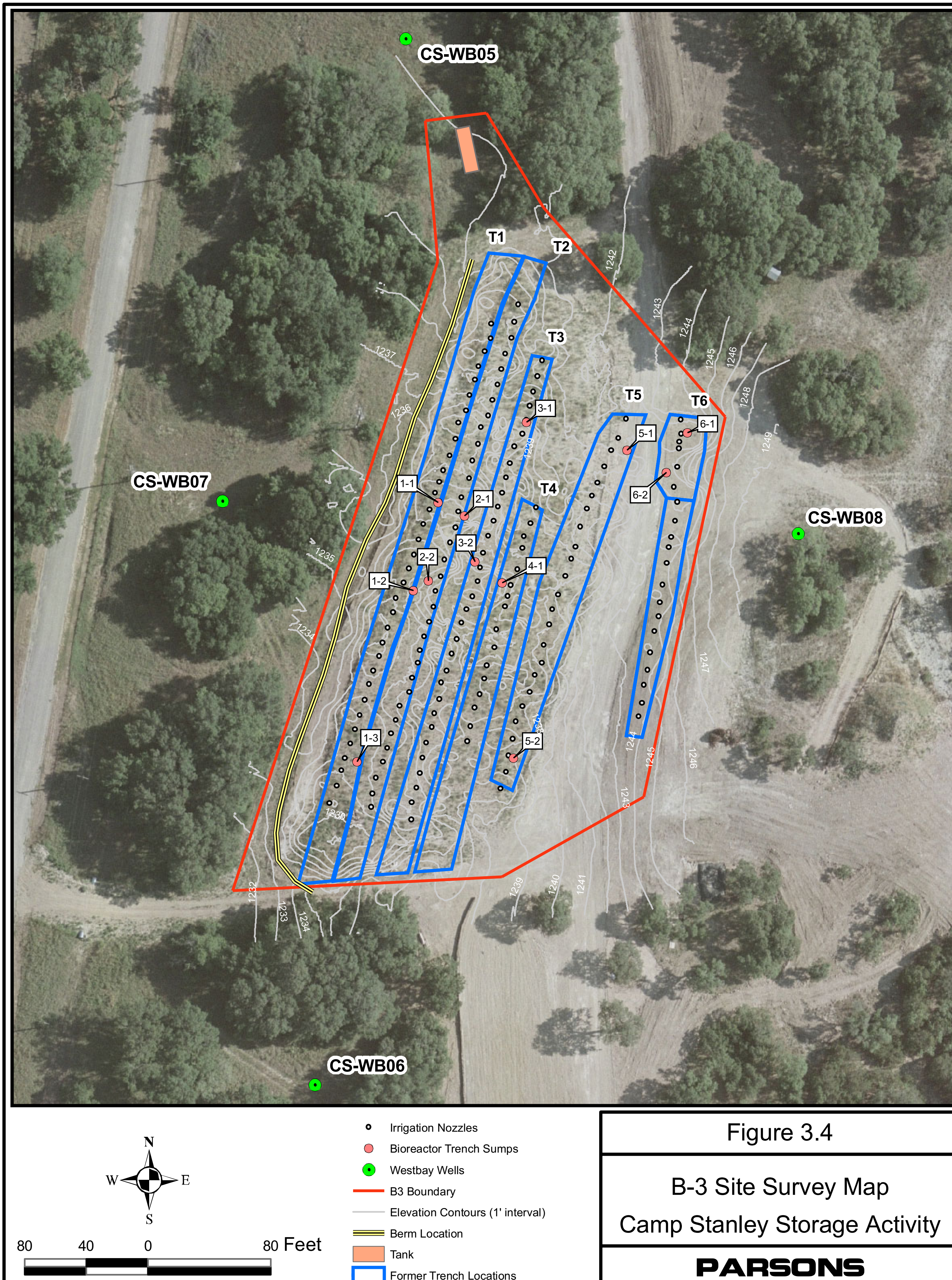


Figure 3.4

B-3 Site Survey Map

Camp Stanley Storage Activity

PARSONS

J:\744\744223 B3 & AOC65\gis\b3-trench_sumps_gp.mxd - 2/9/2007 @ 2:58:32 PM

SECTION 4
SYSTEM MAINTENANCE

4.1 BIOREACTOR INSPECTION

The bioreactor will be inspected weekly to determine if the components are operating properly. Future plans call for the possible installation of equipment to monitor the equipment remotely. Items to include in the inspection include the following:

- Condition of all visible piping;
- Condition of berms identifying any erosional features that may be indicative of surface drainage not being collected in the bioreactor;
- Readings will be collected from pressure gages, flow meters and water levels in the bioreactor sumps weekly;
- Conditions of the storage tank;
- Replacement of bag filter, as necessary.

A System Operation and Maintenance logbook will be maintained documenting all maintenance activities associated with bioreactor system operations, as well as, documenting monthly system inspections.

4.2 MAINTENANCE

To reduce the potential for unexpected equipment shutdown, a maintenance schedule will be incorporated based on the required maintenance specified by the equipment manufacturers.

4.2.1 Filter Bag Replacement

The filters in the bag filtration system must be replaced when they become plugged with particulates. The filters will be replaced when the pressure drop across the filter increases and negatively impacts the capacity of the transfer pump due to high head loss within the treatment system. To prevent the pressure drop across the filter from exceeding safe levels, the filters will be changed if the pressure drop is determined to be 12 pounds per square inch (psi) or greater during a weekly site visit. Spare filters will be stored in the GAC building at CSSA Outfall 002. The procedure for replacing the filter follows:

1. Turn off the system and initiate lockout/tagout procedures in Subsection 3.2.3.
2. Close the ball valve before and after the filter system to isolate the filter from further flow.
3. Carefully bleed off residual pressure inside the filter vessel by slowly opening the vent on the top of the vessel. Think Safety!
4. Loosen the retaining lugs and remove the lid from the top of the vessel.
5. Replace used filters with new ones and place used filters in 55-gal container.

6. Realign the vessel lid and tighten the retaining lugs.
7. Open the ball valves before and after the filter system.
8. Turn the recovery system back on.
9. Check the filter vessel for leaks.

Replacement of the bag filters will be documented on the System Operation and Maintenance Form (Appendix J) to reflect the replacement date of the filters, new filter sizes, and condition of the old filters.

4.2.2 Recovery Pump Maintenance

Pump maintenance will be performed to maintain optimum pump operation, maximize pump life, and to repair pump problems. At a minimum, pump maintenance is scheduled to be performed annually, tentatively scheduled 12 months after initial start-up. During the annual pump maintenance events, each pump will be removed from its well, inspected for wear and damage, and any necessary/recommended repairs made to ensure optimal performance. Pump maintenance may also be performed when determined necessary based on pump performance, such as diminishing groundwater yield. Additionally, any time a recovery well will be idled for periods greater than 1 month, the pump in that well will either be operated for at least two hours each month or removed from the well. This is done to prevent accumulation of calcium or iron precipitation on the idle pump components which may foul the pump and/or shorten the pump life.

During the annual pump maintenance, or more frequently should it become necessary, worn or malfunctioning components will be repaired or replaced. Two spare groundwater pumps are stored in the treatment compound to minimize system down time during such maintenance events. In the event that a pump malfunctions, it will be pulled for service and repaired, as necessary, and a spare pump will be installed in its place. The faulty pump will become a spare after it is repaired.

In the event that a pump must be removed from a well, the following procedures requiring a two-man crew will be followed:

1. Turn off power and initiate lockout/tagout procedures per Subsection 3.3.
2. Disconnect the pipe coupling in the discharge pipe within the well box.
3. Loosen the bolts in the well seal on top of the recovery well so the discharge pipe easily moves through the opening in the seal.
4. Lift the pump from the well by hand until the first flush-thread pipe connection is observed in the discharge pipe.
5. One crew member will secure the discharge pipe below the pipe joint using a pipe wrench while the other crew member loosens and removes the top section of pipe.
6. Care must be taken to secure and manage the electrical cables and steel support cables that attach to the pressure transducer and the pump. These wires/cables should be secured to the discharge pipe by plastic cable ties which must be cut and removed to manage the wiring and cable. CAUTION: The transducer cable includes an internal vented tube. Careful handling of this cable is necessary to

prevent pinching or kinking of the cable which may damage and obstruct the vent tube.

7. Continue to remove sections of the pipe while managing the wires and cables, until the last section of pipe is brought to the surface. Carefully lay the pump and pipe next to the well without allowing dirt to plug the pump head.
8. Make necessary repairs to pump or transducer.
9. Carefully reinsert the pump in the well.
10. Reinstall the pump assembly in the well by reversing the removal instructions. New cable ties should be used to re-secure the transducer and pump lead wires to the discharge pipe as it reinserted into the well. CAUTION: Carefully insert the pump and piping assembly into the well without pinching or kinking the transducer cable which could block the internal vent tube.
11. Turn the system back on.

4.3 SPILL PREVENTION AND CONTAINMENT PLAN

To reduce the potential for offsite drainage from the site, the following guidelines will be incorporated:

1) Construction of a berm along the and western side of the site to help retain water in the bioreactor;

2) Maintain a stand of vegetation along the west side of Trench 1 to reduce the potential for the development of erosional features along the west side of the site; and

3) Precautions, such as storm water diversion berms, will be taken to prevent overfilling of the bioreactor with stormwater infiltration.

4) Level controller located in trench 1 monitoring sump 1 which will cease injection of water upon reaching high level.

4.4 SITE MAINTENANCE

During each visit, the following activities will take place:

- The site will be inspected to ensure no obstructions are present that could impact normal operation.
- The area around the treatment area and bioreactor will be inspected. Ensure that access to the compound is clear of tree branches and debris.
- Buried water and electrical lines will be inspected to ensure that the lines are still properly covered, and that no apparent leaks are present.

See the System Operation and Maintenance Form in Appendix J for a list of necessary activities to perform during each site visit.

SECTION 5
REPORTING REQUIREMENTS

Since the bioreactor design called for the discharge of affected water from both wells CS-MW16-LGR and CS-MW16-CC into the subsurface via a buried water distribution system, it was necessary to apply for a Class V Aquifer Remediation Injection Well Permit through the Industrial and Hazardous Waste Permits Section of the Waste Permits Division at the TCEQ. The permit application was accepted on July 20, 2006 and the following TCEQ Authorization Number was assigned to the SWMU B-3 injection system: No. 5X2600431; WWC 12002216; CN602728206/RN104431655. A copy of the authorization letter is presented in Appendix A.

As stated in the letter, there are four requirements that must be met as set by the Remediation Division and the UIC rules provided by 30 Texas Administrative Code (TAC) Chapter 331.

Requirement 1. All injection wells are to be constructed to meet the standards provided in 30 TAC 331.132 and completed well logs or construction diagrams submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 upon completion. Since a subsurface water distribution system instead of an injection well was proposed and accepted in the permit application, this requirement is not applicable to the B3 bioreactor.

Requirement 2. Operational and status changes shall be reported to and approved by the UIC Permits Team. Any changes to the operation of the B3 bioreactor not presented in a monitoring report can be provided to the UIC Permits Team via a letter.

Requirement 3. Closure (plugging) of injection wells, points and/or trenches shall comply with the standards provided in 30 TAC 331.133. Closure reports including plugging reports and injection well monitoring data (injection volumes, pressures and results) shall be submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 within 60 days of completion of injection or plugging activities. If closure activities do proceed in the future for SWMU B-3, then the most suitable option for closure of the trenches, and the recommended option will be presented to the UIC Permits Team. The volume of water (cumulative) as well as the chemical data results will be presented in each monitoring report submitted to the UIC Permits Team. Additional discussion on the chemical data monitoring is presented in Requirement 4.

Requirement 4. Injection volumes, pressures, and concentrations of contaminants (including pH and total dissolved solids) in the injected groundwater shall be sampled bimonthly at the point of re-injection (prior to fluids being released into the trenches) and submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 on a monthly basis. The concentration of contaminants in the trench bioreactor monitoring sumps and the surrounding monitoring wells shall be sampled monthly and submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 on a quarterly basis. The twice monthly and monthly monitoring and sampling program is presented in Section 4. The sampling and monitoring program will adhere to Requirement 4.

Table 5.1 outlines the monitoring and reporting activities scheduled during months 13 through 24 of the O&M period.

Table 5.1
B-3 O&M Activities Outline Months 13 – 24

	Month	Monday	Tuesday	Wednesday	Thursday	Friday	Week	Reporting
Quarter 5	May, 2008 Month 13				1	2	53	Month 11 Performance Report
		5	6	7	8	9	54	
		12	13	14	15	16	55	
		19	20	21	22	23	56	
		26	27	28	29	30	57	
	June, 2008 Month 14	2	3	4	5	6	**58**	Quarter 4 Performance Report
		9	10	11	12	13	59	
		16	17	18	19	20	60	
		23	24	25	26	27	61	
		30					62	
	July, 2008 Month 15		1	2	3	4		
		7	8	9	10	11	63	
		14	15	16	17	18	64	
		21	22	23	24	25	65	
		28	29	30	31		66	
Quarter 6	August, 2008 Month 16					1		
		4	5	6	7	8	67	
		11	12	13	14	15	68	
		18	19	20	21	22	69	
		25	26	27	28	29	70	
	September, 2008 Month 17	1	2	3	4	5	71	
		8	9	10	11	12	**72**	Quarter 5 Performance Report
		15	16	17	18	19	73	
		22	23	24	25	26	74	
		29	30				75	
	October, 2008 Month 18			1	2	3		
		6	7	8	9	10	76	
		13	14	15	16	17	77	
		20	21	22	23	24	78	
		27	28	29	30	31	79	
Quarter 7	November, 2008 Month 19	3	4	5	6	7	80	
		10	11	12	13	14	81	
		17	18	19	20	21	82	
		24	25	26	27	28	83	B3 UIC Semi-Annual Report
	December, 2008 Month 20	1	2	3	4	5	84	
		8	9	10	11	12	**85**	Quarter 6 Performance Report
		15	16	17	18	19	86	
		22	23	24	25	26	87	
		29	30	31			88	
	January, 2009 Month 21				1	2		
		5	6	7	8	9	89	
		12	13	14	15	16	90	
		19	20	21	22	23	91	
		26	27	28	29	30	92	
Quarter 8	February, 2009 Month 22							
		2	3	4	5	6	93	
		9	10	11	12	13	94	
		16	17	18	19	20	95	
		23	24	25	26	27	96	
	March, 2009 Month 23	2	3	4	5	6	97	
		9	10	11	12	13	**98**	Quarter 7 Performance Report
		16	17	18	19	20	99	
		23	24	25	26	27	100	
		30	31				101	
	April, 2009 Month 24			1	2	3		
		6	7	8	9	10	102	
		13	14	15	16	17	103	
		20	21	22	23	24	104	
		27	28	29	30		105	
Quarter 9 (partial)	May, 2009 Month 25					1		
		4	5	6	7	8	106	
		11	12	13	14	15	107	
		18	19	20	21	22	108	
		25	26	27	28	29	109	B3 UIC Semi-Annual Report
	June 2009	1	2	3	4	5	110	
		8	9	10	11	12	**111**	Quarter 8 Performance Report

Monthly Sampling and UIC Sampling
Quarterly Sampling
Semi-Annual UIC Report submittal
Quarterly Performance Report

Appendix A
TCEQ Authorization Letter

Kathleen Hartnett White, *Chairman*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

July 20, 2006

Mr. Jason Shirley
Installation Manager
U.S. Army, Camp Stanley Storage Activity
25800 Ralph Fair Road
Boerne, TX 78015

Re: Authorization and Registration of Class V Aquifer Remediation Injection Wells
TCEQ Authorization No. 5X2600431; WWC 12002216; CN602728206/RN104431655
Camp Stanley Storage Activity
25800 Ralph Fair Road
Boerne, TX 78015

Dear Mr. Shirley:

The Underground Injection Control (UIC) staff has completed review of the inventory/authorization form dated May 30, 2006 from Parsons requesting approval for the injection of groundwater into five infiltration galleries filled with gravel, wood chips and vegetable oil as part of the remediation process at the above site. Our consideration for this proposed project for injection has included coordination with the commission's Remediation Division. Based on our review, approval is hereby given for construction and operation of the injection wells according to the submitted plans and specifications.

In order to maintain authorization by rule for the injection operations, the project must meet all requirements set by the Remediation Division and the UIC rules provided by 30 TAC Chapter 331. Requirements for the injection include:

1. All injection wells are to be constructed to meet the standards provided in 30 TAC §331.132 and completed well logs or construction diagrams submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 upon completion;

2. Operational and status changes shall be reported to and approved by the UIC Permits Team;

3. Closure (plugging) of injection wells, points and/or trenches shall comply with standards provided in 30 TAC §331.133. Closure reports including plugging reports and injection well monitoring data (injection volumes, pressures, and results) shall be submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 within 60 days of completion of injection or plugging activities; and

4. Injection volumes, pressures, and concentrations of contaminants (including pH and total dissolved solids) in the injected groundwater shall be sampled bimonthly at the point of reinjection (prior to fluids being released into the trenches) and submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 on a monthly basis. The concentration of contaminates in the trench bioreactor monitoring sumps and the surrounding monitoring wells shall be sampled monthly and submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 on a quarterly basis. The concentrations of the contaminants shall not exceed those limits listed in 40 CFR §261.24 Toxicity characteristic table 1 that would deem them hazardous by concentration.

If you have any questions regarding this matter, please contact me at (512) 239-6075. If you will be corresponding by mail, please use mail code MC-130.

Sincerely,

Bryan S. Smith

Bryan Smith, P.G., Engineering Specialist
Industrial and Hazardous Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

BSS/ff

cc: Mr. Brian Vanderglas, Parsons, Austin

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 25, 2007

Mr. Jason Shirley
Installation Manager
U.S. Army, Camp Stanley Storage Activity
25800 Ralph Fair Road
Boerne, TX 78015

Re: Amendment to Authorization of Class V Aquifer Remediation Injection Wells
TCEQ Authorization No. 5X2600431; WWC12033366; CN602728206/RN104431655
Camp Stanley Storage Activity
25800 Ralph Fair Road
Boerne, TX 78015

Dear Mr. Shirley:

The Underground Injection Control (UIC) staff has completed review of the modification request dated November 29, 2006 requesting approval for the addition of one infiltration galleries filled with gravel, wood chips and vegetable oil as part of the remediation process at the above site. Our consideration for this proposed project for injection has included coordination with the commission's Remediation Division. Based on our review, approval is hereby given for construction and operation of the injection wells according to the submitted plans and specifications.

In order to maintain authorization by rule for the injection operations, the project must meet all requirements set by the Remediation Division and the UIC rules provided by 30 Texas Administrative Code (TAC) Chapter 331. Requirements for the injection include:

1. All injection wells are to be constructed to meet the standards provided in 30 TAC Section (§)331.132 and completed well logs or construction diagrams submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 upon completion;

2. Operational and status changes shall be reported to and approved by the UIC Permits Team;

3. Closure (plugging) of injection wells, points and/or trenches shall comply with standards provided in 30 TAC §331.133. Closure reports including plugging reports and injection well monitoring data (injection volumes, pressures, and results) shall be submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 within 60 days of completion of injection or plugging activities; and

4. Injection volumes, pressures, and concentrations of contaminants (including pH and total dissolved solids) in the injected groundwater shall be sampled bimonthly at the point of reinjection (prior to fluids being released into the trenches) and submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 on a monthly basis. The concentration of contaminates in the trench bioreactor monitoring sumps and the surrounding monitoring wells shall be sampled monthly and submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 on a quarterly basis. The concentrations of the contaminants shall not exceed those limits listed in 40 CFR §261.24 Toxicity characteristic table 1 that would deem them hazardous by concentration.

If you have any questions regarding this matter, please contact me at (512) 239-6075. If you will be corresponding by mail, please use mail code MC-130.

Sincerely,

Bryan Smith

Bryan Smith, P.G., Engineering Specialist
Industrial and Hazardous Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

BSS/ff

cc: Mr. Brian Vanderglas, Parsons, Austin

Appendix B

Product Information

CS-MW-16 Recovery Pumps

CS-MW-16-LGR
Pump Specifications

4" Submersible Pumps

Installation and Operation Instructions

Owner's Information

Pump Model #: ____________________

Pump Serial #: ____________________

Motor Model #: ____________________

Motor Serial #: ____________________

Dealer: ____________________

Dealer Telephone: ____________________

Purchase Date: ____________________

Installation Date: ____________________

Volts: ____________________

Amps: ____________________

Table of Contents

Goulds Pumps

ITT Industries

SAFETY INSTRUCTIONS

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

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

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

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

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

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

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

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

MAINTAIN ALL SAFETY DECALS.

Important notice: Read safety instructions before proceeding with any wiring

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

WARNING Standard units are not designed for use in swimming pools, open bodies of water, hazardous liquids, or where flammable gases exist. Well must be vented per local codes.

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

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

⚠ CAUTION	All three phase (3Ø) controls for submersible pumps must provide Class 10, quick-trip, overload protection.
⚠ WARNING	Do not lift, carry or hang pump by the electrical cables. Damage to the Electrical Cables can cause shock, burns or death.
⚠ WARNING	Use only stranded copper wire to pump/motor and ground. The ground wire must be at least as large as the power supply wires. Wires should be color coded for ease of maintenance and troubleshooting.
⚠ DANGER	Install wire and ground according to the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes.
⚠ WARNING	Install an all leg disconnect switch where required by code.
⚠ WARNING	The electrical supply voltage and phase must match all equipment requirements. Incorrect voltage or phase can cause fire, motor and control damage, and voids the warranty.
⚠ WARNING	All splices must be waterproof. If using splice kits follow manufacturer's instructions.
⚠ WARNING	Select the correct type and NEMA grade junction box for the application and location. The junction box must insure dry, safe wiring connections.
⚠ WARNING	Failure to permanently ground the pump, motor and controls before connecting to power can cause shock, burns or death.
⚠ WARNING	4" motors ≥ 2 HP require a minimum flow rate of .25 ft/sec. or 7.62 cm/sec. past the motor for proper motor cooling. The following are the minimum flows in GPM per well diameter required for cooling: 1.2 GPM/4", 7 GPM/5", 13 GPM/6", 20 GPM/7", 30 GPM/8" or 50 GPM in a 10" well. Pumps ≥ 2 HP installed in large tanks should be installed in a flow inducer sleeve to create the needed cooling flow or velocity past the motor.
⚠ CAUTION	This pump has been evaluated for use with Water Only.

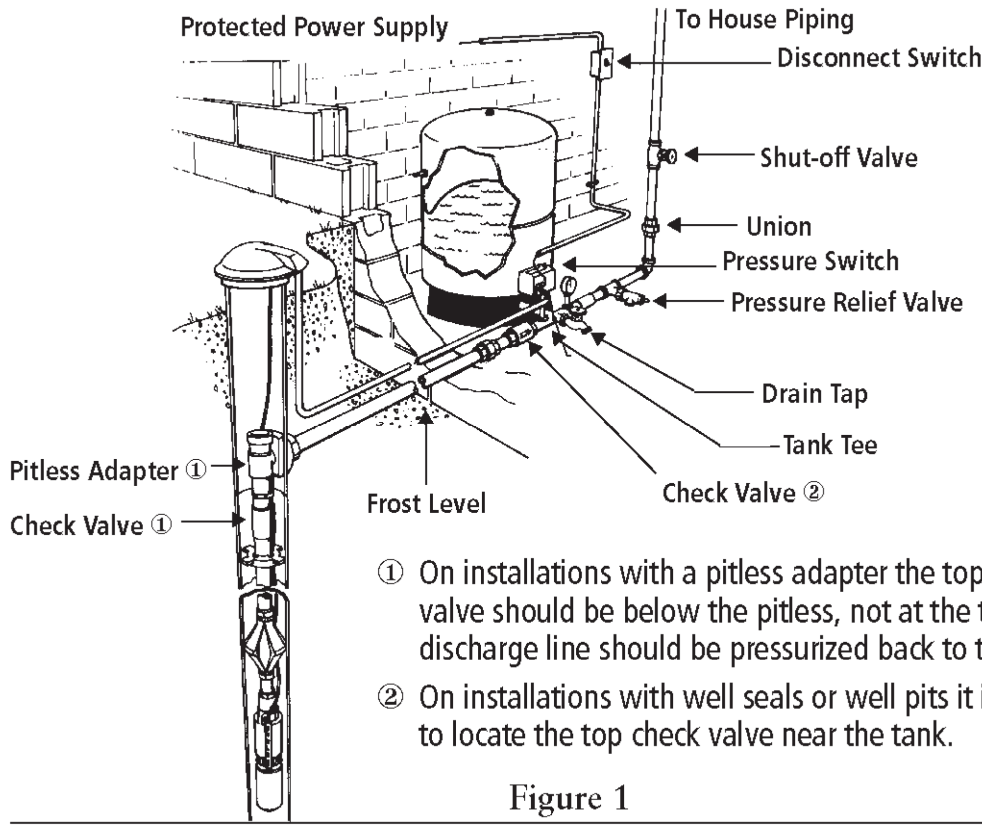
INSTALLATION CHECK LIST

- Enter the pump and motor information and other requested data on the front of this manual.
- Inspect all components for shipping damage, report damage to the distributor immediately.
- Verify that motor HP and pump HP match.
- Match power supply voltage and phase to motor and control specifications.
- Select a dry, shaded location in which to mount the controls.
- Make all underwater and underground splices with waterproof splice connections.
- Hold the pump at the discharge head when installing threaded pipe or an adapter fitting as most pumps have left hand threads which will be loosened if you hold the pump anyplace except the discharge head.
- Check all plumbing connections to insure they are tight and sealed with Teflon tape.
- Verify that the pipe pressure rating is higher than pump shut-off pressure.
- Install a pressure relief valve on any system capable of creating over 75 PSI.
- Locate the pressure switch within 4' of the pressure tank to prevent switch chatter.
- Adjust tank pre-charge to 2 PSI below the system cut-in pressure setting, ex. 28 on a 30/50 system.
- Set the pump 10' above the well bottom to keep above sediment and debris.
- Insure that main power is disconnected, turned OFF, before wiring any components.
- Wiring should be performed only by qualified technicians.
- Wiring and Grounding must be in compliance with national and local codes.
- Restrict the flow with a ball or globe valve, 1/3 open, before starting pump for first time.
- Open a faucet or discharge valve on start-up to keep dirty water from entering the tank.
- Turn main breaker or disconnect ON.
- Run through several on/off cycles to verify proper switch operation.
- Check amps and enter the data on the front of this manual.
- Leave the manual with the owner or at the job site.

1.0 TYPICAL INSTALLATIONS

CAPTIVE AIR TANK INSTALLATION

NOTICE: TANK PRE-CHARGE PRESSURE CHANGES MUST BE MADE USING THE AIR VALVE ON TOP OF THE TANK.



① On installations with a pitless adapter the top check valve should be below the pitless, not at the tank, as the discharge line should be pressurized back to the pitless.

② On installations with well seals or well pits it is allowable to locate the top check valve near the tank.

Figure 1

GALVANIZED TANK INSTALLATION

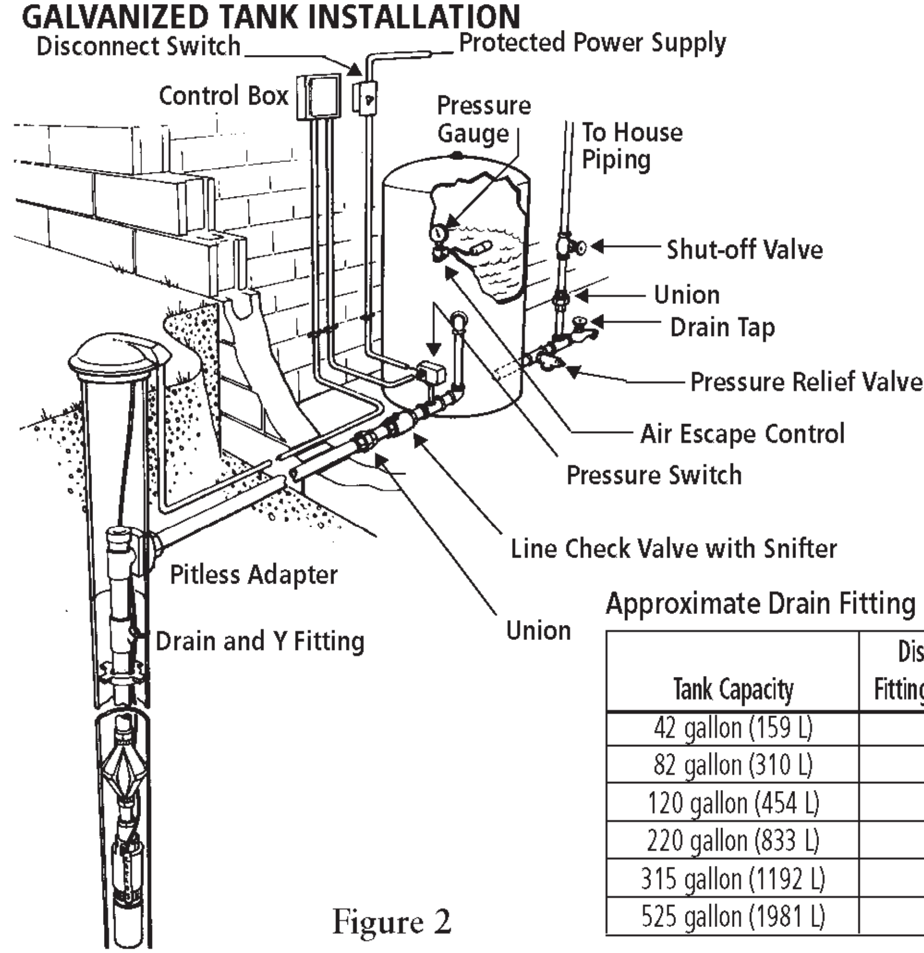


Figure 2

Approximate Drain Fitting Setting

Tank Capacity	Distance Drain and "Y" Fitting Below the Line Check
42 gallon (159 L)	7 feet (2.1m)
82 gallon (310 L)	10 feet (3m)
120 gallon (454 L)	15 feet (4.6m)
220 gallon (833 L)	15 feet (4.6m)
315 gallon (1192 L)	20 feet (6.1m)
525 gallon (1981 L)	20 feet (6.1m)

2.0 PIPING

Notice: Most 4" submersibles have left-hand discharge head threads, hold the pump <u>only</u> at the "discharge head" when installing fittings or threaded pipe.

2.1 General

The pump discharge piping should be sized for efficient pump operation. Use the Friction Loss Tables to calculate total dynamic head using different pipe sizes. As a rule of thumb, use 1" for up to 10 gpm, 1¼" for up to 30 gpm, 1½" for up to 45 gpm, and 2" for up to 80 gpm. In the case of long pipe runs it is best to increase pipe size.

Some pumps are capable of very high discharge pressures, please select pipe accordingly. Consult with your pipe supplier to determine the best type of pipe for each installation.

2.2 Pressure Tank, Pressure Switch and Pressure Relief Valve

Select an area in which the ambient temperature is always above 34° F (1° C) in which to install the tank, pressure switch, and pressure relief valve. The tank should be located in an area where a leak will not damage property.

The pressure switch should be located at the tank cross tee and never more than 4' from the tank. Locating the switch more than 4' from the tank will cause switch chatter.

There should be no valves, filters, or high loss fittings between the switch and the tank(s) as switch chatter may result. As an example, a 1¼" spring check valve has friction loss equal to 12' of pipe, placing the valve between the pressure switch and the pressure tank is the same as moving the pressure switch 12' away from the tank. It will create switch chatter.

On multiple tank installations the switch should be as close to the center of the tanks as possible. Multiple tank installations should have a manifold pipe at least 1½ times the size of the supply pipe from the pump. This will reduce the Friction Head in the manifold and reduce the possibility of switch chatter.

The cut-in setting on a 30 - 50 pressure switch is 30 psi. Cut-in is the lower of the pressure settings.

Pressure relief valves are required on any system that is capable of producing 100 psi or 230' TDH. If in an area where a water leak or blow-off may damage property connect a drain line to the pressure relief valve. Run it to a suitable drain or an area where the water will not damage property.

2.3 Adjusting Tank Pre-Charge

Insure that the tank is empty of water. Use a high quality pressure gauge to check the tank pre-charge pressure. The pressure should be 2 psi below the pump cut-in pressure. As an example, a 30-50 psi system would use a tank pre-charge of 28 psi.

2.4 Discharge Pipe

Note: Most discharge heads are threaded into the casing with left-hand threads. Hold the pump only at the discharge head when installing fittings. Failure to hold the discharge head will loosen it and pump damage will result on start-up.

If your pipe requires an adapter we strongly recommend using stainless steel. Galvanized fittings or pipe should never be connected directly to a stainless steel discharge head as galvanic corrosion may occur. Plastic or brass pumps can use any material for this connection. Barb type connectors should always be double clamped.

The pump discharge head has a loop for attaching a safety cable. The use of a safety cable is at the discretion of the installer.

2.5 Installing Pump in Well

If you are using a torque arrestor, install it per the manufacturer's installation instructions. Consult the seller for information on torque arrestors and for installation instructions.

Connect the discharge pipe to the discharge head or adapter you previously installed. Barb style connectors should always be double clamped. Install the pump into the well using a pitless adapter or similar device at the wellhead. Consult the fitting manufacturer or pitless supplier for specific installation instructions.

Using waterproof electrical tape, fasten the wires to the drop pipe at 10' intervals. Make sure that the tape does not loosen as it will block the pump suction if it falls down the well. Pump suppliers also sell clip-on style wire connectors that attach to the drop pipe.

2.6 Special Piping For Galvanized Tank Systems

When using a galvanized tank you should install an AV11 Drain & Y fitting in the well and a check valve with snifter valve at the tank. This will add air to the tank on each pump start and prevent water logging the tank. Use an AA4 Air Escape on the tank to allow excess air to escape. The distance between the AV11 and check valve with snifter valve determines the amount of air introduced on each cycle. See the table for recommended settings. *See Figure 2 in Sec 1.0.*

Gaseous wells should use galvanized tanks with AA4 air escapes to vent off excess air and prevent "spurting" at the faucets.

Methane and other explosive or dangerous gases require special water treatment for safe removal. Consult a water treatment specialist to address these issues.

Installations with top feeding wells should use flow sleeves on the pump.

2.7 Check Valves

Our pumps use four different style check valves. We recommend check valves as they prevent back-spinning the pump and motor which will cause premature bearing wear. Check valves also prevent water hammer and upthrust damage. Check valves should be installed every 200' – 250' in the vertical discharge pipe.

The following information is for customers who wish to disable a check valve for a drain back system, these systems should use other means to prevent water hammer and upthrust damage:

- **Built-in stainless steel valves** have a flat which is easily drilled through using an electric drill and a ¼" or ⅜" drill bit to disable the valve.
- **Poppet style check valves which are threaded in from the top** of the discharge head can be easily removed using a ½" nut driver or deep socket. The hex hub is visible and accessible from the top.
- **Internal Flomatic™ design plastic poppet style valves** must be removed from inside which requires pump disassembly.

- **Built-in plastic poppet style valves with a stem through the top** may be removed from discharge head by pulling on the stem with pliers.

3.0 WIRE SIZING, SPLICING and POWER SUPPLY

Always follow the National Electric Code (N.E.C.), Canadian Electrical Code, and any state, provincial, or local codes.

We suggest using only copper wire. Size wire from the charts found in the Technical Data section of this manual, in the Franklin Electric AIM manual, or an N.E.C. (National Electric Code) code book. If discrepancies exist the N.E.C. book takes precedence over a manufacturer's recommendations.

3.1 Splicing Wire to Motor Leads

When the drop cable must be spliced or connected to the motor lead it is necessary that the splice be watertight. The splice can be done with heat shrink kits or waterproof tape.

A. Heat Shrink Splice Instructions

To use a typical heat shrink kit: strip ½" from the motor wires and drop cable wires, it is best to stagger the splices. Place the heat shrink tubes on the wires. Place the crimps on the wires and crimp the ends. Slide the heat shrink tubes over the crimps and heat from the center outward. The sealant and adhesive will ooze out the ends when the tube shrinks. The tube, crimps, sealant, and adhesive create a very strong, watertight seal.

B. Taped Splice Instructions

A) Strip individual conductor of insulation only as far as necessary to provide room for a stake type connector. Tubular connectors of the staked type are preferred. If connector O.D. is not as large as cable insulation, build-up with rubber electrical tape.

B) Tape individual joints with rubber electrical tape, using two layers; the first extending two inches beyond each end of the conductor insulation end, the second layer two inches beyond the ends of the first layer. Wrap tightly, eliminating air spaces as much as possible.

C) Tape over the rubber electrical tape with #33 Scotch electrical tape, or equivalent, using two layers as in step "B" and making each layer overlap the end of the preceding layer by at least two inches.

In the case of a cable with three conductors encased in a single outer sheath, tape individual conductors as described, staggering joints.

Total thickness of tape should be no less than the thickness of the conductor insulation.

4.0 WIRING THE CONTROLS and SWITCH

4.1 Mounting the Motor Control Box

Single phase 3-wire control boxes meet U.L. requirements for Type 3R enclosures. They are suitable for vertical mounting in indoor and outdoor locations. They will operate at temperatures between 14°F (-10°C) and 122°F (50°C). Select a shaded, dry place to mount the box. Insure that there is enough clearance for the cover to be removed.

4.2 Verify Voltage and Turn Supply Power Off

Insure that your motor voltage and power supply voltage are the same.

Place the circuit breaker or disconnect switch in the OFF position to prevent accidentally starting the pump before you are ready.

Three-phase starter coils are very voltage sensitive; always verify actual supply voltage with a voltmeter.

High or low voltage, greater than ±10%, will damage motors and controls and is not covered under warranty.

4.3 Connecting Motor Leads to Motor Control Box, Pressure Switch or Starter

Caution Do not power the unit or run the pump until all electrical and plumbing connections are completed. Verify that the disconnect or breaker is OFF before connecting the pressure switch line leads to the power supply. Follow all local and national codes. Use a disconnect where required by code.

A. Three-Wire Single Phase Motor
Connect the color coded motor leads to the motor control box terminals - Y (yellow), R (red), and B (black); and the Green or bare wire to the green ground screw.

Connect wires between the Load terminals on the pressure switch and control box terminals L1 and L2. Run a ground wire between the switch ground and the control box ground. *See Figure 4 or 5.*

B. Two-Wire Single Phase Motor
Connect the black motor leads to the Load terminals on the pressure switch and the green or bare ground wire to the green ground screw. *See Figure 3.*

C. Three phase motors
Connect the motor leads to T1, T2, and T3 on the 3 phase starter. Connect the ground wire to the ground screw in the starter box. Follow starter manufacturers instructions for connecting pressure switch or *see Figure 6.*

4.4 Connect To Power Supply

Complete the wiring by making the connection from the single phase pressure switch Line terminals to the circuit breaker panel or disconnect where used.

Three phase - make the connections between L1, L2, L3, and ground on the starter to the disconnect switch and then to the circuit breaker panel.

Three phase installations must be checked for motor rotation and phase unbalance. To reverse motor rotation, switch (reverse) any two leads. See the instructions for checking three phase unbalance in section 4.6. Failure to check phase unbalance can cause premature motor failure and nuisance overload tripping. If using a generator, see Technical Data for generators.

4.5 Three Phase Overload Protection

Use only Class 10, quick-trip overload protection on three-phase submersible motors. Furnas Class 14 NEMA starters with ESP100 overloads and Class 16 starters equipped with “K” overload heaters or ESP100 overloads will provide adequate protection.

The Franklin Electric Application Manual lists several acceptable starter/overload combinations. Call the FE hotline at 800-348-2420 or the pump manufacturer's Customer Service group for selection assistance.

Note - If replacing an above ground motor with a submersible, verify that the overloads provide Class 10 protection, most above ground motors have Class 20 overloads. Use of Class 20 overloads on submersible motors will not protect the motors and voids the warranty.

4.6 Three Phase Power Unbalance

A full three phase supply consisting of three individual transformers or one three phase transformer is recommended. "Open" delta or wye connections using only two transformers can be used, but are more likely to cause poor performance, overload tripping or early motor failure due to current unbalance.

Check the current in each of the three motor leads and calculate the current unbalance as explained below.

If the current unbalance is 2% or less, leave the leads as connected.

If the current unbalance is more than 2%, current readings should be checked on each leg using each of the three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.

To calculate percent of current unbalance:

A. Add the three line amp values together.

B. Divide the sum by three, yielding average current.

C. Pick the amp value which is furthest from the average current (either high or low).

D. Determine the difference between this amp value (furthest from average) and the average.

E. Divide the difference by the average.
Multiply the result by 100 to determine percent of unbalance.

	Hookup 1			Hookup 2			Hookup 3		
Starter Terminals	L1	L2	L3	L1	L2	L3	L1	L2	L3
Motor Leads	R	B	Y	Y	R	B	B	Y	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Example:

T3-R = 51 amps	T2-Y = 50 amps	T1-B = 50 amps
T1-B = 46 amps	T3-R = 48 amps	T2-Y = 49 amps
T2-Y = 53 amps	T1-B = 52 amps	T3-R = 51 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 or 8%	2 ÷ 50 = .04 or 4%	1 ÷ 50 = .02 or 2%

Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source.

Contact your local power company to resolve the imbalance.

5.0 STARTING THE PUMP

5.1 Throttle the Discharge Before Starting Pump

Install a ball valve in the discharge line and set it ⅓ open before operating the pump in an open discharge manner. This will protect the pump from upthrust damage and also prevent over pumping the well and reduce turbidity. Keep the valve partially closed until the water runs clear.

5.2 Throttling A High Static Level Well To Prevent Upthrust

Any well with a high static water level may allow the pump to operate off the curve to the right or outside the "Recommended Range" shown on the pump curve. We recommend using a "Dole" flow restrictor or throttling with a ball valve to prevent upthrust damage to the pump and motor. The maximum flow must be restricted to be within the pumps recommended operating range. If you use a ball valve, set it, remove the handle, tape the handle to the pipe, and tag the valve with a note saying, "Do not open this valve or pump may be damaged". The easiest way to "set" the flow is to fill a 5 gallon bucket and time how long it takes to produce 5 gallons. Calculate the flow in gpm based on this value. As the water level drops in the well the flow will be reduced due to increased head and the valve will not interfere with performance.

5.3 Start the Pump

Partially open a valve (faucet) in the system and turn the breaker to the ON position.

Check all fittings for leaks.

Close the valve when the water clears and allow the pressure to build. If properly adjusted the switch should turn the pump off at the preset pressure. Open a few faucets and allow the pump to run through a few cycles. Check switch operation and verify that pressure settings are correct.

Recheck all fittings for leaks.

6.0 PAPERWORK and IOM

Please give this filled-in IOM and your business card to the owner.
A sticker with your name and phone number on the tank or control box is a great sales tool for future business!

SINGLE PHASE – 60 HZ MOTOR SPECIFICATIONS

Type	Goulds Motor #/ Control Box	Franklin Motor Model Prefix	HP	Volts	Hz	S.F.	Amps	S.F. Amps	Ohms M=Main S=Start	Inverse Time Breaker	Dual Ele. Time Del. Fuse
4" 2W	S04932/ NR	2445040	½	115	60	1.60	10.0	12.0	1.0 – 1.3	30	20
	S04942/ NR	2445050	½	230	60	1.60	5.0	6.0	4.2 – 5.2	15	10
	S05942/ NR	2445070	¾	230	60	1.50	6.8	8.0	3.0 – 3.6	20	15
	S06942/ NR	2445081	1	230	60	1.40	8.2	9.8	2.2 – 2.7	25	20
	S07942/ NR	2445091	1½	230	60	1.30	10.6	13.1	1.5 – 1.9	30	20
4" 3W	S04930/ 00043	2145044	½	115	60	1.60	Y=10.0 B=10.0 R=0.0	Y=12.0 B=12.0 R=0.0	M = 1.0 – 1.3 S = 4.1 – 5.1	30	20
	S04940/ 00044	2145054	½	230	60	1.60	Y=5.0 B=5.0 R=0.0	Y=6.0 B=6.0 R=0.0	M = 4.2 – 5.2 S = 16.7 – 20.5	15	10
	S05940/ 00054	2145074	¾	230	60	1.50	Y=6.8 B=6.8 R=0.0	Y=8.0 B=8.0 R=0.0	M = 3.0 – 3.6 S = 10.7 – 13.1	20	15
	S06940/ 00064	2145081	1	230	60	1.40	Y=8.2 B=8.2 R=0.0	Y=9.8 B=9.8 R=0.0	M = 2.2 – 2.7 S = 9.9 – 12.1	25	20
4" 3W with RunCap	S07940/ 00074	2243001	1½	230	60	1.30	Y=10.0 B=9.9 R=1.3	Y=11.5 B=11.0 R=1.3	M = 1.5 – 2.3 S = 8.0 – 9.7	30	20
	S08940/ 00084	2243011	2	230	60	1.25	Y=10.0 B=9.3 R=2.6	Y=13.2 B=11.9 R=2.6	M = 1.6 – 2.3 S = 5.8 – 7.2	25	20
	S09940/ 00094 ①	2243027	3	230	60	1.15	Y=14.0 B=11.2 R=6.1	Y=17.0 B=12.6 R=6.0	M = 1.0 – 1.5 S = 4.0 – 4.9	40	30
	S10940/ 00104 ②	2243037	5	230	60	1.15	Y=23.0 B=15.9 R=11.0	Y=27.5 B=19.1 R=10.8	M = 0.68 – 1.0 S = 1.8 – 2.2	60	45

M = Main Winding – Black to Yellow, S = Start Winding – Red to Yellow
Y = Yellow lead – line amps, B = Black lead – main winding amps,
R = Red lead, start or auxiliary winding amps

① Control Boxes date coded 02C and older have 35MFD capacitors and the current values will be

Y14.0 @ FL and	Y17.0 @ SF Load.
B12.2	B14.5
R4.7	R4.5

② Control boxes date coded 01M and older have 60MFD run capacitors and the current values on a 4" motor will be

Y23.0 @ FL and	Y27.5 @ SF Load.
B19.1	B23.2
R8.0	R7.8

THREE PHASE – 60 HZ MOTOR SPECIFICATIONS

Type	Goulds Model #	Franklin Motor Model Prefix					Rated Input		Maximum (S.F. Load)		Line to Line	Locked Rotor	KVA	Inverse Time Breaker	Dual Ele. Time Del. Fuse
			HP	Volts	Hz	S.F.	Amps	Watts	Amps	Watts	Res.	Amps	Code		
4" 3450 RPM	S04978	234501	½	200	60	1.6	2.8	585	3.4	860	6.6-8.4	17.5	N	15	5
	S04970	234511	½	230	60	1.6	2.4	585	2.9	860	9.5-10.9	15.2	N	15	5
	S04975	234521	½	460	60	1.6	1.2	585	1.5	860	38.4-44.1	7.6	N	15	3
	S05978	234502	¾	200	60	1.5	3.6	810	4.4	1150	4.6-5.9	23.1	M	15	8
	S05970	234512	¾	230	60	1.5	3.1	810	3.8	1150	6.8-7.8	20.1	M	15	6
	S05975	234522	¾	460	60	1.5	1.6	810	1.9	1150	27.2-30.9	10.7	M	15	3
	S06978	234503	1	200	60	1.4	4.5	1070	5.4	1440	3.8-4.5	30.9	M	15	10
	S06970	234513	1	230	60	1.4	3.9	1070	4.7	1440	4.9-5.6	26.9	M	15	8
	S06975	234523	1	460	60	1.4	2.0	1070	2.4	1440	19.9-23.0	13.5	M	15	4
	S07978	234504	1½	200	60	1.3	5.8	1460	6.8	1890	2.5-3.0	38.2	K	15	10
	S07970	234514	1½	230	60	1.3	4.5	1460	5.9	1890	3.2-4.0	33.2	K	15	10
	S07975	234524	1½	460	60	1.3	2.5	1460	3.1	1890	13.0-16.0	16.6	K	15	5
	S07979	234534	1½	575	60	1.3	2.0	1460	2.4	1890	20.3-25.0	13.3	K	15	4
	S08978	234305	2	200	60	1.25	7.7	2150	9.3	2700	1.8-2.4	53.6	L	20	15
	S08970	234315	2	230	60	1.25	6.7	2150	8.1	2700	2.3-3.0	46.6	L	20	15
	S08975	234325	2	460	60	1.25	3.4	2150	4.1	2700	9.2-12.0	23.3	L	15	8
	S08979	234335	2	575	60	1.25	2.7	2150	3.2	2700	14.6-18.7	18.6	L	15	5
	S09978	234306	3	200	60	1.15	10.9	2980	12.5	3420	1.3-1.7	71.2	K	30	20
	S09970	234316	3	230	60	1.15	9.5	2980	10.9	3420	1.8-2.2	61.9	K	25	20
	S09975	234326	3	460	60	1.15	4.8	2980	5.5	3420	7.2-8.8	31	K	15	10
	S09979	234336	3	575	60	1.15	3.8	2980	4.4	3420	11.4-13.9	25	K	15	8
	S10978	234307	5	200	60	1.15	18.3	5050	20.5	5810	.74-.91	122	K	50	35
	S10970	234317	5	230	60	1.15	15.9	5050	17.8	5810	1.0-1.2	106	K	40	30
	S10975	234327	5	460	60	1.15	8.0	5050	8.9	5810	4.0-4.7	53.2	K	20	15
	S10979	234337	5	575	60	1.15	6.4	5050	7.1	5810	6.4-7.8	42.6	K	20	15
	S119784	234308	7½	200	60	1.15	26.5	7360	30.5	8450	.46-.57	188	K	70	50
	S119704	234318	7½	230	60	1.15	23.0	7360	26.4	8450	.61-.75	164	K	60	45
	S119754	234328	7½	460	60	1.15	11.5	7360	13.2	8450	2.5-3.1	81.9	K	30	25
	S119794	234338	7½	575	60	1.15	9.2	7360	10.6	8450	4.0-5.0	65.5	K	25	20
	S129724	234329	10	460	60	1.15	17.0	10,000	18.5	11400	1.8-2.3	116	L	45	30
	S119794	234339	10	575	60	1.15	13.6	10,000	14.8	11400	2.8-3.5	92.8	L	35	25

FURNAS STARTERS AND HEATERS

Motor Size	HP	Volts	FURNAS Class 16 Order Number	Heaters	Class 14 Order Number	Inverse Time Breaker	Dual Ele. Time Del. Fuse
4" 3Ø	½	200	16AD	K29	CSBD	15	5
		230	16AG	K28	CSBA	15	5
		460	16AH	K21	CSBC	15	5
	¾	200	16AD	K33	CSBD	15	8
		230	16AG	K31	CSBA	15	6
		460	16AH	K22	CSBC	15	3
	1	200	16AD	K37	CSDD	15	10
		230	16AG	K34	CSDA	15	8
		460	16AH	K26	CSBC	15	4
	1½	200	16AD	K41	CSDD	15	10
		230	16AG	K37	CSDA	15	10
		460	16AH	K28	CSDC	15	5
		575	16AE	K26	CSBE	15	4
	2	200	16AD	K49	CSDD	20	15
		230	16AG	K43	CSDA	20	15

NOTE: The Class 16 starter chart shows the order number for matched coil and load voltage, i.e. a 230 volt power supply with a 230 volt coil. To use a different coil voltage select the same size starter with a different coil.

Nomenclature: Ex. **16 B H;**
16 = Class 16 DP Starter
B = Starter size, sizes are A, B, C, D, E, F, G, H. Size determined by Full Load Amps and Locked Rotor Amps.

Motor Size	HP	Volts	FURNAS Class 16 Order Number	Heaters	Class 14 Order Number	Inverse Time Breaker	Dual Ele. Time Del. Fuse
4" 3Ø	2	460	16AH	K32	CSDC	15	8
		575	16AE	K29	CSDE	15	5
	3	200	16AD	K54	CSED	30	20
		230	16AG	K52	CSEA	25	20
		460	16AH	K37	CSDC	15	10
		575	16AE	K33	CSDE	15	8
	5	200	16AD	K61	DSFD	50	35
		230	16AG	K60	DSFA	40	30
		460	16AH	K49	CSDC	20	15
		575	16AE	K41	CSDE	20	15
	7½	200	16CD	K69	DSFD	70	50
		230	16BG	K64	DSFA	60	45
		460	16AH	K54	DSEC	30	25
		575	16AE	K52	DSEE	25	20
	10	460	16AH	K60	DSEC	45	30
		575	16AE	K57	DSEE	35	25

H = coil voltage. Voltages are: D = 200 V, E = 575 V, F = 115 V, G = 230 V, H = 460 V.

The Class 14 starter nomenclature can be found in your Jet & Submersible Price Book.

MOTOR INSULATION RESISTANCE READINGS

Normal Ohm/Megohm readings, ALL motors, between all leads and ground

⚠ CAUTION To perform insulation resistance test, open breaker and disconnect all leads from QD control box or pressure switch. Connect one ohmmeter lead to any motor lead and one to metal drop pipe or a good ground. **R x 100K Scale**

Condition of Motor and Leads	OHM Value	Megohm Value
New motor, without power cable	20,000,000 (or more)	20.0
Used motor, which can be reinstalled in well	10,000,000 (or more)	10.0
Motor in well – Readings are power cable plus motor		
New motor	2,000,000 (or more)	2.0
Motor in reasonably good condition	500,000 to 2,000,000	0.5 – 2.0
Motor which may be damaged or have damaged power cable *Do not pull motor for these reasons*	20,000 to 500,000	0.02 – 0.5
Motor definitely damaged or with damaged power cable *Pull motor and repair*	10,000 to 20,000	0.01 – 0.02
Failed motor or power cable *Pull motor and repair*	Less than 10,000	0 – 0.01

Generator Operation

- For externally regulated generator kilovolt amperes (KVA) ratings see Table 1. Electrical voltage, frequency, phase and ampacity, MUST match that shown on the motor nameplate, or pump control box.

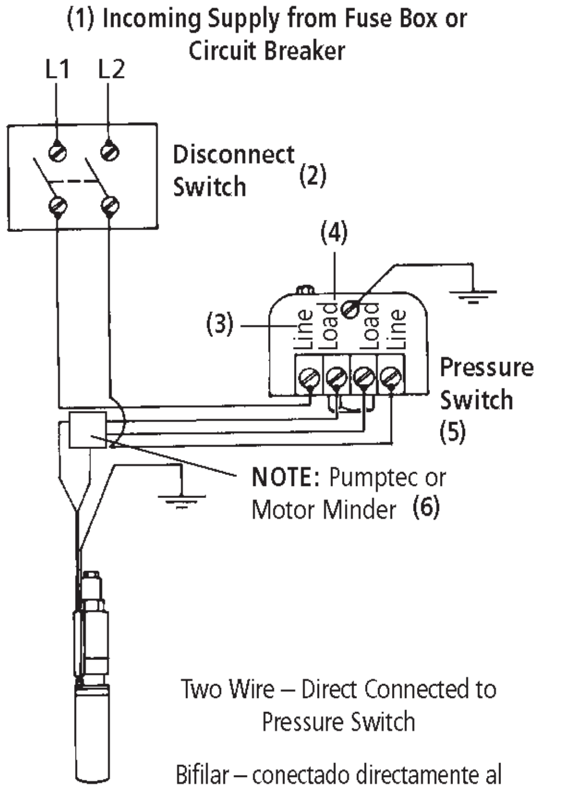
FAILURE TO USE A MANUAL OR AUTOMATIC TRANSFER SWITCH WHEN GENERATOR IS USED AS STANDBY OR BACKUP CAN CAUSE SHOCK, BURNS OR DEATH.

Min. Generator Rating	**Pump Motor Horsepower ①**							
	1/3	1/2	3/4	1	1 1/2	2	3	5
KVA	1.9	2.5	3.8	5.0	6.3	9.4	12.5	18.8
KW	1.5	2.0	3.0	4.0	5.0	7.5	10.0	15.0

① **NOTE:** For two-wire motors, minimum generator ratings 50% higher than shown are necessary.

NOTICE: FOLLOW THE GENERATOR MANUFACTURER'S INSTRUCTIONS CAREFULLY.

Courtesy of Franklin Electric Company

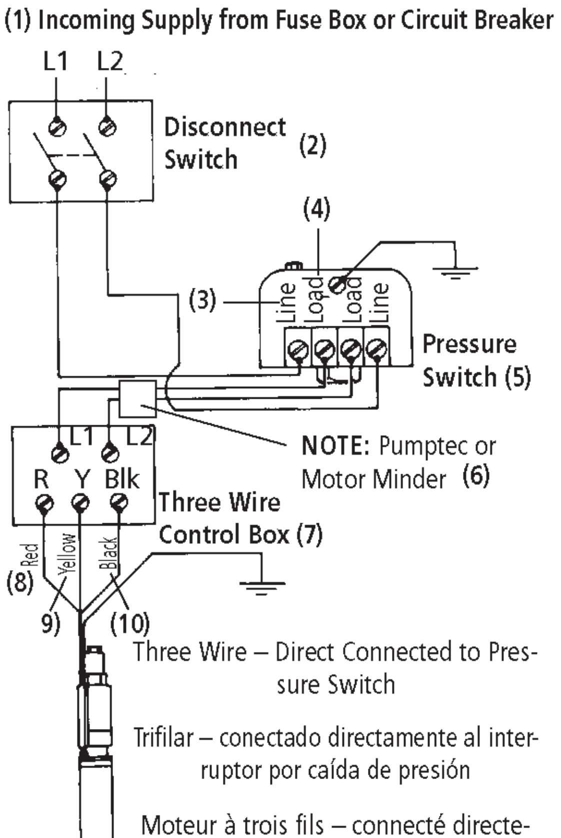


Two Wire – Direct Connected to Pressure Switch

Bifilar – conectado directamente al interruptor por caída de presión

Moteur à deux fils – connecté directement au pressostat

Figure (Figura) 3



Three Wire – Direct Connected to Pressure Switch

Trifilar – conectado directamente al interruptor por caída de presión

Moteur à trois fils – connecté directement au prossostat

Figure (Figura) 4

1.Suministro de entrada de la caja de fusibles o del cortacircuitos

2.Interruptor de desconexión

3.Línea

4. Carga

5. Interruptor por caída de presión

6. NOTA: Pumptec o Motor Minder

7. Caja de control trifilar

8. Rojo

9. Amarillo

10. Negro

1.Courant d'entrée provenant de la boîte à fusibles ou du disjoncteur

2.Sectionneur

3. Ligne

4. Charge

5. Pressostat

6. Protection Pumptec ou Motor Minder

7. Boîte de commande à trois fils

8. Rouge

9. Jaune

10. Noir

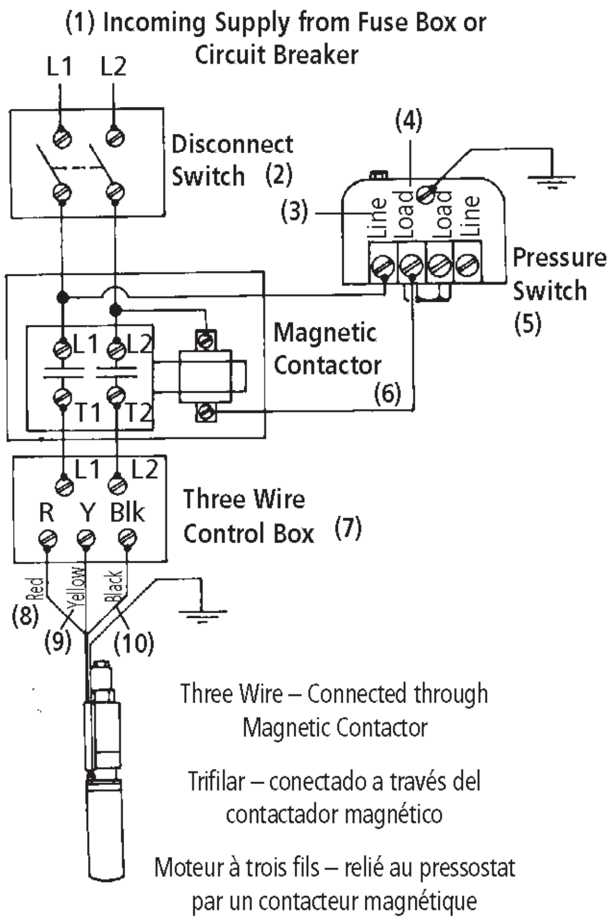


Figure (Figura) 5

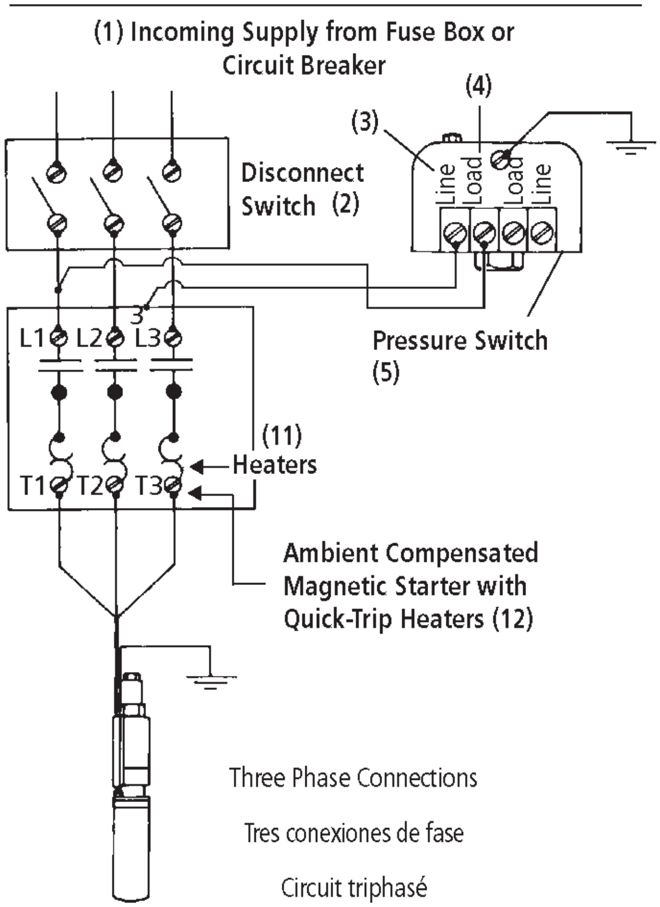
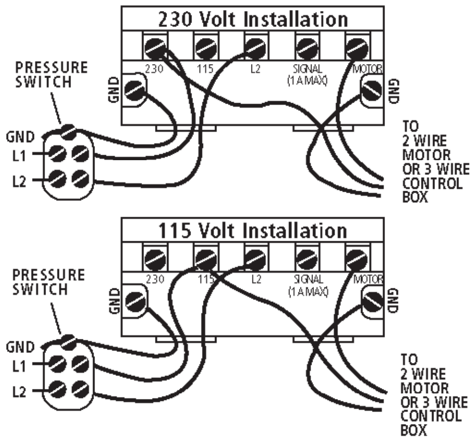


Figure (Figura) 6

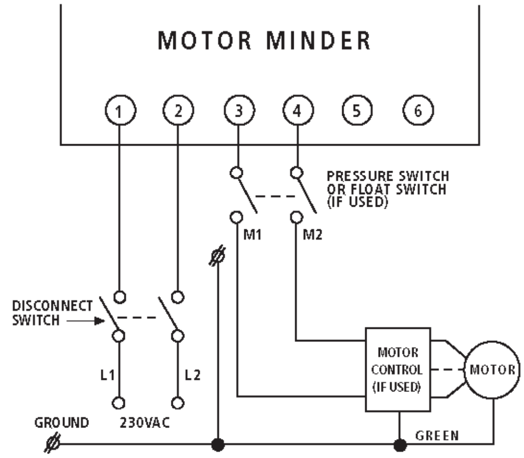
1. Suministro de entrada de la caja de fusibles o del cortacircuitos
2. Interruptor de desconexión
3. Línea
4. Carga
5. Interruptor por caída de presión
6. Contactador magnético
7. Caja de control trifilar
8. Rojo
9. Amarillo
10. Negro
11. Calentadores
12. Arrancador magnético con compensación ambiental con calentadores de disparo rápido

1. Courant d'entrée provenant de la boîte à fusibles ou du disjoncteur
2. Sectionneur
3. Ligne
4. Charge
5. Pressostat
6. Contacteur magnétique
7. Boîte de commande à trois fils
8. Rouge
9. Jaune
10. Noir
11. Dispositifs de protection contre la surcharge (DPS)
12. Démarreur magnétique compensé (température ambiante) avec DPS à déclenchement rapide

PUMPTEC WIRING



MOTOR MINDER WIRING



SINGLE PHASE MOTOR MAXIMUM CABLE LENGTH (motor to service entrance) (2)

Motor Rating		Copper Wire Size (1)								
Volts	HP	14	12	10	8	6	4	2	0	00
115	1/3	130	210	340	540	840	1300	1960	2910	3540
	1/2	100	160	250	390	620	960	1460	2160	2630
230	1/3	550	880	1390	2190	3400	5250	7960	11770	
	1/2	400	650	1020	1610	2510	3880	5880	8720	
	3/4	300	480	760	1200	1870	2890	4370	6470	7870
	1	250	400	630	990	1540	2380	3610	5360	6520
	1.5	190	310	480	770	1200	1870	2850	4280	5240
	2	150	250	390	620	970	1530	2360	3620	4480
	3	120*	190	300	470	750	1190	1850	2890	3610
	5	0	0	180*	280	450	710	1110	1740	2170
	7.5	0	0	0	200*	310	490	750	1140	1410
	10	0	0	0	0	250*	390	600	930	1160
	15	0	0	0	0	170*	270*	430	660	820

(1) This table is based on copper wire. If aluminum wire is used it must be two sizes larger.
Example: When the table calls for #12 copper wire you would use #10 aluminum wire.
(2) Single phase control boxes may be connected at any point of the total cable length.

THREE PHASE MOTOR MAXIMUM CABLE LENGTH (motor to service entrance) (3)

Motor Rating		Copper Wire Size (1)										
Volts	**HP**	**14**	**12**	**10**	**8**	**6**	**4**	**2**	**0**	**00**	**000**	**0000**
200 V 60 Hz	.5	710	1140	1800	2840	4420						
	.75	510	810	1280	2030	3160						
	1	430	690	1080	1710	2670	4140					
	1.5	310	500	790	1260	1960	3050					
	2	240	390	610	970	1520	2360	3610	5420			
	3	180	290	470	740	1160	1810	2760	4130			
	5	110*	170	280	440	690	1080	1660	2490	3050	3670	4440
	7.5	0	0	200	310	490	770	1180	1770	2170	2600	3150
	10	0	0	0	230*	370	570	880	1330	1640	1970	2390
230 V 60 Hz	.5	930	1490	2350	3700	5760	8910					
	.75	670	1080	1700	2580	4190	6490	9860				
	1	560	910	1430	2260	3520	5460	8290				
	1.5	420	670	1060	1670	2610	4050	6160	9170			
	2	320	510	810	1280	2010	3130	4770	7170	8780		
	3	240	390	620	990	1540	2400	3660	5470	6690	8020	9680
	5	140*	230	370	590	920	1430	2190	3290	4030	4850	5870
	7.5	0	160*	260	420	650	1020	1560	2340	2870	3440	4160
	10	0	0	190*	310	490	760	1170	1760	2160	2610	3160
460 V 60 Hz	.5	3770	6020	9460								
	.75	2730	4350	6850								
	1	2300	3670	5770	9070							
	1.5	1700	2710	4270	6730							
	2	1300	2070	3270	5150	8050						
	3	1000	1600	2520	3970	6200						
	5	590	950	1500	2360	3700	5750					
	7.5	420	680	1070	1690	2640	4100	6260				
	10	310	500	790	1250	1960	3050	4680	7050			
575 V 60 Hz	.5	5900	9410									
	.75	4270	6810									
	1	3630	5800	9120								
	1.5	2620	4180	6580								
	2	2030	3250	5110	8060							
	3	1580	2530	3980	6270							
	5	920	1480	2330	3680	5750						
	7.5	660	1060	1680	2650	4150						
	10	490	780	1240	1950	3060	4770					

(3) The portion of the total cable which is between the service entrance and a three phase motor starter should not exceed 25% of the total maximum length to assure reliable starter operation.

Lengths marked * meet the U.S. National Electrical Code ampacity only for individual conductor 75°C cable. Only the lengths without * meet the code for jacketed 75°C cable. Local code requirements may vary.

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

Symptom	Probable Cause	Recommended Action
PUMP MOTOR NOT RUNNING	1. Motor thermal protector tripped a. Incorrect control box b. Incorrect or faulty electrical connections c. Faulty thermal protector d. Low voltage e. Ambient temperature of control box/starter too high f. Pump bound by foreign matter g. Inadequate submergence	1. Allow motor to cool, thermal protector will automatically reset a – e. Have a qualified electrician inspect and repair, as required f. Pull pump, clean, adjust set depth as required g. Confirm adequate unit submergence in pumpage
	2. Open circuit breaker or blown fuse	2. Have a qualified electrician inspect and repair, as required
	3. Power source inadequate for load	3. Check supply or generator capacity
	4. Power cable insulation damage 5. Faulty power cable splice	4 – 5. Have a qualified electrician inspect and repair, as required
LITTLE OR NO LIQUID DELIVERED BY PUMP	1. Faulty or incorrectly installed check valve	1. Inspect check valve, repair as required
	2. Pump air bound	2. Successively start and stop pump until flow is delivered
	3. Lift too high for pump	3. Review unit performance, check with dealer
	4. Pump bound by foreign matter	4. Pull pump, clean, adjust set depth as required
	5. Pump not fully submerged	5. Check well recovery, lower pump if possible
	6. Well contains excessive amounts of air or gases	6. If successive starts and stops does not remedy, well contains excessive air or gases
	7. Excessive pump wear	7. Pull pump and repair as required
	8. Incorrect motor rotation – three phase only.	8. Reverse any two motor electrical leads

GOULDS PUMPS

Bomba sumergible de 4 pulg.

Instrucciones de instalación y funcionamiento

Información del propietario

Número de modelo de la bomba: ________

____

Número de serie de la bomba: ________

____

Número de modelo del motor: ________

____

Número de serie del motor: ________

Agente: ________________

____

No. telefónico del agente: ________

Fecha de compra: ________

Fecha de instalación: ________

Voltios: ________________

Amperios: ________________

Índice

Goulds Pumps

ITT Industries

INSTRUCCIONES DE SEGURIDAD

PARA EVITAR LESIONES PERSONALES GRAVES O AÚN FATALES Y SERIOS DAÑOS MATERIALES, LEA Y SIGA TODAS LAS INSTRUCCIONES DE SEGURIDAD EN EL MANUAL Y EN LA BOMBA.

ESTE MANUAL HA SIDO CREADO COMO UNA GUÍA PARA LA INSTALACIÓN Y OPERACIÓN DE ESTA UNIDAD Y SE DEBE CONSERVAR JUNTO A LA BOMBA.

Éste es un SÍMBOLO DE ALERTA DE SEGURIDAD. Cuando vea este símbolo en la bomba o en el manual, busque una de las siguientes palabras de señal y esté alerta a la probabilidad de lesiones personales o daños materiales.

⚠ PELIGRO Advierte los peligros que CAUSARÁN graves lesiones personales, la muerte o daños materiales mayores.

⚠ ADVERTENCIA Advierte los peligros que PUEDEN causar graves lesiones personales, la muerte o daños materiales mayores.

⚠ PRECAUCIÓN Advierte los peligros que PUEDEN causar lesiones personales o daños materiales.

AVISO: INDICA INSTRUCCIONES ESPECIALES QUE SON MUY IMPORTANTES Y QUE SE DEBEN SEGUIR DE RETROCESO DE DRENAJE; ESTOS SISTEMAS DEBEN UTILIZAR OTROS MEDIOS FRANKLIN ELECTRIC O EN UN MANUAL DEL CÓDIGO N.E.C. (CÓDIGO ELÉCTRICO NACIONAL DE LOS ESTADOS UNIDOS).

EXAMINE BIEN TODAS LAS INSTRUCCIONES Y ADVERTENCIAS ANTES DE REALIZAR CUALQUIER TRABAJO EN ESTA BOMBA.

MANTENGA TODAS LAS CALCOMANÍAS DE SEGURIDAD.

Aviso importante: Lea las instrucciones de seguridad antes de proseguir con el cableado.

⚠ ADVERTENCIA Todo el trabajo eléctrico debe ser realizado por un técnico calificado. Siempre siga el Código Eléctrico Nacional (NEC) o el Código Eléctrico Canadiense, además de todos los códigos locales, estatales y provinciales. Las preguntas acerca del código deben ser dirigidas al inspector eléctrico local. Si se hace caso omiso a los códigos eléctricos y normas de seguridad de OSHA, se pueden producir lesiones personales o daños al equipo. Si se hace caso omiso a las instrucciones de instalación del fabricante, se puede producir electrochoque, peligro de incendio, lesiones personales o aún la muerte, daños al equipo, rendimiento insatisfactorio y podría anularse la garantía del fabricante.

⚠ ADVERTENCIA Las unidades estándar no están diseñadas para usarse en albercas, masas abiertas de agua, líquidos peligrosos o donde existan gases inflamables. El pozo de debe ventear de acuerdo con los códigos locales.

En lugares con líquidos inflamables o donde pudiesen pudiese haber gases inflamables sólo deben usarse bombas específicamente clasificadas para áreas de Clase 1, División 1. C*onsulte los boletines de catálogos de bombas específicas o la placa de identificación de la bomba con respecto a las listas de agencias.*

⚠ ADVERTENCIA Desconecte y bloquee la corriente eléctrica antes de instalar o dar servicio a cualquier equipo eléctrico. Muchas bombas están equi-padas con protección automática contra la sobrecarga térmica, la cual podría permitir que una bomba demasiado caliente rearranque inesperadamente.

⚠ ADVERTENCIA Todos los controles trifásicos (3Ø) para bombas sumergibles deben incluir protección contra sobrecarga de Clase 10, de disparo rápido.

⚠ ADVERTENCIA No levante ni transporte ni cuelgue la bomba de los cables eléctricos. El daño a los cables eléctricos puede producir electrochoque, quemaduras o aún la muerte.

⚠ ADVERTENCIA Use únicamente alambre trenzado de cobre para la bomba/motor y la conexión a tierra. El alambre de conexión a tierra debe ser al menos del mismo tamaño que los alambres de la fuente de alimentación. Los alambres deben codificarse con colores para facilitar el mantenimiento y la identificación y resolución de problemas.

⚠ PELIGRO Instale los cables y la conexión a tierra de acuerdo con el Código Eléctrico Nacional de EE.UU. (NEC) o el Código Eléctrico Canadiense, además de los códigos locales, estatales y provinciales.

⚠ ADVERTENCIA Instale un desconectador de todos los circuitos donde el código lo requiera.

⚠ ADVERTENCIA La tensión y fase de la fuente de alimentación deben corresponder con todos los requerimientos del equipo. La tensión o fase incorrecta puede producir incendio, daño al motor o a los controles y anula la garantía.

⚠ ADVERTENCIA Todos los empalmes deben ser impermeables. Si utiliza juegos de empalme, siga las instrucciones del fabricante.

⚠ ADVERTENCIA Seleccione una caja de conexiones NEMA del tipo correcto para la aplicación y ubicación. La caja de conexiones debe garantizar conexiones de cableado seguras y secas.

⚠ ADVERTENCIA La falla de conectar a tierra permanentemente la bomba, el motor y los controles, antes de conectar la corriente eléctrica, puede causar electrochoque, quemaduras o la muerte.

⚠ ADVERTENCIA Los motores de 4 pulg. ≥ 2 caballos de fuerza requieren una velocidad de flujo mínima de 0.25 pies/seg o 7.62 cm/seg más allá del motor para producir un enfriamiento apropiado del mismo. Los flujos mínimos en GPM por diámetro de pozo requeridos para el enfriamiento son los siguientes: 1.2 GPM/4 pulg., 7 GPM/5 pulg., 13 GPM/6 pulg., 20 GPM/7 pulg., 30 GPM/8 pulg. o 50 GPM en un pozo de 10 pulg. Las bombas ≥ 2 caballos de fuerza instaladas en tanques grandes se deben instalar en una camisa de inducción de flujo para crear el flujo de enfriamiento o la velocidad necesaria más allá del motor.

⚠ PRECAUCIÓN Esta bomba se evaluó para uso con Agua Únicamente.

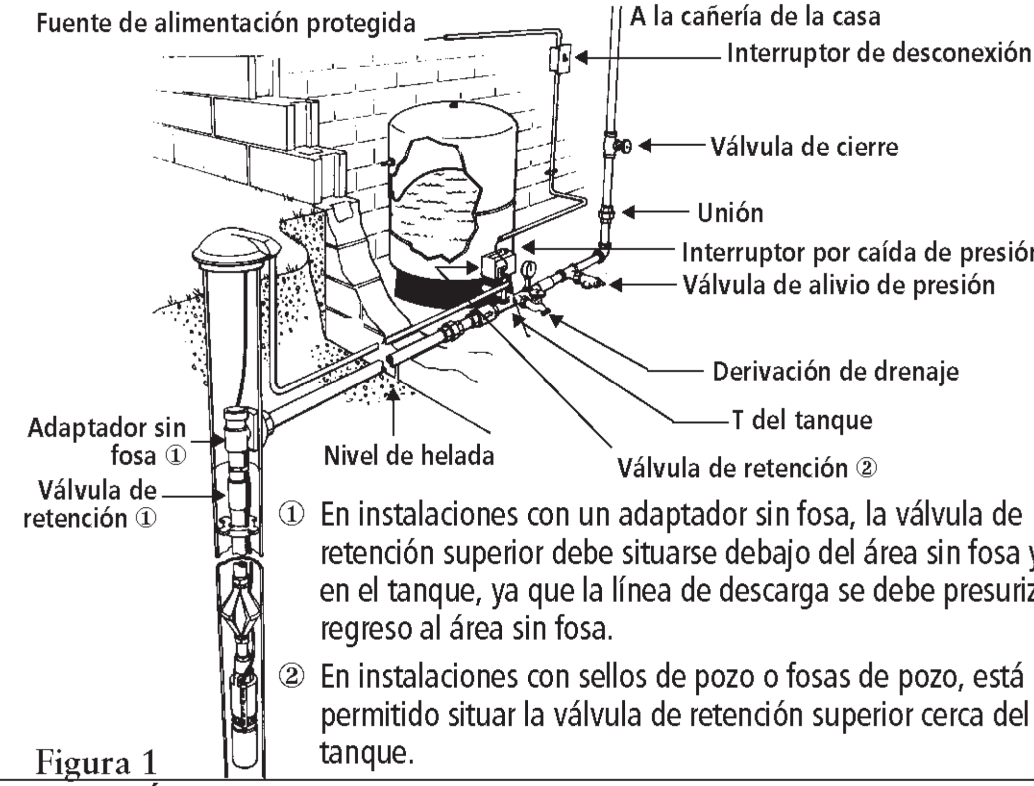
LISTA DE VERIFICACIÓN DE LA INSTALACIÓN

- Anote la información de la bomba y del motor y otros datos solicitados en la portada de este manual.
- Inspeccione todos los componentes para detectar daños de envío; notifique los daños de inmediato al distribuidor.
- Verifique la correspondencia de los caballos de fuerza del motor y de la bomba.
- Haga corresponder la tensión y fase de la fuente de alimentación con las especificaciones de control y del motor.
- Seleccione un lugar sombreado y seco en el cual montar los controles.
- Las conexiones de todos los empalmes sumergidos y subterráneos deben ser impermeables.
- Sujete la bomba en la cabeza de descarga cuando instale tubo roscado o un accesorio adaptador ya que la mayoría de las bombas tienen roscas de mano izquierda que se aflojarán si sujeta la bomba de cualquier otra parte.
- Revise todas las conexiones de plomería para verificar que estén ajustadas y selladas con cinta de Teflon.
- Verifique que la clasificación de presión del tubo sea más alta que la presión de paro de la bomba.
- Instale una válvula de alivio de presión en todo sistema capaz de crear más de 75 PSI.
- Sitúe el interruptor por caída de presión a menos de 4 pies del tanque de presión para evitar el chasquido del interruptor.
- Ajuste la precarga del tanque 2 PSI por debajo de la presión de conexión del sistema, por ejemplo 28 en un sistema de 30/50.
- Instale la bomba 10 pies más arriba del fondo del pozo para mantenerla lejos de los sedimentos y residuos.
- Verifique que el suministro eléctrico principal esté desconectado y APAGADO antes de cablear los componentes.
- El cableado debe ser realizado por técnicos calificados únicamente.
- El cableado y la puesta a tierra deben cumplir con los códigos nacionales y locales.
- Restrinja el flujo con una válvula de bola o de globo, 1/3 abierta, antes de arrancar la bomba por primera vez.
- Abra un grifo o válvula de descarga durante la puesta en marcha para evitar que entre agua sucia al tanque.
- ENCIENDA el cortacircuitos principal o el desconectador.
- Active/desactive varias veces para verificar el funcionamiento correcto del interruptor.
- Verifique los amperios y anote los datos en la portada de este manual.
- Entregue el manual al propietario en el sitio de la obra.

1.0 INSTALACIONES TÍPICAS

INSTALACIÓN DEL TANQUE CAPTIVE AIR

AVISO: LOS CAMBIOS DE PRESIÓN DE PRECARGA DEL TANQUE DEBEN HACERSE CON LA VÁLVULA NEUMÁTICA EN EL EXTREMO SUPERIOR DEL TANQUE.



① En instalaciones con un adaptador sin fosa, la válvula de retención superior debe situarse debajo del área sin fosa y no en el tanque, ya que la línea de descarga se debe presurizar de regreso al área sin fosa.

② En instalaciones con sellos de pozo o fosas de pozo, está permitido situar la válvula de retención superior cerca del tanque.

Figura 1

INSTALACIÓN DE TANQUE GALVANIZADO

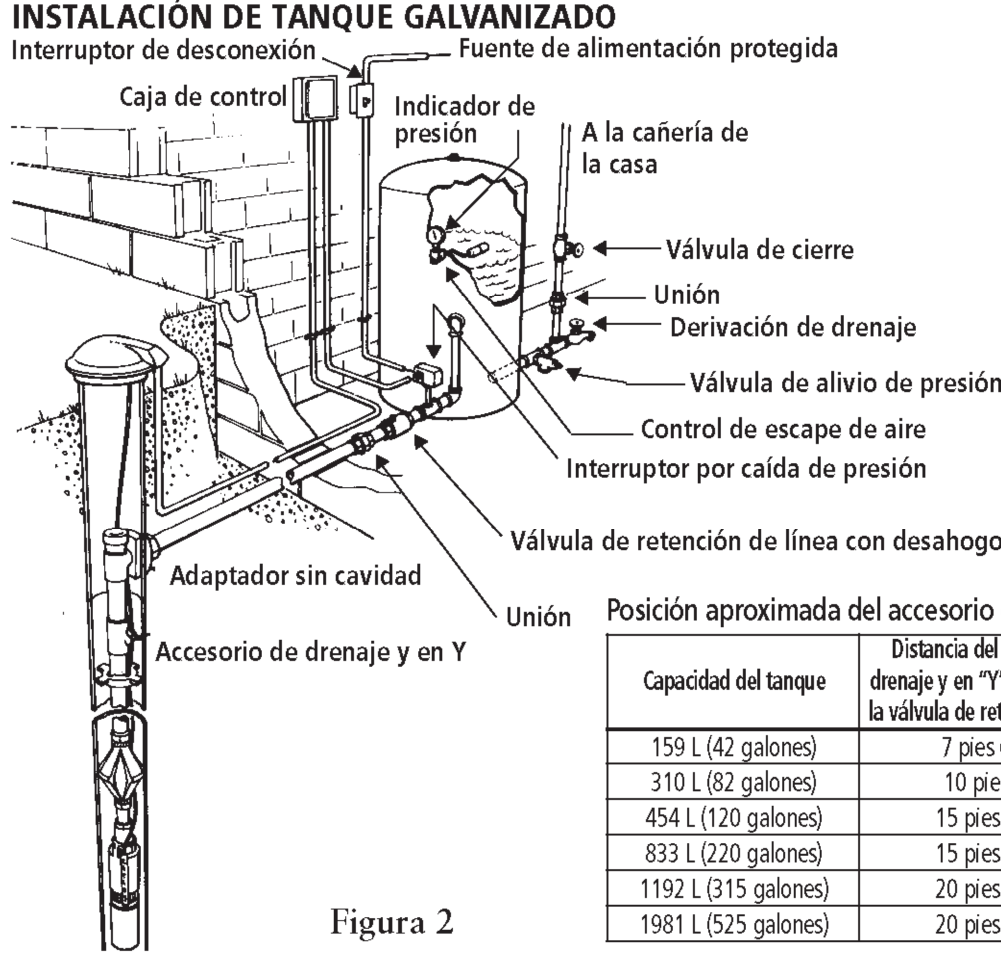


Figura 2

Posición aproximada del accesorio de drenaje

Capacidad del tanque	Distancia del accesorio de drenaje y en "Y" por debajo de la válvula de retención de línea
159 L (42 galones)	7 pies (2.1m)
310 L (82 galones)	10 pies (3m)
454 L (120 galones)	15 pies (4.6m)
833 L (220 galones)	15 pies (4.6m)
1192 L (315 galones)	20 pies (6.1m)
1981 L (525 galones)	20 pies (6.1m)

2.0 TUBERÍA

Aviso: La mayoría de las bombas sumergibles de 4 pulg. tienen roscas de mano izquierda en la cabeza de descarga; sujete la bomba <u>sólo</u> en la "cabeza de descarga" con una llave cuando instale accesorios o tubo roscado.

2.1 Generalidades

La tubería de descarga de la bomba debe dimensionarse para producir un funcionamiento eficiente de la bomba. Utilice las Tablas de pérdida por fricción para calcular la carga dinámica total empleando tubos de tamaños diferentes. Como regla práctica, utilice 1 pulg. para hasta 10 gpm, 1¼ pulg. para hasta 30 gpm, 1½ pulg. para hasta 45 gpm y 2 pulg. para hasta 80 gpm. En el caso de secciones largas de tubería es mejor aumentar el tamaño de la tubería.

Algunas bombas son capaces de producir presiones de descarga muy altas; por lo tanto, seleccione el tubo que corresponda. Consulte con su proveedor de tubería para determinar el mejor tipo para cada instalación.

2.2 Tanque de presión, interruptor por caída de presión y válvula de alivio de presión

Seleccione una área que siempre esté a más de 34° F (1° C) en la cual instalar el tanque, el interruptor por caída de presión y la válvula de alivio de presión. El tanque debe estar situado en una área donde una fuga no produzca daños materiales.

El interruptor por caída de presión debe estar situado en la doble T del tanque y nunca a más de 4 pies del tanque. Si el interruptor se sitúa a más de 4 pies del tanque, emitirá un chasquido.

No debe haber válvulas, filtros ni accesorios sueltos entre el interruptor y el (los) tanque(s) o podría haber chasquido del interruptor. Como ejemplo, una válvula de retención a resorte de 1¼ pulg. tiene una pérdida por fricción igual a 12 pies de tubo; colocar la válvula entre el interruptor por caída de presión y el tanque de presión es lo mismo que mover el interruptor de presión a 12 pies de distancia del tanque. Producirá chasquido del interruptor.

En instalaciones de varios tanques, el interruptor debe situarse lo más cerca posible del centro del tanque. Las instalaciones de varios tanques deben tener un tubo de distribución cuyo tamaño sea al menos 1½ veces el tamaño del tubo de suministro de la bomba. Esto reducirá la carga por fricción en el tubo de distribución y disminuirá la posibilidad de chasquido del interruptor.

El valor de conexión en un interruptor por caída de presión de 30 - 50 es de 30 lbs./pulg. cuadrada. El valor de conexión es el valor más bajo de los valores de presión.

Se requieren válvulas de alivio de presión en cualquier sistema que sea capaz de producir 100 lbs./pulg. cuadrada o 230 pies de carga dinámica total. Si ésta es una área donde una purga o fuga de agua podría dañar la propiedad, conecte una línea de drenaje a la válvula de alivio de presión. Tiéndala a un drenaje adecuado o a una área donde el agua no dañará la propiedad.

2.3 Cómo ajustar la precarga del tanque

Asegure que no haya nada de agua en el tanque. Utilice un indicador de presión de alta calidad para medir la presión de precarga del tanque. La presión debe ser 2 lbs./pulg. cuadrada menos que la presión de conexión de la bomba. Como ejemplo, un sistema de 30-50 lbs./pulg. cuadrada utilizaría una precarga del tanque de 28 lbs./ pulg. cuadrada.

2.4 Tubería de descarga y válvula de retención

Nota: La mayoría de las cabezas de descarga se atornillas en la carcasa con roscas de mano izquierda. Sólo sujete la bomba en la cabeza de descarga cuando instale los accesorios. Si no se sujeta la cabeza de descarga, ésta se aflojará y se dañará la bomba al ponerla en marcha.

Si la tubería necesita un adaptador, recomendamos enfáticamente utilizar acero inoxidable. Los accesorios o tuberías galvanizadas nunca deben conectarse directamente a una cabeza de descarga de acero inoxidable ya que podría producirse corrosión galvánica. Se puede utilizar cualquier material para esta conexión en el caso de bombas de plástico o de latón. Los conectores tipo arpón siempre deben sujetarse con doble abrazadera.

La cabeza de descarga de la bomba tiene una asa para conectar un cable de seguridad. El uso de un cable de seguridad es a discreción del instalador.

2.5 Cómo instalar la bomba en el pozo

Si está utilizando un mecanismo antitorsión, instálelo de acuerdo con las instrucciones de instalación del fabricante. Solicite información al proveedor sobre mecanismos antitorsión e instrucciones de instalación.

Conecte la tubería de descarga a la cabeza de descarga o al adaptador que instaló previamente. Los conectores tipo arpón siempre deben sujetarse con doble abrazadera. Instale la bomba en el interior del pozo utilizando un adaptador sin fosa o dispositivo similar en el cabezal del pozo. Consulte con el fabricante del accesorio o con el proveedor del adaptador con respecto a instrucciones específicas de instalación.

Utilice cinta aislante impermeable para sujetar los alambres al tubo de bajada a intervalos de 10 pies. Asegúrese de que la cinta no se desprenda ya que bloqueará la succión de la bomba si cae dentro del pozo. Los proveedores de bombas también venden conectores de alambre estilo presilla para sujetar el alambre al tubo de bajada.

2.6 Tubería especial para sistemas de tanques galvanizados

Cuando utilice un tanque galvanizado, debe instalar un accesorio de drenaje e “Y” AV11 en el pozo y una válvula de retención con válvula de desahogo en el tanque. Esto introducirá aire al tanque con cada arranque de la bomba y evitará el estancamiento del agua en el tanque. Utilice un escape de aire AA4 en el tanque para permitir el escape del exceso de aire. La distancia entre AV11 y válvula de desahogo determina la cantidad de aire que entra en cada ciclo. Consulte la tabla con respecto a los valores recomendados. *Consulte la Fig. 2 en la Sección 1.0.*

En el caso de pozos de gas, deben utilizarse tanques galvanizados con escapes de aire AA4 para ventear el exceso de aire y evitar la “salida de agua por chorros” en las llaves.

El metano y otros gases explosivos o peligrosos requieren un tratamiento especial del agua para extraerlos en forma segura. Consulte con un especialista de tratamiento de agua para considerar estos asuntos.

En las instalaciones con pozo de alimentación superior se deben usar camisas de flujo en la bomba.

2.7 Válvulas de retención

Nuestras bombas utilizan cuatro estilos distintos de válvulas de retención. Recomendamos el uso de válvulas de retención ya que evitan el giro inverso de la bomba y motor que producirá un desgaste prematuro de los cojinetes. Además, las válvulas de retención evitan que se produzca ariete hidráulico o daños por empuje hacia arriba. Las válvulas de retención se deben instalar cada 200 - 250 pies en la tubería de descarga vertical.

La siguiente información es para clientes que desean desactivar una válvula de retención para un sistema de retroceso de drenaje; estos sistemas deben utilizar otros medios para impedir el ariete hidráulico o los daños por empuje hacia arriba:

- **Las válvulas de acero inoxidable** incorporadas tienen un área plana que se puede perforar con facilidad con un taladro eléctrico y una broca de ¼ pulg. o ⅜ pulg. para desactivar la válvula.
- **Las válvulas de retención estilo aguja que están atornilladas desde arriba** de la cabeza de descarga se pueden retirar con facilidad utilizando un entuercador de 12 pulg. o una boquilla profunda. El cubo hexagonal es visible y accesible desde arriba.
- **Las válvulas internas estilo aguja de plástico de diseño Flomatic™** se deben retirar desde adentro, para lo cual es necesario desarmar la bomba.
- **Las válvulas estilo aguja de plástico incorporadas con un vástago a través del extremo superior** se pueden retirar de la cabeza de descarga tirando el vástago con alicates.

3.0 TAMAÑO Y EMPALME DE ALAMBRES y FUENTE DE ALIMENTACIÓN

Siempre siga el Código Eléctrico de los Estados Unidos (N.E.C.) el Código Eléctrico del Canadá y cualquier código y cualquier código estatal o local.

Sugerimos utilizar alambre de cobre únicamente. Determine el tamaño del alambre de las tablas incluidas en la sección de Datos Técnicos de este manual, en el manual AIM de Franklin Electric o en un manual del código N.E.C. (Código Eléctrico Nacional de los Estados Unidos). Si existen discrepancias, el Código Eléctrico Nacional de los Estados Unidos tiene prioridad sobre las recomendaciones del fabricante.

3.1 Empalme de alambre a los conductores del motor

Cuando deba empalmarse o conectarse un cable de bajada al conductor del motor, es necesario que el empalme sea impermeable. El empalme puede realizarse con juegos de contracción por calor o cinta impermeable.

A. Instrucciones de empalme con juego de contracción por calor

Para utilizar un juego típico de contracción por calor: pele ½ pulgada de los alambres del motor y de los alambres del cable de bajada; es mejor escalonar los empalmes. Coloque los tubos de contracción por calor sobre los alambres. Coloque los plegadores sobre los alambres y pliegue los extremos. Deslice los tubos de contracción por calor sobre los plegadores y caliéntelos desde el centro hacia afuera. El sellador y el adhesivo saldrán por los extremos cuando el tubo se contrae. El tubo, los plegadores, el sellador y el adhesivo crearán un sello impermeable muy resistente.

B. Instrucciones de empalme con cinta

A) Pele el aislamiento del conductor individual sólo lo necesario para dejar espacio para un conector tipo estaca. Se prefieren los conectores tubulares tipo estaca. Si el D.E. del conector no es tan grande como el aislamiento del cable, auméntelo con cinta aislante de caucho.

B) Encinte las juntas individuales con cinta aislante de caucho, empleando dos capas; la primera extendiéndose dos pulgadas más allá de cada extremo de aislamiento del conductor, la segunda capa extendiéndose dos pulgadas más allá de la primera capa. Envuelva en forma apretada, eliminando los espacios de aire lo más posible.

C) Aplique cinta aislante Scotch #33 o equivalente sobre la cinta aislante de caucho, empleando dos capas como en el paso “B” y haciendo que cada capa se superponga al menos dos pulgadas al extremo de la capa anterior.

En el caso de un cable con tres conductores recubiertos con un solo revestimiento exterior, encinte los conductores individuales en la forma descrita, alternando las juntas.

El espesor total de la cinta no debe ser inferior al espesor del aislamiento del conductor.

4.0 CÓMO CONECTAR LOS CONTROLES y EL INTERRUPTOR

4.1 Cómo montar la caja de control del motor

Las cajas de control monofásicas trifilares cumplen con los requerimientos de U.L. para las cubiertas tipo 3R. Son adecuadas para montaje vertical en lugares interiores y exteriores. Funcionarán a temperaturas entre 14°F (-10°C) y 122°F (50°C). Seleccione un lugar sombreado y seco para montar la caja. Asegure que haya suficiente espacio para quitar la tapa.

4.2 Verifique la tensión y apague la fuente de alimentación

Asegure que la tensión del motor y la tensión de la fuente de alimentación sean iguales.

Coloque el cortacircuitos o interruptor de desconexión en la posición OFF (de apagado) para evitar arrancar la bomba accidentalmente antes de que esté listo.

Las bobinas de arrancadores trifásicos son muy sensibles a la tensión; siempre verifique la tensión de suministro real con un voltímetro.

La alta o baja tensión, de más de ±10%, dañará los motores y controles y eso no está cubierto por la garantía.

4.3 Cómo conectar los conductores del motor a la caja de control del motor, interruptor por caída de presión o arrancador

Precaución No energice la unidad ni haga funcionar la bomba hasta que haya completado todas las conexiones eléctricas y de tuberías. Verifique que el desconector o cortacircuitos esté APAGADO antes de conectar los conductores de la línea del interruptor por caída de presión a la fuente de alimentación. Siga todos los códigos locales y nacionales. Utilice un desconector cuando el código así lo requiera.

A. Motor monofásico trifilar
Conecte los conductores del motor codificados con colores a los terminales de la caja de control del motor - Y (amarillo), R (rojo) y B (negro) y el alambre verde o desnudo al tornillo verde de puesta a tierra.

Conecte los alambres entre los terminales de carga en el interruptor por caída de presión y los terminales L1 y L2 de la caja de control. Conecte un alambre de puesta a tierra entre la tierra del interruptor y la tierra de la caja de control.
Consulte la Figura 4 ó 5

B. Motor monofásico bifilar
Conecte los conductores negros del motor a los terminales de carga en el interruptor por caída de presión y el alambre verde o desnudo de puesta a tierra al tornillo verde de puesta a tierra. *Consulte la Figura 3*

C. Motores trifásicos
Conecte los conductores del motor a T1, T2 y T3 en el arrancador trifásico. Conecte el alambre de puesta a tierra al tornillo de puesta a tierra en la caja del arrancador. Siga las instrucciones del fabricante del arrancador para conectar el interruptor por caída de presión o *consulte la Figura 6*.

4.4 Conexión a la fuente de alimentación

Complete el cableado haciendo la conexión desde los terminales de línea del interruptor por caída de presión monofásico al panel de cortacircuitos o al desconector en caso que se utilice.

Instalaciones trifásicas – haga las conexiones entre L1, L2, L3 y tierra en el arrancador al desconector y luego al panel de cortacircuitos.

Deben verificarse las instalaciones trifásicas con respecto a la rotación del motor y al desbalance de fase. Para invertir la rotación del motor, cambie (invierta) dos conductores cualquiera. Consulte las instrucciones para identificar el desbalance trifásico en la Sección Técnica de este manual. Si no se revisa el desbalance de fase, se puede producir una falla prematura del motor o un disparo por sobrecarga falso. Si está utilizando un generador, consulte los Datos Técnicos para generadores.

4.5 Protección contra las sobrecargas en unidades trifásicas

Sólo use la protección de Clase 10, de disparo rápido contra las sobrecargas en los motores sumergibles trifásicos. Los arrancadores Furnas Clase 14 NEMA con sobrecargas ESP 100 y los arrancadores Clase 16 equipados con calentadores “K” o sobrecargas ESP 100 brindarán protección adecuada.

El Manual de aplicaciones de Franklin Electric describe varias combinaciones aceptables de arrancadores/sobrecargas. Llame a la línea directa de FE al 800-348-2420 o al grupo de

Servicio al cliente del fabricante de la bomba para solicitar asistencia de selección.

Nota: Si está reemplazando un motor sobre el suelo por uno sumergible, verifique que las sobrecargas provean protección de Clase 10, la mayoría de los motores de instalación sobre el suelo tienen sobrecargas de Clase 20. El uso de sobrecargas de Clase 20 en los motores sumergibles no los protegerá y anulará la garantía.

4.6 Desbalance de potencia trifásica

Se recomienda un suministro trifásico completo incluyendo tres transformadores individuales o un transformador trifásico. Se pueden usar conexiones en estrella o en triángulo "abierto" empleando sólo dos transformadores, pero hay más posibilidad de que produzcan un rendimiento inadecuado, disparo por sobrecarga o falla prematura del motor debido al desbalance de corriente.

Mida la corriente en cada uno de los tres conductores del motor y calcule el desbalance de corriente en la forma que se explica abajo.

Si el desbalance de corriente es del 2% o menos, deje los conductores tal como están conectados.

Si el desbalance de corriente es de más del 2%, hay que verificar las lecturas de corriente en cada derivación empleando cada una de las tres conexiones posibles. Enrolle los conductores del motor en el arrancador en la misma dirección para evitar una inversión del motor.

Para calcular el porcentaje de desbalance de corriente:

A. Sume los tres valores de corriente de línea.

B. Divida la suma por tres, con lo cual se obtiene la corriente promedio.

C. Seleccione el valor de corriente más alejado de la corriente promedio (ya sea alto o bajo).

D. Determine la diferencia entre este valor de corriente (más alejado del promedio) y el promedio.

E. Divida la diferencia por el promedio.

Multiplique el resultado por 100 para determinar el porcentaje de desbalance.

	Conexión 1			Conexión 2			Conexión 3		
Terminales del arrancador	L1	L2	L3	L1	L2	L3	L1	L2	L3
	⊥ ⊤	⊥ ⊤	⊥ ⊤	⊥ ⊤	⊥ ⊤	⊥ ⊤	⊥ ⊤	⊥ ⊤	⊥ ⊤
Conductores del motor	R T3	B T1	Y T2	Y T2	R T3	B T1	B T1	Y T2	R T3

Ejemplo:

T3-R = 51 amperios	T2-Y = 50 amperios	T1-B = 50 amperios
T1-B = 46 amps	T3-R = 48 amps	T2-Y = 49 amps
T2-Y = <u>53</u> amps	T1-B = <u>52</u> amps	T3-R = <u>51</u> amps
Total = 150 amperioss	Total = 150 amperios	Total = 150 amperios
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 ó 8%	2 ÷ 50 = .04 ó 4%	1 ÷ 50 = .02 ó 2%

El desbalance de corriente no debe exceder el 5% a la carga del factor de servicio o el 10% a la carga de entrada nominal. Si el desbalance no puede corregirse enrollando los conductores, la causa del desbalance debe determinarse y corregirse. Si, en las tres conexiones posibles, la derivación más alejada del promedio está en el mismo conductor de potencia, entonces la mayoría del desbalance proviene de la fuente de potencia.

Contacte a la compañía de electricidad local para solucionar el desbalance.

5.0 CÓMO ARRANCAR LA BOMBA

5.1 Estrangulación de la descarga durante la puesta en marcha

Instale una válvula de bola en la línea de descarga y ábrala ⅓ antes de operar la bomba en modo de descarga abierta. Esto protegerá a la bomba contra los daños por empuje hacia arriba y también evita el bombeo excesivo del pozo y reduce la turbidez. Mantenga la válvula parcialmente cerrada hasta que el agua salga cristalina.

5.2 Estrangulación de un pozo de alto nivel estático para evitar el empuje hacia arriba

Cualquier pozo con un alto nivel estático de agua podría permitir que la bomba funcione fuera de la curva a la derecha o fuera del “intervalo recomendado” mostrado en la curva de la bomba. Recomendamos utilizar un restrictor de flujo “Dole” o estrangular con una válvula de bola para evitar el daño por empuje hacia arriba a la bomba y al motor. Debe restringirse el flujo máximo para que esté dentro del intervalo de funcionamiento recomendado de la bomba. Si utiliza una válvula de bola, ajústela, quite la manija, encinte la manija al tubo y etiquete la válvula con una nota diciendo “No abra esta válvula o podría dañarse la bomba”. La manera más fácil de “ajustar” el flujo es llenar un cubo de 5 galones y medir el tiempo que lleva producir 5 galones. Calcule el flujo en gpm de acuerdo con este valor. A medida que el nivel de agua disminuye en el pozo, se reducirá el flujo debido al aumento de la carga y la válvula no interferirá con el rendimiento.

5.3 Arranque de la bomba

Abra parcialmente una válvula (llave) en el sistema y coloque el cortacircuitos en la posición ON (encendido).

Revise todos los accesorios para detectar fugas.

Cierre la válvula cuando se despeje el agua y permita que aumente la presión. Si está ajustado correctamente, el interruptor debe apagar la bomba a la presión preestablecida. Abra algunas llaves y deje que la bomba funcione durante unos pocos ciclos. Compruebe el funcionamiento del interruptor y verifique que los valores de presión son correctos.

Revise nuevamente todos los accesorios para detectar fugas.

6.0 DOCUMENTACIÓN y EL MANUAL DE INSTRUCCIONES (IOM)

Entregue este manual de instrucciones y su tarjeta al propietario. ¡Una etiqueta con su nombre y número de teléfono en el tanque o en la caja de control es una buena herramienta de venta para los negocios futuros!

ESPECIFICACIONES DE MOTOR DE 60 HZ, MONOFÁSICO

Tipo	Goulds #/ Caja de control	Prefijo de modelo del motor Franklin	HP	Voltios	Hz	S.F.	Amperios	S.F. Amperios	L_1-L_2 Resistencia – M=Principal, S=Arranque	Cortacircuitos estándar	Fusible de retardo
4" de dos alambres	S04932/ NR	2445040	½	115	60	1.60	10.0	12.0	1.0 – 1.3	30	20
	S04942/ NR	2445050	½	230	60	1.60	5.0	6.0	4.2 – 5.2	15	10
	S05942/ NR	2445070	¾	230	60	1.50	6.8	8.0	3.0 – 3.6	20	15
	S06942/ NR	2445081	1	230	60	1.40	8.2	9.8	2.2 – 2.7	25	20
	S07942/ NR	2445091	1½	230	60	1.30	10.6	13.1	1.5 – 1.9	30	20
4" de tres alambres	S04930/ 00043	2145044	½	115	60	1.60	Y=10.0 B=10.0 R=0.0	Y=12.0 B=12.0 R=0.0	M = 1.0 – 1.3 S = 4.1 – 5.1	30	20
	S04940/ 00044	2145054	½	230	60	1.60	Y=5.0 B=5.0 R=0.0	Y=6.0 B=6.0 R=0.0	M = 4.2 – 5.2 S = 16.7 – 20.5	15	10
	S05940/ 00054	2145074	¾	230	60	1.50	Y=6.8 B=6.8 R=0.0	Y=8.0 B=8.0 R=0.0	M = 3.0 – 3.6 S = 10.7 – 13.1	20	15
	S06940/ 00064	2145081	1	230	60	1.40	Y=8.2 B=8.2 R=0.0	Y=9.8 B=9.8 R=0.0	M = 2.2 – 2.7 S = 9.9 – 12.1	25	20
4" de tres alambres con capacitor de funcionamiento	S07940/ 00074	2243001	1½	230	60	1.30	Y=10.0 B=9.9 R=1.3	Y=11.5 B=11.0 R=1.3	M = 1.5 – 2.3 S = 8.0 – 9.7	30	20
	S08940/ 00084	2243011	2	230	60	1.25	Y=10.0 B=9.3 R=2.6	Y=13.2 B=11.9 R=2.6	M = 1.6 – 2.3 S = 5.8 – 7.2	25	20
	S09940/ 00094	2243027	3	230	60	1.15	Y=14.0 B=11.2 R=6.1	Y=17.0 B=12.6 R=6.0	M = 1.0 – 1.5 S = 4.0 – 4.9	40	30
	S10940/ 00104	2243037	5	230	60	1.15	Y=23.0 B=15.9 R=11.0	Y=27.5 B=19.1 R=10.8	M = 0.68 – 1.0 S = 1.8 – 2.2	60	45

M=Devanado principal – Negro a amarillo; S=Devanado de arranque – Rojo a Amarillo
Y=Conductor amarillo - amperios de línea. B=Conductor negro - amperios del devanado principal.
R=Conductor rojo - amperios del devanado de arranque o auxiliar.

ESPECIFICACIONES DE MOTOR DE 60 HZ, TRIFÁSICO

Tipo	Goulds #	Prefijo de modelo del motor Franklin					Entrada nominal		Máxima (carga de factor de servicio)		Línea a Línea	Rotor frenado	KVA	Corta-circuitos de tiempo inverso	Fusible de dos elementos con retardo de tiempo
			HP	Volts	Hz	S.F.	Amps	Watts	Amps	Watts	Resistencia	Amps	Código		
4" 3450 RPM	S04978	234501	½	200	60	1.6	2.8	585	3.4	860	6.6-8.4	17.5	N	15	5
	S04970	234511	½	230	60	1.6	2.4	585	2.9	860	9.5-10.9	15.2	N	15	5
	S04975	234521	½	460	60	1.6	1.2	585	1.5	860	38.4-44.1	7.6	N	15	3
	S05978	234502	¾	200	60	1.5	3.6	810	4.4	1150	4.6-5.9	23.1	M	15	8
	S05970	234512	¾	230	60	1.5	3.1	810	3.8	1150	6.8-7.8	20.1	M	15	6
	S05975	234522	¾	460	60	1.5	1.6	810	1.9	1150	27.2-30.9	10.7	M	15	3
	S06978	234503	1	200	60	1.4	4.5	1070	5.4	1440	3.8-4.5	30.9	M	15	10
	S06970	234513	1	230	60	1.4	3.9	1070	4.7	1440	4.9-5.6	26.9	M	15	8

ESPECIFICACIONES DE MOTOR DE 60 HZ, TRIFÁSICO

Tipo	Goulds #	Prefijo de modelo del motor Franklin					Entrada nominal		Máxima (carga de factor de servicio)		Línea a Línea	Rotor frenado	KVA	Corta-circuitos de tiempo inverso	Fusible de dos elementos con retardo de tiempo
			HP	Volts	Hz	S.F.	Amps	Watts	Amps	Watts	Resistencia	Amps	Código		
4" 3450 RPM	S06975	234523	1	460	60	1.4	2.0	1070	2.4	1440	19.9-23.0	13.5	M	15	4
	S07978	234504	1½	200	60	1.3	5.8	1460	6.8	1890	2.5-3.0	38.2	K	15	10
	S07970	234514	1½	230	60	1.3	4.5	1460	5.9	1890	3.2-4.0	33.2	K	15	10
	S07975	234524	1½	460	60	1.3	2.5	1460	3.1	1890	13.0-16.0	16.6	K	15	5
	S07979	234534	1½	575	60	1.3	2.0	1460	2.4	1890	20.3-25.0	13.3	K	15	4
	S08978	234305	2	200	60	1.25	7.7	2150	9.3	2700	1.8-2.4	53.6	L	20	15
	S08970	234315	2	230	60	1.25	6.7	2150	8.1	2700	2.3-3.0	46.6	L	20	15
	S08975	234325	2	460	60	1.25	3.4	2150	4.1	2700	9.2-12.0	23.3	L	15	8
	S08979	234335	2	575	60	1.25	2.7	2150	3.2	2700	14.6-18.7	18.6	L	15	5
	S09978	234306	3	200	60	1.15	10.9	2980	12.5	3420	1.3-1.7	71.2	K	30	20
	S09970	234316	3	230	60	1.15	9.5	2980	10.9	3420	1.8-2.2	61.9	K	25	20
	S09975	234326	3	460	60	1.15	4.8	2980	5.5	3420	7.2-8.8	31	K	15	10
	S09979	234336	3	575	60	1.15	3.8	2980	4.4	3420	11.4-13.9	24.8	K	15	8
	S10978	234307	5	200	60	1.15	18.3	5050	20.5	5810	.74-.91	122	K	50	35
	S10970	234317	5	230	60	1.15	15.9	5050	17.8	5810	1.0-1.2	106	K	40	30
	S10975	234327	5	460	60	1.15	8.0	5050	8.9	5810	4.0-4.7	53.2	K	20	15
	S10979	234337	5	575	60	1.15	6.4	5050	7.1	5810	6.4-7.8	43	K	20	15
	S119784	234308	7½	200	60	1.15	26.5	7360	30.5	8450	.46-.57	188	K	70	50
	S119704	234318	7½	230	60	1.15	23.0	7360	26.4	8450	.61-.75	164	K	60	45
	S119754	234328	7½	460	60	1.15	11.5	7360	13.2	8450	2.5-3.1	81.9	K	30	25
	S119794	234338	7½	575	60	1.15	9.2	7360	10.6	8450	4.0-5.0	65.5	K	25	20
	S129724	234329	10	460	60	1.15	17.0	10,000	18.5	11400	1.8-2.3	116	L	45	30
	S119794	234339	10	575	60	1.15	13.6	10,000	14.8	11400	2.8-3.5	92.8	L	35	25

ARRANCADORES Y CALENTADORES FURNAS

Tamaño del motor	HP	Volts	FURNAS Clase 16 Número de pedido	FURNAS Clase 16 Calentadores	Clase 14 Número de pedido	Corta-circuitos de tiempo inverso	Fusible de dos elementos con retardo de tiempo
4" 3Ø	½	200	16AD	K29	CSBD	15	5
		230	16AG	K28	CSBA	15	5
		460	16AH	K21	CSBC	15	5
	¾	200	16AD	K33	CSBD	15	8
		230	16AG	K31	CSBA	15	6
		460	16AH	K22	CSBC	15	3
	1	200	16AD	K37	CSDD	15	10
		230	16AG	K34	CSDA	15	8
		460	16AH	K26	CSBC	15	4
	1½	200	16AD	K41	CSDD	15	10
		230	16AG	K37	CSDA	15	10
		460	16AH	K28	CSDC	15	5
		575	16AE	K26	CSBE	15	4
	2	200	16AD	K49	CSDD	20	15
		230	16AG	K43	CSDA	20	15

NOTA: La tabla para el arrancador Clase 16 muestra el número de pedido para la bobina y la tensión de carga correspondientes; es decir, una fuente de alimentación de 230 voltios con una bobina de 230 voltios. Para usar una tensión de bobina diferente, seleccione el arrancador del mismo tamaño con una bobina diferente. Por ejemplo, un motor/arrancador de 15 HP/230 V con una bobina de 460 V = Motor/arrancador 16BH A 15 HP/460 V con una bobina de 230 V = 16BG.

Tamaño del motor	HP	Volts	FURNAS Clase 16 Número de pedido	FURNAS Clase 16 Calentadores	Clase 14 Número de pedido	Corta-circuitos de tiempo inverso	Fusible de dos elementos con retardo de tiempo
4" 3Ø	2	460	16AH	K32	CSDC	15	8
		575	16AE	K29	CSDE	15	5
	3	200	16AD	K54	CSED	30	20
		230	16AG	K52	CSEA	25	20
		460	16AH	K37	CSDC	15	10
		575	16AE	K33	CSDE	15	8
	5	200	16AD	K61	DSFD	50	35
		230	16AG	K60	DSFA	40	30
		460	16AH	K49	CSDC	20	15
		575	16AE	K41	CSDE	20	15
	7½	200	16CD	K69	DSFD	70	50
		230	16BG	K64	DSFA	60	45
		460	16AH	K54	DSEC	30	25
		575	16AE	K52	DSEE	25	20
	10	460	16AH	K60	DSEC	45	30
		575	16AE	K57	DSEE	35	25

Nomenclatura: Ejemplo:. 16 B H; 16 = Arrancador DP Clase 16, tamaño B con bobina de 460 V – H. B = Tamaño del arrancador, los tamaños son A, B, C, D, E, F, G, H. El tamaño está determinado por los amperios de carga completa y los amperios del rotor trabado. H = tensión de la bobina. D = 200 V, E = 575 V, F = 115 V, G = 230 V, H = 460 V. La nomenclatura de la unidad ESP100 se indica en el libro de precios de unidades de inyección y sumergibles.

LECTURAS DE RESISTENCIA DEL AISLAMIENTO DEL MOTOR

Lecturas normales en ohmios/megaohmios, TODOS los motores, entre todos los conductores y tierra

⚠ PRECAUCIÓN Para realizar la prueba de resistencia de aislamiento, abra el cortacircuitos y desconecte todos los conductores de la caja de control QD o del interruptor por caída de presión. Conecte un conductor del ohmímetro a cualquier conductor del motor y otro a un tubo de bajada de metal o a una tierra adecuada. **Escala R x 100K**

Condición del motor y los conductores	Valor en OHMIOS	Valor en Megaohmios
Motor nuevo, sin cable de alimentación	20,000,000 (o más)	20.0
Motor usado, el cual puede reinstalarse en el pozo	10,000,000 (o más)	10.0
Motor en el pozo – lecturas del cable de alimentación más el motor		
Motor nuevo	2,000,000 (o más)	2.0
El motor está em relativamente buenas condiciones	500,000 a 2,000,000	0.5 – 2.0
El motor podría estar dañado o con cable de alimentación dañado *No retire el motor por estas razones*	20,000 a 500,000	0.02 – 0.5
Motor definitivamente dañado o con cable de alimentación dañado *Retire y repare el motor*	10,000 a 20,000	0.01 – 0.02
Falla del motor o del cable de alimentación *Retire y repare el motor*	menos de 10,000	0 – 0.01

Operación del generador

- Consulte la tabla 1 con respecto a las clasificaciones en kilovoltios-amperios (KVA) de un generador de regulación externa. La tensión eléctrica, frecuencia, fase y ampacidad **DEBEN** corresponder con aquellas mostrados en la placa de identificación del motor o la caja de control de la bomba.

SI NO SE USA UN INTERRUPTOR DE TRANSFERENCIA MANUAL O AUTOMÁTICO CUANDO EL GENERADOR SE UTILIZA COMO UNIDAD DE RESERVA, SE PUEDE PRODUCIR ELECTROCHOQUE, QUEMADURAS OLA MUERTE.

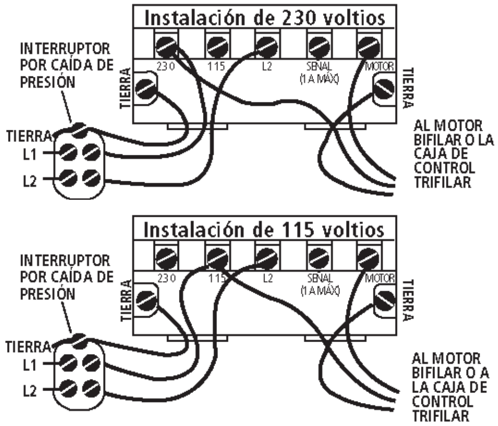
Clasificación mín. del generador	**Potencia en caballos de fuerza del motor de la bomba ①**							
	⅓	½	¾	1	1½	2	3	5
KVA	1.9	2.5	3.8	5.0	6.3	9.4	12.5	18.8
KW	1.5	2.0	3.0	4.0	5.0	7.5	10.0	15.0

① **NOTA:** Para motores bifilares, las clasificaciones mínimas del generador deben ser 50% más altas que las que se muestran.

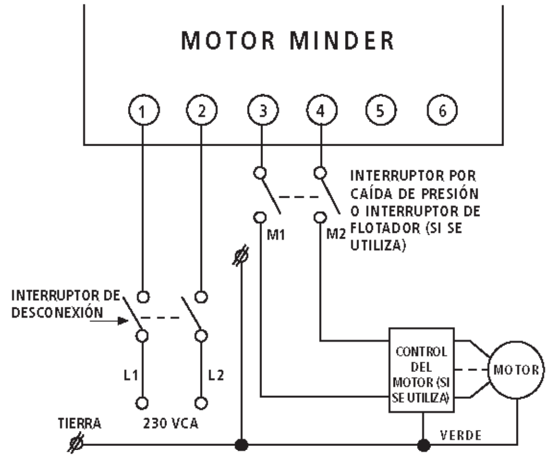
AVISO:SIGA CUIDADOSAMENTE LAS INSTRUCCIONES DEL FABRICANTE DEL GENERADOR.

Cortesía de Franklin Electric Company

CABLEADO DE PUMPTEC



CABLEADO DEL MOTOR MINDER



LARGO MÁXIMO DEL CABLE DEL MOTOR MONOFÁSICO
(del motor a la entrada de servicio) (2)

Clasificación del motor		Tamaño del alambre de cobre (1)								
Voltios	Caballos de fuerza	14	12	10	8	6	4	2	0	00
115	⅓	130	210	340	540	840	1300	1960	2910	3540
	½	100	160	250	390	620	960	1460	2160	2630
230	⅓	550	880	1390	2190	3400	5250	7960	11770	
	½	400	650	1020	1610	2510	3880	5880	8720	
	¾	300	480	760	1200	1870	2890	4370	6470	7870
	1	250	400	630	990	1540	2380	3610	5360	6520
	1.5	190	310	480	770	1200	1870	2850	4280	5240
	2	150	250	390	620	970	1530	2360	3620	4480
	3	120*	190	300	470	750	1190	1850	2890	3610
	5	0	0	180*	280	450	710	1110	1740	2170
	7.5	0	0	0	200*	310	490	750	1140	1410
	10	0	0	0	0	250*	390	600	930	1160
	15	0	0	0	0	170*	270*	430	660	820

(1) Esta tabla se basa en alambre de cobre. Debe ser dos tamaños más grande si se utiliza alambre de aluminio. Ejemplo: Cuando la tabla indica alambre de cobre #12, utilizaría alambre de aluminio #10.
(2) las cajas de control monofásicas pueden conectarse en cualquier punto del largo total del cable.

LARGO MÁXIMO DEL CABLE DEL MOTOR TRIFÁSICO (del motor a la entrada de servicio (3)

Clasificación del motor		Tamaño del alambre de cobre (1)										
Voltios	Caballos de fuerza	14	12	10	8	6	4	2	0	00	000	0000
200 V 60 Hz	.5	710	1140	1800	2840	4420						
	.75	510	810	1280	2030	3160						
	1	430	690	1080	1710	2670	4140					
	1.5	310	500	790	1260	1960	3050					
	2	240	390	610	970	1520	2360	3610	5420			
	3	180	290	470	740	1160	1810	2760	4130			
	5	110*	170	280	440	690	1080	1660	2490	3050	3670	4440
	7.5	0	0	200	310	490	770	1180	1770	2170	2600	3150
	10	0	0	0	230*	370	570	880	1330	1640	1970	2390
230 V 60 Hz	.5	930	1490	2350	3700	5760	8910					
	.75	670	1080	1700	2580	4190	6490	9860				
	1	560	910	1430	2260	3520	5460	8290				
	1.5	420	670	1060	1670	2610	4050	6160	9170			
	2	320	510	810	1280	2010	3130	4770	7170	8780		
	3	240	390	620	990	1540	2400	3660	5470	6690	8020	9680
	5	140*	230	370	590	920	1430	2190	3290	4030	4850	5870
	7.5	0	160*	260	420	650	1020	1560	2340	2870	3440	4160
	10	0	0	190*	310	490	760	1170	1760	2160	2610	3160
460 V 60 Hz	.5	3770	6020	9460								
	.75	2730	4350	6850								
	1	2300	3670	5770	9070							
	1.5	1700	2710	4270	6730							
	2	1300	2070	3270	5150	8050						
	3	1000	1600	2520	3970	6200						
	5	590	950	1500	2360	3700	5750					
	7.5	420	680	1070	1690	2640	4100	6260				
	10	310	500	790	1250	1960	3050	4680	7050			
575 V 60 Hz	.5	5900	9410									
	.75	4270	6810									
	1	3630	5800	9120								
	1.5	2620	4180	6580								
	2	2030	3250	5110	8060							
	3	1580	2530	3980	6270							
	5	920	1480	2330	3680	5750						
	7.5	660	1060	1680	2650	4150						
	10	490	780	1240	1950	3060	4770					

(3) La sección del cable total entre la entrada de servicio y un arrancador de motor trifásico no debe exceder el 25% del largo máximo total para garantizar el funcionamiento confiable del arrancador.

Las secciones marcadas con * cumplen con la ampacidad indicada en el Código Eléctrico Nacional de EE.UU. sólo para cable con conductores individuales de 75ºC.
Sólo las secciones sin * cumplen con el código para cable forrado de 75ºC. Los requerimientos de los códigos locales pueden variar.

Identificación y resolución de problemas

DESCONECTE Y BLOQUEE LA CORRIENTE ELÉCTRICA ANTES INTENTAR DAR SERVICIO. DE LO CONTRARIO, SE PUEDE PRODUCIR ELECTROCHOQUE, QUEMADURAS O LA MUERTE.

Síntoma	Causa probable	Acción recomendada
EL MOTOR DE LA BOMBA NO ESTÁ FUNCIONADO	1. Se disparó el protector térmico del motor a. Caja de control incorrecta b. Conexiones eléctricas incorrectas o defectuoso c. Protector térmico defectuoso d. Baja tensión e. La temperatura ambiente de la caja de control/arrancador es demasiado alta f. La bomba está atascada con materias extrañas g. Sumersión inadecuada	1. Deje que el motor se enfríe, el protector térmico se reposicionará automáticamente a – e. Solicite que un electricista calificado inspeccione y repare, según sea requerido. f. Retire la bomba, límpiela, ajústela, fije la profundidad según sea requerido g. Confirme la sumersión adecuada de la unidad en el agua bombeada
	2. Cortacircuitos abierto o fusible quemado	2. Solicite que un electriciste calificado inspeccione y repare, según sea requerido.
	3. La fuente de energía es inadecuada para la carga	3. Verifique el suministro o la capacidad del generador
	4. Daño del aislamiento del cable de alimentación 5. Empalme defectuoso del cable de alimentación	4 – 5. Solicite que un electricista calificado inspeccione y repare, según sea requerido.
LA BOMBA ENTREGA POCO O NADA DE LÍQUIDO	1. Válvula de retención defectuosa o instalada incorrectamente	1. Inspeccione la válvula de retención, repárela según sea necesario
	2. La bomba está atascada con aire	2. Arranque y detenga labomba sucesivamente hasta que haya flujo
	3. Elevación demasiado alta para la bomba	3. Verifique el rendimiento de la unidad, consulte con agente
	4. La bomba está atascada con materias extrañas	4. Retire la bomba, límpiela ajústela, fije la profundidad según sea requerido
	5. La bomba no está completamente sumergida	5. Verifique la recuperación del pozo, baje la bomba si es posible
	6. El pozo contiene demasiado aire o gases	6. Si los arranques y paradas sucesivos no solucionan el problema, el pozo contiene demasiado aire o gases
	7. Desgaste excesivo de la bomba	7. Retire y repare la bomba, según sea necesario
	8. Rotación incorrecta del motor – unidades trifásicas únicamente.	8. Invierta dos conductores eléctricos cualquiera del motor

Consulte las páginas 14 y 15 con respecto al suministro de entrada de la caja de fusibles o del cortacircuitos.

Notes

GOULDS PUMPS

Pompes submersibles de 4 po

Directives d'installation et d'utilisation

Informations pour le propriétaire

N° de modèle de la pompe : ____________

N° de série de la pompe : ____________

N° de modèle du moteur : ____________

N° de série du moteur : ____________

Détaillant : ____________________

____

N° de téléphone du détaillant :

____

Date d'achat : ______________

Date d'installation : ____________

Tension (V) : ______________

Intensité (A) : ______________

Table des matières

Goulds Pumps

ITT Industries

CONSIGNES DE SÉCURITÉ

AFIN DE PRÉVENIR LES BLESSURES GRAVES OU MORTELLES ET LES DOMMAGES MATÉRIELS IMPORTANTS, LIRE ET SUIVRE TOUTES LES CONSIGNES DE SÉCURITÉ FIGURANT DANS LE MANUEL ET SUR LA POMPE.

LE PRÉSENT MANUEL A POUR BUT DE FACILITER L'INSTALLATION ET L'UTILISATION DE LA POMPE ET DOIT ÊTRE CONSERVÉ PRÈS DE CELLE-CI.

Le symbole ci-contre est un SYMBOLE DE SÉCURITÉ employé pour signaler les mots-indicateurs dont on trouvera la description ci-dessous. Sa présence sert à attirer l'attention afin d'éviter les blessures et les dommages matériels.

⚠ DANGER Prévient des risques qui VONT causer des blessures graves, la mort ou des dommages matériels importants.

⚠ AVERTISSEMENT Prévient des risques qui PEUVENT causer des blessures graves, la mort ou des dommages matériels importants.

⚠ ATTENTION Prévient des risques qui PEUVENT causer des blessures ou des dommages matériels.

AVIS : SERT À ÉNONCER LES DIRECTIVES SPÉCIALES DE GRANDE IMPORTANCE QUE L'ON DOIT SUIVRE.

LIRE SOIGNEUSEMENT CHAQUE DIRECTIVE ET AVERTISSEMENT AVANT D'EFFECTUER TOUT TRAVAIL SUR LA POMPE.

N'ENLEVER AUCUNE DÉCALCOMANIE DE SÉCURITÉ.

Avis important : lire les consignes de sécurité avant de procéder au câblage.

⚠ AVERTISSEMENT L'installation électrique doit être entièrement effectuée par un technicien qualifié. Il faut toujours suivre les prescriptions du code provincial ou national de l'électricité pertinent et les règlements locaux. Adresser toute question relative au code à un inspecteur en électricité. Le non-respect du code et des politiques de santé et de sécurité au travail peut entraîner des blessures et des dommages matériels. L'inobservation des directives d'installation fournies par le fabricant peut se traduire par un choc électrique, un incendie, des blessures ou la mort, ainsi que par des dommages matériels, des performances non satisfaisantes et l'annulation de la garantie du fabricant.

⚠ AVERTISSEMENT Les pompes standard ne sont pas conçues pour les piscines, l'eau libre, les liquides dangereux ni les endroits pouvant contenir des gaz inflammables. On doit aérer le puits suivant les règlements locaux.

Seules les pompes de classe 1, division 1, peuvent servir pour les liquides dangereux et les endroits pouvant contenir des gaz inflammables. *Le nom des organismes de normalisation pertinents figure sur la plaque signalétique des pompes en question ou dans les feuillets du catalogue décrivant ces pompes.*

⚠ AVERTISSEMENT Verrouiller la source de courant en position hors circuit avant de procéder à l'installation ou à l'entretien de tout dispositif électrique. Le protecteur thermique de certains moteurs de pompe coupe le courant lorsqu'il y a surcharge thermique et le rétablit automatiquement, redémarrant ainsi la pompe inopinément.

⚠ ATTENTION	Les commandes triphasées des pompes submersibles doivent assurer une protection rapide de classe 10 contre la surcharge.
⚠ AVERTISSEMENT	Ne pas lever, transporter ni suspendre la pompe par le câble d'alimentation : l'endommagement du câble pourrait causer un choc électrique, des brûlures ou la mort.
⚠ AVERTISSEMENT	N'utiliser que du fil de cuivre torsadé pour l'alimentation et la mise à la terre du moteur et de la pompe. Le calibre du fil de terre doit être au moins égal à celui des fils d'alimentation. Les fils devraient tous être chromocodés pour faciliter l'entretien et le diagnostic des anomalies.
⚠ DANGER	Poser le fil de terre et les autres fils suivant les prescriptions du code provincial ou national de l'électricité pertinent et les règlements locaux.
⚠ AVERTISSEMENT	Installer un sectionneur tout conducteur si le code l'exige.
⚠ AVERTISSEMENT	Le nombre de phases et la tension d'alimentation doivent convenir à tout l'équipement. Un nombre de phases et une tension inappropriés annulent la garantie et peuvent causer un incendie et des dommages au moteur et aux commandes.
⚠ AVERTISSEMENT	Chaque jonction de fils doit être étanche. Si l'on emploie un nécessaire de jonction (« *kit* »), suivre les directives du fabricant.
⚠ AVERTISSEMENT	Choisir la boîte de jonction du type et de la classe NEMA convenant au type et au lieu d'utilisation. La boîte doit assurer une jonction de fils sûre et étanche.
⚠ AVERTISSEMENT	Omettre la mise à la terre permanente de la pompe, du moteur et des commandes avant le branchement à la source de courant peut causer un choc électrique, des brûlures ou la mort.
⚠ AVERTISSEMENT	Pour bien refroidir tout moteur de 4 po de 2 hp et plus, s'assurer que la vitesse d'écoulement minimale de l'eau autour du moteur est de 0,25 pi/s (7,62 cm/s). Donc, le débit minimal nécessaire au refroidissement du moteur en fonction du calibre du tubage devrait être : 1,2 gal US/min pour 4 po ; 7 pour 5 po ; 13 pour 6 po ; 20 pour 7 po ; 30 pour 8 po et 50 pour 10 po. Si une pompe de 2 hp et plus est utilisée dans un grand réservoir, on devrait la placer dans un manchon d'accélération pour obtenir la vitesse d'écoulement ou le débit nécessaires au bon refroidissement du moteur.
⚠ ATTENTION	La pompe submersible de 4 po a été évaluée pour le pompage de l'eau seulement.

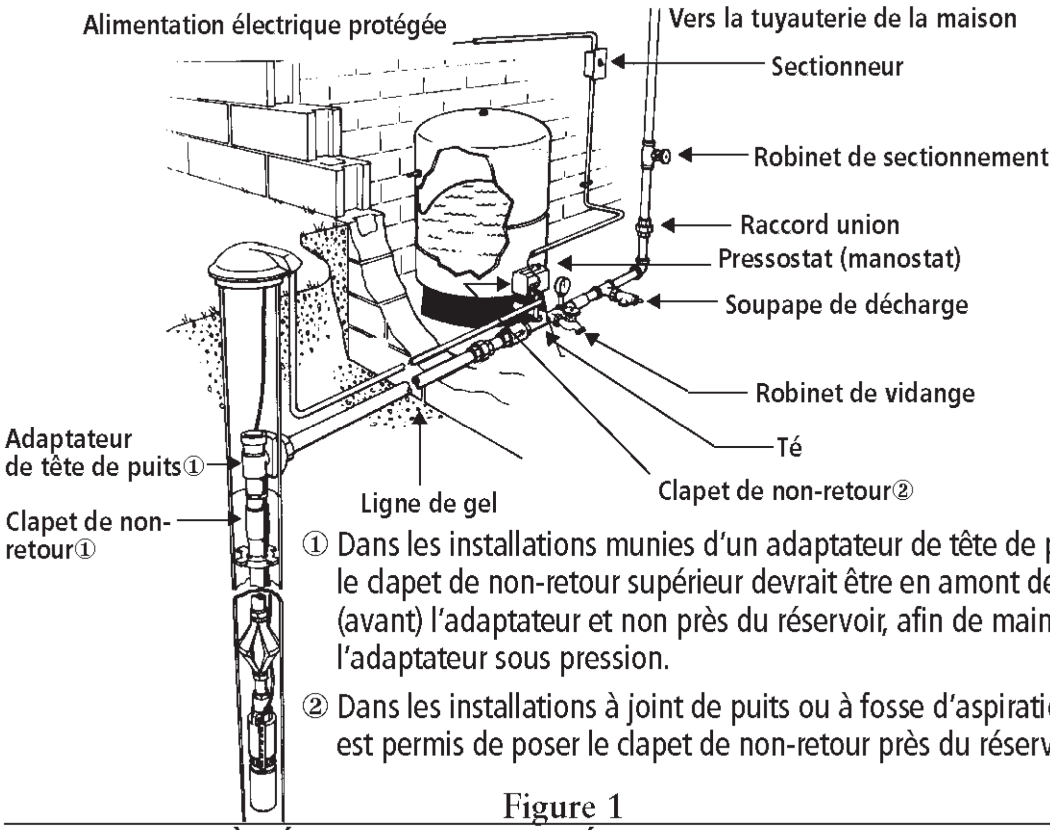
PRÉPARATIFS D'INSTALLATION

- Inscrire en première page les informations pour le propriétaire au sujet de la pompe, du moteur, etc.
- Inspecter tous les composants pour s'assurer qu'ils n'ont pas été endommagés durant le transport. S'ils l'ont été, en aviser le distributeur immédiatement.
- Vérifier si la puissance du moteur (en hp) convient à la pompe.
- S'assurer que la tension d'alimentation et le nombre de phases sont appropriés au moteur et aux commandes.
- Installer les commandes dans un endroit sec et ombragé.
- Effectuer la jonction des fils immergés ou enfouis avec des connecteurs étanches.
- Étant donné que la tête de refoulement de la plupart des pompes est vissée à gauche, immobiliser la tête et non la pompe pour éviter de dévisser la tête au moment d'y fixer le tuyau ou le raccord-adaptateur.
- S'assurer que tous les raccords et accessoires de plomberie sont bien serrés et étanchés avec du ruban de Téflon.
- Vérifier si la pression nominale de la tuyauterie est supérieure à la pression d'arrêt de la pompe.
- Poser une soupape de décharge dans tout système pouvant produire une pression de plus de 75 lbf/po^2.
- Pour empêcher le cliquetis répétitif du pressostat, ne pas le poser à plus de 4 pi du réservoir à pression.
- Régler la pression de l'air précomprimé du réservoir à 2 lbf/po^2 de moins que la pression de démarrage de la pompe, soit à 28 lbf/po^2 pour une plage de pression de service de 30-50 lbf/po^2 par exemple.
- Placer la pompe à au moins 10 pi du fond du puits pour prévenir l'aspiration de sédiments et de débris.
- S'assurer que le disjoncteur principal ou le sectionneur sont HORS circuit avant de câbler les composants.
- Le câblage devrait être effectué uniquement par un technicien qualifié.
- Le câblage et la mise à la terre doivent être conformes au code provincial ou national pertinent et aux règlements locaux.
- Diminuer la section de passage du tuyau avec un robinet à tournant sphérique ou à soupape ouvert à peu près au tiers (⅓) avant de mettre la pompe en marche pour la première fois.
- Ouvrir un robinet de puisage ou de vidange au moment du démarrage de la pompe pour purger l'eau sale afin qu'elle ne puisse entrer dans le réservoir.
- Mettre le disjoncteur principal ou le sectionneur EN circuit.
- Faire fonctionner la pompe durant quelques cycles pour vérifier le fonctionnement du pressostat.
- Vérifier l'intensité (A) du courant et l'inscrire en première page.
- Remettre le manuel au propriétaire ou le laisser près de la pompe.

1. INSTALLATIONS TYPES

INSTALLATION À RÉSERVOIR À AIR CAPTIF

AVIS : ON DOIT UTILISER LA VALVE À AIR COMPRIMÉ SITUÉE SUR LE DESSUS DU RÉSERVOIR POUR RÉGLER LA PRESSION D'AIR DE CELUI-CI.

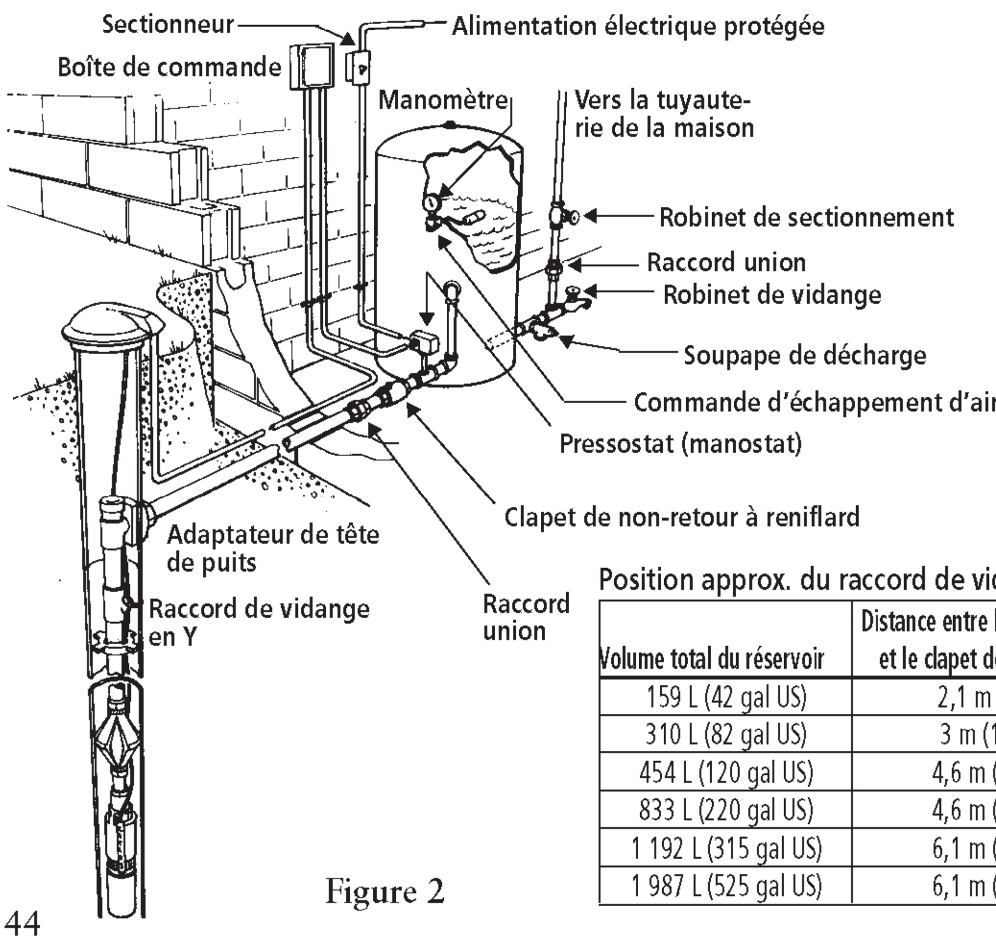


① Dans les installations munies d'un adaptateur de tête de puits, le clapet de non-retour supérieur devrait être en amont de (avant) l'adaptateur et non près du réservoir, afin de maintenir l'adaptateur sous pression.

② Dans les installations à joint de puits ou à fosse d'aspiration, il est permis de poser le clapet de non-retour près du réservoir.

Figure 1

INSTALLATION À RÉSERVOIR GALVANISÉ



Position approx. du raccord de vidange en Y

Volume total du réservoir	Distance entre le raccord en Y et le clapet de non-retour
159 L (42 gal US)	2,1 m (7 pi)
310 L (82 gal US)	3 m (10 pi)
454 L (120 gal US)	4,6 m (15 pi)
833 L (220 gal US)	4,6 m (15 pi)
1 192 L (315 gal US)	6,1 m (20 pi)
1 987 L (525 gal US)	6,1 m (20 pi)

Figure 2

2. TUYAUTERIE

Avis : la tête de refoulement de la majorité des pompes submersibles de 4 po est vissée à gauche. Immobiliser la pompe <u>uniquement</u> par la « tête de refoulement » pour y fixer tout raccord ou tuyau fileté.

2.1. Généralités

Le calibre de la tuyauterie de refoulement devrait être choisi pour permettre le rendement optimal de la pompe. Calculer la hauteur manométrique totale en tenant compte des divers calibres de tuyau figurant dans les tables de perte de charge. En règle générale, on choisit un calibre de 1 po pour un débit maximal de 10 gal US/min, de 1¼ po pour 30 gal US/min, de 1½ po pour 45 gal US/min et de 2 po pour 80 gal US/min. Il vaut mieux accroître le calibre quand la tuyauterie est longue.

Étant donné que certaines pompes produisent une pression de refoulement très élevée, choisir le tuyau en conséquence. Consulter un fournisseur de tuyaux pour déterminer le meilleur type de tuyau pour chaque installation.

2.2. Réservoir à pression, pressostat et soupape de décharge

Pour installer le réservoir, le pressostat et la soupape de décharge, choisir un endroit où la température dépasse toujours 34 °F. Placer le réservoir là où toute fuite ne pourra causer de dommages matériels.

Pour empêcher le cliquetis répétitif du pressostat, on devrait le poser près du té du réservoir, mais jamais à plus de 4 pi de celui-ci.

Pour la même raison, on ne posera entre le pressostat et le(s) réservoir(s) ni soupape, ni clapet, ni filtre, ni raccord causant une perte de charge (par frottement) élevée. Par exemple, un clapet de non-retour à ressort de 1¼ po produit une perte de charge équivalant à 12 pi de tuyau. Le placer entre le pressostat et le réservoir reviendrait donc à écarter ceux-ci de 12 pi de plus et à provoquer ainsi le cliquetis répétitif du pressostat.

Dans les installations à réservoirs multiples, on devrait poser le pressostat aussi près que possible du centre des réservoirs. Afin de réduire la hauteur équivalente de perte de charge (par frottement) dans le tuyau collecteur-répartiteur et d'empêcher le pressostat de cliqueter à répétition, on devrait employer un collecteur-répartiteur de calibre 1½ fois supérieur à celui du tuyau de refoulement de la pompe.

Dans une plage de pression de service de 30-50 lb/po^2, la pression de démarrage de la pompe est de 30 lb/po^2 (la limite inférieure de la plage).

Une soupape de décharge est requise dans tout système ayant une pression supérieure à 100 lb/po^2 ou une HMT supérieure à 230 pi. Dans un endroit où une fuite ou une décharge de fluide sous pression causerait des dommages, poser sur la soupape de décharge une canalisation évacuant le fluide en un lieu à l'abri des risques de dommage.

2.3. Réglage de la pression de l'air précomprimé du réservoir

S'assurer que le réservoir est vide. Utiliser un manomètre de haute qualité pour vérifier la pression de l'air précomprimé du réservoir. Celle-ci devrait être inférieure de 2 lb/po^2 à la pression de démarrage de la pompe. Par exemple, elle serait de 28 lb/po^2 dans un système dont la pression de service est de 30-50 lb/po^2.

2.4. Tuyau de refoulement et clapet de non-retour

Nota : la plupart des têtes de refoulement sont vissées à gauche. Immobiliser la pompe uniquement par la tête de refoulement pendant le vissage du raccord ou du tuyau pour ne pas desserrer celle-ci et abîmer la pompe au démarrage.

Si le tuyau de refoulement requiert un adaptateur, il est fortement recommandé d'en poser un en inox : pour prévenir la corrosion galvanique, on ne devrait jamais fixer de raccords, de tuyaux ni d'accessoires de tuyauterie galvanisés directement sur la tête de refoulement. À ce sujet, aucun matériau de fabrication n'est interdit pour les têtes de refoulement en plastique ou en laiton. Les raccords à barbillons devraient toujours être assujettis avec deux colliers de serrage.

La tête de refoulement est munie d'un œil de fixation pour câble de sécurité. L'usage d'un tel câble est laissé à la discrétion de l'installateur.

2.5. Mise en place de la pompe

Si l'on emploie un dispositif antitorsion, le poser selon les directives du fabricant du dispositif. Pour plus de détails, consulter le vendeur du dispositif.

Raccorder le tuyau de refoulement à l'adaptateur ou à la tête de refoulement de la pompe, selon le cas. Les raccords à barbillons devraient toujours être assujettis avec deux colliers de serrage. Poser un adaptateur de tête de puits ou autre dispositif du même type pour y raccorder le tuyau de refoulement de la pompe. S'adresser au fabricant ou au vendeur de l'adaptateur ou du dispositif en question pour obtenir les directives d'installation pertinentes.

Avec du ruban isolant (chatterton) étanche, fixer les fils d'alimentation au tuyau de refoulement à tous les 10 pi. S'assurer que le ruban ne se détachera pas, car il serait aspiré par la pompe et bloquerait celle-ci. Les fournisseurs de pompes vendent des attaches encliquetables à cette fin.

2.6. Accessoires de tuyauterie spéciaux pour systèmes à réservoir galvanisé

Lorsque l'on utilise un réservoir galvanisé, on devrait poser un raccord de vidange en Y AV11 dans le puits et un clapet de non-retour à reniflard au réservoir. On permettra ainsi l'entrée d'air dans le réservoir à chaque démarrage pour empêcher le réservoir de trop s'emplir d'eau. Poser une commande d'échappement d'air AA4 sur le réservoir pour en laisser sortir l'excès d'air. La distance entre l'AV11 et un clapet de non-retour à reniflard détermine la quantité d'air admise à chaque démarrage. *Voir la distance recommandée à la fig. 2, section 1.*

Si le puits dégage du gaz, il est préférable de munir le réservoir galvanisé d'une commande d'échappement d'air AA4 pour évacuer le surplus d'air et en prévenir le «jaillissement» du robinet.

On doit soumettre l'eau contenant du méthane ou tout gaz explosif ou dangereux à un traitement spécial permettant d'éliminer le gaz en question sans danger. À cet effet, consulter un spécialiste du traitement de l'eau.

Quant aux puits alimentés par le haut, il faudrait poser un manchon d'accélération de l'écoulement de l'eau autour de la pompe.

2.7 Clapets de non-retour

Quatre types de clapets de non-retour sont utilisés avec nos pompes. Ces clapets sont recommandés pour empêcher le liquide de redescendre dans la pompe et de faire ainsi tourner le moteur et la pompe en sens inverse, ce qui en provoquerait l'usure prématurée des roulements et des coussinets. En outre, les clapets préviennent les dommages dus aux coups de bélier et aux poussées axiales. Un clapet de non-retour supplémentaire devrait être posé à tous les 200-250 pi sur le tronçon vertical du tuyau de refoulement.

Ce qui suit s'adresse aux clients qui souhaiteraient mettre un clapet de non-retour hors service afin de pouvoir vidanger le système, mais ils devraient alors employer un autre moyen pour prévenir les dommages dus aux coups de bélier et aux poussées axiales :

- **Clapets de non-retour intégrés en inox** — ils possèdent une surface plane que l'on peut facilement perforer avec une perceuse électrique et un foret de ¼ ou de ⅜ po.
- **Clapets de non-retour à ressort vissés sur la tête de refoulement** — leur obturateur peut s'enlever facilement de son moyeu à l'aide d'une douille ou d'un tournevis à douille de ½ po, que l'on introduit par le haut.
- **Clapets de non-retour internes en plastique du type Flomatic**MC **à ressort** — ils doivent être enlevés et requièrent donc le démontage de la pompe.
- **Clapets de non-retour intégrés en plastique à tige accessible par le haut de la tête de refoulement** — on peut les enlever en tirant sur leur tige avec une pince.

3. ALIMENTATION ÉLECTRIQUE, CÂBLAGE ET JONCTION

On doit toujours suivre les prescriptions du code provincial ou national de l'électricité pertinent et les règlements locaux.

Il est suggéré d'utiliser uniquement des fils de cuivre. En choisir le calibre à l'aide des tables des Données techniques ci-incluses, du manuel «AIM» de Franklin Electric ou du code provincial ou national de l'électricité pertinent. En cas de divergence, les prescriptions du code de l'électricité prévalent.

3.1. Jonction du câble d'alimentation aux fils de moteur

Il est nécessaire que la jonction des fils de moteur au câble d'alimentation soit étanche. Le joint peut être effectué avec une gaine isolante thermorétrécissables ou du ruban isolant étanche.

A. Joints à gaine isolante thermorétrécissable

Pour employer le nécessaire de jonction type à gaines thermorétrécissables : dénuder les fils sur une longueur de ½ po (il vaut mieux échelonner les joints), y enfiler une gaine isolante (une par joint), joindre les fils de moteur aux fils de câble d'alimentation correspondants avec un raccord à sertir, sertir les extrémités de chaque raccord, puis recouvrir celui-ci avec la gaine et chauffer cette dernière à partir du centre. Les gaines contiennent un produit d'étanchéité et une colle dont l'excédent sortira par les extrémités de la gaine pendant son rétrécissement. L'ensemble forme un joint étanche, très résistant.

B. Joints à ruban isolant étanche

a) Dénuder les fils sur une longueur suffisante pour y poser un raccord tubulaire (type préférable). Si le raccord est trop mince, l'épaissir en y enroulant du chatterton en caoutchouc jusqu'à ce qu'il ait le même diamètre que la gaine du fil.

b) Enrouler chaque joint de deux couches de chatterton en caoutchouc : enrouler le ruban de façon aussi serrée que possible pour empêcher la formation de bulles d'air, la première couche dépassant de deux pouces chaque extrémité de la gaine isolante, et la seconde, de deux pouces chaque extrémité de la première couche de chatterton.

c) Enrouler ensuite deux couches – comme à l'étape b) précédente – de chatterton Scotch n° 33 ou l'équivalent sur le chatterton en caoutchouc, chaque couche dépassant la précédente d'au moins deux pouces.

S'il s'agit d'un câble d'alimentation trifilaire (à 3 fils) à gaine unique, séparer chaque fil de façon à échelonner les joints, puis isoler ceux-ci avec du ruban de la manière précitée.

L'épaisseur totale du ruban isolant ne devrait pas être inférieure à celle de la gaine du fil.

4. CONNEXION DE LA BOÎTE DE COMMANDE ET DU PRESSOSTAT

4.1. Pose de la boîte de commande

Les boîtes de commande trifilaires monophasées satisfont aux exigences UL relatives aux boîtiers du type 3R. Elles peuvent être montées à la verticale, à l'intérieur comme à l'extérieur, et fonctionnent entre – 10 et 50°C (14 et 122°F). Choisir un endroit ombragé, sec et suffisamment dégagé pour permettre la dépose du couvercle.

4.2. Vérification de la tension et mise hors tension du système

S'assurer que la tension d'entrée du moteur et la tension d'alimentation sont identiques.

Mettre le disjoncteur ou le sectionneur HORS circuit pour prévenir le démarrage accidentel de la pompe avant qu'elle soit prête à mettre en service.

Les bobines de démarreur triphasé sont très sensibles à la tension. On doit donc toujours vérifier la tension d'alimentation réelle avec un voltmètre.

Une basse ou une haute tension de variation supérieure à ± 10% endommagera le moteur et les commandes et n'est pas couverte par la garantie.

4.3. Connexion des fils de moteur à la boîte de commande, au pressostat ou au démarreur

Mise en garde: ne pas brancher l'appareil au secteur ni mettre la pompe en marche tant que les connexions électriques et hydrauliques n'ont pas toutes été effectuées. S'assurer que le disjoncteur ou le sectionneur est HORS circuit avant de connecter les fils du pressostat à la source d'alimentation électrique. Suivre toutes les prescriptions du code provincial ou national de l'électricité pertinent. Employer un sectionneur quand le code l'exige.

A. Moteurs monophasés à trois fils

Brancher les fils de moteur chromocodés sur les bornes de la boîte de commande comme suit: le jaune sur Y, le rouge sur R, le noir sur B et le vert (ou le fil dénudé) sur la vis de terre (verte).

Connecter les fils reliant les bornes «Charge» du pressostat aux bornes L1 et L2 de la boîte de commande. Relier la borne de terre du pressostat à celle de la boîte de commande par un fil de terre. *Voir la figure 4 ou 5.*

B. Moteurs monophasés à deux fils

Connecter les fils de moteur noirs aux bornes «Charge» et le vert (ou le fil dénudé) à la vis de terre (verte) du pressostat. *Voir la figure 3.*

C. Moteurs triphasés

Brancher les fils de moteur sur les bornes T1, T2 et T3 du démarreur triphasé. Connecter le fil de terre à la borne de terre (dans le démarreur). Pour brancher le pressostat, suivre les directives du fabricant du démarreur ou *voir la fig. 6.*

4.4. Connexion à la source d'alimentation électrique

S'il s'agit d'une alimentation monophasée, finir le câblage en reliant les bornes «Ligne» du pressostat à celles du panneau de disjoncteurs ou du sectionneur, selon le cas.

Alimentation triphasée — relier les bornes L1, L2, L3 et de terre du démarreur à celles du sectionneur, puis au panneau de disjoncteurs.

Dans les installations à moteur triphasé, on doit vérifier si le moteur tourne dans le bon sens et s'il y a différence de phases. Pour inverser le sens de rotation, intervertir deux fils de moteur. Voir les directives de vérification du déséquilibre du courant triphasé à 4.6. La non-vérification de la différence de phases peut causer la défaillance prématurée du moteur et le déclenchement intempestif du limiteur de surcharge. Si l'on emploie une génératrice, voir les données techniques sur son utilisation.

4.5 Protection contre la surcharge en triphasé

Employer uniquement des protections contre la surcharge rapides de classe 10 avec les moteurs submersibles triphasés. Les démarreurs Furnas classés NEMA 14 à limiteurs de surcharge ESP100, ainsi que les démarreurs de classe 16 à dispositifs de protection contre la surcharge de série K ou à limiteurs de surcharge ESP100, offrent une protection adéquate.

Le manuel «AIM» de Franklin Electric suggère quelques combinaisons démarreur-limiteur de surcharge acceptables. Pour obtenir de l'aide dans le choix des protections, téléphoner à Franklin Electric, au 1-800-348-2420, ou au service à la clientèle du fabricant de la pompe.

Nota : si l'on remplace une pompe à moteur hors puits par une pompe à moteur submersible, vérifier si les limiteurs de surcharge offrent une protection de classe 10, car la plupart des moteurs hors puits sont protégés par des limiteurs de classe 20, qui ne conviennent pas aux moteurs submersibles et en annulent la garantie.

4.6. Déséquilibre du courant triphasé

Un circuit d'alimentation électrique entièrement triphasé est recommandé. Il peut être constitué de trois transformateurs distincts ou d'un transformateur triphasé. On peut aussi utiliser deux transformateurs montés en étoile ou en triangle « ouverts », mais il est possible qu'un tel montage crée un déséquilibre de courant se traduisant par des performances médiocres, le déclenchement intempestif du limiteur de surcharge et la défaillance prématurée du moteur.

Vérifier l'intensité du courant sur chacun des trois fils de moteur, puis calculer le déséquilibre du courant.

Si le déséquilibre est de 2 % ou moins, ne pas changer la connexion des fils. S'il dépasse 2%, on devrait vérifier l'intensité du courant sur chaque conducteur, dans les trois montages possibles ci-dessous. Afin de maintenir le sens de rotation du moteur, suivre l'ordre numérique indiqué dans chaque montage pour la connexion des fils de moteur.

Pour calculer le pourcentage de déséquilibre du courant :

A. Faire l'addition des trois intensités mesurées sur les conducteurs.

B. Diviser le total par 3 pour obtenir l'intensité moyenne.

C. Prendre l'écart d'intensité le plus grand par rapport à la moyenne.

D. Soustraire cet écart de la moyenne.

E. Diviser la différence par la moyenne, puis multiplier le résultat par 100 pour obtenir le pourcentage de déséquilibre.

Le déséquilibre de courant ne devrait pas excéder les pourcentages suivants : 5 % avec facteur de surcharge et 10 % avec charge d'entrée nominale. Si le déséquilibre persiste en connectant les fils de moteur dans l'ordre numérique indiqué, on doit en trouver la cause et l'éliminer.
Si, dans les trois montages, l'écart d'intensité le plus grand par rapport à la moyenne est toujours mesuré

	1er montage			2e montage			3e montage		
Bornes de démarreur	L1	L2	L3	L1	L2	L3	L1	L2	L3
Fils de moteur	R	B	Y	Y	R	B	B	Y	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Exemples :

1er montage	2e montage	3e montage
T3-R = 51 A	T2-Y = 50 A	T1-B = 50 A
T1-B = 46 A	T3-R = 48 A	T2-Y = 49 A
T2-Y = 53 A	T1-B = 52 A	T3-R = 51 A
Total = 150 A	Total = 150 A	Total = 150 A
÷ 3 = 50 A	÷ 3 = 50 A	÷ 3 = 50 A
– 46 A = 4 A	– 48 A = 2 A	– 49 A = 1 A
4 ÷ 50 = 0,08 ou 8 %	2 ÷ 50 = 0,04 ou 4 %	1 ÷ 50 = 0,02 ou 2 %

sur le même conducteur, la cause du déséquilibre vient surtout de la source d'alimentation.

On s'adressera alors à la société d'électricité pour rectifier le déséquilibre de courant.

5. MISE EN SERVICE DE LA POMPE

5.1. Étranglement du tuyau de refoulement avant la mise en service

Avant de mettre la pompe en service, réduire par étranglement la section de passage du tuyau de refoulement avec un robinet à tournant sphérique ouvert à peu près au tiers (⅓). On préviendra ainsi les poussées axiales et le surpompage et réduira la turbidité de l'eau. Ouvrir le robinet davantage une fois que l'eau sera devenue limpide.

5.2. Étranglement prévenant les poussées axiales avec un niveau statique élevé

Tout puits ayant un niveau statique élevé peut entraîner le fonctionnement de la pompe en dehors de la « plage de performances recommandée ». Il est donc suggéré d'employer un réducteur de débit Dole ou un robinet à tournant sphérique pour étrangler la section de passage du tuyau de refoulement et empêcher les dommages à la pompe et au moteur dus aux poussées axiales. On doit maintenir le débit maximal dans la plage de fonctionnement recommandée de la pompe. Si l'on utilise un robinet à tournant sphérique, en régler l'ouverture, en enlever la poignée et l'attacher au tuyau avec du ruban adhésif, puis fixer au robinet une étiquette volante portant la mention : « Ne pas ouvrir ce robinet, car cela pourrait endommager la pompe. » La manière la plus simple de « régler » le débit est de remplir un contenant de 5 gallons US, de mesurer le temps nécessaire à son remplissage, puis de se baser sur ce temps pour calculer le débit (en gal US/min). À mesure que le niveau du puits baisse, la hauteur de charge augmente, réduisant le débit et neutralisant l'effet d'étranglement pouvant altérer les performances.

5.3. Mise en marche de la pompe

Entrouvrir un robinet du système et mettre le disjoncteur EN circuit.

Vérifier l'étanchéité de chaque raccord et accessoire de tuyauterie.

Une fois l'eau devenue limpide, fermer le robinet, puis faire monter la pression. Si le pressostat est bien réglé, la pompe s'arrêtera lorsque la pression préréglée sera atteinte. Ouvrir des robinets, puis faire fonctionner la pompe pendant quelques cycles pour vérifier le fonctionnement du pressostat et s'assurer que la plage de pression de service est correcte.

Revérifier l'étanchéité de chaque raccord et accessoire de tuyauterie.

6. DOCUMENTATION ET MANUEL

Remplir la section « Informations pour le propriétaire » en première page, puis remettre le présent manuel au propriétaire, ainsi qu'une carte d'affaires. La pose d'un autocollant portant le nom et le numéro de téléphone du détaillant sur le réservoir ou la boîte de commande est un excellent outil de promotion des affaires !

CARACTÉRISTIQUES DES MOTEURS MONOPHASÉS, 60 Hz

Type	Nº de moteur Goulds/boîte de comm.	Préfixe de modèle de moteur Franklin	hp	V	Hz	FS	A	A avec FS	Ω	Disjonct. à retardem.	Fusible double temporisé
4 po, 2 fils	S04932/ NR	2445040	½	115	60	1,60	10,0	12,0	1,0-1,3	30	20
	S04942/ NR	2445050	½	230	60	1,60	5,0	6,0	4,2-5,2	15	10
	S05942/ NR	2445070	¾	230	60	1,50	6,8	8,0	3,0-3,6	20	15
	S06942/ NR	2445081	1	230	60	1,40	8,2	9,8	2,2-2,7	25	20
	S07942/ NR	2445091	1½	230	60	1,30	10,6	13,1	1,5-1,9	30	20
4 po, 3 fils	S04930/ 00043	2145044	½	115	60	1,60	Y=10,0 B=10,0 R=0,0	Y=12,0 B=12,0 R=0,0	M = 1,0-1,3 S = 4,1-5,1	30	20
	S04940/ 00044	2145054	½	230	60	1,60	Y=5,0 B=5,0 R=0,0	Y=6,0 B=6,0 R=0,0	M = 4,2-5,2 S = 16,7-20,5	15	10
	S05940/ 00054	2145074	¾	230	60	1,50	Y=6,8 B=6,8 R=0,0	Y=8,0 B=8,0 R=0,0	M = 3,0-3,6 S = 10,7-13,1	20	15
	S06940/ 00064	2145081	1	230	60	1,40	Y=8,2 B=8,2 R=0,0	Y=9,8 B=9,8 R=0,0	M = 2,2-2,7 S = 9,9-12,1	25	20
4 po, 3 fils et condensateur de marche	S07940/ 00074	2243001	1½	230	60	1,30	Y=10,0 B=9,9 R=1,3	Y=11,5 B=11,0 R=1,3	M = 1,5-2,3 S = 8,0-9,7	30	20
	S08940/ 00084	2243011	2	230	60	1,25	Y=10,0 B=9,3 R=2,6	Y=13,2 B=11,9 R=2,6	M = 1,6-2,3 S = 5,8-7,2	25	20
	S09940/ 00094	2243027	3	230	60	1,15	Y=14,0 B=11,2 R=6,1	Y=17,0 B=12,6 R=6,0	M = 1,0-1,5 S = 4,0-4,9	40	30
	S10940/ 00104	2243037	5	230	60	1,15	Y=23,0 B=15,9 R=11,0	Y=27,5 B=19,1 R=10,8	M = 0,68-1,0 S = 1,8-2,2	60	45

M = enroulement principal — entre le fil noir et le jaune ; S = enroulement de démarrage — entre le fil rouge et le jaune ; Y=fil jaune — ligne ; B=fil noir — enroulement principal ; R=fil r ouge — enroulement de démarrage ou auxiliaire ; FS = facteur de surcharge ; NR = non requise.

CARACTÉRISTIQUES DES MOTEURS TRIPHASÉS, 60 Hz

Type	Nº de modèle Goulds	Préfixe de modèle de moteur Franklin					Courant et puissance d'entrée nominale		Courant et puiss. max. (avec FS)		Ligne à ligne	Rotor bloqué	kV.A	Disjonct. à retard.	Fusible double temporisé
			hp	V	Hz	FS	A	W	A	W	Ω	A	Code		
4 po, 3 450 r/min	S04978	234501	½	200	60	1,6	2,8	585	3,4	860	6,6-8,4	17,5	N	15	5
	S04970	234511	½	230	60	1,6	2,4	585	2,9	860	9,5-10,9	15,2	N	15	5
	S04975	234521	½	460	60	1,6	1,2	585	1,5	860	38,4-44,1	7,6	N	15	3
	S05978	234502	¾	200	60	1,5	3,6	810	4,4	1 150	4,6-5,9	23,1	M	15	8
	S05970	234512	¾	230	60	1,5	3,1	810	3,8	1 150	6,8-7,8	20,1	M	15	6
	S05975	234522	¾	460	60	1,5	1,6	810	1,9	1 150	27,2-30,9	10,7	M	15	3
	S06978	234503	1	200	60	1,4	4,5	1 070	5,4	1 440	3,8-4,5	30,9	M	15	10
	S06970	234513	1	230	60	1,4	3,9	1 070	4,7	1 440	4,9-5,6	26,9	M	15	8

FS = facteur de surcharge

 (Suite à la page suivante)

CARACTÉRISTIQUES DES MOTEURS TRIPHASÉS, 60 Hz *(suite)*

Type	Nº de modèle Goulds	Préfixe de modèle de moteur Franklin	hp	V	Hz	FS	Courant et puissance d'entrée nominale A	Courant et puissance d'entrée nominale W	Courant et puiss. max. (avec FS) A	Courant et puiss. max. (avec FS) W	Ligne à ligne Ω	Rotor bloqué A	kV.A Code	Disjonct. à retard.	Fusible double temporisé
4 po, 3 450 r/min	S06975	234523	1	460	60	1,4	2,0	1 070	2,4	1 440	19,9-23,0	13,5	M	15	4
	S07978	234504	1½	200	60	1,3	5,8	1 460	6,8	1 890	2,5-3,0	38,2	K	15	10
	S07970	234514	1½	230	60	1,3	4,5	1 460	5,9	1 890	3,2-4,0	33,2	K	15	10
	S07975	234524	1½	460	60	1,3	2,5	1 460	3,1	1 890	13,0-16,0	16,6	K	15	5
	S07979	234534	1½	575	60	1,3	2,0	1 460	2,4	1 890	20,3-25,0	13,3	K	15	4
	S08978	234305	2	200	60	1,25	7,7	2 150	9,3	2 700	1,8-2,4	53,6	L	20	15
	S08970	234315	2	230	60	1,25	6,7	2 150	8,1	2 700	2.3-3.0	46,6	L	20	15
	S08975	234325	2	460	60	1,25	3,4	2 150	4,1	2 700	9,2-12,0	23,3	L	15	8
	S08979	234335	2	575	60	1,25	2,7	2 150	3,2	2 700	14,6-18,7	18,6	L	15	5
	S09978	234306	3	200	60	1,15	10,9	2 980	12,5	3 420	1,3-1,7	71,2	K	30	20
	S09970	234316	3	230	60	1,15	9,5	2 980	10,9	3 420	1,8-2,2	61,9	K	25	20
	S09975	234326	3	460	60	1,15	4,8	2 980	5,5	3 420	7,2-8,8	31	K	15	10
	S09979	234336	3	575	60	1,15	3,8	2 980	4,4	3 420	11,4-13,9	24,8	K	15	8
	S10978	234307	5	200	60	1,15	18,3	5 050	20,5	5 810	0,74-0,91	122	K	50	35
	S10970	234317	5	230	60	1,15	15,9	5 050	17,8	5 810	1,0-1,2	106	K	40	30
	S10975	234327	5	460	60	1,15	8,0	5 050	8,9	5 810	4,0-4,7	53,2	K	20	15
	S10979	234337	5	575	60	1,15	6,4	5 050	7,1	5 810	6,4-7,8	42,6	K	20	15
	S119784	234308	7½	200	60	1,15	26,5	7 360	30,5	8 450	0,46-0,57	188	K	70	50
	S119704	234318	7½	230	60	1,15	23,0	7 360	26,4	8 450	0,61-0,75	164	K	60	45
	S119754	234328	7½	460	60	1,15	11,5	7 360	13,2	8 450	2,5-3,1	81,9	K	30	25
	S119794	234338	7½	575	60	1,15	9,2	7 360	10,6	8 450	4,0-5,0	65,5	K	25	20
	S129724	234329	10	460	60	1,15	17,0	10 000	18,5	11 400	1,8-2,3	116	L	45	30
	S119794	234339	10	575	60	1,15	13,6	10 000	14,8	11 400	2,8-3,5	92,8	L	35	25

DISPOSITIFS DE PROTECTION CONTRE LA SURCHARGE ET DÉMARREURS FURNAS

Moteur	hp	V	FURNAS, classe 16 Nº de catal.	FURNAS, classe 16 DPS	Classe 14 Nº de catal.	Disjonct. à retard.	Fusible double temporisé
4 po, 3 Ø	½	200	16AD	K29	CSBD	15	5
		230	16AG	K28	CSBA	15	5
		460	16AH	K21	CSBC	15	5
	¾	200	16AD	K33	CSBD	15	8
		230	16AG	K31	CSBA	15	6
		460	16AH	K22	CSBC	15	3
	1	200	16AD	K37	CSDD	15	10
		230	16AG	K34	CSDA	15	8
		460	16AH	K26	CSBC	15	4
	1½	200	16AD	K41	CSDD	15	10
		230	16AG	K37	CSDA	15	10
		460	16AH	K28	CSDC	15	5
		575	16AE	K26	CSBE	15	4
	2	200	16AD	K49	CSDD	20	15
		230	16AG	K43	CSDA	20	15

DPS = dispositif de protection contre la surcharge

NOTA : le numéro de catalogue des démarreurs de classe 16 fait correspondre la tension de bobine à la tension en charge (ex. : tension de bobine = tension d'alimentation = 230 V). Pour employer une tension de bobine différente, choisir le même démarreur, mais avec la bobine appropriée.

Moteur	hp	V	FURNAS, classe 16 Nº de catal.	FURNAS, classe 16 DPS	Classe 14 Nº de catal.	Disjonct. à retard.	Fusible double temporisé
4 po, 3 Ø	2	460	16AH	K32	CSDC	15	8
		575	16AE	K29	CSDE	15	5
	3	200	16AD	K54	CSED	30	20
		230	16AG	K52	CSEA	25	20
		460	16AH	K37	CSDC	15	10
		575	16AE	K33	CSDE	15	8
	5	200	16AD	K61	DSFD	50	35
		230	16AG	K60	DSFA	40	30
		460	16AH	K49	CSDC	20	15
		575	16AE	K41	CSDE	20	15
	7½	200	16CD	K69	DSFD	70	50
		230	16BG	K64	DSFA	60	45
		460	16AH	K54	DSEC	30	25
		575	16AE	K52	DSEE	25	20
	10	460	16AH	K60	DSEC	45	30
		575	16AE	K57	DSEE	35	25

Codification (exemple : 16BH) — **16** = démarreur à usage déterminé (*DP*) de classe 16 ; **B** = format de démarreur (formats offerts : A, B, C, D, E, F, G et H — le format est déterminé par l'intensité de courant à pleine charge avec rotor bloqué) ; et **H** = tension de bobine de 460 V (D = 200 V, E = 575 V, F = 115 V, G = 230 V et H = 460 V).

On trouvera la codification des démarreurs Class 14 dans la liste de prix des pompes submersibles et à jet.

Données techniques

VALEURS DE RÉSISTANCE D'ISOLEMENT DU MOTEUR

Valeurs mesurées normalement en ohms et en mégohms entre chaque fil de moteur et le fil de terre, et ce, pour TOUS les moteurs.

⚠ ATTENTION Pour mesurer la résistance d'isolement, mettre le disjoncteur hors circuit et débrancher tous les fils du pressostat ou de la boîte de commande (à déconnexion rapide). Brancher un fil de l'ohmmètre à un fil de moteur et l'autre, au tuyau de refoulement en métal descendant dans le puits ou à une bonne prise de terre. Échelle «R x 100K»

État du moteur et des fils	Ohms	Mégohms
Moteur neuf, sans câble d'alimentation	20 000 000 (et plus)	20,0
Moteur usagé réutilisable (en puits)	10 000 000 (et plus)	10,0
Moteur en puits — valeurs mesurées : câble d'alimentation plus moteur		
Moteur neuf	2 000 000 (et plus)	2,0
Moteur dans un état raisonnablement bon	500 000 à 2 000 000	0,5 à 2,0
Moteur ou câble d'alimentation peut-être endommagé *Ne pas sortir la pompe du puits pour cela.*	20 000 à 500 000	0,02 à 0,5
Moteur ou câble d'alimentation endommagé *Sortir la pompe du puits et effectuer les réparations.*	10 000 à 20 000	0,01 à 0,02
Moteur ou câble d'alimentation défectueux *Sortir la pompe du puits et effectuer les réparations.*	Moins de 10 000	0 à 0,01

Utilisation d'une génératrice

- **S'il s'agit d'une génératrice à régulation externe, voir la table ci-dessous pour la puissance nominale (en kV·A). Les valeurs de tension, de fréquence, de nombre de phases et de courant admissible DOIVENT correspondre à celles qui sont indiquées sur la plaque signalétique du moteur ou sur la boîte de commande de la pompe.**

QUAND ON UTILISE UNE GÉNÉRATRICE DE SECOURS OU DE RÉSERVE, LE NON-USAGE D'UN COMMUTATEUR DE TRANSFERT MANUEL OU AUTOMATIQUE PEUT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

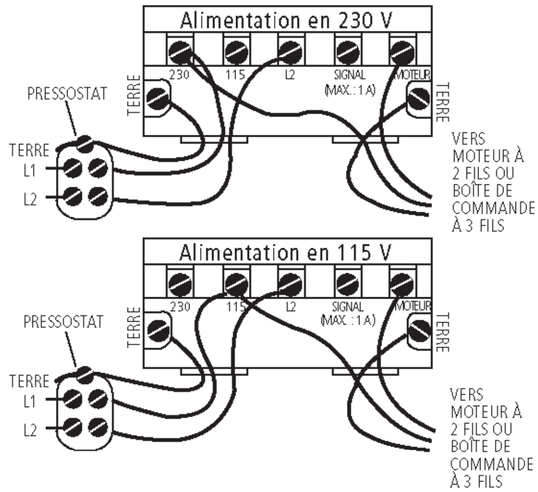
Puiss. nom. min. de la génératrice①	Puissance du moteur en hp							
	⅓	½	¾	1	1½	2	3	5
kV·A	1,9	2,5	3,8	5,0	6,3	9,4	12,5	18,8
kW	1,5	2,0	3,0	4,0	5,0	7,5	10,0	15,0

①Pour les moteurs à deux fils, la puissance nominale minimale de la génératrice doit être 50% plus élevée que ce qui est indiqué.

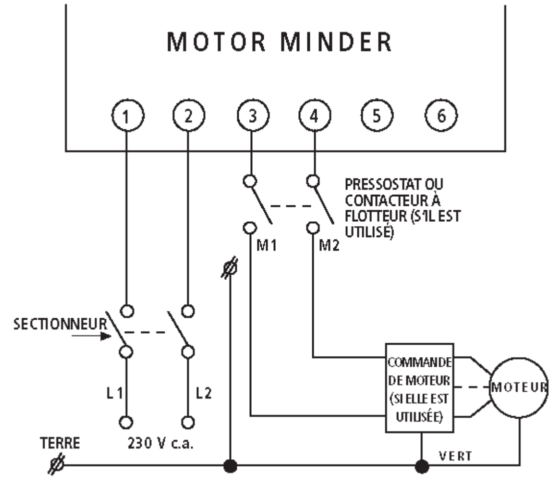
AVIS : SUIVRE SOIGNEUSEMENT LES DIRECTIVES DU FABRICANT DE LA GÉNÉRATRICE.

Gracieuseté de la Franklin Electric Company

CÂBLAGE DES PUMPTEC



CÂBLAGE DES MOTOR MINDER



LONGUEUR MAXIMALE DU CÂBLE DE MOTEUR MONOPHASÉ

(de l'entrée de service au moteur)[1]

Moteur		Calibres de fil (en cuivre)[2]								
Volts	hp	14	12	10	8	6	4	2	0	00
115	⅓	130	210	340	540	840	1300	1960	2910	3540
	½	100	160	250	390	620	960	1460	2160	2630
230	⅓	550	880	1390	2190	3400	5250	7960	11770	
	½	400	650	1020	1610	2510	3880	5880	8720	
	¾	300	480	760	1200	1870	2890	4370	6470	7870
	1	250	400	630	990	1540	2380	3610	5360	6520
	1,5	190	310	480	770	1200	1870	2850	4280	5240
	2	150	250	390	620	970	1530	2360	3620	4480
	3	120*	190	300	470	750	1190	1850	2890	3610
	5	0	0	180*	280	450	710	1110	1740	2170
	7,5	0	0	0	200*	310	490	750	1140	1410
	10	0	0	0	0	250*	390	600	930	1160
	15	0	0	0	0	170*	270*	430	660	820

[1] La longueur des câbles est en pieds. Les boîtes de commande monophasées peuvent être branchées n'importe où sur toute la longueur du câble.

[2] Les calibres ci-dessus s'appliquent aux fils de cuivre. Si l'on emploie des fils d'aluminium, on doit alors choisir un calibre plus gros de deux numéros. Par exemple, si le fil de cuivre approprié est de calibre 12, on utilisera un fil d'aluminium de calibre 10.

* Ces longueurs sont conformes au code national de l'électricité (NEC) états-unien en ce qui a trait à l'intensité maximale, mais seulement pour les conducteurs séparés homologués pour 75 °C. Les longueurs sans astérisque (*) satisfont aux prescriptions du code NEC relatives aux câbles gainés homologués pour 75 °C. Les règlements locaux peuvent différer à ce sujet.

LONGUEUR MAXIMALE DU CÂBLE DE MOTEUR TRIPHASÉ
(de l'entrée de service au moteur)[1]

Moteur		Calibres de fil (en cuivre)[2]										
Volts	hp	14	12	10	8	6	4	2	0	00	000	0000
200 V 60 Hz	0,5	710	1 140	1 800	2 840	4 420						
	0,75	510	810	1 280	2 030	3 160						
	1	430	690	1 080	1 710	2 670	4 140					
	1,5	310	500	790	1 260	1 960	3 050					
	2	240	390	610	970	1 520	2 360	3 610	5 420			
	3	180	290	470	740	1 160	1 810	2 760	4 130			
	5	110*	170	280	440	690	1 080	1 660	2 490	3 050	3 670	4 440
	7,5	0	0	200	310	490	770	1 180	1 770	2 170	2 600	3 150
	10	0	0	0	230*	370	570	880	1 330	1 640	1 970	2 390
230 V 60 Hz	0,5	930	1 490	2 350	3 700	5 760	8 910					
	0,75	670	1 080	1 700	2 580	4 190	6 490	9 860				
	1	560	910	1 430	2 260	3 520	5 460	8 290				
	1,5	420	670	1 060	1 670	2 610	4 050	6 160	9 170			
	2	320	510	810	1 280	2 010	3 130	4 770	7 170	8 780		
	3	240	390	620	990	1 540	2 400	3 660	5 470	6 690	8 020	9 680
	5	140*	230	370	590	920	1 430	2 190	3 290	4 030	4 850	5 870
	7,5	0	160*	260	420	650	1 020	1 560	2 340	2 870	3 440	4 160
	10	0	0	190*	310	490	760	1 170	1 760	2 160	2 610	3 160
460 V 60 Hz	0,5	3 770	6 020	9 460								
	0,75	2 730	4 350	6 850								
	1	2 300	3 670	5 770	9 070							
	1,5	1 700	2 710	4 270	6 730							
	2	1 300	2 070	3 270	5 150	8 050						
	3	1 000	1 600	2 520	3 970	6 200						
	5	590	950	1 500	2 360	3 700	5 750					
	7,5	420	680	1 070	1 690	2 640	4 100	6 260				
	10	310	500	790	1 250	1 960	3 050	4 680	7 050			
575 V 60 Hz	0,5	5 900	9 410									
	0,75	4 270	6 810									
	1	3 630	5 800	9 120								
	1,5	2 620	4 180	6 580								
	2	2 030	3 250	5 110	8 060							
	3	1 580	2 530	3 980	6 270							
	5	920	1 480	2 330	3 680	5 750						
	7,5	660	1 060	1 680	2 650	4 150						
	10	490	780	1 240	1 950	3 060	4 770					

[1] La longueur des câbles est en pieds. Afin de maintenir la fiabilité du démarreur des moteurs triphasés, la distance séparant ce dernier de l'entrée de service ne devrait pas dépasser 25 % de la longueur maximale du câble.

[2] Les calibres ci-dessus s'appliquent aux fils de cuivre. Si l'on emploie des fils d'aluminium, on doit alors choisir un calibre plus gros de deux numéros. Par exemple, si le fil de cuivre approprié est de calibre 12, on utilisera un fil d'aluminium de calibre 10.

* Ces longueurs sont conformes au code national de l'électricité (NEC) états-unien en ce qui a trait à l'intensité maximale, mais seulement pour les conducteurs séparés homologués pour 75 °C. Les longueurs sans astérisque (*) satisfont aux prescriptions du code NEC relatives aux câbles gainés homologués pour 75 °C. Les règlements locaux peuvent différer à ce sujet.

Diagnostic de anomalies

OMETTRE LE VERROUILLAGE DU DISJONCTEUR DU CIRCUIT ÉLECTRIQUE EN POSITION OUVERTE (HORS CIRCUIT) AVANT D'EFFECTUER TOUT TRAVAIL D'ENTRETIEN SUR LA POMPE PEUT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

Anomalies	Causes probables	Correctifs recommandés
NON-FONCTIONNEMENT DU MOTEUR DE LA POMPE	1. Protecteur thermique du moteur déclenché a) Boîte de commande inappropriée b) Connexions électriques défectueuses ou incorrectes c) Protecteur thermique défectueux d) Basse tension électrique e) Température ambiante trop élevée pour la boîte de commande ou le démarreur f) Pompe bloquée par un corps étranger g) Hauteur d'immersion inappropriée	1. Laisser le moteur refroidir, et le protecteur thermique s'enclenchera de nouveau automatiquement. a) à e) Faire inspecter l'appareil par un électricien et effecttuer les réparations requises. f) Sortir la pompe du puits, la nottoyer et la redescendre à la hauteur d'immersion requise. g) Confirmer la bonne hauteur d'immersion dans le liquide pompé.
	2. Disjonsteur ouvert ou fusible sauté	2. Faire inspecter l'appareil par un électricien et effectuer les réparations requises.
	3. Alimentation électrique inappropriée à la charge	3. Vérifier la puissance électrique du circuit d'alimentation ou de la génératrice.
	4. Gaine du câble d'alimentation endommagée 5. Jonction du câble d'alimentation défectueuse	4. et 5. Faire inspecter l'appareil par un électricien et effectuer les répararions requises.
DÉBIT DE REFOULEMENT FAIBLE OU NUL	1. Clapet de non-retour défectueux ou mal posé	1. Inspecter le clapet de non-retour et le réparer au besoin.
	2. Poche d'air dans la pompe	2. Démarrer et arrêter la pompe à répétition jusqu'à ce que son débit soit bon.
	3. Hauteur d'aspiration trop élevée pour la pompe	3. Vérifier les performances de l'appareil et consulter le détaillant.
	4. Pompe bloquée par un corps étranger	4. Sortir la pompe du puits, la nettoyer et la redescendre à la hauteur d'immersion requise.
	5. Pompe non entièrement immergée	5. Vérifier la remontée du niveau du puits et immerger la pompe davantage si c'est possible.
	6. Présence excessive d'air ou de gaz dans le puits	6. Si le démarrage et l'arrêt répétitifs de la pompe ne résolvent pas le problème, il y a trop d'air ou de gaz dans le puits.
	7. Usure excessive de la pompe	7. Retirer la pompe du puits et effectuer les réparations requises.
	8. Mauvais sens de rotation du moteur (en triphasé seulement)	8. Intervertir deux fils du moteur.

Declaration of Conformity

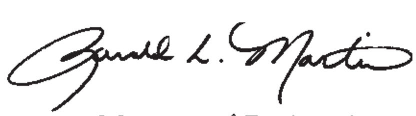
We at,
Goulds Pumps/ITT Industries
1 Goulds Drive
Auburn, NY 13021
Declare that the following products: GS, GSZ, LS, LSZ, SB, SBZ
Comply with Machine Directive 98/37/EC. This equipment is intended to be incorporated with machinery covered by this directive, but must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the actual provisions of the directive.

Declaración de Conformidad

Nosotros en
Goulds Pumps/ITT Industries
1 Goulds Drive
Auburn, NY 13021
Declaramos que los siguientes productos: GS, GSZ, LS, LSZ, SB, SBZ
cumplen con las Directivas para Maquinarias 98/37/EC. Este equipo ha sido diseñado para ser incorporado a la maquinaria cubierta por esta directiva pero no debe ponerse en funcionamiento hasta que se declare que la maquinaria en la que será incorporado cumple con las disposiciones reales de la directiva.

Déclaration de Conformité

Nous, à
Goulds Pumps, ITT Industries
1 Goulds Drive
Auburn, NY, U.S.A. 13021,
déclarons que les produits GS, GSZ, LS, LSZ, SB et SBZ
sont conformes à la directive 98/37/CE (législation relative aux machines). Ils sont destinés à être intégrés dans la machinerie faisant l'objet de ladite directive, mais ne doivent pas être mis en service tant que la machinerie en question ne sera pas déclarée conforme aux stipulations de la directive.



Manager of Engineering

GOULDS PUMPS LIMITED WARRANTY

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

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

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

The warranty excludes:

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

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

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

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

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

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

GARANTÍA LIMITADA DE GOULDS PUMPS

Esta garantía es aplicable a todas las bombas para sistemas de agua fabricadas por Goulds Pumps.

Toda parte o partes que resulten defectuosas dentro del período de garantía serán reemplazadas sin cargo para el comerciante durante dicho período de garantía. Tal período de garantía se extiende por doce (12) meses a partir de la fecha de instalación, o dieciocho (18) meses a partir de la fecha de fabricación, cualquiera se cumpla primero.

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

La presente garantía excluye:

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

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

(1) "Distribuidor" es aquel individuo, sociedad, corporación, asociación u otra entidad jurídica que opera entre Goulds Pumps y el comerciante para la compra, consignación o contratos de venta de las bombas en cuestión.

(2) "Comerciante" es todo individuo, sociedad, corporación, asociación u otra entidad jurídica que realiza negocios de venta o alquiler-venta (leasing) de bombas a clientes.

(3) "Cliente" es toda entidad que compra o que adquiere bajo la modalidad de leasing las bombas en cuestión de un comerciante. El término "cliente" puede significar un individuo, una sociedad, una corporación, una sociedad de responsabilidad limitada, una asociación o cualquier otra entidad jurídica con actividades en cualquier tipo de negocios.

LA PRESENTE GARANTÍA SE EXTIENDE AL COMERCIANTE ÚNICAMENTE

GARANTIE LIMITÉE DE GOULDS PUMPS

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

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

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

La garantie ne couvre pas :

a) les frais de main-d'œuvre ou de transport ni les frais connexes encourus par le détaillant;

b) les frais de réinstallation de l'équipement réparé ; c) les frais de réinstallation de l'équipement de remplacement ;

d) les dommages indirects de quelque nature que ce soit ; e) ni les pertes découlant de la panne.

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

1) « Distributeur » signifie une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique servant d'intermédiaire entre Goulds Pumps et le détaillant pour les achats, les consignations ou les contrats de vente des pompes en question.

2) « Détaillant » veut dire une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique dont les activités commerciales sont la vente ou la location de pompes à des clients.

3) « Client » signifie une entité qui achète ou loue les pompes en question chez un détaillant. Le « client » peut être une personne, une société de personnes, une société de capitaux, une société à responsabilité limitée, une association ou autre entité juridique se livrant à quelque activité que ce soit.

LA PRÉSENTE GARANTIE SE RAPPORTE AU DÉTAILLANT SEULEMENT.

GOULDS PUMPS

Goulds Pumps

ITT Industries

ITT

Residential Water Systems

Goulds Pumps

33GS, 40GS, 55GS, 60GS, 75GS, 80GS
REPAIR PARTS

60 Hz High Capacity 4" Submersible pumps

GOULDS PUMPS

Goulds Pumps is a brand of ITT Residential and Commercial Water.

www.goulds.com

Engineered for life

GOULDS PUMPS
Residential Water Systems

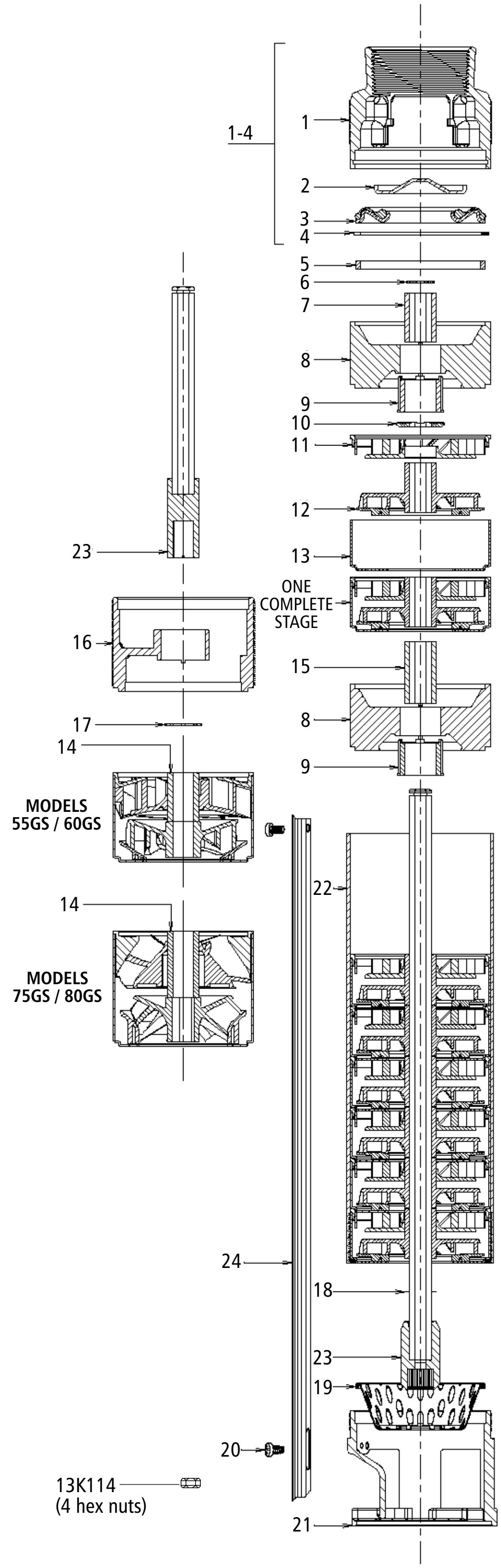
Item No.	Description		Current 4-TEP Models						
			HP	33GS	40GS	55GS	60GS	75GS	80GS
	Number of stages		1	6	—	—	—	—	—
			1½	8	5	5	4	—	—
			2	10	6	7	5	—	—
			3	14	8	9	7	7	5
			5	22 ①	14	15 ①	11 ①	11	9
			7½	34 ②	21 ①	22 ②	17 ①	16	14
			10	44 ②	—	29 ②	—	21 ②	—
1 - 4	Discharge head assembly			7K2841	7K2841	7K2841	7K2841	7K2841	7K2841
2	Check valve poppet			7K1366	7K1366	7K1366	7K1366	7K1366	7K1366
3	Check valve seal and seat assembly			7K2123	7K2123	7K2123	7K2123	7K2123	7K2123
4	Check valve retaining ring			7K1364	7K1364	7K1364	7K1364	7K1364	7K1364
5	Adapter ring			7K1597	7K1597	7K1597	7K1597	7K1597	7K1597
6	Shaft retaining ring			7K817	7K817	7K817	7K817	7K817	7K817
7	Upper Shaft sleeve			7K1571	7K1571	7K1571	7K1571	7K1571	7K1571
8	Bearing spider (upper & some int.) ①			7K1593	7K1593	7K1593	7K1593	—	—
9	Bearing ① ②			7K2756	7K2756	7K2756	7K2756	7K2756	7K2756
10	Upthrust washer			7K1575	7K1575	7K1575	7K1575	7K1575	7K1575
11	Diffuser			7K1590	7K1590	7K1591	7K1591	7K1592	7K1592
12	Impeller			7K1739	7K1587	7K1779	7K1588	7K1787	7K1589
13	Bowl			7K1584	7K1584	7K1585	7K1585	7K1586	7K1586
14	Diffuser shaft sleeve			—	—	7K1571	7K1571	7K1573	7K1573
15	Intermediate shaft sleeve ①			7K1572	7K1572	7K1572	7K1572	—	—
16	Intermediate bearing spider ②			7K2246	—	7K2246	—	7K2246	—
17	Lower shaft retaining ring ②			7K1629	—	7K1629	—	7K1629	—
18	Shim			7K1574	7K1574	7K1574	7K1574	7K1574	7K1574
19	Stainless steel strainer			7K1370	7K1370	7K1370	7K1370	7K1370	7K1370
20	Cable guard screws			13K91	13K91	13K91	13K91	13K91	13K91
21	Motor adapter			7K1363	7K1363	7K1363	7K1363	7K1363	7K1363
22	Casings		1	7K2082	—	—	—	—	—
			1½	7K2912	7K2912	7K2923	7K2675	—	—
			2	7K2888	7K2716	7K2721	7K2923	—	—
			3	7K2022	7K2912	7K2327	7K2340	7K2733	7K1636
			5	7K2913	7K2022	7K2924	7K2931	7K2936	7K2939
		Upper	7½	7K2328	7K2916	7K2332	7K2932	7K2937	7K2940
		Lower	7½	7K2983		7K2335			
		Upper	10	7K2984	—	7K2331	—	7K2333	—
		Lower	10	7K2011		7K2925		7K2938	
23	Shaft and coupling assemblies		1	7K1605	—	—	—	—	—
			1½	7K1606	7K1610	7K1662	7K1661	—	—
			2	7K1768	7K1605	7K1663	7K1662	—	—
			3	7K1631	7K1606	7K1784	7K1663	7K1631	7K1648
			5	7K1769	7K1631	7K1785	7K1664	7K1689	7K1649
		Upper	7½	7K2269	7K1611	7K2262	7K1665	7K1871	7K1650
		Lower	7½	7K2303		7K2301			
		Upper	10	7K2275	—	7K2276	—	7K2277	—
		Lower	10	7K2311		7K2310		7K2309	
24	Cable guards		1	7K2763	—	—	—	—	—
			1½	7K1891	7K2228	7K2233	7K2229	—	—
			2	7K1414	7K2763	7K2677	7K2233	—	—
			3	7K2906	7K1891	7K1923	7K2677	7K2777	7K2900
			5	7K1635	7K2906	7K2851	7K1423	7K2762	7K1927
			7½	7K1721	7K2908	7K2758	7K2761	7K2764	7K2773
			10	7K2679	—	7K2759	—	7K2765	—

① Indicates model with one intermediate bearing spider.

② Indicates model with split cases and shafts.

ITT

GOULDS PUMPS
Residential Water Systems



ITT

Residential Water Systems

GOULDS PUMPS

R33-80GS August, 2006

Engineered for life

ITT

Residential Water Systems

Goulds Pumps

33GS, 40GS, 55GS, 60GS, 75GS, 80GS

60 Hz High Capacity
4" Submersible Pumps

GOULDS PUMPS

Goulds Pumps is a brand of ITT
Residential and Commercial Water.

www.goulds.com

Engineered for life

FEATURES

- **Powered for Continuous Operation:** All ratings are within the working limits of the motor as recommended by the motor manufacturer. Pump can be operated continuously without damage to the motor.
- **Field Serviceable:** Units have left hand threads and are field serviceable with common tools and readily available repair parts.
- **Sand Handling Design:** Our face clearance, floating impeller stack has proven itself for over 40 years as a superior sand handling, durable pump design.
- **FDA Compliant Non-Metallic Parts:** Impellers, diffusers and bearing spiders are constructed of glass filled engineered composites. They are corrosion resistant and non-toxic.
- **Discharge Head/Check Valve:** Cast 303 stainless steel for strength and durability. Two cast-in safety line loops for installer convenience. The built-in check valve is constructed of stainless steel and FDA compliant BUNA rubber for abrasion resistance and quiet operation.
- **Motor Adapter:** Cast 303 stainless steel for rigid, accurate alignment of pump and motor. Easy access to motor mounting nuts using standard open end wrench.
- **Stainless Steel Casing:** Polished stainless steel is strong and corrosion resistant.
- **Hex Shaft Design:** Six sided shafts for positive impeller drive.
- **Engineered Polymer Bearings:** The proprietary, engineered polymer bearing material is strong and resistant to abrasion and wear. The upper bearing is mounted in a durable engineered composite bearing spider for excellent abrasion resistance.

WATER END DATA

Series	Model	Required H.P.	Stages	Water End	
				Length (in)	Wt (lbs)
33GS	33GS10	1	6	14.2	8
	33GS15	1.5	8	16.6	9
	33GS20	2	10	19.1	10
	33GS30	3	14	24	13
	33GS50	5	22	35.2	19
	33GS75	7.5	34	50.6	27
	33GS100	10	44	62.8	33
40GS	40GS15	1.5	5	12.9	8
	40GS20	2	6	14.2	8
	40GS30	3	8	16.6	9
	40GS50	5	14	24.0	13
	40GS75	7.5	21	34.0	18
55GS	55GS15	1.5	5	17.1	10
	55GS20	2	7	21.2	12
	55GS30	3	9	25.3	15
	55GS50	5	15	39.1	22
	55GS75	7.5	22	54.1	32
	55GS100	10	29	98.4	39
60GS	60GS15	1.5	4	15.0	8
	60GS20	2	5	17.1	9
	60GS30	3	7	21.2	10
	60GS50	5	11	30.9	14
	60GS75	7.5	17	43.2	19
75GS	75GS30	3	7	24.1	14
	75GS50	5	11	34.8	19
	75GS75	7.5	16	48.2	27
	75GS100	10	21	63.8	35
80GS	80GS30	3	5	21.4	10
	80GS50	5	9	29.4	13
	80GS75	7.5	14	42.8	24

NOMENCLATURE

See price book for complete order numbers.

33 GS 20 4 1 2 (C)

GPM at Best Efficiency — 33, 40, 55, 60, 75, 80

GS Pump Series

Horsepower Code
15 = 1½
20 = 2
30 = 3
50 = 5
75 = 7½
100 = 10

4 = 4" Motor

Phase
1 = 1 Phase 3 Wire
2 = 1 Phase 2 Wire
3 = 3 Phase 3 Wire

Voltage
1 = 115 V
2 = 230 V
3 = 380 V
4 = 460 V
7 = 575 V

Blank = w/ F.E. Motor
C = CentriPro Motor

SPECIFICATIONS

Model	Flow Range GPM	Horse-power Range	Best Efficiency GPM	Discharge Connection	Minimum Well Size	Rotation①
33GS	10 – 50	1 – 10	33	2″	4″	CCW
40GS	20 – 65	1½ – 7½	40	2″	4″	CCW
55GS	20 – 80	1½ – 10	55	2″	4″	CCW
60GS	40 – 80	1½ – 7½	60	2″	4″	CCW
75GS	40 – 100	3 – 10	75	2″	4″	CCW
80GS	50 – 120	3 – 7½	80	2″	4″	CCW

① Rotation is counterclockwise when observed from pump discharge end.

"GS" SERIES MATERIALS OF CONSTRUCTION

Part Name	Material
Discharge Head	AISI 303 SS
Check Valve Poppet	AISI 304 SS
Check Valve Seal	BUNA, FDA compliant
Check Valve Seat	AISI 304 SS
Check Valve Retaining Ring	AISI 302 SS
Bearing Spider – Upper	Glass Filled Engineered Composite
Bearing	Proprietary Engineered Polymer
Klipring	AISI 301 SS
Diffuser	Lexan®
Impeller	Noryl®
Bowl	AISI 304 SS
Intermediate Sleeve*	AISI 304 SS, Powder Metal
Intermediate Shaft Coupling*	AISI 304 SS, Powder Metal
Intermediate Bearing Spider*	Glass Filled Engineered Composite
Intermediate Bearing Spider*	AISI 303 SS
Shim	AISI 304 SS
Screws – Cable Guard	AISI 304 SS
Motor Adapter	AISI 303 SS
Casing	AISI 304 SS
Shaft	
Coupling	AISI 304 SS, Powder Metal
Cable Guard	AISI 304 SS
Suction Screen	AISI 304 SS

*See repair parts for where used.

AGENCY LISTINGS

All factory assembled, complete pump/motor assemblies are UL778 and CSA listed. All pumps and motors comply with ANSI/NSF 61-1992. Motors are UL778 recognized.

Canadian Standards Association

Underwriters Laboratories

ANSI/NSF 61 - Drinking Water System Components 4P49

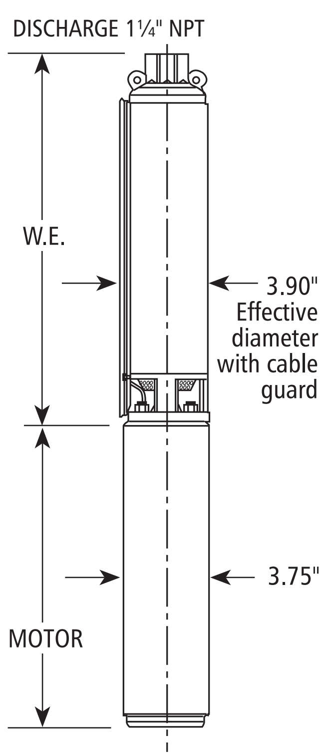
Goulds Pumps is ISO 9001 Registered.

CENTRIPRO 4" SINGLE-PHASE MOTORS

Order No.	Type	HP	Volts	Length (in)	Weight (lb)
M10422	2 Wire PSC	1	230	13.3	24.5
M15422		1.5	230	14.9	28.9
M10412	3 Wire	1	230	11.7	23.1
M15412		1.5	230	13.6	27.4

FRANKLIN ELECTRIC 4" SINGLE-PHASE MOTORS

Order No.	Type	HP	Volts	Length (in)	Weight (lb)
S06942	2 Wire SP	1	230	11.8	24
S07942		1.5	230	15.1	31
S06940	3 Wire	1	230	11.8	24
S07940		1.5	230	13.6	28
S08940		2	230	15.1	33
S09940		3	230	19.1	41
S09940HT		3	230	22.2	55
S10940		5	230	28.2	70



FRANKLIN ELECTRIC 4" THREE-PHASE MOTORS

Order No.	HP	Volts	Length (in)	Weight (lb)
S06978	1	200	11.8	24
S06970		230		
S06975		460		
S07978	1.5	200	11.8	24
S07970		230		
S07975		460		
S07979		575		
S08978	2	200	13.6	28
S08970		230		
S08975		460		
S08979		575		
S09978	3	200	16.1	35
S09970		230		
S09975		460		
S09979		575		
S09978HT	3 High Thrust	200	19.2	42
S09970HT		230		
S09975HT		460		
S09979HT		575		
S10978	5	200	22.2	55
S10970		230		
S10975		460		
S10979		575		
S119784	7.5	200	28.2	70
S119704		230		
S119754		460		
S129724	10	460	30.5	75

NEMA MOTOR

- Corrosion resistant stainless steel construction.
- Built-in surge arrestor is provided on single phase motors through 5 HP.
- Stainless steel splined shaft.
- Hermetically sealed windings.
- Replaceable motor lead assembly.
- UL 778 recognized.
- NEMA mounting dimensions.
- Control box is required with 3 wire single phase units.
- Three phase units require a magnetic starter with three leg protection. Magnetic starter and heaters must be ordered separately.

Model 33GS

SELECTION CHART

Horsepower Range 1 – 3, Recommended Range 10 – 50 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																										
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	520	560	600
33GS10	1	0		48	45	41	36	30	22	11																			
		20	44	39	34	28	19																						
		30	39	33	27	17																							
		40	32	25	15																								
		50	24	14																									
		60	12																										
Shut-off PSI			67	58	50	41	32	24	15	6																			
33GS15	1½	0		50	48	46	43	40	37	32	26	19																	
		20	48	45	43	39	35	31	24	17																			
		30	45	42	39	35	30	23	15																				
		40	42	38	34	29	22	14																					
		50	38	33	28	21	12																						
		60	33	27	20	11																							
Shut-off PSI			95	86	78	69	60	52	43	34	26	17																	
33GS20	2	0			49	48	46	44	41	38	35	32	28	22															
		20	49	47	45	43	40	38	34	31	26	21	14																
		30	47	45	42	40	37	34	30	25	20	13																	
		40	44	42	40	37	33	29	24	19	11																		
		50	42	39	36	33	29	24	18																				
		60	39	36	32	28	23	16																					
Shut-off PSI			121	112	103	95	86	77	69	60	51	43	34	26															
33GS30	3	0				49	48	46	45	43	41	40	38	35	33	31	28	24	20	15									
		20	50	49	47	46	44	43	41	39	37	35	32	30	27	23	19	13											
		30	49	47	46	44	42	41	39	37	34	32	29	26	22	18	12												
		40	47	45	44	42	40	38	36	34	32	29	25	22	17	11													
		50	45	44	42	40	38	36	34	31	28	25	21	16															
		60	43	42	40	38	36	33	31	28	24	20	15																
Shut-off PSI			170	161	152	144	135	126	118	109	100	92	83	74	66	57	48	40	31	23									

Horsepower Range 5-10, Recommended Range 10 – 50 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																										
			50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350
33GS50	5	0		50	48	46	44	41	38	35	31	27	20	11															
		20	50	48	46	44	41	38	35	32	27	21	11																
		30	49	47	45	43	40	37	34	30	25	17																	
		40	48	46	44	41	39	36	32	27	21	12																	
		50	47	45	43	40	37	34	30	25	18																		
		60	46	44	42	39	36	32	28	22	13																		
Shut-off PSI			264	242	220	199	177	156	134	112	91	69	47	26															
33GS75	7½	0				50	48	47	46	44	42	40	38	36	33	31	27	23	19	14									
		20			50	49	47	46	44	42	41	38	36	34	31	28	24	19	14										
		30		50	49	48	46	45	43	42	40	37	35	32	29	26	22	17	12										
		40		50	49	47	46	44	43	41	39	36	34	31	28	24	20	15											
		50		49	48	47	45	43	42	40	38	35	33	30	26	22	17	12											
		60	50	49	47	46	44	43	41	39	37	34	31	28	24	20	15												
Shut-off PSI			415	393	371	350	328	306	285	263	241	220	198	176	155	133	111	90	68	47									
33GS100	10	0							49	48	46	45	43	42	41	40	39	38	36	34	31	28	25	22	18	13			
		20						50	48	46	45	43	42	41	40	39	38	36	34	31	29	25	22	18	14				
		30						49	47	45	44	43	42	41	40	38	37	35	33	30	27	24	20	16	12				
		40					50	48	46	45	44	43	42	40	39	38	36	34	32	29	26	22	18	14					
		50					49	47	45	44	43	42	41	40	39	37	35	33	30	27	24	20	16	12					
		60				50	48	46	45	44	43	42	41	39	38	36	34	32	29	26	22	19	14						
Shut-off PSI			551	529	508	486	464	443	421	399	378	356	334	313	291	269	248	226	205	183	161	140	118	96	75	53			

Model 40GS

SELECTION CHART

Horsepower Range 1½ – 7½, Recommended Range 20 – 65 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																									
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	440	480	520	560	600	640
40GS15	1½	0		65	59	53	46	35																				
		20	58	51	43	31																						
		30	50	41	28																							
		40	40	25																								
		50	22																									
		60																										
Shut-off PSI			57	49	40	31	23	14																				
40GS20	2	0			63	58	53	47	38	25																		
		20	61	57	51	44	35																					
		30	56	50	43	33																						
		40	49	42	31																							
		50	40	29																								
		60	26																									
Shut-off PSI			71	62	53	45	36	27	19	10																		
40GS30	3	0				63	59	56	51	47	41	33	20															
		20	65	62	58	54	50	45	38	32	30																	
		30	61	58	54	49	44	37	28																			
		40	57	53	48	43	36	26																				
		50	52	48	42	35	24																					
		60	47	41	33	21																						
Shut-off PSI			97	88	80	71	62	54	45	36	28	19	10															
40GS50	5	0						65	64	62	60	58	56	53	51	48	45	42	38	33	26							
		20				65	63	61	59	57	55	52	50	47	44	41	36	31	23									
		30			64	63	61	59	57	54	52	50	47	44	40	36	30	21										
		40		64	62	60	58	56	54	52	49	46	43	39	35	29	20											
		50	64	62	60	58	56	54	51	49	46	43	39	34	28													
		60	62	60	58	56	53	51	48	45	42	38	33	26														
Shut-off PSI			178	169	161	152	143	135	126	117	109	100	91	83	74	65	57	48	39	31	22							
40GS75	7½	0										65	64	63	62	61	60	59	57	56	54	53	49	44	38	30		
		20								65	64	63	62	61	59	58	57	55	54	52	50	48	43	37	28			
		30							65	64	63	62	61	59	58	57	55	53	52	50	48	45	40	32	22			
		40						65	64	63	62	60	59	58	56	55	53	51	49	47	45	42	36	27				
		50					65	64	62	61	60	59	58	56	55	53	51	50	47	45	42	39	31	20				
		60			65	64	63	62	61	60	59	57	56	54	53	51	49	47	44	41	38	35	25					
Shut-off PSI			271	263	254	245	237	228	219	211	202	194	185	176	168	159	150	142	133	124	116	107	90	72	55	38		

Model 55GS

SELECTION CHART

Horsepower Range 1½ – 5, Recommended Range 20 – 80 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																								
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
55GS15	1½	0	78	71	64	54	42	24																			
		20	61	51	37																						
		30	49	35																							
		40	32																								
		50																									
		60																									
Shut-off PSI			52	43	35	26	17	9																			
55GS20	2	0		76	71	65	58	50	41	28																	
		20	69	63	56	48	37	24																			
		30	62	55	46	35	21																				
		40	54	45	34																						
		50	43	32																							
		60	29																								
Shut-off PSI			76	67	58	50	41	32	24	15																	
55GS30	3	0		80	76	72	68	63	58	52	44	35															
		20	75	71	67	62	56	49	42	32																	
		30	70	66	61	55	48	40	30																		
		40	65	60	54	47	39	28																			
		50	59	53	46	37	26																				
		60	52	45	36	25																					
Shut-off PSI			102	94	85	76	68	59	50	42	33	24															
55GS50	5	0				80	78	76	73	71	68	65	62	58	55	50	46	40	34	27							
		20		80	77	75	73	70	67	64	61	57	53	49	44	39	32	25									
		30	79	77	75	72	70	67	64	60	57	53	48	43	38	31	24										
		40	77	74	72	69	66	63	60	56	52	47	42	37	30	23											
		50	74	71	69	66	63	59	55	51	47	42	36	29	22												
		60	71	68	65	62	59	55	51	46	41	35	28	20													
Shut-off PSI			178	169	161	152	143	135	126	117	109	100	91	83	74	65	57	48	39	31							

Horsepower Range 7½ – 10, Recommended Range 20 – 80 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																								
			20	60	100	140	180	220	260	300	340	380	420	460	500	540	580	620	660	700	740	780	820	860	900	940	980
55GS75	7½	0			79	76	73	70	66	62	58	52	46	39	31	22											
		20		78	76	73	69	66	61	57	52	45	38	30	20												
		30	80	77	74	71	67	63	59	54	48	41	33	24													
		40	78	75	72	69	65	61	56	51	44	37	28														
		50	76	73	70	67	63	58	53	47	40	32	23														
		60	75	72	68	64	60	55	50	43	36	27															
Shut-off PSI			261	243	226	209	191	174	157	139	122	105	88	70	53	36											
55GS100	10	0			80	78	76	75	73	71	68	66	63	60	56	51	47	41	35	28							
		20		80	78	76	74	73	70	68	65	62	59	55	51	46	40	33	26								
		30		79	77	75	73	71	69	67	64	61	57	53	48	42	36	29	22								
		40	79	78	76	74	72	70	68	65	62	59	55	50	45	39	32	25									
		50	78	77	75	73	71	69	66	63	60	56	52	47	42	35	28	21									
		60	77	76	74	72	70	67	65	61	58	54	49	44	38	31	24										
Shut-off PSI			353	336	319	301	284	267	250	232	215	198	180	163	146	128	111	94	76	59							

Model 60GS

SELECTION CHART

Horsepower Range 1½ – 7½, Recommended Range 40 – 80 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																							
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480
60GS15	1½	0		75	64	51																				
		20	60	47																						
		30	44																							
		40																								
		50																								
		60																								
Shut-off PSI			45	36	28	19																				
60GS20	2	0			73	63	52																			
		20	70	60	48																					
		30	58	46																						
		40	44																							
		50																								
		60																								
Shut-off PSI			58	50	41	32	24	15	6																	
60GS30	3	0				77	70	62	54	45																
		20		74	67	59	51	42																		
		30	73	66	58	50	40																			
		40	65	57	48																					
		50	56	47																						
		60	45																							
Shut-off PSI			86	77	68	60	51	42	34	25																
60GS50	5	0							75	70	65	60	55	49	43											
		20					73	69	64	59	53	47	41													
		30				73	68	63	58	52	47	40														
		40		76	72	67	62	57	52	46	39															
		50	76	71	66	62	56	51	45	38																
		60	70	66	61	55	50	44																		
Shut-off PSI			140	131	123	114	105	97	88	79	71	62	53	45	36											
60GS75	7½	0											78	75	72	69	66	62	59	55	51	47	42			
		20								80	77	74	71	68	65	61	58	54	50	46	41					
		30							80	77	74	71	68	64	61	57	53	49	45	40						
		40						79	76	73	70	67	64	60	56	52	48	44	40							
		50					79	76	73	70	67	63	60	56	52	48	43									
		60				78	76	73	69	66	63	59	55	51	47	43										
Shut-off PSI			224	215	207	198	189	181	172	163	155	146	137	129	120	111	103	94	85	77	68	59	51			

Model 75GS

SELECTION CHART

Horsepower Range 3 – 10, Recommended Range 40 – 100 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																									
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520
75GS30	3	0					80	67	52																			
		20			77	63	47																					
		30		75	61	45																						
		40	73	58	42																							
		50	56	39																								
		60	37																									
Shut-off PSI			77	69	60	51	43	34	25																			
75GS50	5	0							90	83	75	65	55	44														
		20						80	72	62	51	41																
		30					79	70	60	50																		
		40				78	69	59	48																			
		50			77	67	57	47																				
		60		75	66	55	45																					
Shut-off PSI				120	111	102	94	85	76	68	59	50	42	33														
75GS75	7½	0													80	75	68	61	54	47	40							
		20											79	73	66	59	52	45										
		30										78	72	65	58	51	44											
		40									77	71	64	57	50	43												
		50								76	70	63	56	49	42													
		60							75	69	62	55	48	41														
Shut-off PSI									146	137	129	120	111	103	94	85	77	68	59	51	42							
75GS100	10	0												100	97	95	92	88	85	81	76	72	67	62	56	51	45	40
		20										99	96	94	91	87	84	79	75	70	65	60	55	49	44			
		30									99	96	94	91	87	83	79	74	69	64	59	54	48	43				
		40								98	96	93	90	86	82	78	74	69	64	58	53	48	42					
		50							98	95	92	89	86	82	77	73	68	63	57	52	47	41						
		60					100	97	95	92	89	85	81	77	72	67	62	57	51	46	40							
Shut-off PSI			272	263	254	246	237	228	220	211	202	194	185	176	168	159	150	142	133	124	116	107	98	90	81	72	64	55

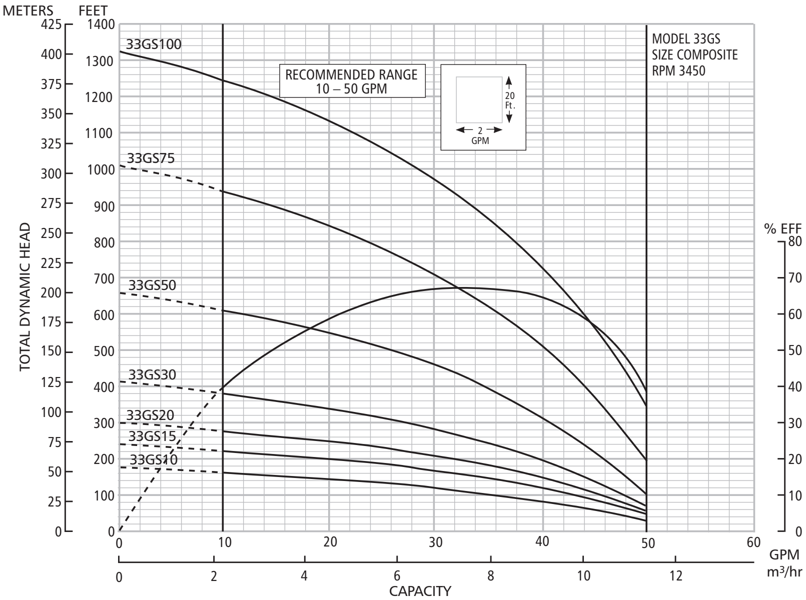
Model 80GS

SELECTION CHART

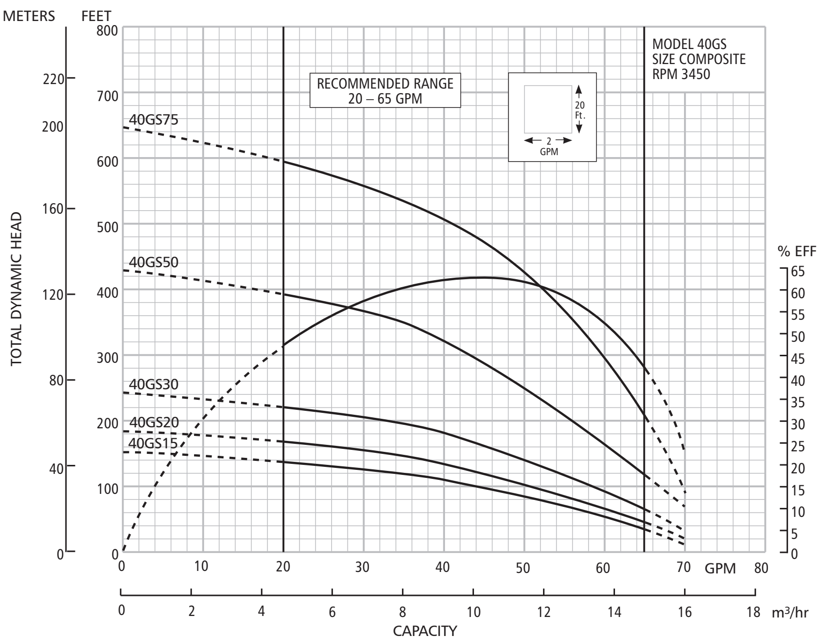
Horsepower Range 3 – 7½, Recommended Range 50 – 120 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																							
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480
80GS30	3	0		114	100	82	63																			
		20	94	77	57																					
		30	74	53																						
		40	50																							
		50																								
		60																								
Shut-off PSI			55	46	38	29	20																			
80GS50	5	0				115	106	98	89	79	68	55														
		20	120	112	104	95	86	75	64	51																
		30	111	102	94	84	74	62																		
		40	101	92	83	72	60																			
		50	91	81	70	58																				
		60	79	69	56																					
Shut-off PSI			107	98	90	81	72	64	55	46	38	29														
80GS75	7½	0						118	113	107	101	95	89	82	75	68	60									
		20			122	117	111	105	100	93	87	80	73	66												
		30		121	116	110	105	99	92	86	79	72	65													
		40	120	115	109	104	98	91	85	78	71	63														
		50	114	109	103	97	90	84	77	70	62															
		60	108	102	96	89	83	76	69	61																
Shut-off PSI			171	162	153	145	136	127	119	110	101	93	84	75	67	58	49									

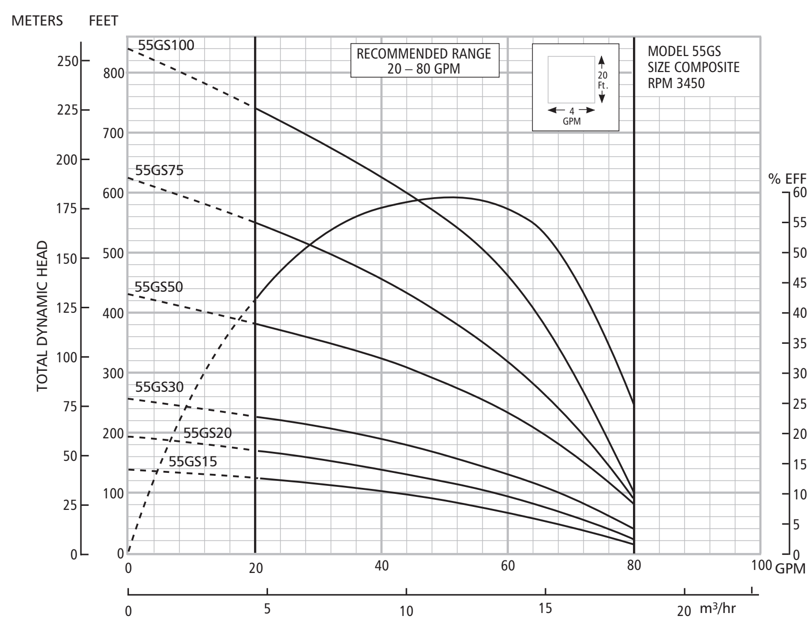
Model 33GS



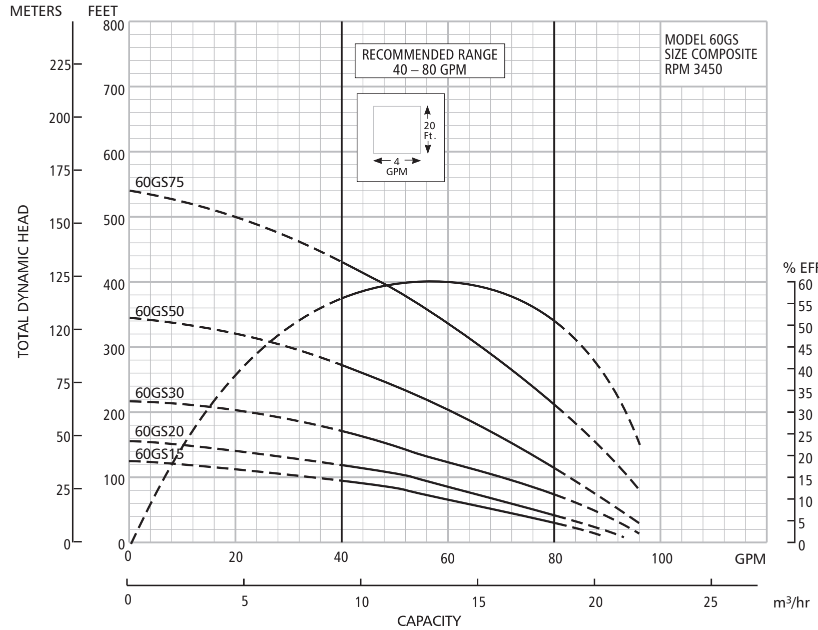
Model 40GS



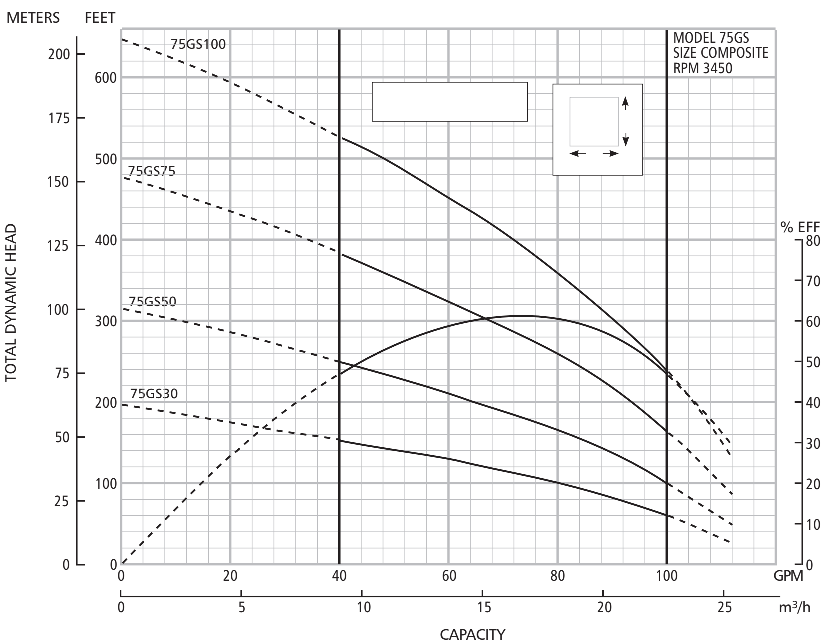
Model 55GS



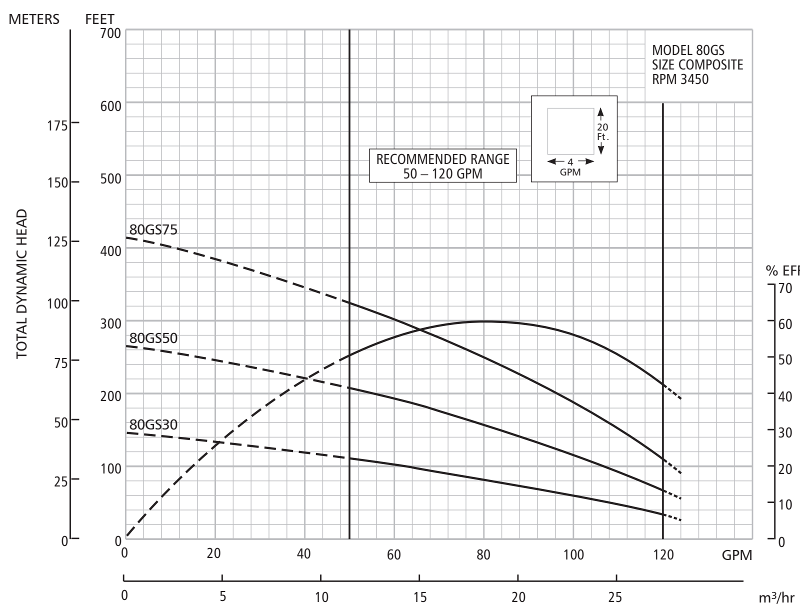
Model 60GS



Model 75GS



Model 80GS



ITT

Residential Water Systems

GOULDS PUMPS

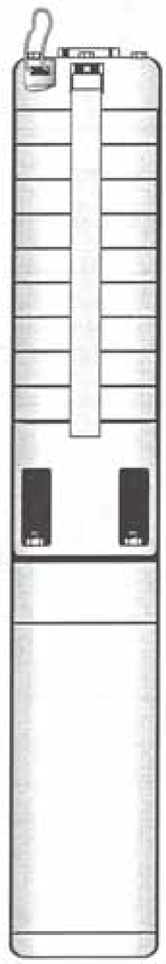
SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

B33-80GS July, 2006

Engineered for life

CS-MW-16-LGR
Pump Specifications

GRUNDFOS



Kits List

4" Submersibles

Contents

Kits List

Tools

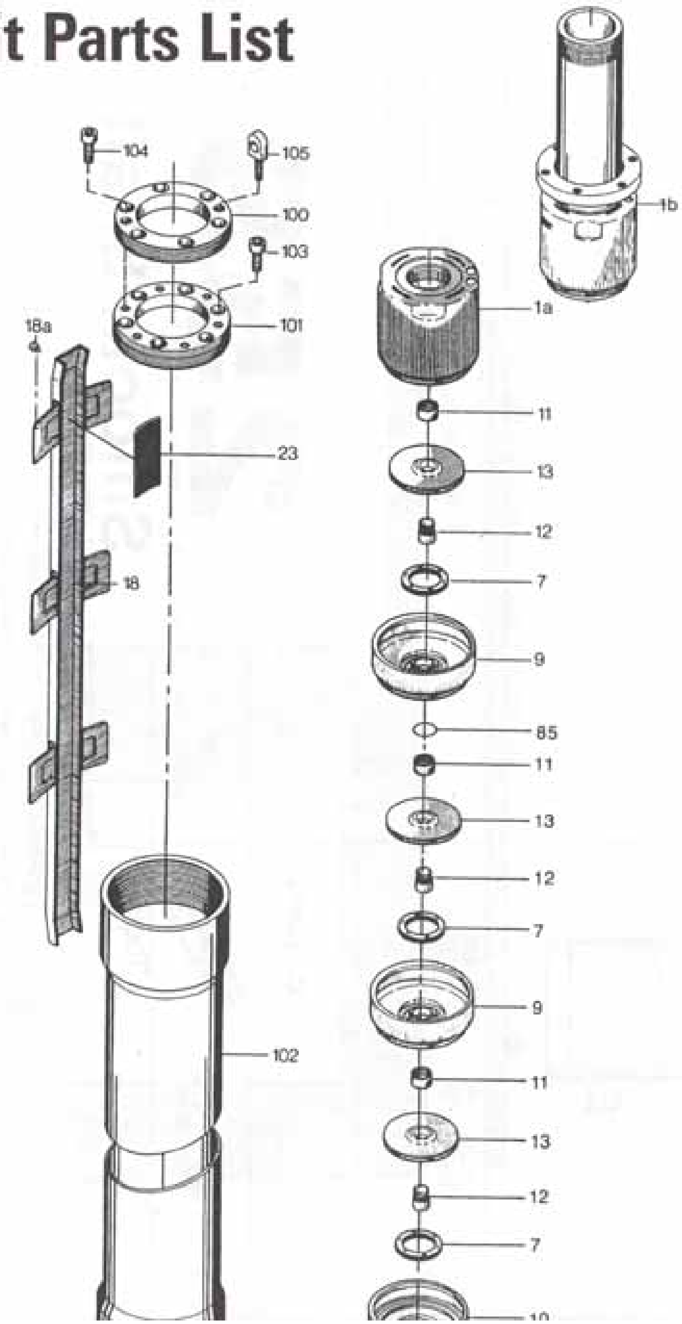
25S

Smooth Shaft

LSP-KL-0055 (Rev. 5/95)

CS-MW-16-CC
Pump Specifications

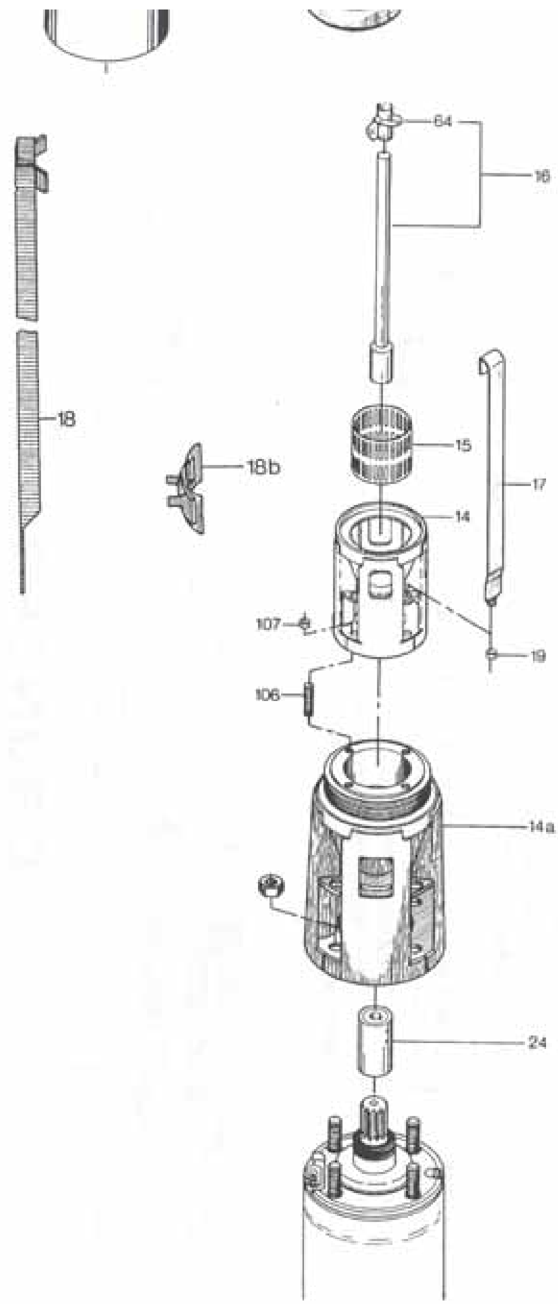
Kit Parts List



25S SMOOTH SHAFT

GRUNDFOS
"Leaders in Pump Technology"

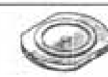
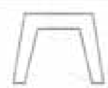
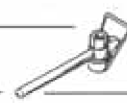
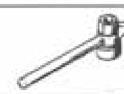
POS.	DESCRIPTION	QTY	PART #	KIT
	INLET/DISCHARGE KIT			
1a	H/P TOP PIECE W/CHECK VALVE	1	105015	***INLET/DISCHARGE KIT***
14	4"X6" INLET	1	115038	***Part No. 05003Z***
10	CHAMBER LOWER INT	1	095004	
15	STRAINER	1	090017	
	INLET/DISCHARGE SLEEVE KIT			
1b	DISCHARGE W /PIPE	1	105020	***INLET/DISCHARGE KIT***
10	CHAMBER LOWER INT.	1	095004	52 STAGES 6" ***Pn. 05004Z***
14a	INLET W/ CONN. PIECE 6"	1	115031	
14	INLET 4"	1	115023	
15	STRAINER	1	090017	
	BEARING KIT			
85	UPTHRUST WASHER	3	100090	***BEARING KIT***
7	SEAL RINGS (NBR)	SEE KIT	095006	39 STAGES ***Pn. 08006Z***
				52 STAGES ***Pn. 08008Z***
	IMPELLER KIT			
13	IMPELLER	SEE KIT	055002	***IMPELLER KIT***
19	NUT FOR STRAP	4	ID7187	39 STAGES ***Pn. 05008Z***
12	SPLIT CONE	SEE KIT	090012	52 STAGES ***Pn. 05009Z***
11	SPLIT CONE NUT	SEE KIT	095515	
	NUT KIT 6"	1	UB9001	
	CHAMBER KIT			
9	INT. CHAMBERS	SEE KIT	055005	***CHAMBER KIT***
19	NUT FOR STRAP	4	ID7187	39 STAGES ***Pn. 05013Z***
10	CHAMBER LOWER INT	1	095004	52 STAGES ***Pn. 05014Z***
	NUT KIT 6"	1	UB9001	
	25S75-39DS STRAP KIT			
17	STRAP	4	099039	***STRAP KIT***
19	NUT FOR STRAP	4	ID7187	***Part No. 08072Z***
18	CABLE GUARD	1	109339	
18b	CABLE GUARD CLIP	1	080509	
	25S100-52DS STRAP KIT			
17	STRAP	4	119026	***STRAP KIT***
19	NUT FOR STRAP	4	ID7187	***Part No.08075Z***
102	SLEEVE	1	108752	
100	TIGHT FLANGE COUNTER	1	110080	
101	TIGHT FLANGE	1	110081	
105	EYE BOLT	1	ID7389	
103/104	ALLEN SCREW	12	ID1368	
18a	CHEESE HD SCREW	6	ID1393	
18	CABLE GUARD	1	109052	



	SHAFT KIT			***SHAFT KIT***
16	25S75-39 SHAFT	1	106439	***Part No. 08044Z***
16	25S100-52DS SHAFT	1	106052	***Part No. 08046Z***
*	NUT KIT	1	UB9011	
24	COUPLING	1	795939	

Special Tool Kits

(Tools not generally available from normal sources)

Part Number	Description	
96022539	**Tool Kit: 5S-75S Model Pumps**	
ID1204	Tool Kit Includes: ALLEN WRENCH 6mm	
SV0006/ SV0007 SV0008 SV0009 SV0011	SHAFT SPACER 39.3mm SHAFT SPACER 38mm SHAFT SPACER 39mm SHAFT SPACER 41mm SHAFT SPACER 77mm	
SV0231 SV00211 SV00261	SHAFT SPACER 76mm SHAFT SPACER 77.5mm SHAFT SPACER 42.5mm	
SV0049	MOUNTING PLATE 4" & 6" MOTORS	
SV0054 SV0055	BOX/OPEN END WRENCH 19mm BOX/OPEN END WRENCH 13mm	
SV0074 SV0183	BOLT FOR SHAFT M8X65mm BOLT FOR SHAFT M8X110mm	
SV0114 SV0115	SHAFT HEIGHT GAUGE 4" MOTOR SHAFT HEIGHT GAUGE 6" MOTOR	
SV0182	SPLIT CONE NUT WRENCH 5S-25S	
SV0187 SV0217	SPLIT CONE NUT WRENCH 40S SPLIT CONE NUT WRENCH 60S-75S	
SV0226	SHAFT SPACER 43mm (SPLINE SHAFT MODELS)	
SV0280	SHAFT BEARING DRIVER KIT	
SV0288	SPECIAL KEY FOR SLEEVE MODELS	
SV0853	STRAP WRENCH	

* All tools may be purchased separately

96022537	TORQUE WRENCH KIT: 5S - 225S MODEL PUMPS (Kit includes three torque wrenches with fittings, range: 4Nm-200Nm)	

GRUNDFOS®

"Leaders in Pump Technology"

Grundfos Pumps Corporation • 2555 Clovis Avenue • Clovis, CA 93612
Regional Centers: Allentown, PA • Atlanta, GA • Chicago, IL • Clovis, CA • Seattle, WA • Dallas, TX
Phone: (800) 333-1366 • **Fax:** (800) 333-1363
Canada: Mississauga, Ontario • **Mexico:** Apodaca, N.L.

Motors
4-6-8-10"

CONTENTS

HP	Kw	Voltage	Service Factor	AMPERAGE Full Load*	Service Factor	Locked Rotor	Eff. %	Power Factor	Line-to-Line Resistance Black-Yellow	Red-Yellow	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.

4 Inch (Two Wire) Motors - *Control Box Not Required*

SINGLE PHASE

HP	Kw	Voltage	Service Factor	Full Load*	Service Factor	Locked Rotor	Eff. %	Power Factor	Black-Yellow	Red-Yellow	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.
1/3	.25	230	1.75	2.6	4.6	25.7	59	0.77	6.8-8.2		S	900	79952101	96465614
1/2	.37	115	1.60	7.5	12	55	62	0.76	1.1-1.3		R	900	79922102	96465574
		230	1.60	3.8	6	34.5	62	0.76	5.2-6.3		R	900	79952102	96465616
3/4	.55	230	1.50	5.6	8.4	40.5	62	0.75	3.2-3.8		N	900	79952103	96465618
1	.75	230	1.40	7.0	9.8	48.4	63	0.82	2.5-3.1		M	900	79952104	96465620
1 1/2	1.1	230	1.30	10.1	13.1	62	64	0.85	1.9-2.3		L	900	79952105	96465622

4 Inch (Three Wire) Motors

SINGLE PHASE

HP	Kw	Voltage	Service Factor	Full Load*	Service Factor	Locked Rotor	Eff. %	Power Factor	Black-Yellow	Red-Yellow	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.
1/3	.25	115	1.75	5.1	9	29	59	0.77	1.55-1.9	2.4-3	M	900	79423101	96465571
		230	1.75	2.6	4.6	14	59	0.77	6.8-8.3	17.3-21.1	L	900	79453101	96465603
1/2	.37	115	1.60	7.5	12	42.5	61	0.76	.9-1.1	1.9-2.35	L	900	79423102	96023039
		230	1.60	3.8	6	21.5	62	0.76	4.7-5.7	15.8-19.6	L	900	79453102	96465606
3/4	.55	230	1.50	5.6	8.4	31.4	62	0.75	3.2-3.9	14-17.2	L	900	79453103	96465608
1	.75	230	1.40	7.0	9.8	37	63	0.82	2.6-3.1	10.3-12.5	K	900	79453104	96465610
1 1/2	1.1	230	1.30	8.9	11.6	45.9	69	0.89	1.9-2.3	7.8-9.6	H	900	79453105	96465612
2	1.5	230	1.25	10.6	13.2	57	72	0.86	1.5-1.8	3.4-4.1	G	1500	79454506	96449947
3	2.2	230	1.15	14.8	17	77	74	0.93	1.2-1.4	2.45-3	F	1500	79454507	96449948
5	3.7	230	1.15	23.9	27.5	110	77	0.92	.65-.85	2.1-2.6	F	1500	79454509	96449949

4 Inch Motors

THREE PHASE

HP	Kw	Voltage	Service Factor	Full Load*	Service Factor	Locked Rotor	Eff. %	Power Factor	Black-Yellow	Red-Yellow	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.
1/2	.37	208	1.60	2.2	3.5	24.5	70	0.87	2.24		N	900	79322002	96465633
		230	1.60	2.0	3.15	15.7	69	0.72	8.1		N	900	79302002	96465624
		460	1.60	1.0	1.6	7.85	69	0.72	6.92		N	900	79362002	96465638
3/4	.55	208	1.50	3.4	5.1	24.5	69	0.7	4.6		N	900	79322003	96465634
		230	1.50	3.1	4.6	22.3	69	0.7	5.7		N	900	79302003	96465626
		460	1.50	1.5	2.3	11.2	69	0.7	23.2		N	900	79362003	96465639
1	.75	208	1.40	4.3	6	30	71	0.73	3.72		M	900	79322004	96465635
		230	1.40	3.9	5.4	27	71	0.73	4.7		M	900	79302004	96465627
		460	1.40	1.9	2.7	13.5	71	0.73	19		M	900	79362004	96465650
1 1/2	1.1	208	1.30	6.2	8.1	44.6	75	0.72	2.68		M	900	79322005	96465636
		230	1.30	5.6	7.3	40.3	75	0.72	3.12		M	900	79302005	96465629
		460	1.30	2.8	3.7	20.1	75	0.72	15.9		K	900	79362005	96465651
		575	1.30	2.2	2.9	16.1	75	0.72	25.2		K	900	79392005	–
2	1.5	208	1.25	7.7	9.6	53	77	0.75	1.9		L	900	79322006	96465637
		230	1.25	7.0	8.7	48	76	0.75	3		J	900	79302006	96465630
		460	1.25	3.5	4.4	24	76	0.75	12.1		J	900	79362006	96465652
		575	1.25	2.8	3.5	19.2	76	0.75	18.8		J	900	79392006	–
3	2.2	208	1.00	10.8	10.8	–	89	0.84	2.12		–	1500	79324507	96405806
		208/230	1.15	10.6	12.2	56	77	0.75	2.2		H	1500	79304507	96405801
		460	1.15	5.3	6.1	28	77	0.75	9		H	1500	79354507	96405810
		575	1.15	4.2	4.8	22	77	0.75	13		H	1500	79395507	–
5	3.7	208	1.15	18.1	20.8	–	80	0.82	1.2		–	1500	79324509	96405807
		208/230	1.15	17.2	19.8	108	80	0.82	1.2		H	1500	79304509	96405802
		440/460	1.15	8.6	9.9	54	80	0.82	5		H	1500	79354509	96405811
		575	1.15	6.9	7.9	54	80	0.82	7.3		H	1500	79394509	–
7 1/2	5.5	208/230	1.15	21.7	25	130	81	0.82	0.84		H	1500	79305511	96405805
		440/460	1.15	11.1	12.8	67	81	0.82	3.24		J	1500	79355511	96405814
		575	1.15	9.2	10.6	53	81	0.82	5.2		J	1500	79395511	–
10	7.5	440/460	1.15	15.7	18	90	81	0.80	1.16		H	1500	79355512	96440318
		575	1.15	12.5	14.4	72	81	0.80	1.84		H	1500	79395512	–

*This is a calculated value.

HP	Kw	Voltage	FUSE(5) Fast Acting	FUSE(5) Time Delay	Circuit Breaker	NEMA Starter Size	IEC Starter Size	OVERLOADS Cutler Hammer (1)	OVERLOADS Allen Bradley (2)	OVERLOADS General Electric (3)	OVERLOADS Siemens (4)

4 Inch (Two Wire) Motors - *Control Box Not Required*

SINGLE PHASE

HP	Kw	Voltage	Fast Acting	Time Delay	Circuit Breaker	NEMA Starter Size	IEC Starter Size	Cutler Hammer (1)	Allen Bradley (2)	General Electric (3)	Siemens (4)
1/3	.25	230	8	5	10	–	–	–	–	–	–
1/2	.37	115	25	15	20	–	–	–	–	–	–
		230	15	7	10	–	–	–	–	–	–
3/4	.55	230	20	10	15	–	–	–	–	–	–
1	.75	230	25	12	20	–	–	–	–	–	–
1 1/2	1.1	230	30	20	25	–	–	–	–	–	–

4 Inch (Three Wire) Motors

SINGLE PHASE

HP	Kw	Voltage	Fast Acting	Time Delay	Circuit Breaker	NEMA Starter Size	IEC Starter Size	Cutler Hammer (1)	Allen Bradley (2)	General Electric (3)	Siemens (4)
1/3	.25	115	15	9	15	–	–	–	–	–	–
		230	8	5	10	–	–	–	–	–	–
1/2	.37	115	25	15	20	–	–	–	–	–	–
		230	15	7	10	–	–	–	–	–	–
3/4	.55	230	20	10	15	–	–	–	–	–	–
1	.75	230	25	12	20	–	–	–	–	–	–
1 1/2	1.1	230	30	20	25	–	–	–	–	–	–
2	1.5	230	35	20	30	–	–	–	–	–	–
3	2.2	230	45	30	40	–	–	–	–	–	–
5	3.7	230	70	45	60	–	–	–	–	–	–

4 Inch Motors

THREE PHASE

HP	Kw	Voltage	Fast Acting	Time Delay	Circuit Breaker	NEMA Starter Size	IEC Starter Size	Cutler Hammer (1)	Allen Bradley (2)	General Electric (3)	Siemens (4)
1/2	.37	208	7	4	10	00	A	H2106B-3	J12	255A	K26
		230	6	3	10	00	A	H2106B-3	J11	232A	K24
		460	3	2	10	00	A	104	J4	193A	K21
3/4	.55	208	10	6	10	00	A	108	J17	420A	K32
		230	9	5	10	00	A	107	J16	380A	K29
		460	5	3	10	00	A	105	J8	174A	K21
1	.75	208	15	8	15	00	A	108	J19	510A	K34
		230	15	7	10	00	A	108	J18	463A	K33
		460	6	3	10	00	A	105	J10	232A	K23
1 1/2	1.1	208	20	15	20	00	A	109	J23	750A	K41
		230	20	10	15	00	A	109	J22	680A	K39
		460	9	5	10	00	A	107	J15	343A	K28
		575	7	4	10	00	A	106	J12	255A	K26
2	1.5	208	25	15	20	0	B	110	J25	910A	K43
		230	20	15	20	0	B	109	J24	825A	K43
		460	10	6	10	00	A	108	J17	420A	K32
		575	8	5	10	00	A	107	J15	343A	K28
3	2.2	208	40	25	35	0	C	111	J30	147B	K56
		208/230	35	20	30	0	C	110	J28	122B	K53
		460	20	9	15	0	A	109	J21	618A	K37
		575	15	7	10	0	A	108	J19	510A	K34
5	3.7	208	60	35	45	1	D	112	J34	220B	K61
		208/230	50	30	45	1	D	112	J33	199B	K60
		440/460	30	15	25	0	B	110	J26	100B	K50
		575	25	15	20	0	A	109	J24	825A	K43
7 1/2	5.5	208/230	65	40	60	1	E	112	J36	265B	K64
		440/460	35	20	30	1	C	111	J29	135B	K54
		575	30	20	25	1	B	110	J27	111B	K50
10	7.5	440/460	50	30	40	1	D	112	J32	181B	K60
		575	40	25	35	1	C	111	J30	147B	K56

Notes:

(1) These overloads are for both NEMA and IEC Freedom series starters by EATON Cutler-Hammer. The complete part number is H2_B-3. This information was collected from EATON Cutler-Hammer catalog number CA08102001E.

(2) These overload heater coils are for the Allen Bradley Bulletin 509 Starter. This information was collected from the Allen Bradley catalog number A115-CA001A-EN-P.

(3) These overloads are designed for use with GE NEMA starters. Complete part numbers are CR123L____. For use with GE CR124 single element overloads. This information was collected from page 1-107 of the Control Catalog, Rev. 07/03.

(4) These overloads are designed for Siemens NEMA Overload Relays. This information was collected from page 8/151 of the 2006 Siemens Industrial Control Catalog.

(5) The Fuses and Circuit Breakers were calculated from the NEC table 430.52.

Starters and overloads should always be sized by a licensed electrician that is familiar with local codes and standards. The overloads for submersible motors should be Class 10 Quick trip ambient compensated.

HP	Kw	Voltage	Service Factor	AMPERAGE Calculated Full Load	AMPERAGE Service Factor	AMPERAGE Locked Rotor	Eff %	Power Factor	Line-to-Line Resistance Black-Yellow	Line-to-Line Resistance Red-Yellow	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.

6 Inch (Three Wire) Motors

THREE PHASE

HP	Kw	Voltage	Service Factor	Calculated Full Load	Service Factor	Locked Rotor	Eff %	Power Factor	Black-Yellow	Red-Yellow	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.
7 1/2	5.5	208/230	1.15	23.9/23.9	27.5/27.5	118.3/132	80.5	0.76	0.56		H	1500	78305511	96405781
		440/460	1.15	11.5	13.2/13.2	56.8/59.4	80.5	0.76	2.4		G	1500	78355511	96405794
		575	1.15	9.2	10.6	48	80.5	0.76	4.07		H	1500	78395511	–
10	7.5	208/230	1.15	31.7/30.9	36.5/35.5	153.3/170.4	82.5	0.79	0.41		H	1500	78305512	96405782
		440/460	1.15	15.1/14.8	17.4/17	74.8/78.2	82	0.79	1.8		G	1500	78355512	96405795
		575	1.15	11.8	13.6	63	82	0.79	3.1		G	1500	78395512	–
15	11	208/230	1.15	47/43.9	54/50.5	232.2/252.5	82.5	0.82	0.25		H	7000	78305514	96405783
		440/460	1.15	22.2/21.3	25.5/24.5	109.7/115.2	82.5	0.82	1.16		G	7000	78355514	96405796
		575	1.15	17.0	19.6	92	82.5	0.82	1.9		G	7000	78395514	–
20	15	208/230	1.15	60.9/58.7	70/67.5	329/364.5	84	0.81	0.2		J	7000	78305516	96405784
		440/460	1.15	29.1/28.7	33.5/33	164.2/171.6	84	0.82	0.8		H	7000	78355516	96405797
		575	1.15	23.0	26.4	137	84	0.82	1.32		H	7000	78395516	–
25	18.5	208/230	1.15	76.5/74.3	88/85.5	431.2/470.3	84.5	0.80	0.156		J	7000	78305517	96405785
		440/460	1.15	36.5/35.7	42/41	210/217.3	84.5	0.80	0.62		H	7000	78355517	96405798
		575	1.15	28.7	33	175	84.5	0.80	1.04		H	7000	78395517	–
30	22	208/230	1.15	87.8/84.3	101/97	464.6/514.1	85	0.83	0.13		H	7000	78305518	96405786
		440/460	1.15	41.7/40.4	48/46.5	225.6/237.2	85	0.83	0.55		G	7000	78355518	96405799
		575	1.15	32.2	37	189	84.5	0.83	0.92		G	7000	78395518	–
40	30	440/460	1.15	57.8/55.7	66.5/64	305.9/320	64	0.82	0.39		H	7000	78355520	96405800

*This is a calculated value.

HP	Kw	Voltage	FUSE(5) Fast Acting	FUSE(5) Time Delay	Circuit Breaker	NEMA Starter Size	IEC Starter Size	OVERLOADS Cutler Hammer (1)	OVERLOADS Allen Bradley (2)	OVERLOADS General Electric (3)	OVERLOADS Siemens (4)

6 Inch (Three Wire) Motors

THREE PHASE

HP	Kw	Voltage	Fast Acting	Time Delay	Circuit Breaker	NEMA Starter Size	IEC Starter Size	Cutler Hammer (1)	Allen Bradley (2)	General Electric (3)	Siemens (4)
7 1/2	5.5	208/230	70	45	60	1	E	113	J36	293B	K64
		440/460	35	20	30	1	C	111	J29	135B	K55
		575	30	18	30	1	B	110	J27	111B	K50
10	7.5	208/230	90	60	80	2	F	114	J39	352B	K70
		440/460	45	30	40	1	D	112	J32	181B	K58
		575	35	20	30	1	C	111	J29	147B	K55
15	11	208/230	150	90	125	2	H	116	J42	593B	K75
		440/460	70	40	60	2	E	113	J35	265B	K63
		575	50	30	50	2	D	112	J33	199B	K60
20	15	208/230	200	110	150	3	J	117	J44	710B	K77
		440/460	90	50	80	2	F	114	J38	352B	K69
		575	70	40	60	2	E	113	J36	265B	K64
25	18.5	208/230	225	150	200	3	K	–	J70	950B	K85
		440/460	110	65	100	2	G	115	J39	464B	K72
		575	90	50	80	2	F	114	J38	352B	K69
30	22	208/230	300	150	225	3	L	–	J71	107C	K87
		440/460	125	75	110	3	H	–	J42	464B	K72
		575	100	55	80	3	G	–	J39	352B	K70
40	30	440/460	175	100	150	3	J	–	J44	710B	K77

Notes:

(1) These overloads are for both NEMA and IEC Freedom series starters by EATON Cutler-Hammer. The complete part number is H2_B-3. This information was collected from EATON Cutler-Hammer catalog number CA08102001E.

(2) These overload heater coils are for the Allen Bradley Bulletin 509 Starter. This information was collected from the Allen Bradley catalog number A115-CA001A-EN-P.

(3) These overloads ae designed for use with GE NEMA starters. Complete part numbers are CR123L____. For use with GE CR124 single element overloads. This information was collected from page 1-107 of the Control Catalog, Rev. 07/03.

(4) These overloads are designed for Siemens NEMA Overload Relays. This information was collected from page 8/151 of the 2006 Siemens Industrial Control Catalog.

(5) The Fuses and Circuit Breakers were calculated from the NEC table 430.52.

Starters and Overloads should always be sized by a licensed electrician that is familiar with local codes and standards. The Overloads for submersible motors should be Class 10 Quick trip ambient compensated.

HP	Kw	Voltage	Service Factor	AMPERAGE Full Load*	Service Factor	Locked Rotor	Eff %	Power Factor	Line-to-Line Resistance	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.

4 Inch Industrial Motors

THREE PHASE

HP	Kw	Voltage	Service Factor	Full Load*	Service Factor	Locked Rotor	Eff %	Power Factor	Line-to-Line Resistance	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.
3	2.2	230	1.15	9.9	11.4	–	78	0.81	2.08	J	1500	79305807	96415732
		460	1.15	5.0	5.7	–	78	0.81	8.00	J	1500	79355807	96415734
		575	1.15	4.0	4.55	–	78	0.81	12.00	J	1500	79395807	96415736
5	3.7	230	1.15	15.7	18	–	80.5	0.82	1.12	K	1500	79305809	96415733
		460	1.15	7.9	9.05	–	80.5	0.83	4.20	K	1500	79355809	96415735
		575	1.15	6.5	7.5	–	80.5	0.83	6.40	K	1500	79395809	96415737

6 Inch (Three Wire) Industrial Motors

THREE PHASE

HP	Kw	Voltage	Service Factor	Full Load*	Service Factor	Locked Rotor	Eff %	Power Factor	Line-to-Line Resistance	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.
7 1/2	5.5	230	1.15	23.9	27.5	457.25	77.5	0.82	0.477	K	4400	78305311	96415738
		460	1.15	12.0	13.8	81.42	78	0.82	1.833	K	4400	78195811	96415744
10	7.5	230	1.15	30.4	35	206.5	81.5	0.86	0.393	J	4400	78305312	96415739
		460	1.15	15.3	17.6	103.84	81.5	0.86	1.493	K	4400	78195812	96415745
15	11	230	1.15	44.3	51	244.8	82.5	0.86	0.27	G	4400	78305314	96415740
		460	1.15	22.2	25.5	122.4	82	0.86	1.067	H	4400	78195814	96415746
20	15	230	1.15	60.4	69.5	403.1	84	0.86	0.17	J	4400	78305316	96415741
		460	1.15	30.0	34.5	200.1	83.5	0.86	0.657	K	4400	96415747	96415747
25	18.5	230	1.15	72.2	83	473.1	84.5	0.86	0.143	J	4400	78305317	96415742
		460	1.15	36.1	41.5	236.55	84.5	0.86	0.553	J	4400	78195817	96415748
30	22	230	1.15	86.5	99.5	557.2	84	0.86	0.116	H	4400	78305318	96415743
		460	1.15	43.5	50	280	84	0.86	0.483	J	4400	78195818	96415749

*This is a calculated value.

HP	Kw	Voltage	FUSE(5) Fast Acting	FUSE(5) Time Delay	Circuit Breaker	NEMA Starter Size	IEC Starter Size	OVERLOADS Cutler Hammer Overload (1)	OVERLOADS Allen Bradley (2)	OVERLOADS General Electric (3)	OVERLOADS Siemens (4)

4 Inch Motors Industrial Motors

THREE PHASE

3	2.2	230	30	17	25	0	C	110	J28	122B	K52
		460	15	9	15	0	C	109	J21	618A	K37
		575	12	7	10	0	A	108	J18	463A	K33
5	3.7	230	50	30	40	1	D	112	J32	181B	K60
		460	25	15	20	1	D	110	J25	910A	K49
		575	20	11	20	0	B	109	J23	750A	K42

6 Inch (Three Wire) Industrial Motors

THREE PHASE

7 1/2	5.5	230	75	45	60	1	E	114	J36	293B	K64
		460	40	25	30	1	C	111	J30	147B	K55
10	7.5	230	100	60	80	2	F	114	J38	352B	K70
		460	50	30	40	1	D	112	J32	181B	K60
15	11	230	140	80	125	2	H	116	J42	520B	K76
		460	65	40	60	2	E	113	J35	265B	K64
20	15	230	200	110	150	3	J	117	J44	710B	K77
		460	90	60	80	2	F	114	J38	352B	K69
25	18.5	230	225	150	200	3	K	117	J46	866B	K83
		460	110	70	90	2	G	115	J40	464B	K72
30	22	230	275	150	225	3	L	-	J71	107C	K87
		460	130	80	125	3	H	-	J41	520B	K75

Notes:

(1) These overloads are for both NEMA and IEC Freedom series starters by EATON Cutler-Hammer. The complete part number is H2_B-3. This information was collected from EATON Cutler-Hammer catalog number CA08102001E.

(2) These overload heater coils are for the Allen Bradley Bulletin 509 Starter. This information was collected from the Allen Bradley catalog number A115-CA001A-EN-P.

(3) These overloads ae designed for use with GE NEMA starters. Complete part numbers are CR123L____. For use with GE CR124 single element overloads. This information was collected from page 1-107 of the Control Catalog, Rev. 07/03.

(4) These overloads are designed for Siemens NEMA Overload Relays. This information was collected from page 8/151 of the 2006 Siemens Industrial Control Catalog.

(5) The Fuses and Circuit Breakers were calculated from the NEC table 430.52.

Starters and Overloads should always be sized by a licensed electrician that is familiar with local codes and standards. The Overloads for submersible motors should be Class 10 Quick trip ambient compensated.

HP	Kw	Voltage	Service Factor	AMPERAGE Full Load	AMPERAGE Service Factor	AMPERAGE Locked Rotor	Eff %	Power Factor	Line-to-Line Resistance	KVA Code	Max. Thrust	Nameplate Number	GRUNDFOS MATERIAL NO.

6 Inch (460V) Motors

THREE PHASE

50	37	460	1.15	68.7	79	470	84	0.83	0.378	G	13000	96476890	96023200

8 Inch (460V) Motors

THREE PHASE

40	30	460	1.15	55.7	64	380	83	0.85	0.35	K	13000	96530180	96023204
50	37	460	1.15	67.8	78	550	84	0.85	0.25	J	13000	96530182	96023205
60	45	460	1.15	80.4	92.5	640	86	0.85	0.18	K	13000	96476891	96023206
75	55	460	1.15	97.4	112	580	86	0.86	0.15	J	13000	96476892	96023207
100	75	460	1.15	130.4	150	570	87	0.86	0.13	J	13000	96476893	96023208
125	92	460	1.15	160.0	184	600	87	0.87	0.09	J	13000	96476894	96023209
150	110	460	1.15	191.3	220	580	86	0.87	0.08	J	13000	96511375	96023210

10 Inch (460V) Motors

THREE PHASE

100	75	460	1.15	133.9	154	570	87	0.84	0.092	J	13000	–	96023211
125	92	460	1.15	165.2	190	550	87	0.83	0.7	J	13000	96540300	96023212
150	110	460	1.15	194.8	224	580	88	0.84	0.055	J	13000	96540301	96023213
175	132	460	1.15	230.4	265	570	88	0.85	0.045	J	13000	96521619	96023214
200	147	460	1.15	265.2	305	620	87	0.82	0.04	K	13000	96540302	96023215
250	190	460	1.15	352.2	405	610	87	0.79	0.033	K	13000	96463669	96023217

*This is a calculated value.

			FUSE					OVERLOADS			
HP	Kw	Voltage	Standard	Time Delay	Circuit Breaker	NEMA Size	IEC Size	Cutler Hammer (1)	Allen Bradley (2)	General Electric (3)	Siemens (4)

6 Inch (460V) Motors

THREE PHASE

50	37	460	225	125	175	3	N	117	J46	866B	K83

8 Inch (460V) Motors

THREE PHASE

40	30	460	175	100	150	3	N	117	J43	710B	K76
50	37	460	225	125	175	3	–	117	J46	866B	K83
60	45	460	250	150	200	4	–	105	J70	950B	K86
75	55	460	300	175	250	4	–	105	J72	107C	K88
100	75	460	400	225	350	4	–	106	J75	155C	K92
125	92	460	500	300	400	5	–	107	J14	100B	K94
150	110	460	600	350	500	5	–	107	J16	111B	K96

10 Inch (460V) Motors

THREE PHASE

100	75	460	400	250	350	4	–	106	J75	155C	K92
125	92	460	500	300	400	5	–	107	J15	100B	K96
150	110	460	600	350	500	5	–	107	J17	122B	–
175	132	460	700	400	600	5	–	108	J18	135B	–
200	147	460	800	500	700	5	–	108	J20	165B	–
250	190	460	1100	600	1000	6	–	107	J14	–	–

Notes:

(1) These overloads are for both NEMA and IEC Freedom series starters by EATON Cutler-Hammer. The complete part number is H2___B-3. This information was collected from EATON Cutler-Hammer catalog number CA08102001E.

(2) These overload heater coils are for the Allen Bradley Bullitin 509 Starter. This information was collected from the Allen Bradley catalog number A115-CA001A-EN-P.

(3) These overloads are designed for use with GE NEMA starters. Complete part numbers are CR123L_ _ _ _. For use with GE CR124 single element overloads. This information was collected from page 1-107 of the Control Catalog Rev. 07/03.

(4) These overloads are designed for Siemens NEMA Overload Relays. This information was collected form page 8/151 of the 2006 Siemens Industrial Control Catalog.

(5) The Fuses and Circuit Breakers were calculated from the NEC table 430.52.

Starters and Overloads should always be sized by a licensed electrician that is familiar with local codes and standards.
The Overloads for submersible motors should be Class 10 Quick trip Ambient compensated.

Generator Sizing

HP	Kw	KVA
1/3	1.5	1.9
1/2	2	2.5
3/4	3	3.8
1	4	4.8
1 1/2	5.9	7
2	7	9
3	10	12
5	15	18.75
7 1/2	25	33
10	35	31.5
15	49	60
20	66	81
25	82	102
30	96	116
40	125	153
50	138	162
60	163	192
75	200	233
100	269	320
125	382	461
150	456	543
175	546	642
200	606	740
250	776	982

Notes:
These values were calculated by using the following formulas:

Single Phase: (3 X FLA)V X PF/1000

Three phase through 100 HP:
(3 X FLA) V X PF X1.73/1000

Three phase 125 and above:
(3.5 X FLA) V X PF X1.73/1000

This is a guide. The generator manufacturer should be asked to assist in sizing all generators.

Transformer Capacity

Required for Three-Phase Motors

Submersible Three- Phase Motor HP Rating	Total Effective KVA Required *	Smallest KVA Rating — Each Transformer	
		Open WYE or DELTA 2 Transformers	WYE or DELTA 3 Transformers
1.5	3 **	2	1
2	4 **	2	1.5
3	5 **	3	2
5	7.5 **	5	3
7.5	10 **	7.5	5
10	15 **	10	5
15	20 **	15	7.5
20	25	15	10
25	30	20	10
30	40	25	15
40	50	30	20
50	60	35	20
60	75	40	25
75	90	50	30
100	120	65	40
125	150	85	50
150	175	100	60
175	200	115	70
200	230	130	75

* Pump motor KVA requirements only -- does not include allowances for other loads
** This is also the KVA required for single phase motors

Motor Cooling

(refer to page 12 of the Troubleshooting section of this Service Manual)

Total Resistance of Drop Cable

(refer to page 16 of the Troubleshooting section of this Service Manual)

Motor Service to Entrance

SINGLE PHASE 60 HZ

Motor Rating		Copper Wire Size												
VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300
115	1/3	130	210	340	540	840	1300	1960	2910					
	1/2	100	160	250	390	620	960	1460	2160					
230	1/3	550	880	1390	2190	3400	5250	7960						
	1/2	400	650	1020	1610	2510	3880	5880						
	3/4	300	480	760	1200	1870	2890	4370	6470					
	1	250	400	630	990	1540	2380	3610	5360	6520				
	1 1/2	190	310	480	770	1200	1870	2850	4280	5240				
	2	150	250	390	620	970	1530	2360	3620	4480				
	3	120	190	300	470	750	1190	1850	2890	3610				
	5			180	280	450	710	1110	1740	2170				
	7 1/2				200	310	490	750	1140	1410				
	10					250	390	600	930	1160				

THREE PHASE 60 HZ

VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300
208	1 1/2	310	500	790	1260									
	2	240	390	610	970	1520								
	3	180	290	470	740	1160	1810							
	5		170	280	440	690	1080	1660						
	7 1/2			200	310	490	770	1180	1770					
	10				230	370	570	880	1330	1640				
	15					250	390	600	910	1110	1340			
	20						300	460	700	860	1050	1270		
	25							370	570	700	840	1030	1170	
	30							310	470	580	700	850	970	1110
230	1 1/2	360	580	920	1450									
	2	280	450	700	1110	1740								
	3	210	340	540	860	1340	2080							
	5		200	320	510	800	1240	1900						
	7 1/2			230	360	570	890	1350	2030					
	10				270	420	660	1010	1520	1870				
	15					290	450	690	1040	1280	1540			
	20						350	530	810	990	1200	1450		
	25						280	430	650	800	970	1170	1340	
	30							350	540	660	800	970	1110	1270
460	1 1/2	1700												
	2	1300	2070											
	3	1000	1600	2520										
	5	590	950	1500	2360									
	7 1/2	420	680	1070	1690	2640								
	10	310	500	790	1250	1960	3050							
	15			540	850	1340	2090	3200						
	20			410	650	1030	1610	2470	3730					
	25				530	830	1300	1990	3010	3700				
	30				430	680	1070	1640	2490	3060	3700			
	40						790	1210	1830	2250	2710	3290		
	50						640	980	1480	1810	2190	2650	3010	
	60							830	1250	1540	1850	2240	2540	2890
	75								1030	1260	1520	1850	2100	2400
	100									940	1130	1380	1560	1790
	125											1080	1220	1390
	150												1050	1190
	200												1080	1300
	250													1080
575	1 1/2	2620												
	2	2030												
	3	1580	2530											
	5	920	1480	2330										
	7 1/2	660	1060	1680	2650									
	10	490	780	1240	1950									
	15		530	850	1340	2090								
	20			650	1030	1610	2520							
	25			520	830	1300	2030	3110						
	30				680	1070	1670	2560	3880					
	40					790	1240	1900	2860	3510				
	50						1000	1540	2310	2840	3420			
	60						850	1300	1960	2400	2890	3500		
	75							1060	1600	1970	2380	2890	3290	
	100								1190	1460	1770	2150	2440	2790

FOOTNOTES:

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

Please Note:

For Franklin motor specifications, refer to Franklin's Submersible Motor Application • Installation • Maintenance • Manual

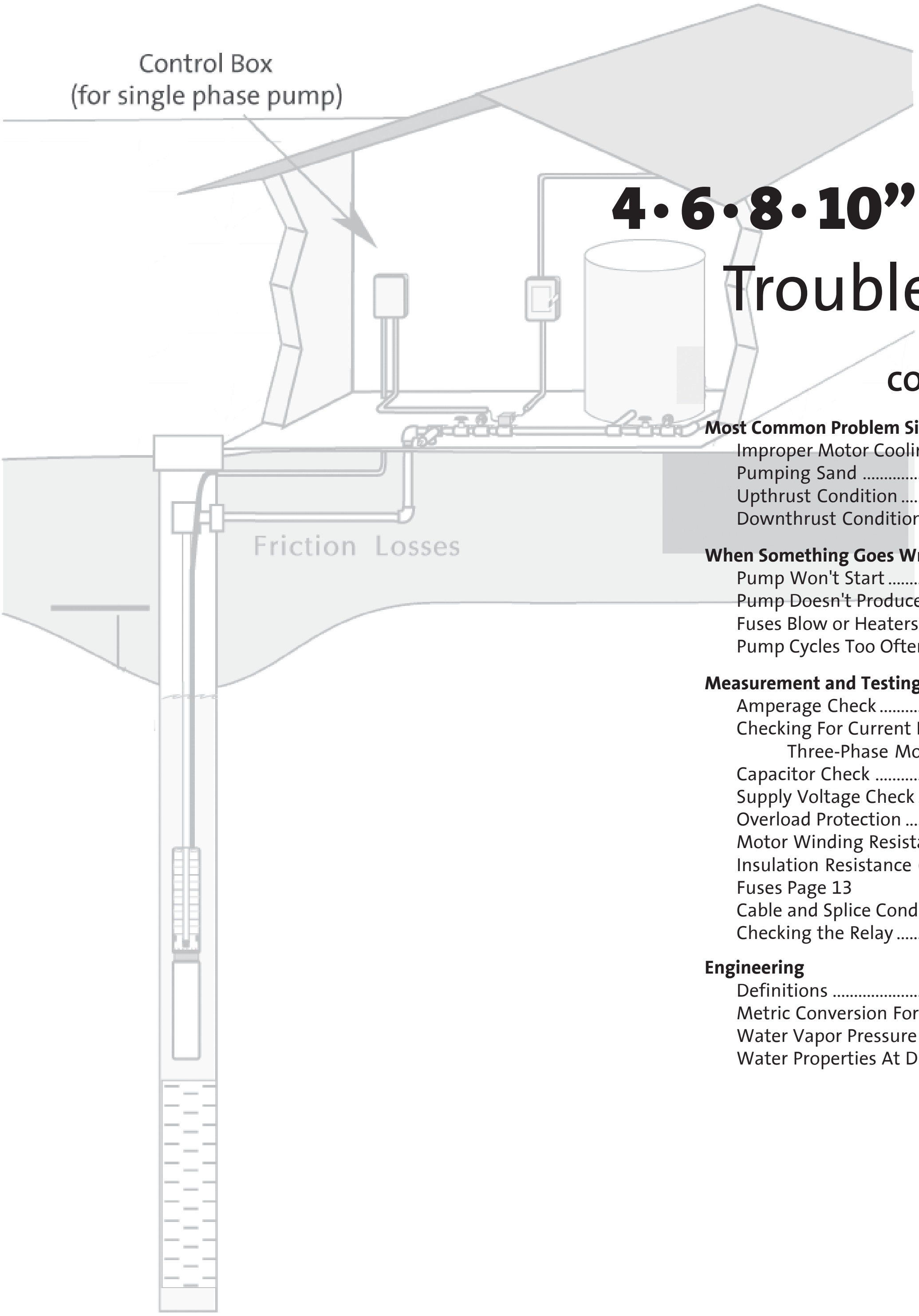
LSP-TL-010 Rev. 12/06
PRINTED IN USA

GRUNDFOS Pumps Corporation
17100 W. 118th Terrace
Olathe, Kansas 66062
Phone: 913.227.3400
Fax: 913.227.3500

www.grundfos.com

GRUNDFOS Canada, Inc.
2941 Brighton Road
Oakville, Ontario L6H 6C9 Canada
Phone: 905.829.9533
Fax: 905.829.9512

Bombas GRUNDFOS de Mexico S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. Mexico 66600
Phone: 52.81.8144.4000
Fax: 52.81.8144.4010



4•6•8•10" Submersibles
Troubleshooting

CONTENTS

Most Common Problem Situations

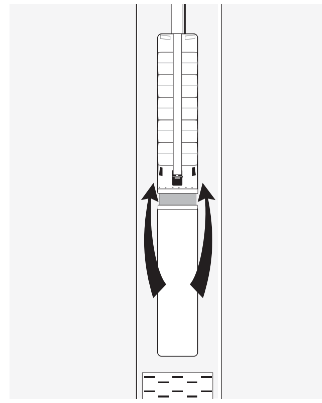
Poor Motor Cooling*

A submersible pump motor is cooled by the flow of water past its outer housing as the pump is pumping. The water must flow past the motor at a certain velocity for proper cooling to take place, and the minimum velocity needed is different for each diameter motor.

MINIMUM VELOCITY OF WATER PAST MOTOR*

4" diameter motor	.25 feet per second
6" diameter motor	.5 feet per second
8" diameter motor	.5 feet per second
10" diameter motor	.5 feet per second

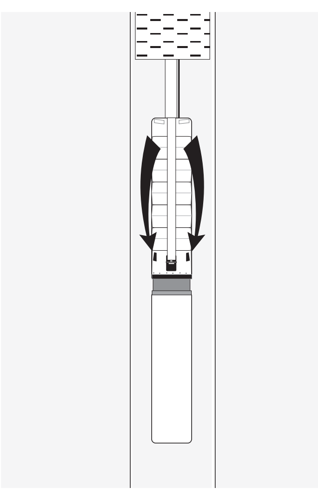
To determine whether water is flowing past the motor at a high enough velocity, note where the motor diameter and outside sleeve or casing diameter intersect on the following chart. The Gallons Per Minute scale indicates the **minimum flow required** to keep the motor properly cooled.



Correct screen position for proper cooling

MINIMUM FLOW REQUIREMENTS FOR SUBMERSIBLE MOTORS*

WELL CASING OR FLOW INDUCER SLEEVE (internal diameter in inches)	4" motor	6" motor	8" motor	10" motor	MOTOR DIAMETER
4 inches	1.2 GPM	--	--	--	
5	7	--	--	--	
6	13	10	--	--	**MINIMUM FLOW (GPM)**
7	21	28	--	--	(to ensure proper motor cooling)
8	30	45	10	--	
10	--	85	55	30	
12	--	140	110	85	
14	--	198	180	145	
16	--	275	255	220	
18	--	--	--	305	



Cascading water from screen does not flow past motor

Insufficient cooling can sometimes result when:

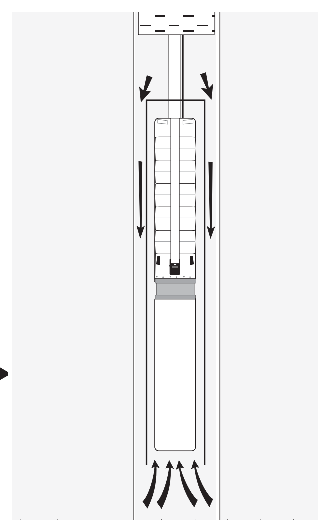
(1) The screen is located above or at the pump, so that the water cascades down into the pump's suction intake without first flowing past the motor.

(2) The casing diameter is so large that the water is drawn into the pump's suction intake from the side without first flowing past the motor.

These problems can be solved by fitting the pump and motor into a **Flow Inducer Sleeve.** This sleeve attaches to the pump and forces water to pass around it and enter the pump's suction intake from below the motor.

If the diameter of the well's casing is too small for a sleeve inducer, a rigid tube (usually 1/4" inside diameter) can be tapped into the discharge piping above the pump (but below any check valves) with the other end positioned below the motor and pointing upwards.

***Grundfos motors have a more effective internal cooling design; therefore, a cooling sleeve is not required in water up to 30° C (86° F). However, all motors will have a longer life with a cooling sleeve installed.**



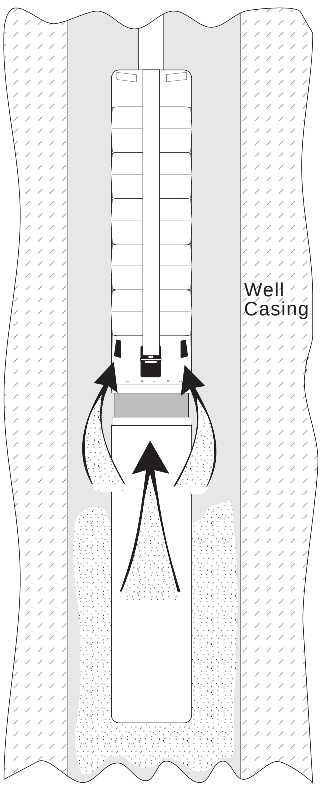
Flow Inducer Sleeve forces water past motor

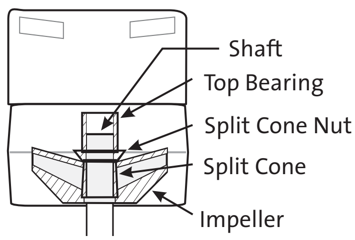
Pumping Sand

All submersible water pumps are designed with the idea they will be used to pump clean, clear water. Some design changes can be made to enable them to better handle situations that don't meet this ideal, but only to a limited degree.

No situation shortens the life of submersible pump more than pumping silt or **SAND**.

Effect On Pump	Will Be First Noticed By...	Design Changes To Deal With The Problem
SAND works its way into all moving parts of the pump, grinding bearings, impellers, and all other components as they spin against each other.	Reduced flow (GPM) and head, since the perfect fit of the impellers and other components will be slowly worn away and the pump will become less and less efficient.	There is no way to eliminate all pump damage due to pumping sand. The effects can only be minimized. Since sand tends to be carried along with flow rates greater than 5-8 feet per second (water velocity), an enlarged drop pipe can reduce the water velocity and thereby reduce the chance sand can enter the pump. Of course, if the water velocity drops below the chart on the previous page, motor cooling may become a problem.



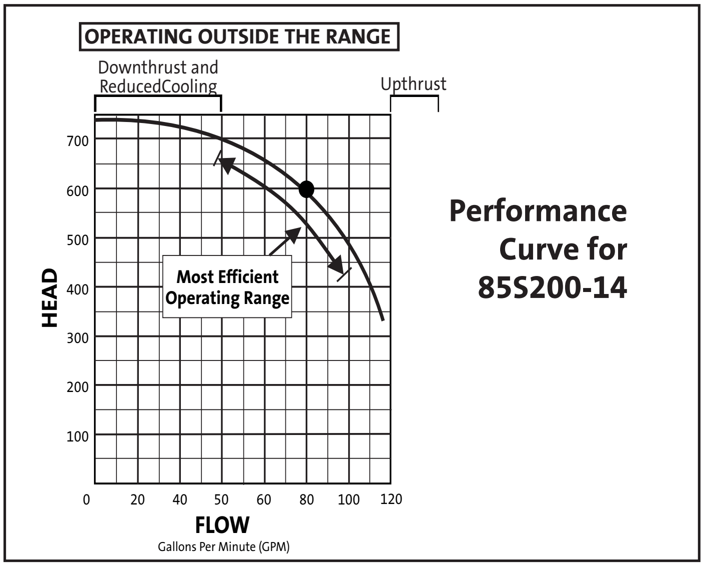


At some point, the pump's performance will become so poor it becomes quite apparent that something is seriously wrong.

If the pump is pulled out of the well and the impellers and other moving components are examined, **uniform** wear (not random pitting, which might indicate that pump may have been cavitating) can be seen on virtually every moving part.

Upthrust Condition

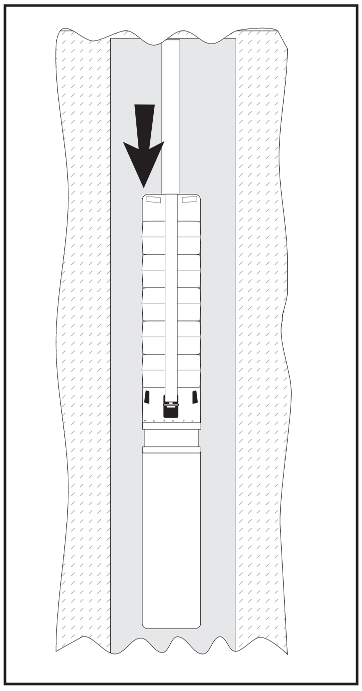
Pumps are designed with the expectation that the correct size pump will be used in the right situation. An 80 gallon per minute pump which can produce about 600 feet of head (at the same time it delivers 80 GPM) is designed so that if it is used in this situation, the pump will operate at its best efficiency **and** all its components will have a long life. The perfomance curve to the right shows the most efficient operating range for this type of pump.



If the pump is not operated within this range, problems can occur.

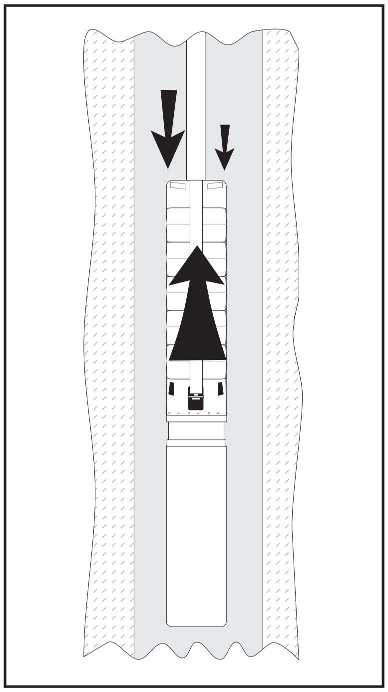
One such problem can occur when a pump is installed and run in a situation in which it will produce far GREATER flow (GPM) than it was designed for. **In other words, the pump is oversized for what is really needed.** When such a pump is started, the initial thrust (upward water surge) generated by the spinning impellers is so much GREATER than the downward thrust it is expecting to overcome (such as the force of the different water pressure, the weight of the impellers and shaft, etc.), that the entire stack of impellers within the pump is lifted upwards **(UPTHRUST).** Pumps are manufactured with bearings designed to handle intermittent upward water surges up to a certain degree. If the actual flow is much greater than this, an upthrust condition exists. The force of this **UPTHRUST** will first put pressure on the motor's thrust bearing. If and when this bearing wears out, the pump's components will begin to absorb the upthrust as they grind against each other. Upthrust is especially damaging when the pump is started and the drop pipe is empty -- causing a great upthrust of water since no head is present. Check valves in the drop pipe will prevent this from occuring.

BEFORE
pump starts pumping



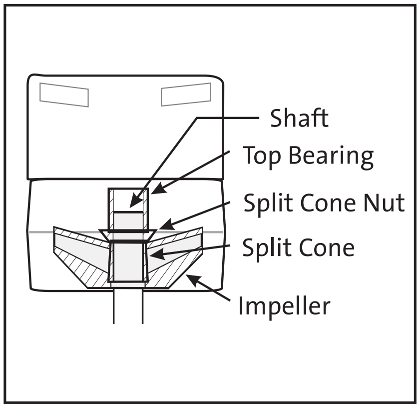
Weight of water and impellers pushes down

AFTER
pump starts pumping



Initial surge of water thrusts impellers upwards

DAMAGE CAUSED



Once the motor's thrust bearing is worn, the pump components begin wearing

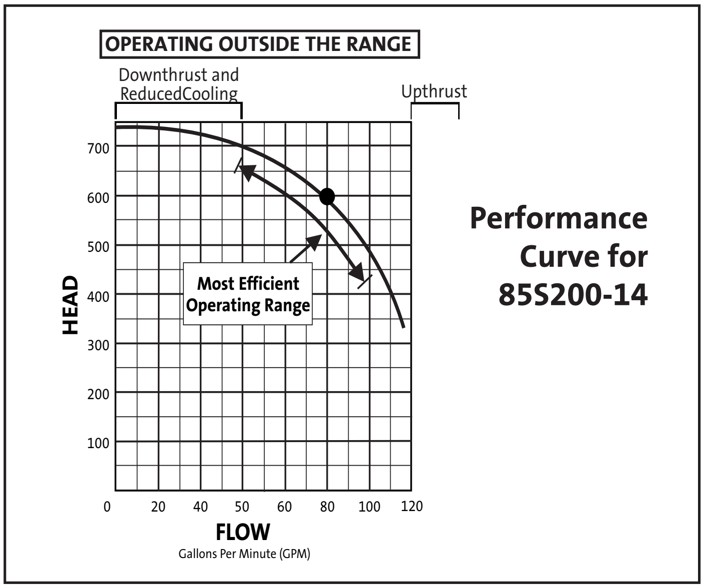
Usually, the **UPTHRUST** condition lasts for only a few seconds until the water pressure above the impellers acts as a counterforce to press the impeller stack down onto the motor shaft. Sometimes, however, if the pump is producing far more flow than for which it was designed, the upthrust condition can continue until the pump is stopped.

Downthrust Condition

Pumps are designed with the expectation that the correct size pump will be used in the right situation. An 80 gallon per minute pump which can produce about 600 feet of head (at the same time it delivers 80 GPM) is designed so that if it is used in this situation, the pump will operate at its best efficiency **and** all its components will have a long life. The perfomance curve at right shows the most efficient operating range for this type of pump.

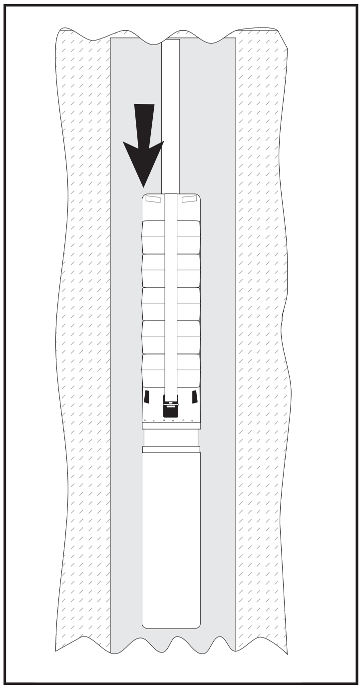
If the pump is not operated in this range, problems can occur.

One such problem can occur when a pump is installed and run in a situation in which it will produce HEAD in the range of shut-off pressure (left part of the curve, as shown above). Although the pump is designed to operate over the full curve, if it does not produce enough flow the weight of the shaft and the pressure of the water in the drop pipe is not counterbalanced, causing possible wear to the bearings in the pump and motor. **This can occur if a valve has been closed down so far that the flow is greatly restricted or when the pump is pumping water faster than the well can refill itself.**



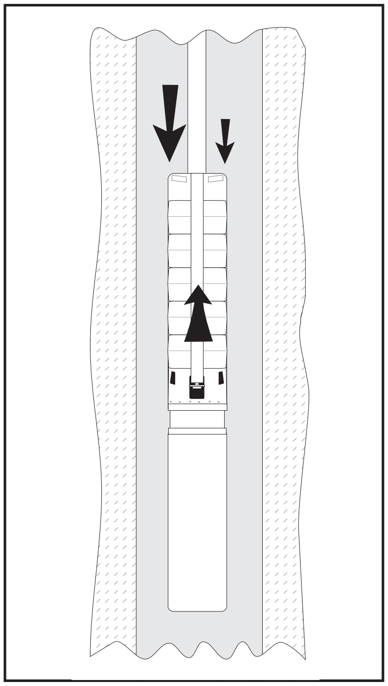
In addition to causing possible bearing damage, operating the pump in a downthrust condition is an inefficient use of energy and may not allow for proper motor cooling (see page 2).

BEFORE
pump starts pumping



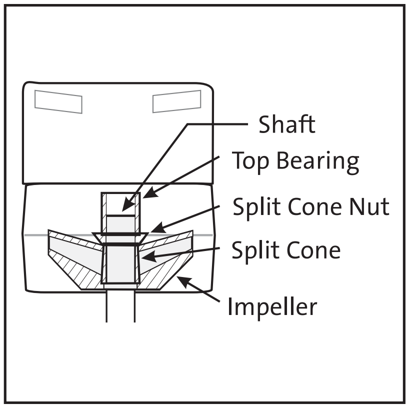
Weight of water and impellers pushes down

AFTER
pump starts pumping



Impellers can produce so much pressure they can grind down against each other

DAMAGE CAUSED



After motor's thrust bearing has worn out, pump components begin to show equal wear from grinding

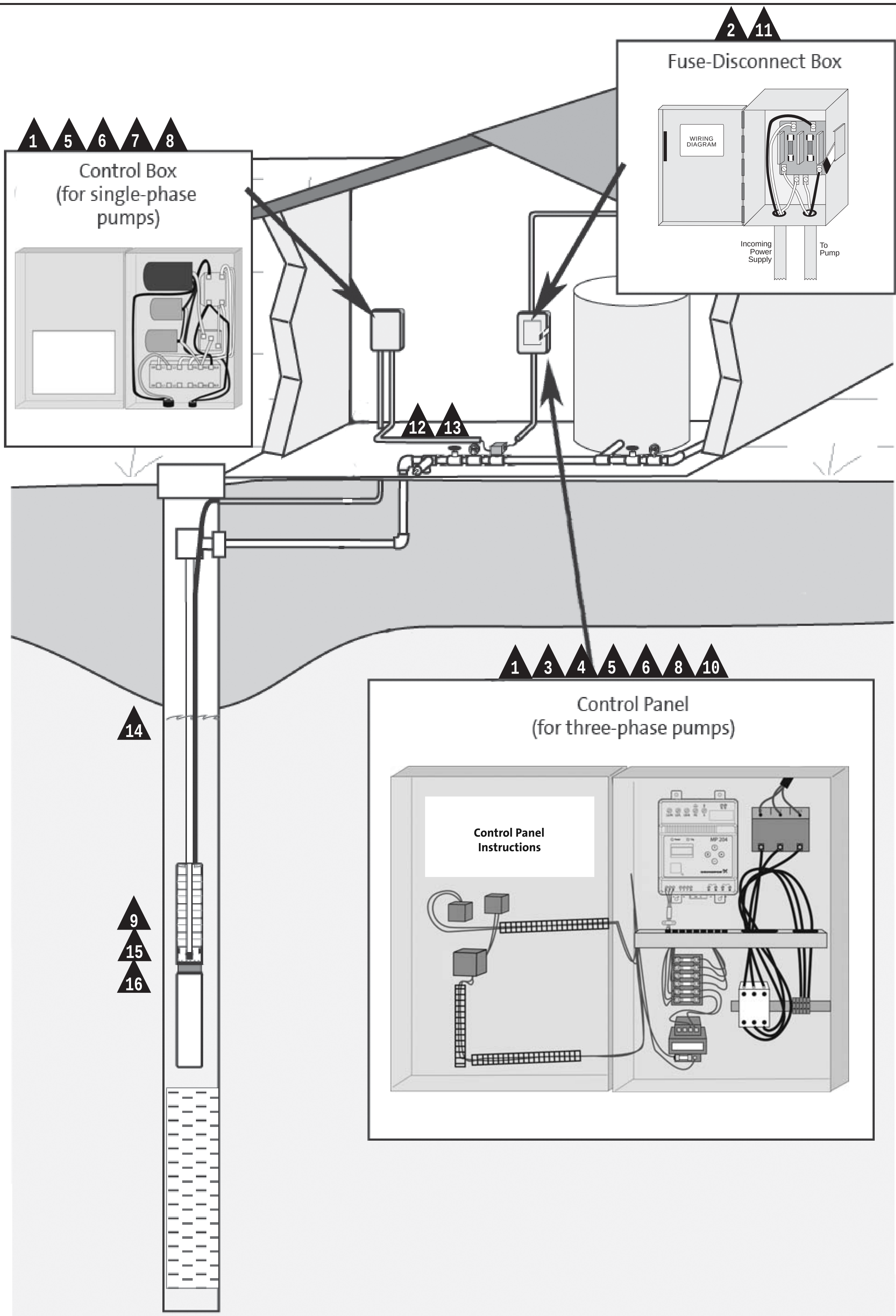
The best way to check for motor bearing damage is with a shaft height gauge. Refer to the Dismantling & Reassembly section of this manual for complete instructions.

Pump Won't Start

Possible Cause	Check This By . . .	Correct This By . . .	
Low or no power at the motor	Check for voltage at the control box or panel. See page 11 for instructions.	If there is no voltage at the control panel, check the feeder panel for tripped circuits and reset those circuits.	1
Fuses are blown or the circuit breakers have tripped.	Turn off the power and remove the fuses. Check for continuity with an ohmmeter as shown on page 13.	Replace the blown fuses or reset the circuit breaker. If the new fuses blow or the circuit breaker trips, the electrical installation, motor, and wires must be checked for defects.	2
(3-phase motors only) **Motor starter overloads are burned or have tripped**	Check for voltage on the line and load side of the starter. Check the amp draw and make sure the heater is sized correctly.	Replace any burned heaters or reset. Inspect the starter for other damage. If the breaker trips again, check the supply voltage. Ensure that heaters are sized correctly and the trip setting is appropriately adjusted.	3
(3-phase motors only) **Starter does not energize**	Energize the control circuit and check for voltage at the holding coil.	If there is no voltage, check the control circuit fuses. If there is voltage, check the holding coil for weak connections. Ensure that the holding coil is designed to operate with the available control voltage. Replace the coil if defects are found.	4
Defective controls	Check all safety and pressure switches for defects. Inspect the contacts in control devices.	Replace worn or defective parts or controls.	5
Motor or cable is defective	Turn off the power and disconnect the motor leads from the control box. Measure the lead-to-lead resistance of the drop cable with an ohmmeter (set to R x 1). Measure the lead-to-ground values with a megohmmeter (set to R x 100K). See pages 12 and 13. Compare these measurements to the rated values for your motor.	If an open or grounded winding is found, pull the pump from the well and recheck the measurements with the lead separated from the motor. Repair or replace the motor or cable.	6
(1-phase motors only) **Defective capacitor**	Turn off the power and discharge the capacitor by shorting the leads together. Check it with an analog ohmmeter (set to R x 100K). See page 11 or use an audible capacitor tester.	When the meter is connected to the capacitor, the needle should jump toward 0 (zero) ohms and slowly drift back to infinity (∞). Replace the capacitor if it is defective.	7
Defective pressure switch or the tubing to it is plugged.	Watch the pressure gauges as the pressure switch operates. Remove the tubing and blow through it.	Replace as neccessary.	8
The pump is mechanically bound or stuck	Turn off the power, pull the pump, and manually rotate the pump shaft. Also check the motor shaft rotation, the shaft height, and the motor's amp draw (to see if it indicates a locked rotor).	If the pump shaft doesn't rotate, remove the pump and examine it. If necessary, dismantle it and check the impellers for obstruction. Check for motor corrosion.	9

Pump Does Not Produce Enough Flow (GPM)

Possible Cause	Check This By . . .	Correct This By . . .	
Shaft is turning in the wrong direction.	Check to make sure the electrical connections in the control panel are correct.	Turn off the power. Correct the wiring. For single phase motors, check the wiring diagram on the motor. For three phase motors, simply switch any two power leads.	10
Pump is operating at the wrong speed (too slow)	Check for low voltage (as shown on page 11) and phase imbalance (as shown on page 10)	Replace defective parts or contact power company, as applicable.	11
Check valve is stuck (or installed backwards)	Pull the pump and reove the check valve.	Re-install or replace.	12
Parts in the pump are worn **or** **Impellers, Inlet Strainer, or Well Screen is clogged**	Install a pressure gauge, start the pump, and gradually close the discharge valve. Read the pressure at shutoff. (Do not allow the pump to operate for an extended period at shutoff).	Convert the PSI you read on the gauge to Feet of Head by: **PSI x 2.31 ft** Add to this number the number of feet (vertically) from the gauge down to the water's pumping level. Refer to the pump curve for the model you are working with to determine the shutoff head expected for that model. If those figures and yours do not match, remove the pump and inspect impellers, chambers, etc., for clogging.	13
The water level in the well may be too low to supply the flow desired **or** **Collapsed well**	Using a depth gauge, check the drawdown in the well while the pump is operating.	If the pumping water level (including drawdown) is not **AT LEAST 3 FEET** above the pump's inlet strainer, either: 1. Lower the pump further down the well. 2. Throttle back the discharge valve to decrease the flow, thereby reducing drawdown.	14
Broken shaft or coupling	Pull pump and inspect	Replace as necessary.	15
There are leaks in the fittings or piping	Pull the pump out of the well.	The suction pipe, valves, and fittings must be made tight. Repair any leaks and retighten all loose fittings.	16

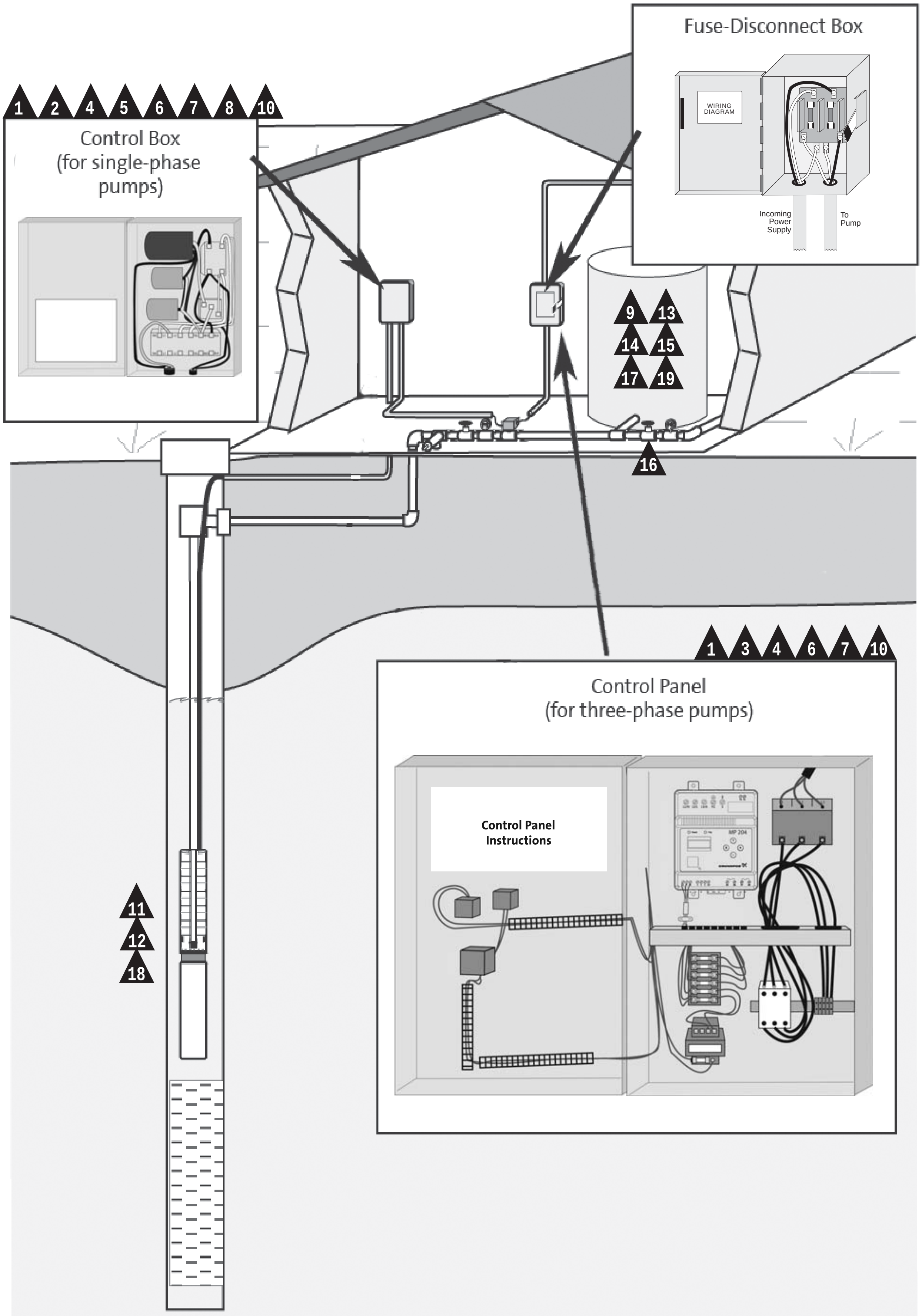

2
11
Fuse-Disconnect Box
WIRING DIAGRAM
Incoming Power Supply
To Pump
1
5
6
7
8
Control Box (for single-phase pumps)
12
13
14
9
15
16
1
3
4
5
6
8
10
Control Panel (for three-phase pumps)
Control Panel Instructions
MP 204

Fuses Blow or Heaters Trip

Possible Cause	Check This By . . .	Correct This By . . .	
Improper voltage	Check the voltage at the control box or panel. See page 11 for instructions. If the incoming voltage is + or -10%, check the wire size and then measure the distance between the pump motor and the pump control panel.	If voltage varies by more than 10% (+ or -), contact the power company. Rewire with correct gauge. Undersized wire and a great distance between the control panel and the pump motor increases resistance and decreases the voltage by the time it reaches the pump motor.	1
The starter overload is set too low.	Cycle the pump and measure the amperage. See page 10 for instructions.	Increase the heater size (use a slo-bio) or adjust the trip setting. Do not, however, exceed the recommended rating.	2
(3-phase motors only) **Current is imbalanced.**	Check the current draw on each lead to the motor. See page 11 for instructions.	The current imbalance must be within 5% of each other. If they are not, check the wiring and the power supply.	3
The wiring or connections are faulty.	Check to make sure the wiring is correct and there are no loose terminals.	Tighten any loose terminals and replace any damaged wire.	4
(1-phase motors only) **Capacitor is defective**	Turn off the power and discharge the capacitor. Check start and run capacitors with an ohmmeter (set at R x 100K). See page 11 for instructions.	When the meter is connected to the capacitor, the needle should jump towards 0 (zero) ohms and then slowly drift back to infinity (∞). Replace the capacitor if it is defective.	5
Fuse, heater, or starter are the wrong size	Check the fuses and heaters against the motor manufacturer's specification charts.	Replace as necessary.	6
The control box location is too hot	Touch the box with your bare hand during the hottest part of the day -- you should be able to keep your hand on it without burning.	Shade, ventilate, or move the control box so its environment does not exceed 120°F.	7
(1-phase motors only) **Wrong control box**	Check requirements for the motor against the control box specifications.	Replace as necessary.	8
Defective pressure switch	Watch gauges as pressure switch operates.	Replace as necessary.	9
The motor is shorted or grounded.	Turn off the power and disconnect the wiring. Measure the lead-to-lead resistance with an ohmmeter (set to R x1). Measure the lead-to-ground resistance (set to R x100K). Compare these measurements to the rated values for your motor.	If you find an open or grounded winding, remove the motor and recheck the leads. If OK, check the leads for continuity and for bad splice.	10
Poor motor cooling	Find the internal diameter of the well casing (or sleeve, if used) on the chart on page 2 and check for proper cooling.	Increase the pump flow (GPM) so proper cooling is possible (see chart on page 2) or pull the pump out of the well and add a sleeve with a smaller internal diameter *(see chart on page 2).*	11
Bad motor thrust bearing	Measure for high amps as explained on page 10.	If amps are too high, pull the pump and replace the motor.	

Pump Cycles Too Often

Possible Cause	Check This By . . .	Correct This By . . .	
The pressure switch is defective or is not properly adjusted.	Check the pressure setting on the switch. Check the voltage across closed contacts.	Adjust the pressure switch with a screwdriver or replace it if defective.	13
The tank is too small	Check the tank size and amount of air in the tank. The tank size should be about 10 gallons for each GPM needed (16 GPM = 160 gal.). At the pump cut-in pressure, the tank should be about 2/3 filled with air.	Replace the tank with one that is the correct size.	14
There is insufficient air charging of the tank or piping is leaking.	Pump air into the tank or diaphragm chamber. Check the diaphragm for leaks. Check the tank and piping for leaks with soapy water. Check the air-to-water ratio in the tank.	Repair as necessary.	15
Plugged snifter valve or bleed orifice (causing pressure tank to be water-logged)	Examine them for dirt or erosion.	Repair or replace as necessary.	16
Leak in the pressure tank or piping.	Check the setting and operation of the level control.	Readjust the level control setting (according to the manufacturer's instructions) or replace it if defective.	17
The level control is defective or is not properly set.	Check the yield of the well (determined by the well-test) against the pump's performance curve.	Reduce the flow by throttling back the valve. or Change the pump.	18
Pump is oversized for the application. It is outpumping the yield of the well and pumping itself dry.	Refer to the tank's operating and installation instructions and make sure it is installed correctly.	Repair or replace as needed.	19

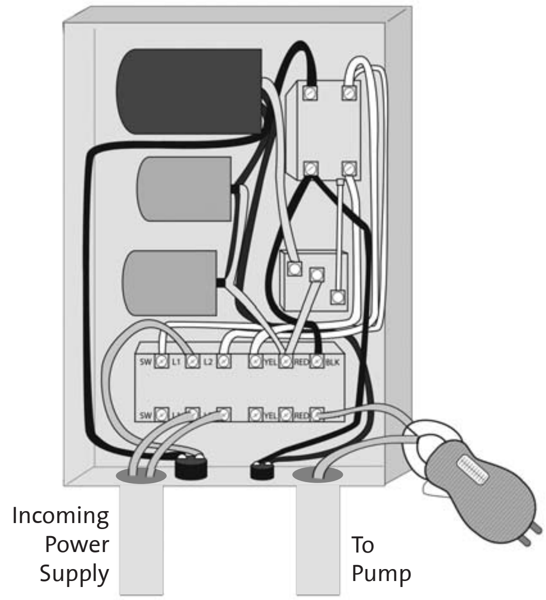

1 2 4 5 6 7 8 10
Control Box
(for single-phase pumps)
Fuse-Disconnect Box
WIRING DIAGRAM
Incoming Power Supply
To Pump
9 13
14 15
17 19
16
1 3 4 6 7 10
Control Panel
(for three-phase pumps)
Control Panel Instructions
MP 204
11
12
18

Amperage Check

To check the electrical current (measured in amperes, or "amps") use an ammeter.

Instructions

1. Make sure the pump is running
2. Set the rotary scale on the front of the ammeter to the highest scale.
3. Open the control box and place the jaws of the ammeter around the wire to be measured.
4. Slowly rotate the scale on the ammeter back towards 0 (zero) until an exact reading is shown.
5. Record the measurement
6. Repeat for the other wires.



Evaluation

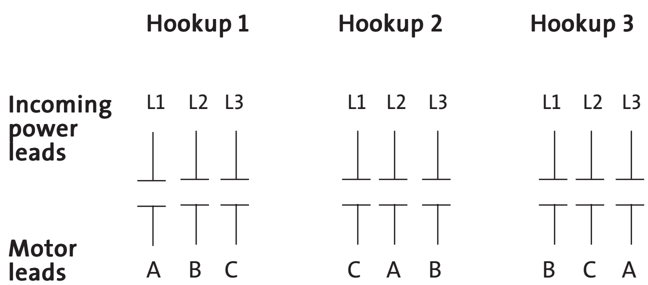
If the amp draw exceeds the service factor amps for the pump (as listed in the Motors section of the Service Manual), then:

- The motor starter may have burned contacts
- The terminals in the starter or terminal box may be loose
- There may be a winding defect. Check the winding and insulation resistance (see pages 12 and 13)
- The motor windings may be shorted or grounded
- The pump may be damaged in some way and may be causing a motor overload.
- A voltage supply or current imbalance (3-phase only) may exist. Follow the steps below to determine if this is true.
- The insulation on the drop cable may be torn, exposing the cable.

Current Imbalance On Three-Phase Motors

If the motor is connected to three-phase power, the balance of those three phases can be checked in the following way:

1. Measure the amperage of each wire as instructed above and record these figures.
2. Add together the total amperage measured by the three wires.
3. Divide this number by three to get the **average** amperage reading for the three wires.
4. Check over your numbers and determine which wire has the greatest difference from the average.
5. Take that number and subtract it from the average to determine the amount of **difference**.
6. Divide the **difference** by the **average**.
7. Multiply this number by 100 to obtain the percent of current imbalance for that particular hookup.
8. Turn **POWER OFF**
9. Repeat these steps for the other two possible hookup installations so that each motor lead is connected to a different power lead than it was before.



(where A, B, and C represent each motor lead or each set of leads joined together to make a single motor lead)

Example:

A	=	51 amps	C	=	50 amps	B	=	50 amps
B	=	46 amps	A	=	49 amps	C	=	48 amps
C	=	53 amps	B	=	51 amps	A	=	52 amps
Total	=	150	Total	=	150	Total	=	150
150/3	=	50	150/3	=	50	150/3	=	50
- 46	=	4	- 49	=	1	- 48	=	2
4/50	=	.08 or 8 %	1/50	=	.02 or 2 %	2/50	=	.04 or 4 %

Evaluation

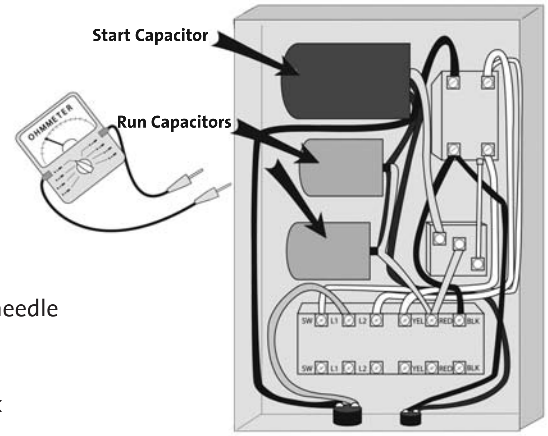
If the the current imbalance is greater than 5% on all three hookups, then:

- If the largest difference in amps is consistently drawn from the same power lead (L1, L2, or L3 above), contact the power company. Your voltage should be balanced to within + or - 5%.
- If the largest difference in amps is consistently drawn from the same motor lead (A, B, or C above), there is likely a problem with the motor. Check the items listed under "Evaluation" near the top of this page.

If the current imbalance exceeds 5% one or two of the legs, use the hookup that has the least difference and check the motor for some of the other problems listed under "Evaluation" near the top of this page.

Capacitor Check

To check the condition of any capacitor on single phase motors, use an ohmmeter.



Instructions:

1. Turn the **POWER OFF**.
2. Disconnect the capacitor from the power source.
3. Discharge the capacitor by touching its leads together.
4. Set the scale selector on the ohmmeter to R x 100K.
5. Connect the leads of the ohmmeter to the black and orange wires of the capacitor.
6. Watch the ohmmeter scale.
7. Disconnect one lead from the capacitor for approximately 30 seconds. The needle should return to the last reading taken.

Evaluation

If the capacitor is OK, the needle should swing towards zero and then float back towards infinity (∞). If the needle drops and remains at zero, the capacitor is probably shorted. If the needle remains at a high value, there is an open circuit.
CAUTION: This test may indicate a good capacitor even though it may have lost some capacitance, making the motors run noisy or draw high amps. To safeguard against this, the capacitor can be checked with a capacitor meter.

Supply Voltage Check

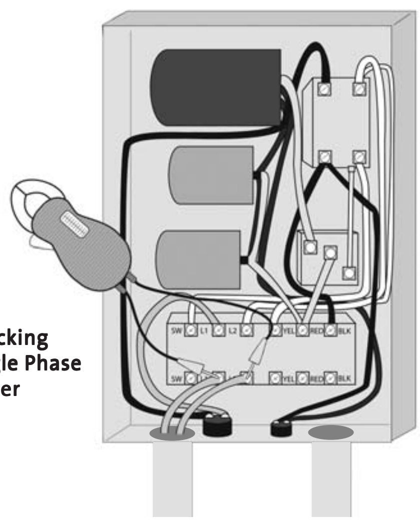
To check the supply voltage, use a voltmeter (or amprobe) with the power on.

Instructions

1. Set the voltmeter to the highest scale
2. Remove the cover of the control box...BE CAREFUL -- POWER IS STILL BEING SUPPLIED TO THE CIRCUIT. Do not touch the voltmeter leads together while they are in contact with the power lines.
3. Touch the ends of the voltmeter leads as follows:

Single Phase Motors
Touch one voltmeter lead to each of the lines supplying power to the control (L_1 and L_2 , or L_1 and N for 115V circuits). →

Checking Single Phase Power



Three Phase Motors
Touch a voltmeter lead to the following:

- Power leads L_1 and L_2
- Power leads L_2 and L_3
- Power leads L_3 and L_1

} *These tests should give a reading of full line voltage.*

- Two fuses
- Two contact points
- Two heaters

Evaluation

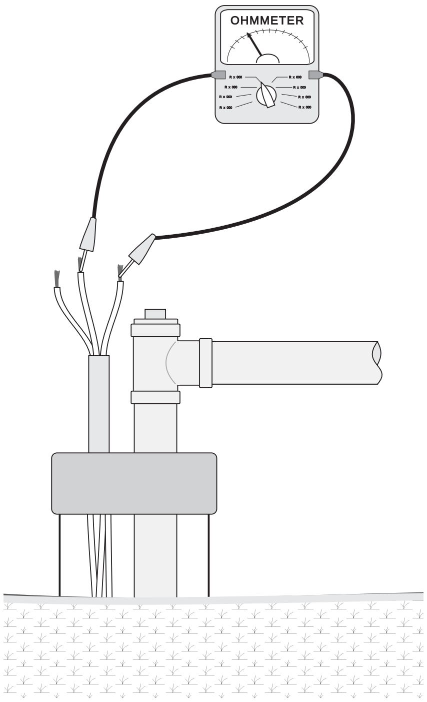
When the motor is under load, the voltage should be -10% and +6% of the nameplate voltage. Any variation larger than this can cause damage to the motor windings and should be noticeable as a high amp problem.

If The Motor Nameplate Reads . . .	Then the minimum and maximum voltage should be . . .	
	Minimum	Maximum
115V (single phase)	105 volts	121 volts
208V (single or three phase)	188 "	220 "
230V " "	210 "	243 "
460V (three phase)	414 "	487 "
575V " "	518 "	609 "

Any variations larger than these may indicate a poor electrical supply. The motor should not be operated under these conditions. Contact your power supplier to correct the problem or change the motor to one requiring the voltage you are receiving.

Motor Winding Resistance (lead-to-lead)

To check the electrical condition of the drop cable, splice, and motor windings, a resistance check with an ohmmeter is required.



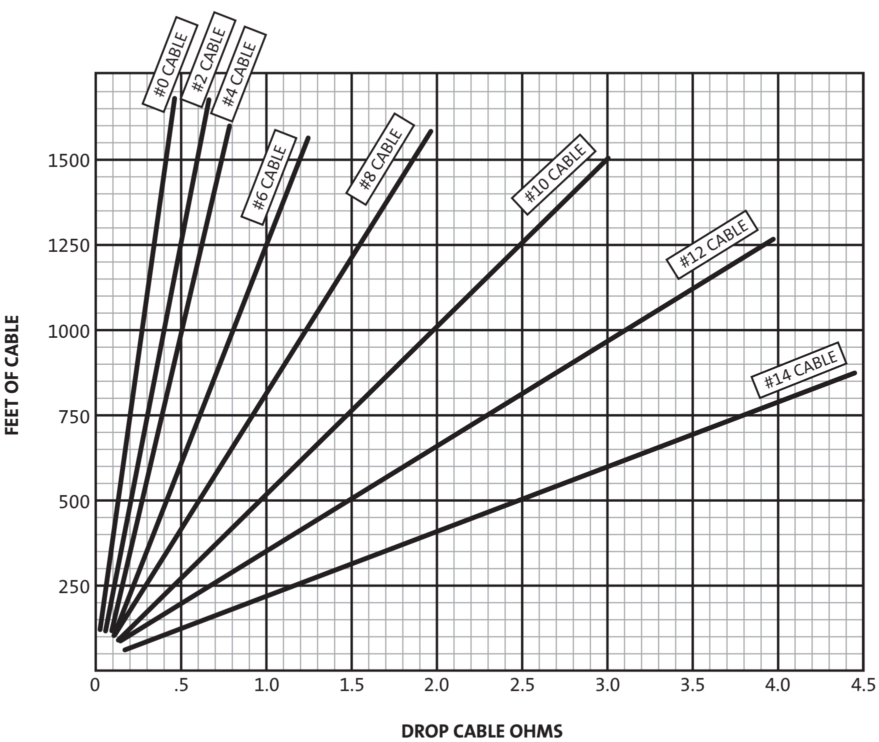
Instructions:

1. Turn the **POWER OFF**.
2. Disconnect all electrical leads to the drop cable.
3. Set the scale selector on the ohmmeter to R x 1 (if you expect ohm values under 10) or R x 10 (for ohm values over 10).
4. Touch the leads of the ohmmeter to two motor leads:
   Single Phase Motors
   Touching the leads of the ohmmeter to the black and yellow leads will measure the main winding's resistance for Franklin and Grundfos 402 motors. The red and yellow leads will be the start winding's resistance.
   Three Phase Motors
   Touching the leads of the ohmmeter to any two black leads will measure that winding's resistance. Repeat for all three possible lead combinations.
5. Watch the ohmmeter scale and record this figure. Subtract the ohm resistance for the drop cable (chart below) from the number. Compare the remaining figure with the one shown in the Motors section of this manual.

If:	Then:
Ohm values are normal	Motor windings are okay
One ohm value is less than normal	That motor winding may be starting to short
One ohm value is greater than normal	That winding may be starting to open
Some ohm values are greater than normal (>25%) and some are less than normal (± 25%)	The leads may be connected incorrectly, or have a break in the insulating jacket

If ohm readings are not normal and you want to verify the problem is not with the splice or drop cable, remove the lead from the motor and check the resistances from pin to pin directly at the motor. If the motor checks out okay, the fault is in the lead or splice (see page 14).

Total Resistance of Drop Cable *(from control box to motor and back)*

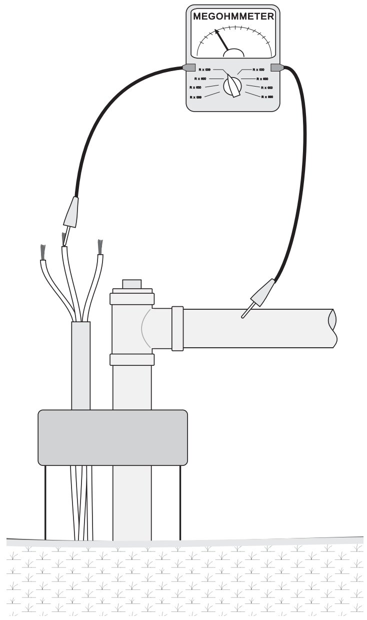


The values shown are for copper conductors. If aluminum conductor drop cable is used, the resistance will be higher for each foot of cable of the same size.

Copper ÷ .61 = Aluminum

Insulation Resistance (lead-to-ground)

To check the insulation resistance of the drop cable, splice, and motor leads, a megohmmeter is required.



Instructions:

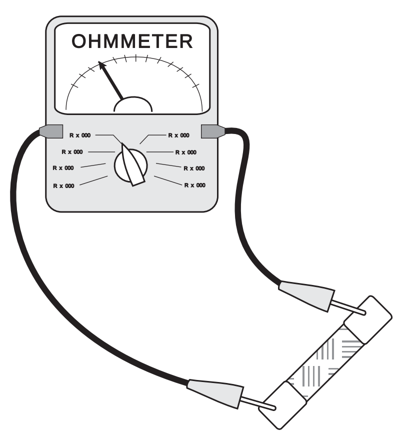
1. Turn the **POWER OFF**.
2. Disconnect all electrical leads to the drop cable.
3. Set the scale selector on the megohmmeter to R x 100, touch its leads together, and adjust the indicator to zero.
4. Touch the leads of the megohmmeter to each of the motor leads and to ground (i.e. L_1 to ground; L_2 to ground, etc.). The well casing, if made of steel, makes an excellent ground.
5. Watch the megohmmeter scale and compare this figure with the chart below.

Evaluation: In general, any ohm value above 1,000,000 ohms indicates everything is OK. The following table gives more specifics.

OHM VALUE	MEGAohm VALUE	THIS INDICATES THAT ...
		If The Motor HAS NOT Yet Been Installed:
2,000,000 (or more)	2.0	It is a new motor
1,000,000 (or more)	1.0	It is a used motor than can be used again (insulation OK)
		If The Motor HAS Been Installed: *(means that ohm readings will be for the drop cable plus the motor)*
500,000 - 1,000,000	0.5 - 1.0	The motor is in reasonably good condition
20,000 - 500,000	.02 - 0.5	The motor may have been damaged by lightning or has damaged leads.
10,000 - 20,000	.01 - .02	The motor has certainly been damaged or has damaged leads. The pump should be pulled and repairs made to the motor leads or replace the motor completely. The motor may still operate, but probably not for long.
less than 10,000	0 - .01	The motor has failed or the motor lead insulation has been completely destroyed. The pump must be pulled and the motor lead (drop cable) repaired or the entire motor replaced. **The motor will not run in this condition.**

Fuses

To check the condition of electrical fuses, an ohmmeter is required.



Instructions:

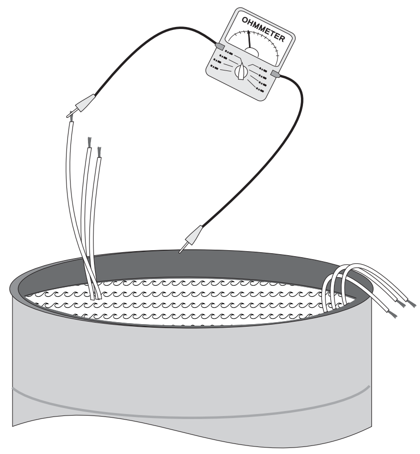
1. Turn the **POWER OFF** at the main disconnect or power source.
2. Remove the fuse.
3. Set the scale selector on the ohmmeter to R x 1.
4. Touch each lead of the ohmmeter to one end of the fuse.

Evaluation:

A good fuse should have zero (0) ohm reading. If the ohm value is near or past infinity, the fuse must be replaced.

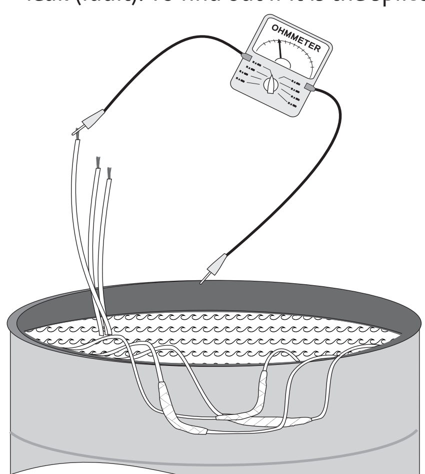
Cable and Splice Condition

To check the electrical condition of the cable and splice insulation, a megohmmeter is required.



Instructions:

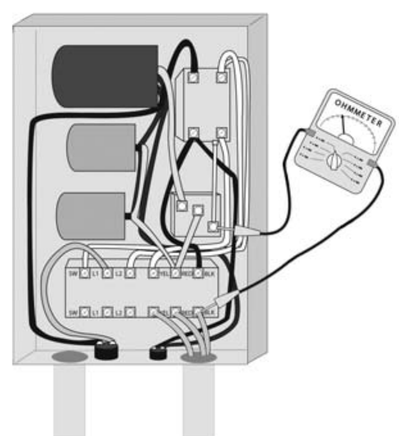
1. Turn the **POWER OFF.**
2. Remove the cable from the motor and electrical supply.
3. Submerge the cable in a steel barrel of water. Make sure both ends stay out of the water. Salt may be added to increase the conductance of the water.
4. Set the megohmmeter to R x 100K. Zero-adjust the ohmmeter by touching its two leads together.
5. Touch one megohmmeter lead to the steel barrel and other to a bare cable lead.
6. If the megohmmeter drifts towards zero (0), either that lead or the splice for that lead has a leak (fault). To find out if it is the splice:



   a. Raise the splice for that lead out of the water.
   b. Repeat step 5.
   c. If the megohmmeter drifts towards infinity, the fault is in the splice.
   d. If the megohmmeter drifts towards zero (0), the fault is somewhere else in that lead. Gradually pull the rest of that cable lead out of the water until the megohmmeter drifts towards infinity. When it does, the leak is at that point in the cable lead.

7. Repeat for each of the motor leads.

Evaluation:
Any faulty leads should be replaced using waterproof electrical tape.

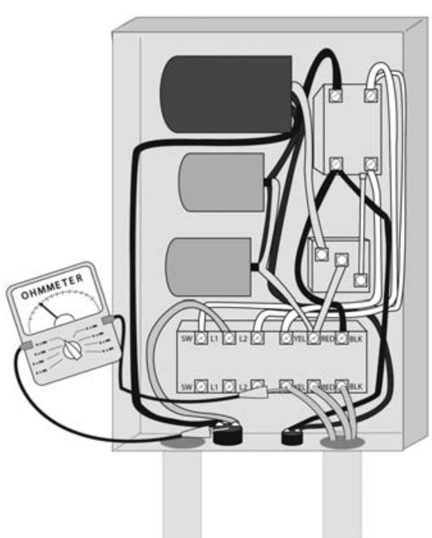


Checking the Relay

(SINGLE-PHASE CONTROL BOXES ONLY)

To check the electrical condition of the relays on single phase control boxes, an ohmmeter is required.

Specific instructions for checking the relay differ from control box to control box. Refer to the inside cover of your control box.



Overload Protection

To check the electrical condition of the thermal overloads, an ohmmeter is required.

Instructions:

1. Turn the **POWER OFF**.
2. Set the scale selector on the ohmmeter to R x 1.
3. Touch one of the ohmmeter leads to an overload protector and one to terminal 1, then terminal 3. Repeat for each overload protector.

Evaluation:
If the ohm values are 0.5 ohms or less, the overload protectors should still be functional. If not, they should be replaced.

Definitions

NET POSITIVE SUCTION HEAD (two types)

Before a centrifugal water pump can operate, the water must enter the pump under a certain minimum amount of pressure. For submersible pumps, this minimum is easily reached, since the pump is submerged in water and both the atmospheric pressure (14.7 psi) and the pressure of the water in the well are present. The amount of pressure (expressed in feet of head) required for a given pump to operate is known as its Net Positive Suction Head **Required**.

This number is determined by extensive testing of the pump by the manufacturer. These requirements are normally shown in graphical form (an **NPSH curve**) for a pump at every flow (GPM) within the flow range for which the pump is designed**.** As a pump's flow (GPM) increases, the NPSHR needed to continue that flow (without cavitating) also increases.

The amount of pressure (expressed in feet of head) that is actually available to a pump is known as its Net Positive Suction Head **Available**. Since the NPSH **Available** to the pump is almost always greater than the NPSH **Required** (for submersible pumps, that is), they are usually not a cause for any concern when sizing a pump or troubleshooting.

For submersible pumps, NPSH Required should not be confused with Total Dynamic Head, which is the amount of head the pump must produce to deliver water at the desired flow rate (GPM) in a given situation. ***Total Dynamic Head*** *(or TDH, as it is sometimes called) is explained below.*

TOTAL DYNAMIC HEAD

When selecting (or "sizing") a pump, two questions must be answered:

1. How much flow is needed ?
   (expressed in Gallons Per Minute)

2. How much head must the pump produce ?
   (known as ***Total Dynamic Head****)*

To determine the Total Dynamic Head the pump must produce, 5 pieces of information are needed:

A **STATIC WATER LEVEL**

+

B **DRAWDOWN**
(as the pump is pumping)

+

C **TANK ELEVATION**

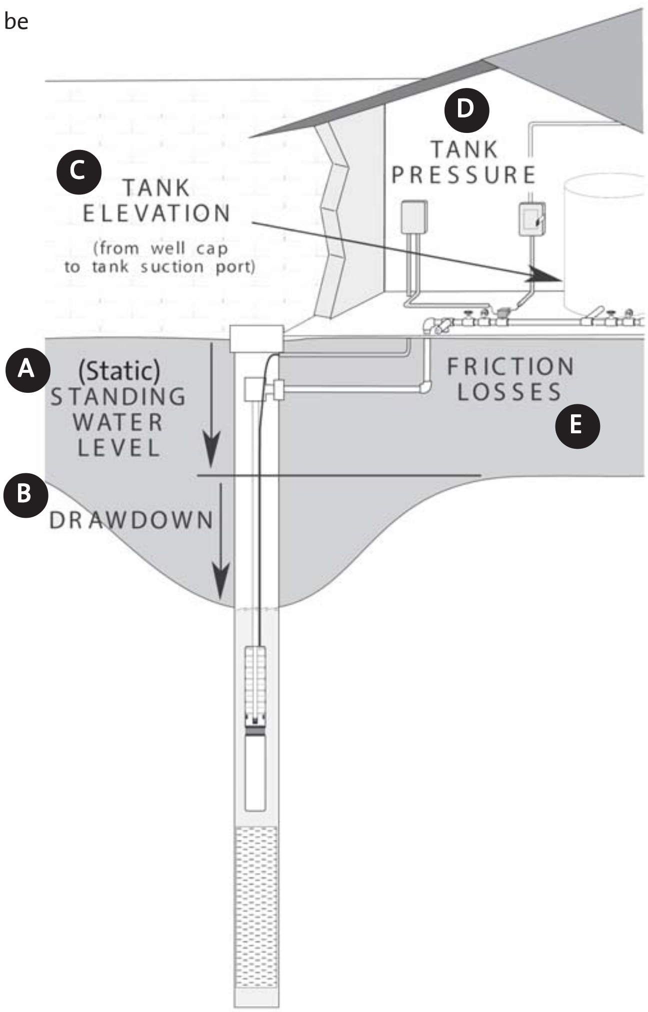
+

D **TANK PRESSURE**
(multiply by 2.31 to convert psi to feet of head)

+

E **FRICTION LOSSES**

THE TOTAL
OF THESE 5 NUMBERS IS THE AMOUNT OF HEAD THE PUMP MUST PRODUCE



AFFINITY LAWS

The mathematical relationships which permit the head, capacity, brake horsepower (BHP), and NPSH of centrifugal pumps to be predicted based on small changes in impeller diameter size or shaft speed (RPM) changes. These relationships are:

For diameter changes at a constant RPM:

$$\frac{D_1}{D_2} = \frac{GPM_1}{GPM_2}$$

Flow changes in direct proportion to the ratio of the diameter change.

$$\left(\frac{D_1}{D_2}\right)^2 = \frac{H_1}{H_2}$$

Head changes to the square ratio of the ratio of the diameter change.

$$\left(\frac{D_1}{D_2}\right)^3 = \frac{BHP_1}{BHP_2}$$

BHP changes to the cube of the ratio of the diameter change

For RPM changes:

$$\frac{RPM_1}{RPM_2} = \frac{GPM_1}{GPM_2}$$

$$\left(\frac{RPM_1}{RPM_2}\right)^2 = \frac{NPSH_1}{NPSH_2}$$

$$\left.\begin{array}{l} \left(\frac{RPM_1}{RPM_2}\right)^2 = \frac{H_1}{H_2} \\ \left(\frac{RPM_1}{RPM_2}\right)^3 = \frac{BHP_1}{BHP_2} \end{array}\right\}$$

Head is affected by the square of the ratio of RPM change and BHP is affected by the cube of the ratio of the RPM change

Conversion Formulas

HEAD
(in feet)

$$= \frac{\text{Pressure (PSI) x 2.31}}{\text{Specific Gravity (for water, 1.0 at ambient temperatures)}}$$

PRESSURE
(PSI)

$$= \frac{\text{HEAD (in ft) x Specific Gravity (for water, 1.0 at ambient temperatures)}}{2.31}$$

ATMOSPHERIC PRESSURE
Pressure of the Atmosphere Pushing Down (at sea level)

= 14.7 PSI = 34 feet of HEAD

BRAKE HORSEPOWER
Horsepower Delivered to the Pump Shaft

$$= \frac{\text{GPM x HEAD x Specific Gravity (for water, 1.0 at ambient temps)}}{\text{3960 x Efficiency Of Pump}}$$

PUMP EFFICIENCY
Of The Pump

$$= \frac{\text{GPM x HEAD x Specific Gravity}}{\text{3960 x Brake Horsepower}}$$

FOOT POUNDS = Newton Meters (or Nm) x .7376

DEGREES FARENHEIT = (Degrees Celsius x 9/5) + 32

Water Vapor Pressure and Specific Gravity

°F	°C	Specific Gravity (1 at 60°F)	Weight (Lbs per cubic foot)	Vapor Pressure (PSIA)	Vapor Pressure (in feet)
32	0	1.002	62.42	0.0885	0.204
40	4.4	1.001	62.42	0.1217	0.281
45	7.2	1.001	62.40	0.1475	0.340
50	10.0	1.001	62.38	0.1781	0.411
55	12.8	1.000	62.34	0.2563	0.591
60	15.6	1.000	62.34	0.2563	0.591
65	18.3	.999	62.31	0.3056	0.839
70	21.1	.999	62.27	0.3631	0.839
75	23.9	.998	62.24	0.4298	0.994
80	26.7	.998	62.19	0.5069	1.172
85	29.4	.997	62.16	0.5959	1.379
90	32.2	.996	62.11	0.6982	1.617
95	35.0	.995	62.06	0.8153	1.890
100	37.8	.994	62.00	0.9492	2.203
110	43.3	.992	61.84	1.275	2.965
120	48.9	.990	61.73	1.692	3.943
130	54.4	.987	61.54	2.223	5.196
140	60.0	.985	61.39	2.889	6.766
150	65.6	.982	61.20	3.718	8.735
160	71.1	.979	61.01	4.741	11.172
170	76.7	.975	60.79	5.992	14.178
180	82.2	.972	60.57	7.510	17.825
190	87.8	.968	60.35	9.339	22.257
200	93.3	.964	60.13	11.526	27.584
212 (boiling point)	100.0	.959	59.81	14.696	35.353
220	104.4	.956	59.63	17.186	41.343
240	115.6	.948	59.10	24.97	60.77
260	126.7	.939	58.51	35.43	87.05
280	137.8	.929	58.00	49.20	122.18
300	148.9	.919	57.31	67.01	168.22
320	160.0	.909	56.66	89.66	227.55
340	171.1	.898	55.96	89.66	227.55
360	182.2	.886	55.22	153.04	398.49
380	193.3	.874	54.47	195.77	516.75
400	204.4	.860	53.65	247.31	663.42
420	215.6	.847	52.80	308.83	841.17
440	226.7	.833	51.92	381.59	1056.8
460	237.8	.818	51.02	466.9	1317.8
480	248.9	.802	50.00	566.1	1628.4
500	260.0	.786	49.02	680.8	1998.2

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

Water Properties at Different Altitudes

ALTITUDE		BAROMETER READING		ATMOS. PRESSURE		Boiling Point Of Water F°
Feet	Meters	IN. HG.	MM. HG	PSIA	Feet of Water	
-1000	-304.8	31.0	788	15.2	35.2	213.8
-500	-152.4	30.5	775	15.0	34.6	212.9
0	**0.0**	**29.9**	**760**	**14.7**	**33.9**	**212.0**
+500	+152.4	29.4	747	14.4	33.3	211.1
+1000	304.8	28.9	734	14.2	32.8	210.2
1500	457.2	28.3	719	13.9	32.1	209.3
2000	609.6	27.8	706	13.7	31.5	208.4
2500	762.0	27.3	694	13.4	31.0	207.4
3000	914.4	26.8	681	13.2	30.4	206.5
3500	1066.8	26.3	668	12.9	29.8	205.6
4000	1219.2	25.8	655	12.7	29.2	204.7
4500	1371.6	25.4	645	12.4	28.8	203.8
5000	1524.0	24.9	633	12.2	28.2	202.9
5500	1676.4	24.4	620	12.0	27.6	201.9
6000	1828.8	24.0	610	11.8	27.2	201.0
6500	1981.2	23.5	597	11.5	26.7	200.1
7000	2133.6	23.1	587	11.3	26.2	199.2
7500	2286.0	22.7	577	11.1	25.7	198.3
8000	2438.4	22.2	564	10.9	25.2	197.4
8500	2590.8	21.8	554	10.7	24.7	196.5
9000	2743.2	21.4	544	10.5	24.3	195.5
9500	2895.6	21.0	533	10.3	23.8	194.6
10000	3048.0	20.6	523	10.1	23.4	193.7
15000	4572.0	16.9	429	8.3	19.2	184.0

LSP-TL-015 | Rev. 08/06
PRINTED IN USA

GRUNDFOS Pumps Corporation
17100 W. 118th Terrace
Olathe, Kansas 66062
Phone: 913.227.3400
Fax: 913.227.3500

www.grundfos.com

GRUNDFOS Canada, Inc.
2941 Brighton Road
Oakville, Ontario L6H 6C9 Canada
Phone: 905.829.9533
Fax: 905.829.9512

Bombas GRUNDFOS de Mexico S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. Mexico 66600
Phone: 52.81.8144.4000
Fax: 52.81.8144.4010

GRUNDFOS®

PART 1: INTRODUCTION

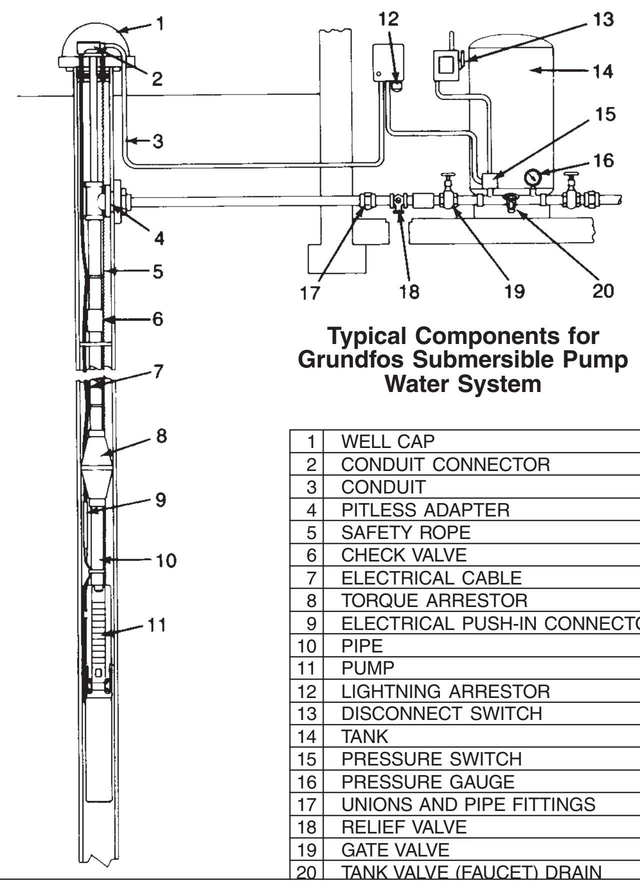
General

This section will provide the technical information needed to properly select GRUNDFOS groundwater products. The information applies primarily to domestic groundwater systems using 4-inch wells with submersible or jet pumps, pressure tanks, and accessories. It is important to be familiar with typical system components and their basic hydraulic principles to ensure a better understanding of the more technical information found later in this section.

Prior to selecting the pump, the basic system requirements must be determined. System capacity and system pressure must be calculated and friction losses determined to ensure proper system performance. These calculations are covered in detail in **Part 1.** In **Part 2**, information is provided on proper cable selection. Also provided in **Part 3** are miscellaneous technical data and formulas commonly used in the selection of domestic groundwater systems.

Typical System Components

Domestic groundwater systems are made up of a pump, storage tank, and accessories to operate the system automatically. Pumps are generally of the submersible or jet variety and include the pump and motor as a unit. Refer to Figure 8-A for the components found in a typical automatic groundwater pumping system.



Typical Components for Grundfos Submersible Pump Water System

1	WELL CAP
2	CONDUIT CONNECTOR
3	CONDUIT
4	PITLESS ADAPTER
5	SAFETY ROPE
6	CHECK VALVE
7	ELECTRICAL CABLE
8	TORQUE ARRESTOR
9	ELECTRICAL PUSH-IN CONNECTOR
10	PIPE
11	PUMP
12	LIGHTNING ARRESTOR
13	DISCONNECT SWITCH
14	TANK
15	PRESSURE SWITCH
16	PRESSURE GAUGE
17	UNIONS AND PIPE FITTINGS
18	RELIEF VALVE
19	GATE VALVE
20	TANK VALVE (FAUCET) DRAIN

FIGURE 8-A
Components found in a typical automatic groundwater pumping system including a submersible pump, pressure tank, and pressure control accessories.

In a ***closed, automatic water system*** a pressure tank is used to store water and maintain system pressure between specified limits (such as 30 to 50 psi). As the water level in the tank rises, tank air is compressed in the upper part of the tank until the upper pressure limit is reached (i.e., 50 psi). At this "cut-out" point a pressure switch opens the electrical circuit to the motor and the pump stops.

The compressed air in the tank acts like a spring pushing down on the water to create system pressure. When a valve is opened in the water system, the air pressure in the upper part of the tank forces the water to flow out of the tank and into the system. As the water is drawn from the tank, the air occupies a larger space and the pressure drops until the lower limit is reached (i.e., 30 psi). At this "cut-in" point the pressure switch closes the electrical circuit to the motor and the pump starts. A cycle is thereby completed.

In an ***open, automatic water system*** the pump is used to fill a large, elevated storage tank which utilizes gravity to maintain system pressure. Tank level controls are used to cycle the pump to maintain water levels within prescribed limits.

Refer to the following illustrations for schematic layouts of typical domestic groundwater systems and components: Figure 8-B (Submersible Pump - Closed System), Figure 8-C (Submersible Pump - Open System), Figure 8-D (Shallow Well Jet Pump), and Figure 8-E (Deep Well Jet Pump).

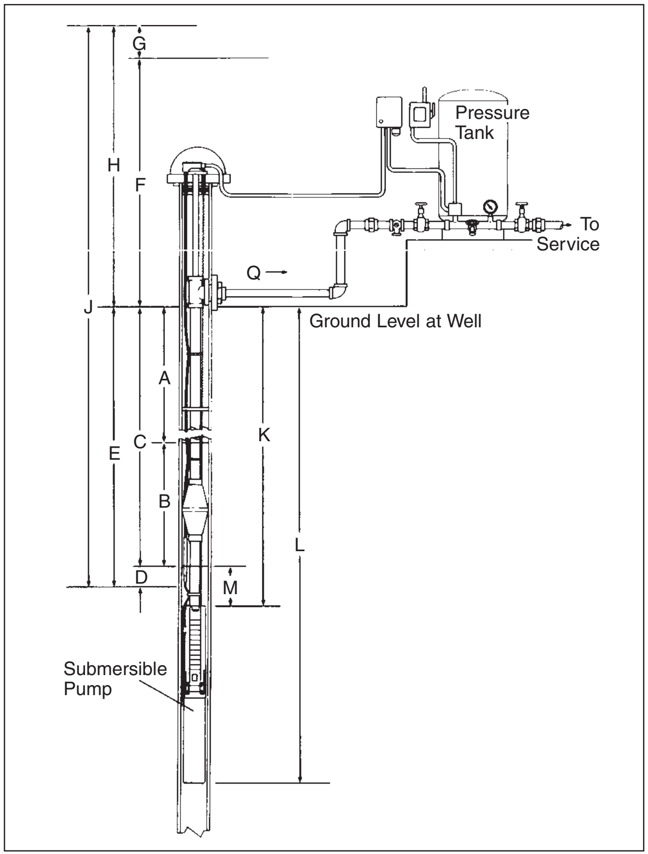


FIGURE 8-B
Figure 8-B illustrates a schematic layout of a CLOSED goundwater pumping system using a submersible pump and pressure tank set for automatic operation. A pressure switch controls the cycling of the pump.

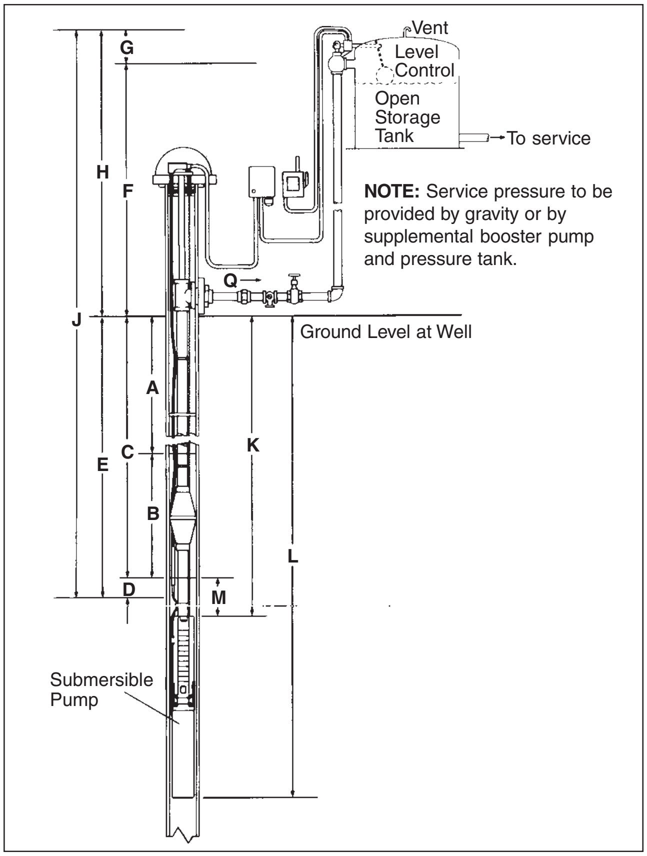


FIGURE 8-C
Figure 8-C illustrates a schematic layout of an OPEN groundwater pumping system using a submersible pump and an elevated storage tank set for automatic operation. A level control on the storage tank controls the cycling of the pump.

Closed Groundwater System with Submersible Pump

A. STATIC WATER LEVEL (in feet): vertical distance from the top of the well to the standing water level or water table.

B. DRAWDOWN (in feet): reduction in the water level during pumping (varies with well yield and pump capacity).

C. PUMPING WATER LEVEL or LIFT (in feet): C = A + B.

D. FRICTION LOSSES in the WELL (in feet): friction losses caused by the drop pipe and fittings between the pump and the top of the well.

E. TOTAL LIFT in the WELL (in feet): E = A + B + D.

F. STATIC DISCHARGE HEAD (in feet): for PRESSURE TANK SYSTEMS it is the elevation rise in feet of the pressure tank, discharge nozzles, etc., above the top of the well plus the pressure (in feet) required at that level.

G. FRICTION LOSSES in the DISCHARGE SYSTEM (in feet): friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.

H. TOTAL DISCHARGE HEAD (in feet): H = F + G.

J. TOTAL PUMPING HEAD (in feet): J = E + H.

K. SETTING OF PUMP (in feet): vertical distance from the top of the well to the top of the pump.

L. OVERALL LENGTH (in feet): vertical distance from the top of the well to the bottom of the pump.

M. SUBMERGENCE (in feet): M = K - C.

Q. CAPACITY (in gpm or gph): rate of pumping.

Open Groundwater System with Submersible Pump

A. STATIC WATER LEVEL (in feet): vertical distance from the top of the well to the standing water level or water table.

B. DRAWDOWN (in feet): reduction in the water level during pumping (varies with well yield and pump capacity).

C. PUMPING WATER LEVEL or LIFT (in feet): C = A + B.

D. FRICTION LOSSES in the WELL (in feet): friction losses caused by the drop pipe and fittings between the pump and the top of the well.

E. TOTAL LIFT in the WELL (in feet): E = A + B + D.

F. STATIC DISCHARGE HEAD (in feet): for OPEN DISCHARGE SYSTEMS it is the elevation of the highest water level above the top of the well.

G. FRICTION LOSSES in the DISCHARGE SYSTEM (in feet): friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.

H. TOTAL DISCHARGE HEAD (in feet): H = F + G.

J. TOTAL PUMPING HEAD (in feet): J = E + H.

K. SETTING OF PUMP (in feet): vertical distance from the top of the well to the top of the pump.

L. OVERALL LENGTH (in feet): vertical distance from the top of the well to the bottom of the pump.

M. SUBMERGENCE (in feet): M = K - C.

Q. CAPACITY (in gpm or gph): rate of pumping.

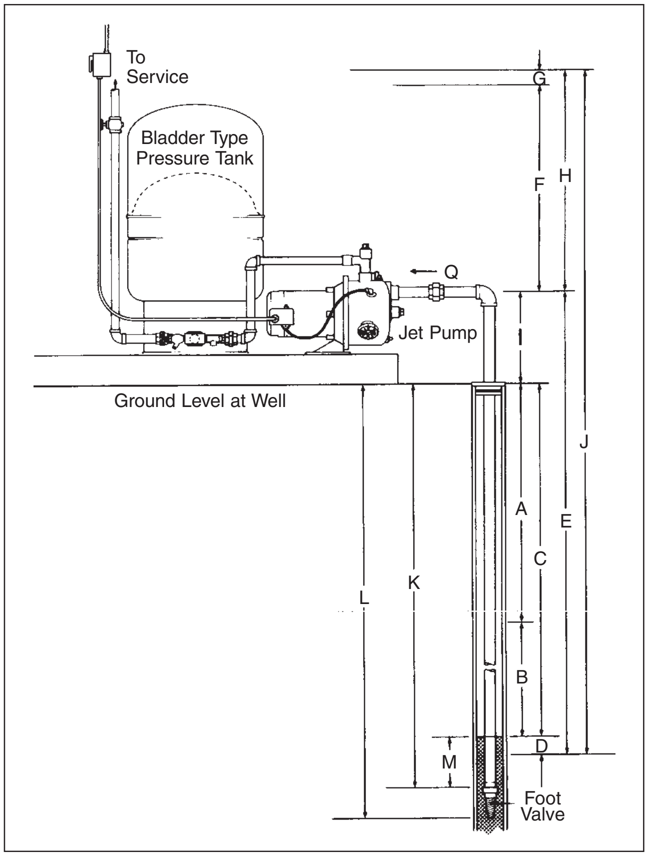


FIGURE 8-D
Figure 8-D illustrates a schematic layout of a SHALLOW WELL groundwater pumping system using a shallow well JET PUMP designed for setting to 25 feet. The pressure tank is set for automatic operation with a pressure switch controlling the cycling of the pump.

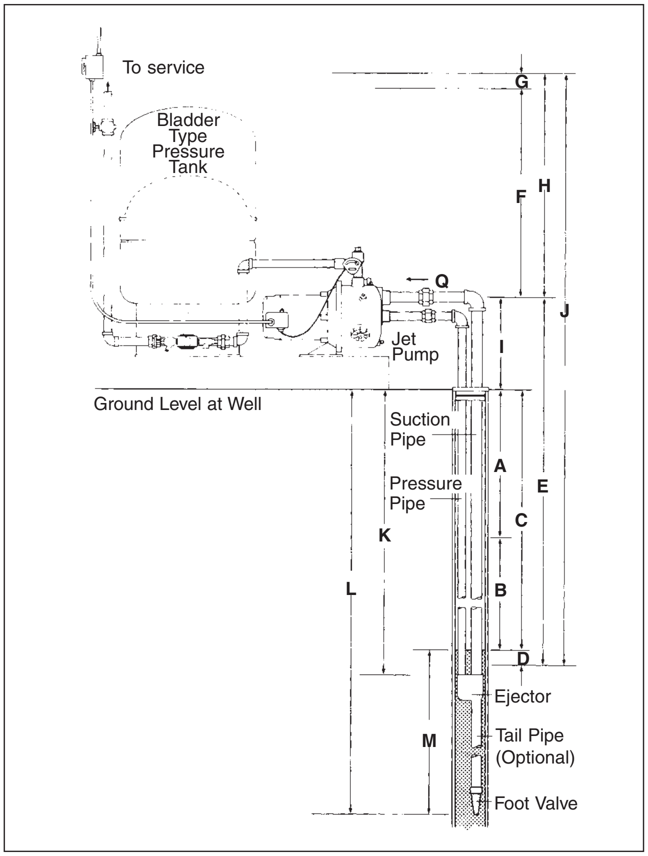


FIGURE 8-E
Figure 8-E illustrates a schematic layout of an DEEP WELL groundwater pumping system using a deep well JET PUMP designed for settings to 100 feet. The pressure tank is set for automatic operation with a pressure switch controlling the cycling of the pump.

CLOSED GROUNDWATER SYSTEM WITH SHALLOW WELL JET PUMP

- **A. Statics Water Level (in feet):** vertical distance from the top of the well to the standing water level or water table.
- **B. Drawdown (in feet):** reduction in the water level during pumping (varies with well yield and pump capacity).
- **C. Pumping Water Level or Lift (in feet):** C = A + B.
- **D. Friction Losses in the Suction System (in feet):** friction losses caused by suction piping between the pump and foot valve.
- **E. Total Suction Lift (in feet):** E = A + B + D + I.
- **F. Static Discharge Head (in feet):** for *Pressure Tanks Systems* it is the elevation rise in feet of the pressure tank, discharge nozzles, etc., above the pump plus the pressure (in feet) discharge nozzles, etc., above the pump plus the pressure (in feet) required at that level. For *Open Discharge Systems* it is the elevation in feet of the highest water level above the pump.
- **G. Friction Losses in the Discharge System (in feet):** friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.
- **H. Total Discharge Head (in feet):** H = F + G.
- **I. Elevation of the Pump above the Top of the Well (in feet).**
- **J. Total Pumping Head (in feet):** J = E + H.
- **K. Setting of the Foot Valve or Strainer (in feet):** vertical distance from the top of the well to the top of the foot valve or strainer.
- **L. Overall Length (in feet):** vertical distance from the top of the well to the bottom of the foot valve or strainer.
- **M. Submergence (in feet):** M = K - C.
- **Q. Capacity (in gpm or gph):** rate of pumping.

CLOSED GROUNDWATER SYSTEM WITH SHALLOW WELL JET PUMP

- **A. Static Water Level (in feet):** vertical distance from the top of the well to the standing water level or water table.
- **B. Drawdown (in feet):** reduction in the water level during pumping (varies with well yield and pump capacity).
- **C. Pumping Water Level or Lift (in feet):** C = A + B.
- **D. Friction Losses in the Suction System (in feet):** friction losses caused by suction piping between the pump and foot valve.
- **E. Total Suction Lift (in feet):** E = A + B + D + I.
- **F. Static Discharge Head (in feet):** for PRESSURE TANK SYSTEMS it is the elevation rise in feet of the pressure tank, discharge nozzles, etc., above the pump plus the pressure (in feet) discharge nozzles, etc., above the pump plus the pressure (in feet) required at that level. For OPEN DISCHARGE SYSTEMS it is the elevation in feet of the highest water level above the pump.
- **G. Friction Losses in the Discharge System (in feet):** friction losses caused by piping, valves, and fittings between the top of the well and the point of discharge.
- **H. Total Discharge Head (in feet):** H = F + G.
- **I. Elevation of the Pump above the Top of the Well (in feet).**
- **J. Total Pumping Head (in feet):** J = E + H.
- **K. Setting of the Foot Valve or Strainer (in feet):** vertical distance from the top of the well to the top of the foot valve or strainer.
- **L. Overall Length (in feet):** vertical distance from the top of the well to the bottom of the foot valve or strainer.
- **M. Submergence (in feet):** M=K–C. The ejector should be set as close to the bottom of its maximum depth rating as the well will permit.
- **Q. Capacity (in gpm or gph):** rate of pumping.

Head and Pressure

Head and pressure are related in a very simple and direct manner. Since water has known weight, we know that a 231 foot long, one-inch square pipe holds 100 pounds of water. At the bottom of the one-inch square pipe we refer to the pressure as 100 pounds per square inch (psi). For any diameter pipe 231 feet high, the pressure will always be 100 psi at the bottom. Refer to Figure 8-F.

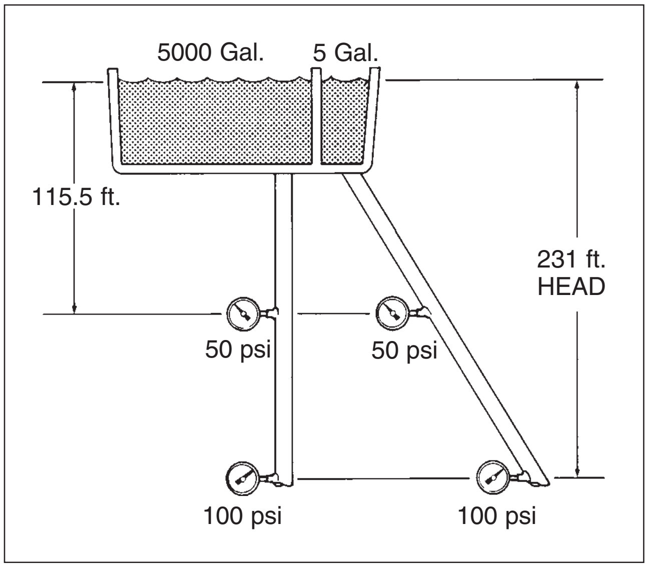


FIGURE 8-F
Figure 8-F illustrates the relationship between head and pressure.

Head is usually expressed in feet and refers to the height, or elevation, of the column of water. In Figure 8-F we see that a column of water 231 feet high creates a pressure reading of 100 psi. That same column of water is referred to as having 231 feet of **head**. Thus, for water, 231 feet of head is equivalent to 100 psi. Or, 2.31 feet of head equals 1 psi.

It should be noted that head and pressure readings for non-flowing water depend on the elevation of the water and not on the volume of water nor the size or length of piping.

Flow and Friction Loss

Flow is measured as the volume of water moved over a given length of time. This is generally referred to as gallons per minute (gpm) for larger flows and gallons per hour (gph) for smaller flows. When water moves through a pipe, it must overcome resistance to flow caused by friction as it moves along the walls of the pipe as well as resistance caused by its own turbulence. Added together, these losses are referred to as **friction losses** and may significantly reduce system pressure.

Figure 8-G illustrates the relationship of flow and friction loss. For any flow through a level pipe the gauge pressure at the pipe inlet will be greater than the gauge pressure at the pipe outlet. The difference is attributed to friction losses caused by the pipe itself and by fittings.

In general, friction losses occur or are increased under the following conditions:

1. Friction losses result from flow through any size or length of pipe (Figure 8-G).
2. Friction losses increase as the flow rate increases or as the pipe size decreases (if the flow rate doubles for a given pipe size, friction losses quadruple, Figure 8-G).
3. Friction losses increase with the addition of valves and fittings to the system (Figure 8-G).

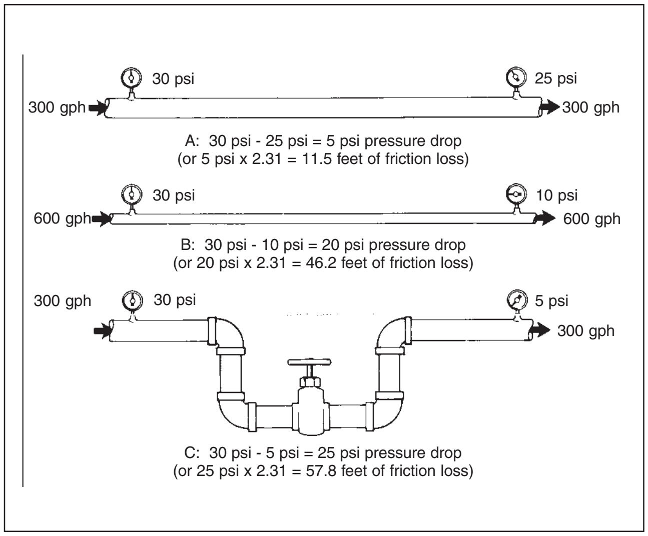


FIGURE 8-G
As shown in these illustrations friction losses increase with additional flow

Power is required to push water to a higher elevation, to increase outlet pressure, to increase flow rates, and to overcome friction losses. Good system design and common sense indicate that friction losses should be minimized whenever possible. The costs of larger pumps, bigger motors, and increased power consumption to overcome friction losses must be balanced against the increased cost of larger, but more efficient, system piping. In either case, unnecessary valves and fittings should be eliminated wherever possible.

Submersible Pumps vs. Jet Pumps

Submersible and jet pumps are both used in domestic groundwater systems. When high flow rates and pressure settings are required at high operating efficiencies, submersible pumps are generally preferred. Submersible pumps have the advantage of performing well both in shallow well applications as well as at depths to 2,000 feet. An extensive range of submersible pump models is also available allowing a precise match to exact system requirements.

Convertible jet pumps are sometimes an economical alternative to submersibles, especially in shallow well installations of 25 feet or less. The pumps are less expensive, installation is simplified, and they are easily converted for deep well installations down to 100 feet (Figure 8-H).

In "weak" well applications where the pump lowers the water level in the well faster than the well can replenish itself, a deep well jet pump with a tail pipe is particularly effective when flow requirements are relatively small. By adding 35 feet of tail pipe below the jet assembly with the foot valve attached to the bottom, it will not be possible to pull the well down and allow air to enter the system. Pump delivery remains at 100% of the rated capacity down to the level of the jet assembly. If the water level falls below that point, flow decreases in proportion to the drawdown as shown in Figure 8-I. When pump delivery equals well inflow, the water level remains constant until the pump shuts off. At 33.9 feet of drawdown the pump will no longer deliver water but the foot valve will remain fully submerged.

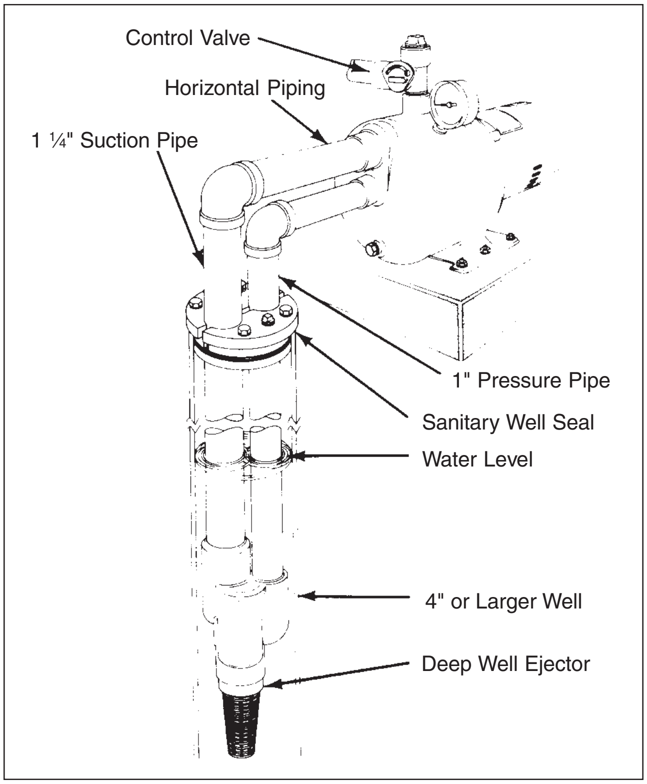


FIGURE 8-H
Figure 8-H illustrates a convertible jet pump set for deep well use (to 100 feet).

Final Pump Selection

Final pump selection will depend upon specific application requirements and cost considerations. Regardless of the pump type, system flow and head requirements (discussed in detail in Part 2) must be determined prior to actual pump selection.

Flow requirement will be determined by the size of the house or farm (including the number of bathrooms, outlets and appliances), the size of family, and the number of farm animals, if applicable.

Total Pumping Head must be calculated to ensure that the pump selected will meet all head or discharge pressure requirements. Total pumping head is the combination of the total suction lift (or lift in well), plus the pump discharge head (consisting of the elevation from the pumping water level to pressure tank plus pressure tank discharge pressure), plus all system friction losses.

Total Dynamic Head is equivalent to total pumping head plus velocity head. In most residential systems, velocity head is negligible. Because of this, the velocity head term has been left out of future examples and formulas. From the information gathered on flow and head requirements, a specific submersible or jet pump may be selected and an appropriately sized pressure tank ordered.

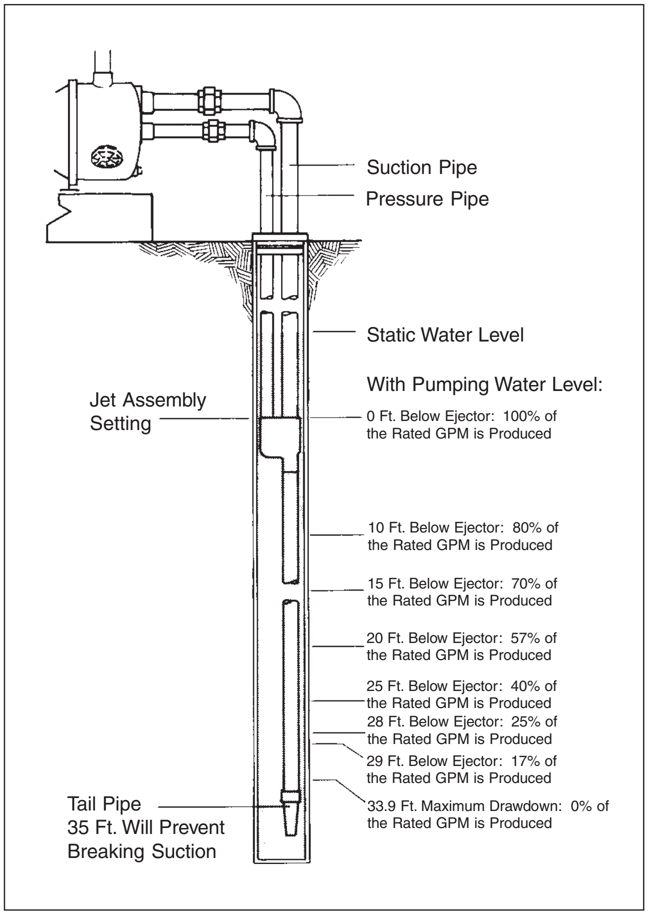


FIGURE 8-I
Figure 8-I illustrates the use of a tail pipe on a deep well convertible jet pump to compensate for weak well conditions.

PART 2: CABLE SELECTION

Submersible Pump Cable Selection Charts (60 Hz)

CABLE LENGTH SELECTION TABLES

The following table (Table 8-Q(2)) lists the recommended copper cable sizes and various cable lengths for submersible pump motors. Proper wire size will ensure that adequate voltage will be supplied to the motor.

This table complies with the 1978 edition of the National Electric Table 310-16, Column 2 for 75°C wire. The ampacities (current carrying properties of a conductor) have been divided by 1.25 per the N.E.C., Article 430-22, for motor branch circuits based on motor amps at rated horsepower.

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

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

CALCULATING MIXED CABLE SIZES

In a submersible pump installation any combination of cable sizes may be used as long as the total percentage length of the individual cables does not exceed 100%. Mixed cable sizes are most often encountered when a pump is being replaced with a larger horsepower model and part of the old cable will be left in place.

In the following example, a 2 HP, 230 volt, 1 phase pump is being installed to replace a smaller model. The 115 feet of buried #12 cable located between the service entrance and the well head will be used in the replacement installation. The well driller must be able to calculate the required size of cable in the well to connect the new motor at a setting of 270 feet.

Cable Size Calculation:
Step 1–Check Table 8-Q(2) to see if the 115 feet of existing #12 cable is large enough to provide current to the larger 2 HP replacement pump. The table tells us that #12 cable is adequate for a maximum length of 250 feet.

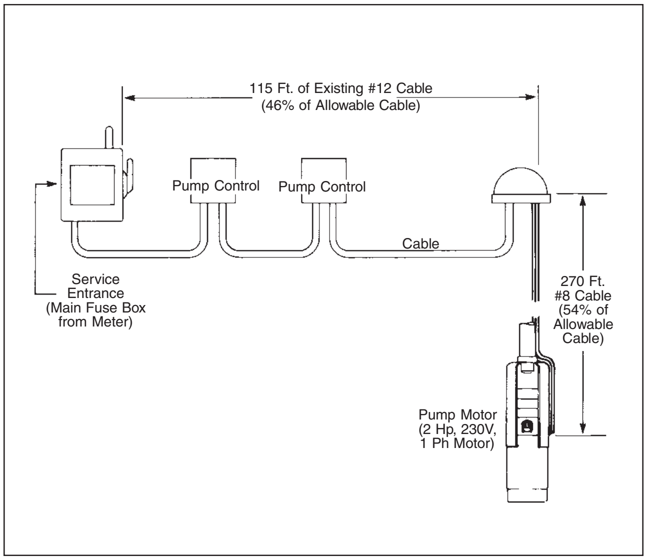


FIGURE 8-Q(1)
Example of Mixed Cable Installation

Step 2–Since 250 feet is the maximum allowable cable length for the #12 cable, calculate the percent used by the 115-foot run. (115 ft. ÷ 250 ft. = 46%)

Step 3–With 46% of the total allowable cable used between the service entrance and the well head, 54% remains for use in the well (100% - 46% = 54%). Therefore, the 270 feet of cable required in the well can utilize only 54% of the total feet allowed in the table.

Step 4–From Table 8-Q(2) determine the proper size cable required for the 2 HP pump set at 270 feet. (Remember, you are limited to 54% of the length listed in the table.) A check of #10 cable at 2 HP indicates that only 210 feet of this cable could be used (390 ft. x 54% = 210 ft.). Since this is less than the 270 required, the next larger size should be tried. For #8 cable, 54% of 620 feet = 335 feet. ***The #8 cable is suitable for use in the well at a pump setting of 270 feet.***

See Chart 8-Q(2) next page.

MAXIMUM MOTOR CABLE LENGTH

(Motor Service to Entrance)

TABLE 8-Q(2)
Single Phase 60Hz

Motor Rating		Copper Wire Size												
Volts	**HP**	**14**	**12**	**10**	**8**	**6**	**4**	**2**	**0**	**00**	**000**	**0000**	**250**	**300**
115	1/3	130	210	340	540	840	1300	1960	2910					
	1/2	100	160	250	390	620	960	1460	2160					
230	1/3	550	880	1390	2190	3400	5250	7960						
	1/2	400	650	1020	1610	2510	3880	5880						
	3/4	300	480	760	1200	1870	2890	4370	6470					
	1	250	400	630	990	1540	2380	3610	5360	6520				
	1½	190	310	480	770	1200	1870	2850	4280	5240				
	2	150	250	390	620	970	1530	2360	3620	4480				
	3	120	190	300	470	750	1190	1850	2890	3610				
	5			180	280	450	710	1110	1740	2170				
	7½				200	310	490	750	1140	1410				
	10					250	390	600	930	1160				

Three Phase 60Hz

Volts	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300
208	1½	310	500	790	1260									
	2	240	390	610	970	1520								
	3	180	290	470	740	1160	1810							
	5		170	280	440	690	1080	1660						
	7½			200	310	490	770	1180	1770					
	10				230	370	570	880	1330	1640				
	15					250	390	600	910	1110	1340			
	20						300	460	700	860	1050	1270		
	25							370	570	700	840	1030	1170	
	30							310	470	580	700	850	970	1110
230	1½	360	580	920	1450									
	2	280	450	700	1110	1740								
	3	210	340	540	860	1340	2080							
	5		200	320	510	800	1240	1900						
	7½			230	360	570	890	1350	2030					
	10				270	420	660	1010	1520	1870				
	15					290	450	690	1040	1280	1540			
	20						350	530	810	990	1200	1450		
	25						280	430	650	800	970	1170	1340	
	30							350	540	660	800	970	1110	1270
460	1½	1700												
	2	1300	2070											
	3	1000	1600	2520										
	5	590	950	1500	2360									
	7½	420	680	1070	1690	2640								
	10	310	500	790	1250	1960	3050							
	15			540	850	1340	2090	3200						
	20			410	650	1030	1610	2470	3730					
	25				530	830	1300	1990	3010	3700				
	30				430	680	1070	1640	2490	3060	3700			
	40						790	1210	1830	2250	2710	3290		
	50						640	980	1480	1810	2190	2650	3010	
	60							830	1250	1540	1850	2240	2540	2890
	75								1030	1260	1520	1850	2100	2400
	100									940	1130	1380	1560	1790
	125											1080	1220	1390
	150												1050	1190
	200												1080	1300
	250													1080
575	1½	2620												
	2	2030												
	3	1580	2530											
	5	920	1480	2330										
	7½	660	1060	1680	2650									
	10	490	780	1240	1950									
	15		530	850	1340	2090								
	20			650	1030	1610	2520							
	25			520	830	1300	2030	3110						
	30				680	1070	1670	2560	3880					
	40					790	1240	1900	2860	3510				
	50						1000	1540	2310	2840	3420			
	60						850	1300	1960	2400	2890	3500		
	75							1060	1600	1970	2380	2890	3290	

CAUTION: Use of wire size smaller than listed will void warranty.

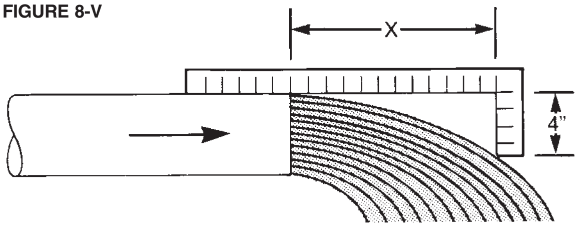
Notes:
1. If aluminum conductor is used, multiply lengths by 0.5 Maximum allowable length of aluminum is considerably shorter than copper wire of same size.
2. The portion of the total cable which is between the service entrance and a 3ø motor starter should not exceed 25% of the total maximum length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

Calculating Discharge Rate by Using The Horizontal Open Discharge Method

The most reliable method of measuring flow is to use a flow meter. When a flow meter is not available, however, it is possible to estimate the discharge capacity by constructing an “L” shaped measuring stick similar to that shown in Figure 8-V. With the water flowing from the pipe, place the long end of the “L” on top of the pipe. Position the “L” so that the end of the short 4-inch side just touches the stream of water as the stream slants downward. Note the horizontal distance “X” from this point to the open end of the discharge pipe. With the value “X” and and the nominal inside diameter of the pipe, use Table 8-X to find the discharge rate in gallons per minute.

EXAMPLE: Horizontal distance ”X” is measured to be 12 inches. The size of the pipe Is known to be 1½" (nominal diameter). Find 12 inches in the left hand column of the chart and move across to the 1½" pipe size column. Table 8-X indicates that the discharge rate is 40.0 gallons per minute.

FIGURE 8-V



Calculating Low Capacity Outlets: A simple procedure for measuring low capacity outlets such as small pump outlets, hose spigots, and faucets is to record the amount of time it takes to fill a container of known size.

EXAMPLE: Select a container of known size such as a 5-gallon paint bucket. With a watch, measure, in seconds, the amount of time it takes to fill the bucket. If it takes 30 seconds to fill a 5-gallon bucket, Table 8-W indicates that the flow is 10.0 gallons per minute. To obtain gallons per hour (gph) multiply 10.0 x 60 to obtain 600 gph.

TABLE 8-W

Discharge Rate in Gallons Per Minute (GPM) for Low Capacity Systems

Capacity of Container (Gallons)	Time (in seconds) to Fill Container							
	10	15	20	30	45	60	90	120
	Discharge Rate in Gallons Per Minute (GPM)							
1	6.0	4.0	3.0	2.0	1.3	1.0	.7	.5
3	18.0	12.0	9.0	6.0	4.0	3.0	2.0	1.5
5	30.0	20.0	15.0	10.0	6.7	5.0	3.3	2.5
10	60.0	40.0	30.0	20.0	13.3	10.0	6.7	5.0

NOTE: Multiply gallons per minute (GPM) by 60 to obtain gallons per hour (GPH).

Calculating Distance to Water Level

Install ⅛" or ¼" pipe or tubing into the well so that the end of the tubing extends 10 to 20 feet below the lowest possible pumping water level. Be sure that all joints in the tubing are airtight. As the tubing is lowered into the well measure its length. Record the measurement.

TABLE 8-X

Discharge Rate in Gallons Per Minute (GPM) for Large Capacity Systems

Horiz. Dist. (X) Inches	Nominal Pipe Size (in Inches)									
	1	1 ¼"	1 ½"	2"	2 ½"	3"	4"	5"	6"	8"
	Discharge Rate in Gallons Per Minute (GPM)									
4	5.7	9.8	13.3	22.0	31	48	83			
5	7.1	12.2	16.6	27.5	39	61	104	163		
6	8.5	14.7	20.0	33.0	47	73	125	195	285	
7	10.0	17.1	23.2	38.5	55	85	146	228	334	380
8	11.3	19.6	26.5	44.0	62	97	166	260	380	665
9	12.8	22.0	29.8	49.5	70	110	187	293	430	750
10	14.2	24.5	33.2	55.5	78	122	208	326	476	830
11	15.6	27.0	36.5	60.5	86	134	229	360	525	915
12	17.0	29.0	40.0	66.0	94	146	250	390	570	1000
13	18.5	31.5	43.0	71.5	102	158	270	425	620	1080
14	20.0	34.0	46.5	77.0	109	170	292	456	670	1160
15	21.3	36.3	50.0	82.5	117	183	312	490	710	1250
16	22.7	39.0	53.0	88.0	125	196	334	520	760	1330
17		41.5	56.5	93.0	133	207	355	550	810	1410
18			60.0	99.0	144	220	375	590	860	1500
19				100.0	148	232	395	620	910	1580
20					156	244	415	650	950	1660
21						256	435	685	1000	1750

Once the tubing is fixed in a stationary position at the top of the well, connect an air line and pressure gauge. With a tire pump or other air supply, pump air into the line until the pressure gauge reaches a point where it doesn't read any higher. Record the pressure gauge reading at this point.

Figure 8-Y illustrates a typical method for measuring distance to water level:

X = Distance to water level (in feet). This figure to be determined.

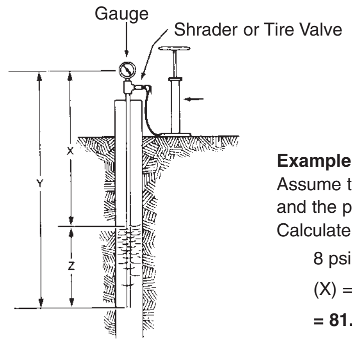
Y = Total length of air line (in feet).

Z = Length of submerged air line. This value is obtained from the pressure gauge reading which reads in pounds per square inch (psi). Multiply the pressure gauge reading by 2.31 to obtain the length of the submerged air line in feet.

Distance to water level (X) = (Y) - (Z)
= The total length of the air line (Y) minus the length of the submerged portion of the air line (Z).

Figure 8-Y

Calculating the distance to water level.



Example:
Assume that the air line is 100 feet long and the pressure gauge reads 8 psi. Calculate the distance to water level (X).

8 psi x 2.31 = 18.5 feet

(X) = 100 feet (Y) - 18.5 feet (Z)

= 81.5 feet = distance to water level

FORMULAS

TEMPERATURE CONVERSIONS:

$$\text{Degrees } \mathbf{C} = \frac{5}{9} \times (\text{Degrees F} - 32)$$

$$\text{Degrees } \mathbf{F} = \left(\frac{9}{5} \times \text{Degrees C}\right) + 32$$

Area of a Circle:

Area = πr^2

Circumference of a Circle:

Circumference = $2 \pi r$

r = radius

π = 3.14

Volume of a Tank or Cistern:

3.14 x (radius of tank)^2 x (ht. of tank) x 7.48 = Gallons
Radius and height of tank measured in feet
7.48 = number of gallons per cubic foot of water

WORK, POWER, AND EFFICIENCY:

The amount of work required to lift 1 pound to a height of 1 foot is defined as 1 ft.-lb. To lift 100 pounds to a height of 60 feet is 100 pounds x 60 feet = 6,000 ft-lbs. This amount of energy remains the same whether it takes one minute or one hour to lift the weight. The rate of working, however, is referred to as **power** and was 6,000 ft-lbs. per minute in the first case and 100 foot pounds per minute in the second case.

Power can be represented either mechanically or electrically. **Mechanical power** is measured in horsepower (HP). One HP is the theoretical power required to raise 33,000 pounds to a height of one foot in one minute, or:

1 HP = 33,000 ft.-lb./minute
= 550 ft.-lb./second

Electrical power is measured in watts(w) or kilowatts(kw), and:

1,000 w = 1 kw = 1.34 hp, or
1 HP = 745 w = 0.746 kw

WATER HORSEPOWER (WHP):

Water horsepower is the power required to raise water at a specified rate against a specified head, assuming 100% efficiency.

$$\text{WHP} = \frac{\text{GPM x Total Pumping Head}}{3{,}960}$$

BRAKE HORSEPOWER (BHP):

Brake horsepower is based on test data and can be either the horsepower developed at the motor shaft (motor output) or that absorbed at the pump shaft (pump input).

$$\text{Pump BHP} = \frac{\text{WHP x 100}}{\text{Pump Efficiency (\%)}}$$

$$= \frac{\text{GPM x Total Pumping Head x 100}}{\text{3,960 x Pump Efficiency (\%)}}$$

$$\text{Motor BHP} = \frac{\text{Power input x Motor Efficiency (\%)}}{100}$$

$$= \frac{\text{1.34 x kw input x Motor Efficiency (\%)}}{100}$$

PUMP EFFICIENCY:

Pumps and motors, like all machines, are not 100% efficient. Not all of the energy supplied to them is converted into useful work. Pump efficiency is the ratio of power output to power input, or:

$$\text{Efficiency (\%)} = \frac{\text{Power Output x 100}}{\text{Power Input}}$$

$$\text{Pump Eff. (\%)} = \frac{\text{WHP x 100}}{\text{Pump BHP (Input)}}$$

$$= \frac{\text{GPM x Total Pumping Head x 100}}{\text{3960 x Pump BHP (Input)}}$$

$$\text{Motor Eff. (\%)} = \frac{\text{Motor BHP (Output) x 100}}{\text{1.34 x kw input}}$$

$$\text{Plant Eff. (\%)} = \frac{\text{GPM x Total Pumping Head x 100}}{\text{5,300 x kw Input}}$$

ELECTRIC POWER (AC):

E = Electrical pressure (volts). Similar to hydraulic head.

I = Electrical current (amps). Similar to rate of flow.

W = Electrical power (watts) = E x I x PF

kw = Kilowatt (1,000 watts)

kw-hr. = Kilowatt-hour = 1,000 watts for one hour

Apparent Power = E x I = volt-amperes

PF = Power Factor = Useful Power ÷ Apparent Power

Power Calculations for Single-Phase Power
W (Watts) = E x I x PF
NOTE: When measuring single-phase power use a single-phase wattmeter.

Input HP to motor = W ÷ 746 = 1.34 x kw

Power Calculations for Three-Phase Power
W (Watts) = 1.73 x E x I x PF
Where: E = effective (RMS) voltage between phases
I = average current in each phase
NOTE: When measuring three-phase power use either (1) three-phase wattmeter, (2) single-phase wattmeters, or the power company's revolving disc wattmeter.

When calculating power with a revolving disc wattmeter use the following formulas:

$$\text{kw input} = \frac{\text{K x R x 3.60}}{t}$$

$$\text{Input HP (to motor)} = \frac{\text{K x R x 3,600}}{\text{746 x t}}$$

$$= \frac{\text{K x R x 4.83}}{t}$$

FORMULAS

Motor BHP (output) = $\dfrac{\text{Input HP x Motor Eff.(\%)}}{100}$

Where K = Meter constant = watts per revolution of revolving disc (value of K is marked on the meter nameplate or on the revolving disc). Where current transformers are used, multiply meter constant by current transformer ratio.

R = Number of disc revolutions counted.

t = Time in seconds for R revolutions.

CALCULATING OPERATING COSTS OF PUMPS:
Costs in Cents per 1,000 Gallons:

Cost (¢) = $\dfrac{\text{kw Input x r x 1,000}}{\text{GPH}}$

Cost in Cents per Acre-Inch

Cost (¢) = $\dfrac{\text{kw Input x r x 452.6}}{\text{GPM}}$

Where: r = cost of power in cents per kw-hr.

FRICTION LOSS TABLES

Friction Loss Table – SCH 40 STEEL PIPE

(Friction Loss in Feet of Head Per 100 Feet of Pipe)

GPM	GPH	1/2" ID 0.622"	3/4" ID 0.824"	1" ID 1.049"	1 1/4" ID 1.380"	1 1/2" ID 1.610"	2" ID 2.067"	2 1/2" ID 2.469"	3" ID 3.068"	4" ID 4.026"
2	120	4.8								
3	180	10	2.5							
4	240	17.1	4.2							
5	300	25.8	6.3	1.9						
6	360	36.5	8.9	2.7						
7	420	48.7	11.8	3.6						
8	480	62.7	15	4.5						
9	540	78.3	18.8	5.7						
10	600	95.9	23	6.9	1.8					
12	720		32.6	9.6	2.5	1.2				
14	840		43.5	12.8	3.3	1.5				
16	960		56.3	16.5	4.2	2				
20	1,200		86.1	25.1	6.3	2.9				
25	1,500			38.7	9.6	4.5	1.3			
30	1,800			54.6	13.6	6.3	1.8			
35	2,100			73.3	18.2	8.4	2.4			
40	2,400			95	23.5	10.8	3.1	1.3		
45	2,700				29.4	13.5	3.9	1.6		
50	3,000				36	16.4	4.7	1.9		
60	3,600				51	23.2	6.6	2.7		
70	4,200				68.8	31.3	8.9	3.6	1.2	
80	4,800				89.2	40.5	11.4	4.6	1.6	
90	5,400					51	14.2	5.8	2	
100	6,000					62.2	17.4	7.1	2.4	
120	7,200						24.7	10.1	3.4	
140	8,400						33.2	13.5	4.5	1.2
160	9,600						43	17.5	5.8	1.5
200	12,000						66.3	27	8.9	2.3
260	15,600							45	14.8	3.7
300	18,000							59.6	19.5	4.9

Friction Loss Table – SCH 40 PVC

(Friction Loss in Feet of Head Per 100 Feet of Pipe)

GPM	GPH	1/2" ID 0.622"	3/4" ID 0.824"	1" ID 1.049"	1 1/4" ID 1.380"	1 1/2" ID 1.610"	2" ID 2.067"	2 1/2" ID 2.469"	3" ID 3.068"	4" ID 4.026"
2	120	4.1								
3	180	8.7	2.2							
4	240	14.8	3.7							
5	300	22.2	5.7	1.8						
6	360	31.2	8	2.5						
7	420	41.5	10.6	3.3						
8	480	53	13.5	4.2						
9	540	66	16.8	5.2						
10	600	80.5	20.4	6.3	1.7					
12	720		28.6	8.9	2.3	1.1				
14	840		38	11.8	3.1	1.4				
16	960		48.6	15.1	4	1.9				
20	1,200		60.5	22.8	6	2.8				
25	1,500			38.7	9.1	4.3	1.3			
30	1,800				12.7	6	1.8			
35	2,100				16.9	8	2.4			
40	2,400				21.6	10.2	3	1.1		
45	2,700				28	12.5	3.8	1.4		
50	3,000					15.4	4.6	1.7		
60	3,600					21.6	6.4	2.3		
70	4,200					28.7	8.5	3	1.2	
80	4,800					36.8	10.9	3.8	1.4	
90	5,400					45.7	13.6	4.8	1.8	
100	6,000					56.6	16.5	5.7	2.2	
120	7,200						23.1	8	3	
140	8,400						30.6	10.5	4	1.1
160	9,600						39.3	13.4	5	1.4
200	12,000						66.3	20.1	7.6	2.1
260	15,600							32.4	12.2	3.4
300	18,000							42.1	15.8	4.4

Friction Loss Table – VALVES and FITTINGS

(Friction Loss in Equivalent Number of Feet of Straight Pipe)

TYPE OF FITTING AND APPLICATION	PIPE AND FITTING	NOMINAL SIZE OF FITTING AND PIPE						
		1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"
		EQUIVALENT LENGTH OF PIPE(IN FEET)						
Insert Coupling	Plastic	3	3	3	3	3	3	3
Threaded Adapter (Plastic to Thread)	Plastic	3	3	3	3	3	3	3
90° Standard Elbow	Steel	2	2	3	4	4	5	6
	Plastic	2	2	3	4	4	5	6
Standard Tee (Flow Through Run)	Steel	1	2	2	3	3	4	4
	Plastic	1	2	2	3	3	4	4
Standard Tee (Flow Through Side)	Steel	4	5	6	7	8	11	13
	Plastic	4	5	6	7	8	11	13
Gate Valve[1]	Steel	1	1	1	1	2	2	2
Swing Check Valve[1]	Steel	5	7	9	12	13	17	21

NOTES:

Based on schedule 40 steel and plastic fittings.

Figures given are friction losses in terms of Equivalent Lenghts of straight pipe.

① Friction loss figures are for screwed valves and are based on equivalent lengths of steel pipe.

CONVERSION TABLES

UNITS OF FLOW

CONVERT TO ➧ / CONVERT FROM ⬇	U.S. GALLONS PER MINUTE	MILLION U.S. GALLONS PER DAY	CUBIC FEET PER SECOND	CUBIC METERS PER HOUR	LITERS PER SECOND
	MULTIPLY BY:				
(1) U.S. GALLON PER MINUTE	1	0.001440	0.00223	0.2271	0.0631
(1) MILLION U.S. GALLONS PER DAY	694.5	1	1.547	157.7	43.8
(1) CUBIC FOOT PER SECOND	448.83	0.646	1	101.9	28.32
(1) CUBIC METER PER HOUR	4.403	0.00634	0.00982	1	0.2778
(1) LITER PER SECOND	15.85	0.0228	0.0353	3.60	1

UNITS OF PRESSURE AND HEAD

CONVERT TO ➧ / CONVERT FROM ⬇	LBS. PER SQUARE INCH	FEET OF WATER ①	METERS OF WATER ①	INCHES OF MERCURY ②	ATMOSPHERES	KILOGRAMS PER SQUARE CM
	MULTIPLY BY:					
(1) LB. PER SQUARE INCH	1	2.31	0.704	2.04	0.0680	0.0703
(1) FOOT OF WATER ①	0.433	1	0.305	0.881	0.02945	0.0304
(1) METER OF WATER ①	1.42	3.28	1	2.89	0.0966	.1
(1) INCH OF MERCURY ②	0.491	1.135	0.346	1	0.0334	0.0345
(1) ATMOSPHERE (at Sea Level)	14.70	33.96	10.35	29.92	1	1.033
(1) KILOGRAM PER SQUARE CM	14.22	32.9	10	28.96	0.968	1

NOTES: ① Equivalent units are based on density of fresh water at 68°F.
② Equivalent units are based on density of mercury at 32°F.
Each 1,000 feet of ascent decreases pressure about ½ pound per square inch.

UNITS OF VOLUME AND WEIGHT

CONVERT TO ➧ / CONVERT FROM ⬇	U.S. GALLONS	IMPERIAL GALLONS	CUBIC INCHES	CUBIC FEET	ACRE FEET	POUNDS ③	CUBIC METERS	LITERS
(1) U.S. GALLON	1	0.833	231	0.1337	3.07×10^{-6}	8.34	0.003785	3.785
(1) IMPERIAL GALLON	1.201	1	277.4	0.1605	3.69×10^{-6}	10.01	0.004546	4.546
(1) CUBIC INCH	0.00433	0.00360	1	0.000579	—	0.0361	1.64×10^{-5}	0.0164
(1) CUBIC FOOT	7.48	6.23	1728	1	2.30×10^{-5}	62.4	0.02832	28.32
(1) ACRE FOOT	325,850	271,335	—	43,560	1	2.7×10^{6}	1233.5	1.23×10^{6}
(1) POUND ③	0.120	0.0998	27.7	0.0160	3.68×10^{-7}	1	4.54×10^{-4}	0.454
(1) CUBIC METER	264.2	220	61,024	35.315	8.11×10^{-4}	2202	1	1000
(1) LITER	0.2642	0.220	61.024	0.0353	8.11×10^{-7}	2.202	0.001	1

NOTES: ③ Weight equivalent basis water at 60°F.

UNITS OF LENGTH

(1) Inch = 0.0833 Ft. = 0.0278 Yd. = 25.4 mm = 2.54 cm
(1) Ft. = 12 Inches = 0.333 Yd. = 30.48 cm = 0.3048 Meter
(1) Yard = 36 Inches = 3 Ft. = 91.44 cm = 0.9144 Meters

(1) Mile = 5280 Ft. = 1760 Yds. = 1.61 km = 1609 Meters
(1) Meter = 3.281 Ft. = 39.37 In. = 0.000621 Miles = 0.001 km
(1) Kilometer = 1000 m = 1093.61 Yds. = 0.62137 Miles = 3281 Ft.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

L-SP-PG-001	2/06
PRINTED IN USA	

Subject to alterations.

U.S.A.
GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Phone: (913) 227-3400
Telefax: (913) 227-3500

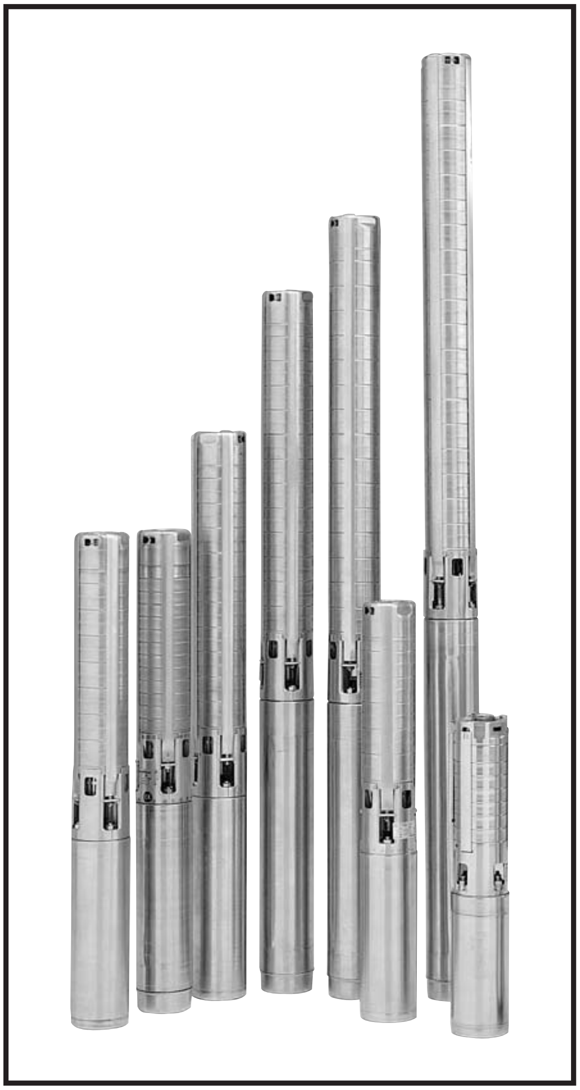
Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: (905) 829-9533
Telefax: (905) 829-9512

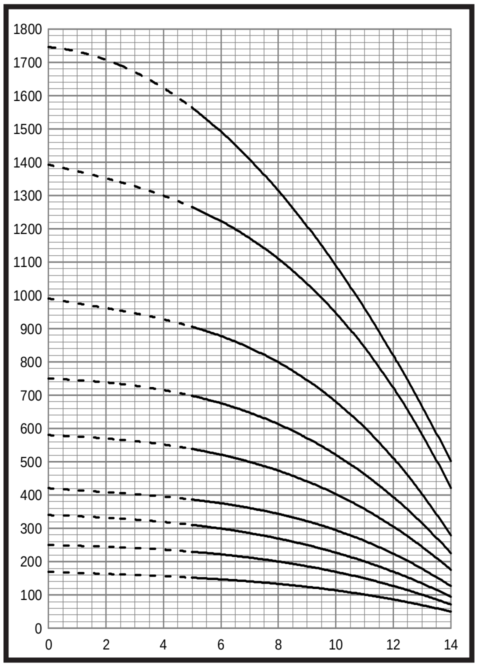
Mexico
Bombas GRUNDFOS de Mexico S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
C.P. 66600 Apodaca, N.L. Mexico
Phone: 011-52-81-8144 4000
Telefax: 011-52-81-8144 4010

www.grundfos.com

GRUNDFOS®

Easy Selection Chart
Performance Curves and Technical Data
4-Inch Submersible Pumps





Performance Curves


Materials of Construction

Grundfos Stainless Steel Submersible Pumps

4" Submersible
Easy Selection Charts.

5 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE

(1.2 TO 7 GPM)

PUMP OUTLET
1 " NPT

PUMP MODEL	HP	PSI	DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																							
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
5S03-9	1/3	0				7.1	6.7	6.2	5.8	5.3	4.8	4.3	3.2	2.1													
		20		7.0	6.6	6.1	5.7	5.2	4.6	4.0	2.8	1.6															
		30		6.5	6.0	5.6	5.1	4.6	3.8	2.9	1.5																
		40	6.7	6.0	5.5	5.1	4.4	3.8	2.4																		
		50	6.2	5.5	4.9	4.4	3.4	2.5	1.3																		
		60	5.6	4.9	4.2	3.5	1.9																				
SHUT-OFF PSI:			102	94	85	76	68	59	50	42	33	24	16	7													
5S05-13	1/2	0						7.1	6.8	6.4	6.1	5.8	5.5	5.2	4.8	4.5	3.9	2.3									
		20			7.3	7.0	6.7	6.3	6.0	5.7	5.4	5.1	4.7	4.3	3.7	3.1	2.0										
		30		7.2	6.9	6.6	6.3	6.0	5.7	5.4	5.0	4.7	4.2	3.7	2.8	2.0											
		40	7.2	6.9	6.6	6.3	5.9	5.6	5.3	5.0	4.6	4.2	3.5	2.8	1.6												
		50	6.8	6.5	6.2	5.9	5.6	5.3	4.9	4.6	4.0	3.5	2.6	1.6													
		60	6.5	6.2	5.8	5.5	5.2	4.9	4.5	4.0	3.3	2.6	1.3														
SHUT-OFF PSI:			152	143	134	126	117	108	100	91	82	74	65	56	48	39	30	13									
5S07-18	3/4	0								7.1	6.9	6.7	6.4	6.2	6.0	5.8	5.6	5.1	4.2	2.7							
		20						7.1	6.8	6.6	6.4	6.2	5.9	5.7	5.5	5.3	5.0	4.5	3.2								
		30					7.0	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.2	5.0	4.7	4.0	2.5								
		40			7.2	7.0	6.8	6.5	6.3	6.1	5.9	5.6	5.4	5.2	4.9	4.7	4.4	3.5	1.5								
		50		7.2	7.0	6.7	6.5	6.3	6.1	5.8	5.6	5.4	5.1	4.9	4.6	4.3	3.9	2.9									
		60	7.1	6.9	6.7	6.5	6.2	6.0	5.8	5.6	5.3	5.1	4.9	4.6	4.3	3.9	3.4	2.1									
SHUT-OFF PSI:			213	204	195	187	178	169	161	152	143	135	126	117	109	100	91	74	48	22							
5S10-22	1	0										7.1	6.9	6.7	6.6	6.4	6.2	5.8	5.3	4.7	3.8	1.7					
		20								7.1	6.9	6.7	6.5	6.3	6.1	6.0	5.8	5.4	4.8	4.0	2.8						
		30							7.0	6.8	6.7	6.5	6.3	6.1	5.9	5.7	5.6	5.2	4.6	3.6	2.1						
		40						7.0	6.8	6.6	6.5	6.3	6.1	5.9	5.7	5.5	5.4	5.0	4.3	3.1	1.3						
		50				7.2	7.0	6.8	6.6	6.4	6.2	6.1	5.9	5.7	5.5	5.3	5.1	4.7	3.9	2.5							
		60			7.1	6.9	6.8	6.6	6.4	6.2	6.0	6.0	5.7	5.5	5.3	5.1	4.9	4.4	3.5	1.7							
SHUT-OFF PSI:					245	237	228	219	211	202	194	185	176	168	159	150	142	124	98	72	46	12					
5S15-26	1 1/2	0												7.1	7.0	6.8	6.7	6.4	5.9	5.4	4.9	4.1	2.1				
		20										7.1	6.9	6.8	6.6	6.5	6.3	6.0	5.5	5.1	4.5	3.4					
		30									7.1	6.9	6.7	6.6	6.4	6.3	6.1	5.8	5.4	4.8	4.2	2.9					
		40								7.0	6.9	6.7	6.6	6.4	6.3	6.1	6.0	5.6	5.2	4.6	5.6	2.4					
		50							7.0	6.9	6.7	6.5	6.4	6.2	6.1	5.9	5.8	5.5	5.0	4.4	3.6	1.7					
		60						7.0	6.8	6.7	6.5	6.4	6.2	6.1	5.9	5.8	5.6	5.3	4.8	4.1	3.1						
SHUT-OFF PSI:								269	260	252	243	234	226	217	208	200	191	174	148	122	96	61	18				
5S15-31	1 1/2	0														7.1	7.0	6.7	6.3	5.9	5.5	6.7	4.1	2.6			
		20												7.1	6.9	6.8	6.7	6.4	6.0	5.6	5.2	4.6	3.5	1.6			
		30											7.0	6.9	6.8	6.6	6.5	6.2	5.9	5.5	5.1	4.4	3.2	0.9			
		40										7.0	6.9	6.8	6.6	6.5	6.4	6.1	5.7	5.3	4.9	4.2	2.8				
		50								7.1	7.0	6.9	6.7	6.6	6.5	6.3	6.2	6.0	5.6	5.2	4.7	4.0	2.3				
		60							7.1	7.0	6.8	6.7	6.6	6.5	6.3	6.2	6.1	5.8	5.4	5.0	4.5	3.7	1.7				
SHUT-OFF PSI:									320	311	303	294	285	277	268	259	251	233	207	181	155	121	77	34			

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

7S EASY SELECTION CHART

7 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE

(3 TO 10 GPM)

PUMP OUTLET
1 " NPT

DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
7S03-8	1/3	20	10.0	9.5	8.7	8.0	7.2	6.4	5.0	3.7	1.8																
		30	9.3	8.7	7.9	7.1	6.1	5.1	2.6																		
		40	8.5	7.8	7.0	6.1	4.5	2.9	1.5																		
		50	7.6	6.9	5.8	4.7	2.3																				
		60	6.7	5.8	3.9	2.0																					
SHUT-OFF PSI:			86	77	69	60	52	43	34	26	17	8															
7S05-11	1/2	0					9.9	9.5	8.9	8.4	7.8	7.3	6.7	6.0	5.0	4.0											
		20			9.8	9.3	8.8	8.2	7.7	7.1	6.5	5.8	4.7	3.5	1.8												
		30	10.1	9.7	9.2	8.7	8.1	7.6	7.0	6.4	5.6	4.7	2.9														
		40	9.6	9.2	8.6	8.1	7.5	6.9	6.2	5.6	4.3	3.0	1.5														
		50	9.1	8.5	8.0	7.4	6.8	6.2	5.3	4.3	2.2																
		60	8.4	7.9	7.3	6.8	6.0	5.3	3.8	2.3																	
SHUT-OFF PSI:			122	113	105	96	87	79	70	61	53	44	35	27	18	10											
7S07-15	3/4	0						10.2	9.9	9.5	9.2	8.8	8.4	8.0	7.6	7.1	6.7	5.6	2.9								
		20				10.1	9.8	9.4	9.0	8.6	8.2	7.8	7.4	7.0	6.5	6.1	5.4	3.6									
		30			10.0	9.7	9.4	9.0	8.6	8.2	7.8	7.4	6.9	6.5	5.9	5.4	4.5	1.8									
		40		10.0	9.7	9.3	8.9	8.5	8.1	7.7	7.3	6.9	6.4	5.9	5.2	4.5	3.2	1.0									
		50	9.9	9.6	9.2	8.9	8.5	8.1	7.6	7.2	6.8	6.4	5.8	5.2	4.2	3.2	1.6										
		60	9.5	9.2	8.8	8.4	8.0	7.6	7.2	6.7	6.2	5.7	4.9	4.2	2.8	1.4											
SHUT-OFF PSI:			170	101	153	144	135	127	118	110	101	92	84	75	66	58	49	32	6								
7S10-19	1	0								10.1	9.8	9.6	9.3	9.0	8.7	8.4	8.0	7.4	6.4	4.8							
		20						10.0	9.8	9.5	9.2	8.9	8.6	8.3	7.9	7.6	7.3	6.6	5.3	2.8							
		30					10.0	9.7	9.5	9.2	8.9	8.5	8.2	7.9	7.6	7.3	6.9	6.2	4.6	1.4							
		40				10.0	9.7	9.4	9.1	8.8	8.5	8.2	7.8	7.5	7.2	6.9	6.5	5.6	3.7								
		50		10.2	9.9	9.7	9.4	9.1	8.8	8.4	8.1	7.8	7.5	7.2	6.8	6.5	6.0	5.0	2.4								
		60	10.1	9.9	9.6	9.3	9.0	8.7	8.4	8.1	7.8	7.4	7.1	6.8	6.4	6.0	5.5	4.2									
SHUT-OFF PSI:			218	209	200	192	183	174	166	157	148	140	131	123	114	105	97	79	53	27							
7S15-26	1 1/2	0											10.1	9.9	9.7	9.5	9.3	8.8	8.1	7.4	6.7	5.5					
		20									10.0	9.8	9.6	9.4	9.2	9.0	8.8	8.3	7.6	6.9	6.1	4.4					
		30								10.0	9.8	9.6	9.4	9.2	9.0	8.7	8.5	8.0	7.3	6.6	5.7	3.7					
		40						10.1	10.0	9.8	9.6	9.4	9.1	8.9	8.7	8.5	8.2	7.8	7.1	6.3	5.2	2.9					
		50					10.1	9.9	9.7	9.6	9.3	9.1	8.9	8.7	8.4	8.2	8.0	7.5	6.8	5.9	4.7	1.9					
		60				10.1	9.9	9.7	9.5	9.3	9.1	8.9	8.6	8.4	8.2	7.9	7.7	7.2	6.5	5.5	4.1						
SHUT-OFF PSI:						274	265	257	248	239	231	222	213	205	196	187	179	161	135	110	84	49					
7S20-32	2	0	0										10.6	10.5	10.4	10.4	10.3	10.1	9.6	9.1	8.4	7.3	5.7				
		20	46.2								10.5	10.5	10.4	10.3	10.3	10.2	10.0	9.8	9.2	8.6	7.8	6.6	4.8				
		30	69.3							10.5	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.6	9.0	8.3	7.5	6.2	4.3				
		40	92.4						10.5	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.7	9.4	8.8	8.0	7.2	5.8	3.9				
		50	116						10.5	10.4	10.3	10.2	10.1	10.0	9.8	9.7	9.5	9.1	8.5	7.7	6.8	5.4	3.3				
		60	139					10.5	10.4	10.3	10.2	10.1	10.0	9.8	9.7	9.5	9.3	8.9	8.2	7.4	6.4	5.0					
SHUT-OFF PSI:							343	334	326	317	308	300	291	282	274	265	256	239	213	187	161	126	83				

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

10 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE

(5 TO 14 GPM)

PUMP OUTLET
1 1/4" NPT

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																								
PUMP MODEL	**HP**	**PSI**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**340**	**400**	**460**	**520**	**600**	**700**	**800**	**900**	**1000**	**1100**
10S03-6	**1/3**	20	14.0	13.2	12.4	10.6	8.9	5.3																			
		30	13.2	11.8	10.4	8.4																					
		40	11.9	10.1	8.3																						
		50	9.8	7.5																							
		60	7.7	3.9																							
SHUT-OFF PSI:			64	55	47	38	29	21	12	3																	
10S05-9	**1/2**	0				14.1	13.4	12.4	11.4	10.4	9.5	8.3	6.6	3.5													
		20		13.9	13.1	12.1	11.1	10.1	9.2	7.9	5.8	2.0															
		30	13.8	13.0	12.0	11.0	10.0	9.0	7.6	5.3	1.2																
		40	12.8	11.8	10.8	9.8	8.8	7.3	4.8																		
		50	11.7	10.7	9.7	8.6	7.0	4.3																			
		60	10.5	9.5	8.4	6.7	3.7																				
SHUT-OFF PSI:			100	92	83	74	66	57	48	40	31	23	14	5													
10S07-12	**3/4**	0					14.3	13.8	13.2	12.5	11.7	11.0	10.2	9.5	8.7	7.6	6.0										
		20			14.2	13.6	12.9	12.2	11.5	10.7	10.0	9.3	8.4	7.2	5.4	2.6											
		30		14.1	13.5	12.9	12.1	11.4	10.6	9.9	9.2	8.2	7.0	5.0	2.0												
		40	14.0	13.4	12.8	12.0	11.3	10.5	9.8	9.0	8.1	6.7	4.7	1.4													
		50	13.3	12.6	11.9	11.1	10.4	9.7	8.9	7.9	6.5	4.2															
		60	12.5	11.8	11.0	10.3	9.6	8.8	7.7	6.2	3.8																
SHUT-OFF PSI:			137	129	120	111	103	94	85	77	68	59	51	42	33	25	16										
10S10-15	**1**	0							14.1	13.6	13.1	12.5	11.9	11.3	10.7	10.1	9.6	8.2	3.8								
		20					13.9	13.5	12.9	12.3	11.7	11.1	10.5	10.0	9.4	8.7	7.9	5.2									
		30				13.9	13.4	12.8	12.2	11.6	11.0	10.5	9.9	9.3	8.6	7.7	6.6	2.6									
		40		14.2	13.8	13.3	12.7	12.1	11.5	10.9	10.4	9.8	9.2	8.5	7.6	6.3	4.6										
		50	14.1	13.7	13.2	12.6	12.1	11.4	10.9	10.3	9.7	9.1	8.3	7.4	6.1	4.3	1.7										
		60	13.6	13.1	12.6	12.0	11.4	10.8	10.2	9.6	9.0	8.2	7.2	5.9	3.9												
SHUT-OFF PSI:			174	165	157	148	139	131	122	113	105	96	87	79	70	61	53	35	10								
10S15-21	**1 1/2**	0									14.2	13.9	13.6	13.3	12.9	12.5	12.0	11.2	9.9	8.5	6.3						
		20							14.1	13.9	13.5	13.1	12.7	12.3	11.9	11.5	11.0	10.2	8.9	6.9	2.9						
		30						14.1	13.8	13.5	13.1	12.7	12.3	11.8	11.4	11.0	10.5	9.7	8.3	5.7							
		40					14.1	13.8	13.4	13.0	12.6	12.2	11.8	11.3	10.9	10.5	10.1	9.2	7.5	4.1							
		50				14.0	13.7	13.3	13.0	12.5	12.1	11.7	11.3	10.8	10.4	10.0	9.6	8.7	6.5	2.0							
		60		14.2	14.0	13.6	13.3	12.9	12.5	12.1	11.6	11.2	10.8	10.4	9.9	9.5	9.1	8.0	5.1								
SHUT-OFF PSI:				237	229	220	211	203	194	185	177	168	159	151	142	133	125	107	81	55	29						
10S20-27	**2**	0												14.1	13.9	13.7	13.4	12.8	11.8	10.8	9.8	8.3	4.7				
		20										14.1	13.8	13.6	13.3	13.0	12.7	12.0	11.0	10.0	9.0	7.1	1.5				
		30									14.0	13.8	13.5	13.3	12.9	12.6	12.3	11.6	10.6	9.7	8.6	6.2					
		40							14.2	14.0	13.8	13.5	13.2	12.9	12.6	12.2	11.9	11.2	10.3	9.3	8.1	5.2					
		50						14.2	14.0	13.7	13.5	13.2	12.8	12.5	12.2	11.9	11.5	10.9	9.9	8.9	7.4	3.8					
		60					14.1	13.9	13.7	13.4	13.1	12.8	12.5	12.1	11.8	11.5	11.1	10.5	9.5	8.4	6.6	2.1					
SHUT-OFF PSI:							285	276	268	259	250	242	233	224	216	207	198	181	155	129	103	68	25				
10S30-34	**3**	0																13.8	13.2	12.5	11.9	10.9	9.6	7.9	4.8		
		20														13.9	13.7	13.3	12.7	12.0	11.3	10.3	8.9	6.7	2.7		
		30													13.9	13.7	13.5	13.1	12.4	11.7	11.0	10.0	8.5	6.0	1.3		
		40											14.0	13.8	13.7	13.5	13.3	12.8	12.2	11.5	10.8	9.7	8.0	5.1			
		50										14.0	13.8	13.6	13.4	13.2	13.0	12.6	11.9	11.2	10.5	9.4	7.5	4.2			
		60										13.8	13.6	13.4	13.2	13.0	12.8	12.3	11.6	10.9	10.2	9.0	6.9	3.1			
SHUT-OFF PSI:												332	324	315	306	298	289	272	246	220	194	159	116	73	29		

See 10S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

16S EASY SELECTION CHART

16 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE

(10 TO 20 GPM)

PUMP OUTLET
1 1/4 " NPT

DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
		20	20.3	18.2	14.1	10.0	5.0																				
16S05-5	1/2	30	17.3	14.4	8.0	1.6																					
		40	12.7	8.0	4.0																						
		50	6.5																								
		60	2.9																								
SHUT-OFF PSI:			58	49	40	32	23	14																			
		0					20.5	19.2	17.5	15.8	12.8	9.8	5.2														
		20			20.1	18.8	16.9	15.2	11.8	8.5	4.3																
16S07-8	3/4	30	21.2	19.9	18.4	16.9	14.3	11.8	7.5	3.2	1.6																
		40	19.7	18.3	16.3	14.3	10.8	7.2	3.6																		
		50	17.9	16.3	13.5	10.7	6.2	1.7																			
		60	15.7	13.5	9.6	5.8	2.9																				
SHUT-OFF PSI:			97	88	80	71	62	54	45	36	28	19	10														
		0						20.8	19.8	18.8	17.3	15.9	13.7	11.4	8.0	4.7											
		20				20.5	19.4	18.3	16.8	15.3	12.9	10.5	7.0	3.5	1.8												
16S10-10	1	30			20.3	19.3	18.1	16.8	14.8	12.8	9.8	6.7	3.3														
		40		20.2	19.1	18.0	16.4	14.8	12.2	9.6	5.9	2.3															
		50	20.0	19.0	17.7	16.3	14.2	12.0	8.8	5.6	2.8																
		60	18.8	17.6	15.8	14.1	11.3	8.6	4.8																		
SHUT-OFF PSI:			123	115	106	97	89	80	71	63	54	45	37	28	19	11											
		0								21.0	20.3	19.6	18.8	18.0	16.9	15.8	14.3	10.7	3.3								
		20							20.1	19.3	18.5	17.7	16.6	15.4	13.8	12.2	10.0	5.1									
16S15-14	1 1/2	30					20.7	20.0	19.2	18.4	17.4	16.5	15.1	13.7	11.8	9.8	7.3	2.4									
		40				20.6	19.8	19.1	18.3	17.4	16.0	15.0	13.3	11.6	9.3	7.0	4.3										
		50			20.4	19.8	18.9	18.2	17.2	16.1	14.7	13.2	11.2	9.1	6.5	3.9	2.0										
		60		20.3	19.6	18.8	18.0	17.1	15.8	14.5	12.8	11.0	8.6	6.3	3.4												
SHUT-OFF PSI:				167	158	149	141	132	123	115	106	97	89	80	71	63	54	37	28								
		0										21.2	20.6	20.0	19.5	18.9	18.2	16.7	13.5	8.8	2.7						
		20									20.4	19.8	19.3	18.7	18.0	17.3	16.4	14.3	10.0	4.2							
16S20-18	2	30								20.3	19.8	19.2	18.6	17.9	17.2	16.3	15.3	12.8	7.9	1.9							
		40							20.3	19.7	19.1	18.5	17.8	17.1	16.1	15.2	13.9	11.1	5.7								
		50						20.2	19.6	19.0	18.3	17.7	16.8	16.0	14.9	13.8	12.3	9.2	3.2								
		60					20.1	19.5	18.9	18.3	17.5	16.8	15.8	14.8	13.5	12.3	10.6	7.0									
SHUT-OFF PSI:							194	186	177	168	160	151	142	134	125	116	108	90	65	39	13						
		0																19.6	18.3	16.5	14.2	9.8	2.1				
		20													20.3	19.9	19.5	18.6	17.0	14.8	11.8	6.5					
16S30-24	3	30												20.3	19.8	19.4	19.0	18.0	16.3	13.7	10.4	4.7					
		40											20.2	19.8	19.3	18.9	18.4	17.3	15.3	12.5	8.9	2.8					
		50										20.2	19.8	19.3	18.8	18.3	17.8	16.7	14.3	11.3	7.3						
		60									20.1	19.7	19.2	18.8	18.3	17.8	17.2	15.8	13.3	9.8	5.5						
SHUT-OFF PSI:											239	230	221	213	204	195	187	169	143	117	91	57	13				
		0																			21.5	20.4	18.7	16.5	13.4	8.9	2.1
		20																			20.9	19.6	17.7	15.2	11.5	6.1	
16S50-38	5	30																		21.4	20.5	19.2	17.2	14.5	10.5	4.5	
		40																		21.1	20.2	18.8	16.7	13.7	9.3	2.7	
		50																	21.6	20.7	19.8	18.4	16.1	12.8	8.0	0.8	
		60																	21.3	20.4	19.4	17.9	15.4	11.9	6.6		
SHUT-OFF PSI:																			314	288	262	227	184	141	98	54	11

See 16S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

25 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE

(18 TO 32 GPM)

PUMP OUTLET
1 1/2" NPT

DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
		20	18.6	6.5	3.3																						
25S05-3	1/2	30	10.5																								
		40																									
		50																									
		60																									
SHUT-OFF PSI:			31	22	13	5																					
		0			34.5	29.8	23.9	18.1																			
		20	32.9	28.6	21.8	15.1	7.5																				
25S07-5	3/4	30	27.1	22.5	12.3	2.0																					
		40	19.5	11.8	5.8																						
		50	10.1																								
		60	4.1																								
SHUT-OFF PSI:			57	48	39	31	22	13																			
		0					31.3	28.5	24.3	20.2	12.7	5.1															
		20		33.2	30.3	27.6	22.9	18.3	10.4	2.5	1.3																
25S10-7	1	30	33.0	29.9	26.5	23.1	13.0	9.6	4.8																		
		40	29.4	26.6	21.3	16.2	8.2																				
		50	25.3	21.5	14.3	7.0	3.5																				
		60	19.7	13.9	7.0																						
SHUT-OFF PSI:			83	74	65	57	48	39	31	22	13	5															
		0						32.2	30.0	27.9	24.8	21.6	16.3	10.8													
		20				31.5	29.3	27.2	23.7	20.3	14.5	8.8	4.4														
25S15-9	1 1/2	30			31.3	29.1	26.4	23.7	18.9	14.2	7.8	1.5															
		40		30.8	28.6	26.3	22.6	18.8	12.8	6.8	3.4																
		50	30.6	28.4	25.5	22.5	17.4	12.3	6.2																		
		60	27.8	25.5	21.3	17.2	11.0	4.8	2.4																		
SHUT-OFF PSI:			109	100	91	83	74	65	57	48	39	31	22	13													
		0						33.1	31.1	29.3	27.6	25.1	22.5	18.5	14.5	9.3											
		20					32.5	30.6	28.8	27.0	24.3	21.5	17.3	13.0	7.8	2.5											
25S20-11	2	30				32.0	30.3	28.7	26.4	24.2	20.6	16.9	12.0	7.0	3.5												
		40			31.8	30.1	28.2	26.3	23.3	20.4	15.9	11.4	6.3														
		50		31.5	29.8	28.1	25.7	23.3	19.4	15.6	10.4	5.3	2.7														
		60	31.3	29.6	27.6	25.6	22.4	19.3	14.5	9.8	4.9																
SHUT-OFF PSI:			135	126	118	109	100	92	83	74	66	57	48	40	31	23											
		0										32.3	31.0	29.8	28.4	27.1	25.2	20.7									
		20								31.8	30.6	29.3	28.0	26.6	24.6	22.7	19.8	13.5									
25S30-15	3	30						33.0	31.7	30.4	29.2	27.8	26.2	24.5	22.1	19.7	16.4	9.3									
		40					32.8	31.5	30.3	29.0	27.5	26.0	24.0	21.9	19.0	16.1	12.4	4.9									
		50				32.6	31.3	30.0	28.7	27.4	25.7	23.8	21.3	18.8	15.3	12.0	8.2	2.2									
		60			32.4	31.1	29.8	28.6	27.0	25.5	23.3	21.2	18.1	15.0	11.3	7.6	3.8										
SHUT-OFF PSI:					170	161	152	144	135	126	118	109	100	92	83	74	66	48									
		0																32.5	30.3	28.0	25.3	19.9	10.2				
		20															32.3	30.8	28.6	25.9	22.5	15.8	5.0				
25S50-26	5	30														32.1	31.3	29.9	27.7	24.7	20.8	13.5	2.5				
		40													32.0	31.3	30.5	29.1	26.7	23.3	18.9	11.0					
		50											32.7	31.8	31.2	30.4	29.7	28.2	25.5	21.8	16.8	8.5					
		60										32.5	31.8	31.0	30.3	29.6	28.8	27.3	24.3	20.0	14.6	5.8					
SHUT-OFF PSI:												253	245	236	227	219	210	193	167	141	115	80	37				

See 25S performance curves for higher head models.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

40S EASY SELECTION CHART

40 GPM

SELECTION CHARTS

(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE

(24 TO 55 GPM)

PUMP OUTLET
2 " NPT

DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI		20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
40S10-3	1	20	46.2	33.0																								
		30	69.3																									
		40	92.4																									
		50	116																									
		60	139																									
SHUT-OFF PSI:			0	28	19	11	2																					
40S15-5	1 1/2	0	0				52.0	41.0	24.0																			
		20	46.2	57.0	50.0	37.0	18.0																					
		30	69.3	48.0	34.0	15.0																						
		40	92.4	31.0	11.0																							
		50	116	7.0																								
		60	139																									
SHUT-OFF PSI:			0	52	44	35	26	18	9																			
40S20-7	2	0	0					54.0	49.0	40.0	29.0	15.0																
		20	46.2			53.0	46.0	37.0	25.0	10.0																		
		30	69.3		52.0	45.0	35.0	23.0	8.0																			
		40	92.4	51.0	44.0	33.0	21.0	5.0																				
		50	116	42.0	32.0	18.0	2.0																					
		60	139	30.0	16.0																							
SHUT-OFF PSI:			0	77	68	59	51	42	33	25	16	7																
40S30-9	3	0	0							53.0	47.0	41.0	32.0	22.0														
		20	46.2					51.0	45.0	38.0	29.0	19.0																
		30	69.3				50.0	44.0	37.0	28.0	17.0																	
		40	92.4		54.0	50.0	43.0	35.0	26.0	15.0																		
		50	116	54.0	49.0	42.0	34.0	24.0	13.0																			
		60	139	48.0	41.0	33.0	23.0	11.0																				
SHUT-OFF PSI:			0	102	94	85	76	68	59	50	42	33	24	16	7													
40S50-12	5	0	0									53.0	49.0	44.0	39.0	32.0	25.0	16.0										
		20	46.2							52.0	48.0	43.0	37.0	30.0	22.0	13.0												
		30	69.3						51.0	47.0	42.0	36.0	29.0	21.0	12.0													
		40	92.4					51.0	46.0	41.0	35.0	28.0	20.0	11.0														
		50	116			54.0	50.0	45.0	40.0	34.0	26.0	18.0	9.0															
		60	139		53.0	49.0	45.0	39.0	33.0	25.0	17.0	8.0																
SHUT-OFF PSI:			0		130	122	113	104	96	87	78	70	61	52	44	35	26	18										
40S50-15	5	0	0											52.0	49.0	46.0	42.0	37.0	26.0									
		20	46.2									51.0	48.0	45.0	40.0	35.0	30.0	24.0										
		30	69.3								51.0	48.0	44.0	40.0	35.0	29.0	23.0	16.0										
		40	92.4							51.0	47.0	43.0	39.0	34.0	28.0	21.0	14.0											
		50	116						50.0	47.0	43.0	38.0	33.0	27.0	20.0	13.0												
		60	139					50.0	46.0	42.0	37.0	32.0	26.0	19.0	12.0													
SHUT-OFF PSI:			0					141	132	124	115	107	98	89	81	72	63	55	37	11								
40S75-21	7 1/2	0	0																49.0	41.0	29.0	15.0						
		20	46.2													53.0	51.0	48.0	43.0	32.0	19.0							
		30	69.3												52.0	50.0	48.0	45.0	39.0	27.0	13.0							
		40	92.4											52.0	50.0	48.0	45.0	42.0	35.0	22.0	6.0							
		50	116										52.0	50.0	47.0	44.0	41.0	38.0	30.0	16.0								
		60	139									51.0	49.0	47.0	44.0	41.0	38.0	34.0	25.0	10.0								
SHUT-OFF PSI:			0									181	172	163	155	146	137	129	111	85	59	33						
40S75-25	7 1/2	0	0																	51.0	45.0	37.0	23.0					
		20	46.2																52.0	47.0	39.0	29.0	14.0					
		30	69.3															54.0	50.0	44.0	35.0	25.0						
		40	92.4														54.0	52.0	48.0	41.0	32.0	21.0						
		50	116													53.0	52.0	50.0	45.0	38.0	28.0							
		60	139												53.0	51.0	49.0	47.0	43.0	34.0	24.0							
SHUT-OFF PSI:			0												203	194	186	177	160	134	108	82	47					
*40S100-30 40S100-30	10	0	0																		53.0	49.0	41.0	27.0				
		20	46.2																	54.0	50.0	44.0	35.0	20.0				
		30	69.3																	52.0	48.0	42.0	32.0	16.0				
		40	92.4																	51.0	46.0	39.0	28.0	12.0				
		50	116																	49.0	43.0	36.0	25.0	8.0				
		60	139																52.0	47.0	41.0	33.0	21.0					
SHUT-OFF PSI:																			222	196	170	144	110	66	23			

*** 6" Motor**

See 40S performance curves for higher head models.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

60 GPM

SELECTION CHARTS
(Ratings are in GALLONS PER MINUTE-GPM)

FLOW RANGE
(40 TO 75 GPM)

PUMP OUTLET
2 " NPT

DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET

PUMP MODEL	HP	PSI	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
60S20-4	2	20	72.3	64.5	38.6	12.7	6.3																				
		30	58.6	44.9	22.4																						
		40	30.4																								
		50	17.9																								
		60																									
SHUT-OFF PSI:			46	37	29	20	11	3																			
60S30-5	3	0				74.8	66.8	58.8	34.3																		
		20	77.8	72.9	63.8	54.8	27.4																				
		30	76.0	64.3	47.3	30.0	15.0																				
		40	60.4	49.9	25.0																						
		50	40.4	19.4	9.8																						
		60	22.0																								
SHUT-OFF PSI:			60	51	42	34	25	16	8																		
60S50-7	5	0					77.5	73.8	68.4	63.1	52.2	41.3															
		20			76.3	72.4	66.6	61.1	48.3	35.8	17.9																
		30		76.0	71.3	66.5	57.8	49.2	24.6																		
		40	75.1	71.0	64.6	58.2	43.8	29.4	14.8																		
		50	69.7	64.6	54.8	44.9	22.5																				
		60	62.3	55.3	38.7	22.0	11.0																				
SHUT-OFF PSI:			88	80	71	62	54	45	36	28	19	10															
60S50-9	5	0							74.8	71.7	67.3	63.0	55.6	48.2	32.8	17.3											
		20					73.8	70.5	65.9	61.3	53.0	44.8	27.5	10.2	5.1												
		30			76.5	73.5	69.6	65.7	59.4	53.2	40.7	28.1	14.0														
		40		76.2	72.8	69.3	64.3	59.4	50.3	41.0	20.5																
		50	75.5	72.5	68.3	64.2	57.3	50.4	36.3	22.2	11.1																
		60	71.7	68.1	62.7	57.3	47.1	36.8	18.4																		
SHUT-OFF PSI:			115	106	98	89	81	72	63	55	46	37	29	20	11	3											
*60S75-13	7 1/2	0									77.3	75.4	73.1	70.7	67.8	64.8	60.7	50.0	21.5								
		20							76.8	74.8	72.3	69.9	66.8	63.8	59.3	55.0	47.9	28.9									
		30						76.6	74.3	72.1	69.3	66.6	62.8	59.2	53.3	47.7	38.2	14.3									
		40					76.2	74.1	71.6	69.1	65.8	62.7	57.9	53.3	45.6	37.9	25.0	6.0									
		50				75.9	73.6	71.3	68.4	65.6	61.7	57.7	51.6	45.4	35.0	24.7	12.3										
		60			75.5	73.3	70.8	68.2	64.8	61.4	56.3	51.3	43.1	34.8	20.8	6.8											
SHUT-OFF PSI:					152	143	134	126	117	108	100	91	82	74	65	56	48	30	4								
*60S100-18	10	0													76.5	75.0	73.3	69.8	63.1	52.6	35.8						
		20											76.1	74.6	72.8	71.2	69.2	64.7	55.8	40.0	14.2						
		30										75.9	74.3	72.7	70.8	68.9	66.7	61.6	50.9	31.5							
		40									75.7	74.1	72.3	70.6	68.5	66.5	63.9	58.0	45.0	20.7							
		50								75.4	73.8	72.1	70.2	68.3	66.0	63.7	60.7	53.6	37.5	10.0							
		60							75.2	73.6	71.8	70.0	67.8	65.8	63.1	60.5	56.8	48.2	28.3								
SHUT-OFF PSI:									186	177	169	160	152	143	134	126	117	100	74	46	22						

*** 6" Motor**
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

75S EASY SELECTION CHART

75 GPM

SELECTION CHARTS
(Ratings are in GALLONS PER MINUTE-GPM)

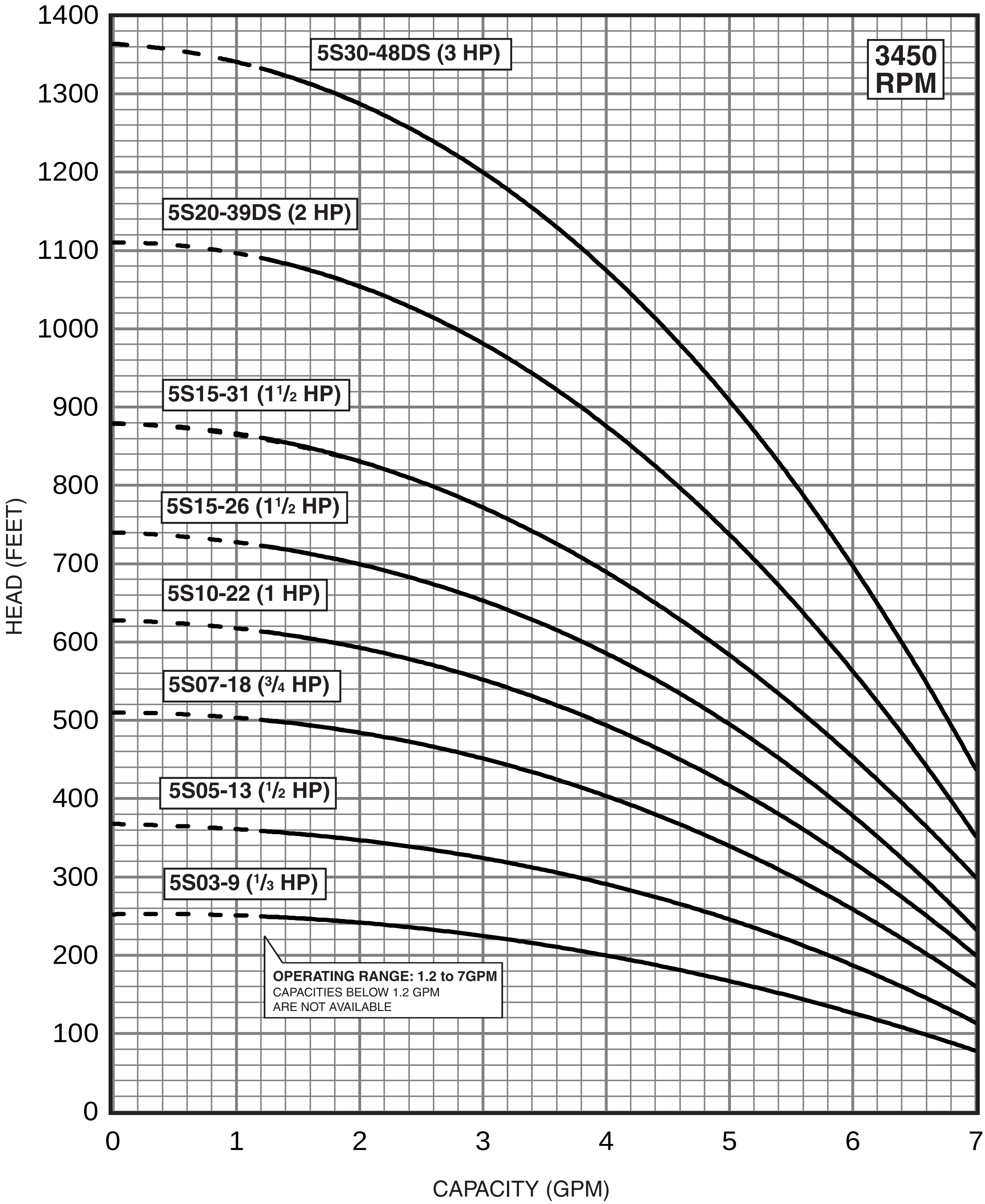
FLOW RANGE
(45 TO 95 GPM)

PUMP OUTLET
2" NPT

			DEPTH TO PUMPING WATER LEVEL (LIFT) IN FEET																								
PUMP MODEL	**HP**	**PSI**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**340**	**400**	**460**	**520**	**600**	**700**	**800**	**900**	**1000**	**1100**
75S20-3	**2**	20	69.6	45.8	22.9																						
		30	36.2																								
		40	12.4																								
		50																									
		60																									
SHUT-OFF PSI:			32	23	14	6																					
75S30-5	**3**	0			89.8	90.2	78.8	67.6																			
		20	96.3	86.8	74.8	62.9	31.5																				
		30	85.8	74.2	51.8	29.5	14.8																				
		40	70.2	57.1	28.6																						
		50	35.3																								
		60	24.2																								
SHUT-OFF PSI:			58	49	41	32	23	15																			
75S50-8	**5**	0						93.3	86.5	79.6	72.0	64.5	46.9	29.4													
		20			97.4	91.3	84.7	77.5	69.4	61.3	40.3	19.4	9.8														
		30		96.9	90.1	83.3	76.3	69.3	56.3	43.1	21.6																
		40	95.5	89.1	82.3	75.4	66.5	57.5	28.8																		
		50	88.0	81.2	73.9	66.7	51.2	35.8	17.9																		
		60	80.2	73.3	63.2	53.0	26.5																				
SHUT-OFF PSI:			98	90	81	72	64	55	46	38	29	20	12	3													
***75S75-11**	**7 1/2**	0								97.8	93.3	88.8	84.3	79.8	75.1	70.4	63.7	43.4									
		20						96.5	92.0	87.4	82.9	78.3	73.5	68.8	61.4	54.0	38.8	11.8									
		30					95.7	91.3	86.8	82.2	77.6	73.1	67.3	61.4	50.3	39.3	19.7										
		40				95.2	90.6	86.0	81.5	77.0	72.0	67.0	58.9	50.8	33.5	16.3	8.2										
		50			94.3	89.9	85.3	80.8	76.2	71.6	65.3	59.0	46.6	34.2	17.1												
		60	97.9	93.8	89.2	84.6	80.1	75.6	70.3	65.2	56.1	47.0	23.5														
SHUT-OFF PSI:			151	142	133	125	116	107	99	90	81	73	64	55	47	38	29	12									
***75S100-15**	**10**	0											96.7	93.4	90.0	86.5	83.2	76.3	64.7	40.9							
		20									95.7	92.4	88.9	85.5	82.1	78.7	75.2	67.4	49.3	12.5							
		30								95.3	91.8	88.4	85.0	81.5	78.2	74.8	70.9	61.6	37.1								
		40						98.0	94.7	91.3	87.8	84.4	81.0	77.7	74.1	70.6	66.0	54.0	19.9								
		50					97.3	94.3	90.8	87.3	83.9	80.5	77.1	73.7	69.7	65.8	59.8	43.5									
		60				97.0	93.7	90.3	86.8	83.3	80.0	76.6	73.0	69.3	64.5	59.6	51.5	21.7									
SHUT-OFF PSI:						178	170	161	152	144	135	126	118	109	100	92	83	66	40	14							

*** 6" Motor** Performance is the same at Best Efficiency Point only, consult factory for actual performance.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

FLOW RANGE: 1.2 - 7 GPM **OUTLET SIZE: 1" NPT** **NOMINAL DIA. 4"**



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

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
5S03-9	A	1/3	4"	1" NPT	22.3	8.8	13.5	3.8	3.9	27
5S05-13	A	1/2	4"	1" NPT	26.4	9.5	16.9	3.8	3.9	31
5S07-18	A	3/4	4"	1" NPT	31.7	10.7	21.0	3.8	3.9	34
5S10-22	A	1	4"	1" NPT	36.1	11.8	24.3	3.8	3.9	42
5S15-26	A	1 1/2	4"	1" NPT	41.2	13.6	27.6	3.8	3.9	46
5S15-31	A	1 1/2	4"	1" NPT	47.1	13.6	33.5	3.8	3.9	58
5S20-39DS	A	2	4"	1" NPT	55.2	15.1	40.1	3.8	3.9	65
5S30-48DS	A	3	4"	1" NPT	70.0	20.6	45.8	3.8	3.9	90

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

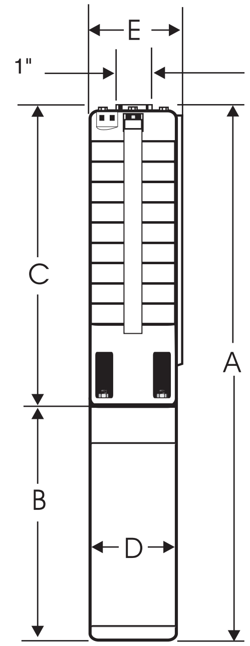


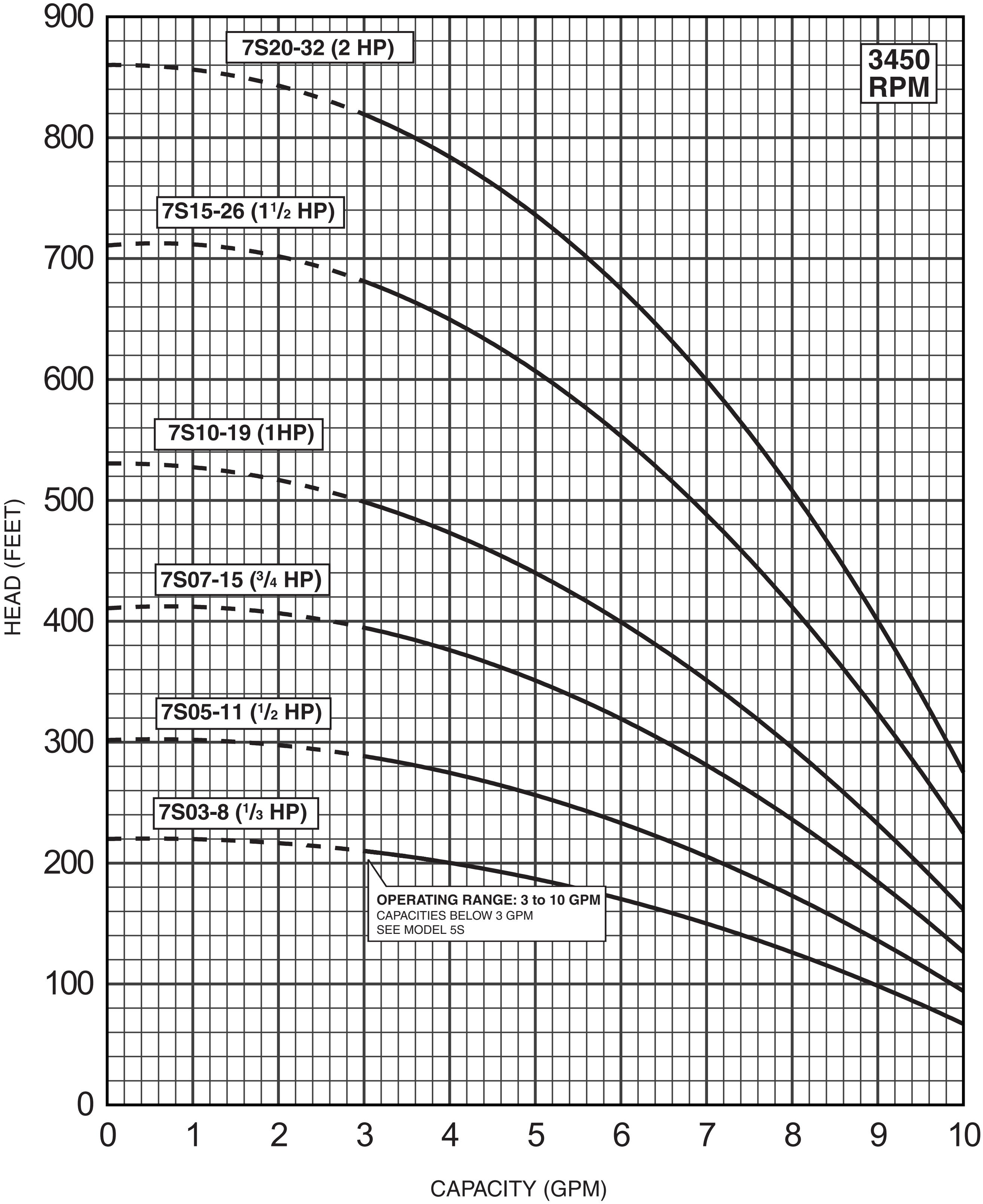
Fig. A

MATERIALS OF CONSTRUCTION

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

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

FLOW RANGE: 3 -10 GPM **OUTLET SIZE: 1" NPT** **NOMINAL DIA. 4"**



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

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
7S03-8	A	1/3	4"	1" NPT	21.5	8.8	12.7	3.8	3.9	27
7S05-11	A	1/2	4"	1" NPT	24.7	9.5	15.2	3.8	3.9	30
7S07-15	A	3/4	4"	1" NPT	29.2	10.7	18.5	3.8	3.9	33
7S10-19	A	1	4"	1" NPT	33.6	11.8	21.8	3.8	3.9	36
7S15-26	A	1 1/2	4"	1" NPT	41.2	13.6	27.6	3.8	3.9	46
7S20-32	A	2	4"	1" NPT	48.5	14.0	34.5	3.8	3.9	59

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

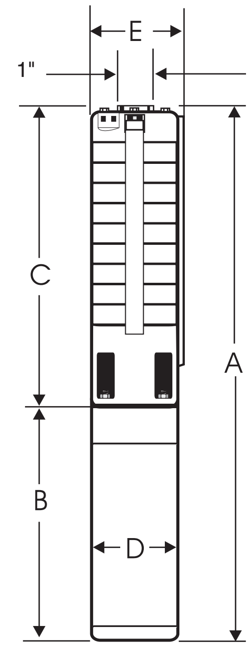


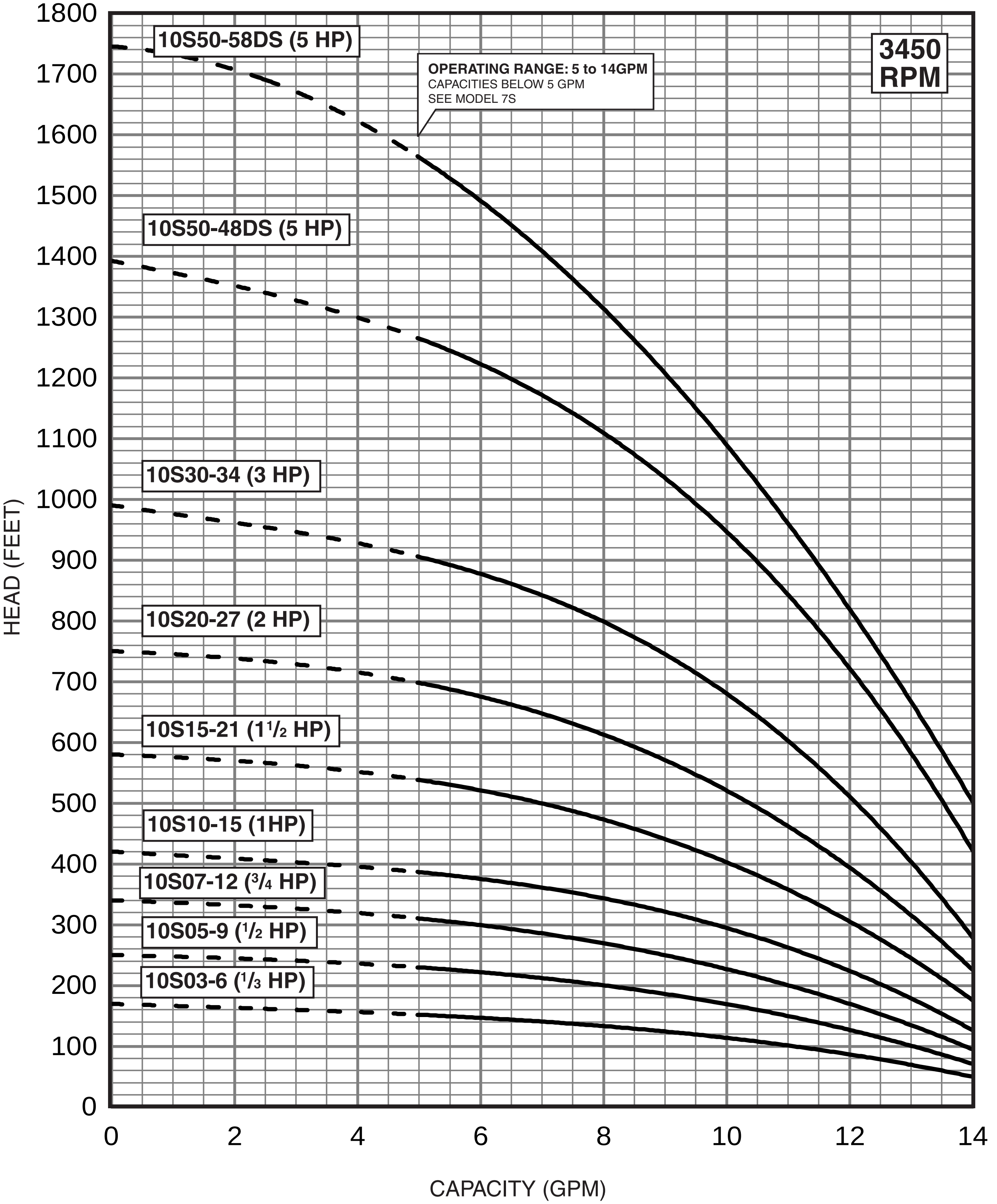
Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINE SHAFT
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/431 Stainless Steel
Check Valve Seat	NBR/304 Stainless Steel
Top Bearing	NBR
Impeller Seal Ring	NBR/PBT (Valox ®)
Intermediate Bearings	NBR

NOTES: Specifications subject to change without notice.
Valox® is a registered trademark of General Electric Co.

FLOW RANGE: 5 -14 GPM **OUTLET SIZE: 1¼ " NPT** **NOMINAL DIA. 4"**



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

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
10S03-6	A	1/3	4"	1 1/4" NPT	19.9	8.8	11.1	3.8	3.9	26
10S05-9	A	1/2	4"	1 1/4" NPT	23.0	9.5	13.5	3.8	3.9	29
10S07-12	A	3/4	4"	1 1/4" NPT	26.7	10.7	16.0	3.8	3.9	32
10S10-15	A	1	4"	1 1/4" NPT	30.3	11.8	18.5	3.8	3.9	34
10S15-21	A	1 1/2	4"	1 1/4" NPT	37.1	13.6	23.5	3.8	3.9	44
10S20-27	A	2	4"	1 1/4" NPT	43.5	15.1	28.4	3.8	3.9	49
10S30-34	A	3	4"	1 1/4" NPT	54.7	20.6	34.1	3.8	3.9	83
10S50-48DS	A	5	4"	1 1/4" NPT	71.3	23.6	47.7	3.8	3.9	115
10S50-58DS*	B	5	4"	1 1/4" MPT	88.2	23.6	64.5	3.8	4.3	142

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Built into sleeve 1 1/4" MPT discharge, 5" min. well dia.

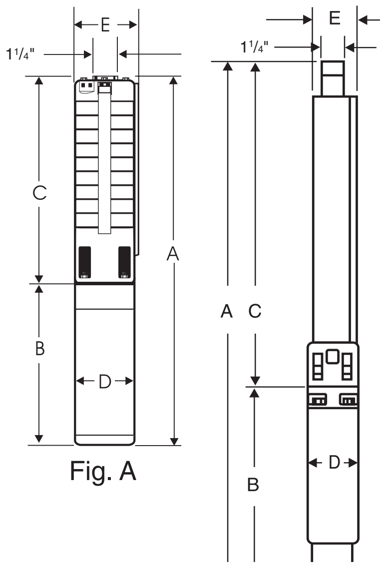


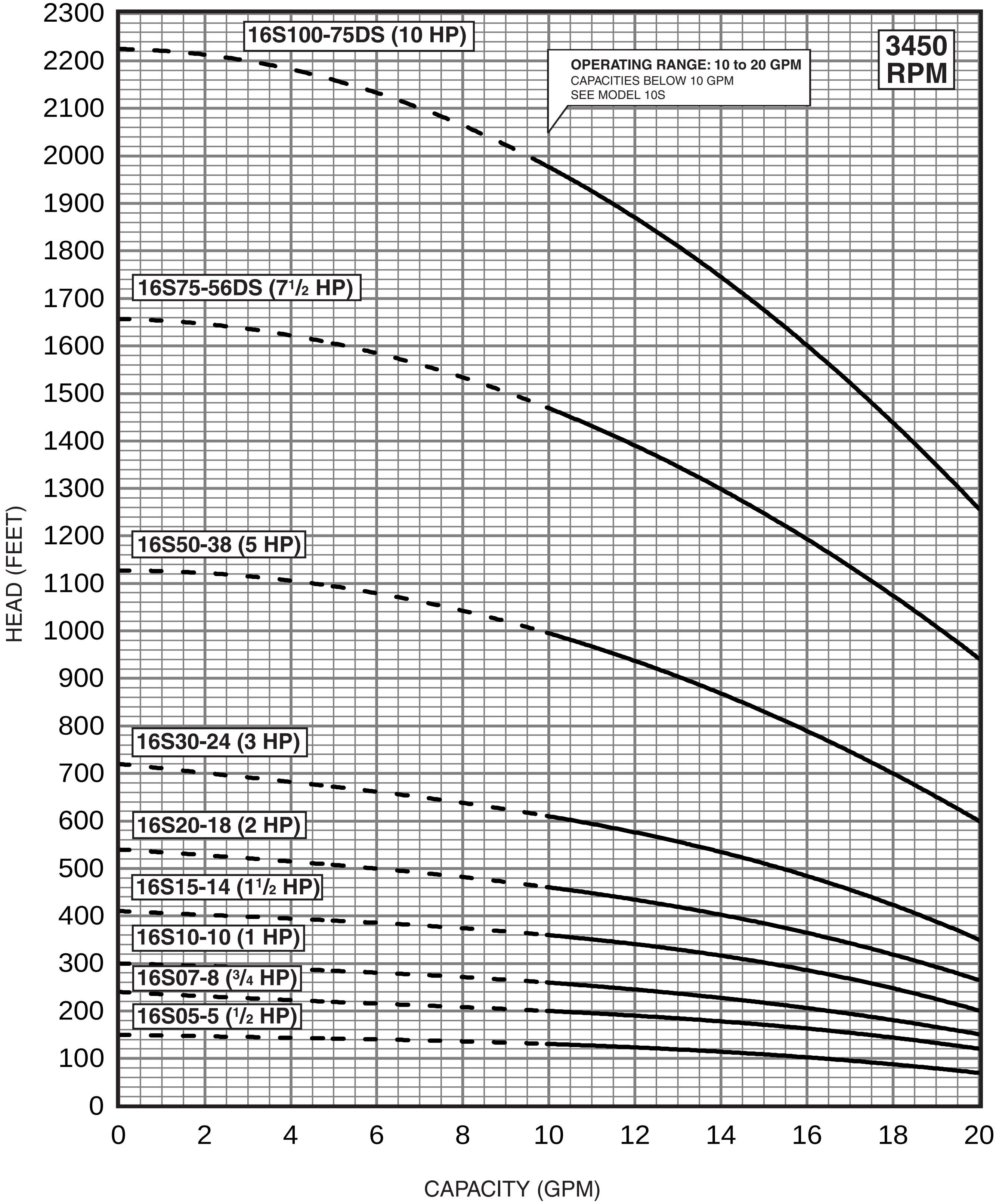
Fig. A Fig. B

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (6-27 Stgs.)	CYLINDRICAL SHAFT (34-48 Stgs.)	DEEP SET (58 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel	316/431 Stainless Steel	316/431 Stainless Steel
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Not Required	Zincless Bronze*

NOTES: Specifications subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.
*** Stainless Steel option available.**

FLOW RANGE: 10 -20 GPM **OUTLET SIZE: 1¼ " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, .5 -5 HP/3450 RPM.
6" MOTOR STANDARD,7.5 -10HP/3450 RPM.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
16S05-5	A	1/2	4"	1 1/4" NPT	19.7	9.5	10.2	3.8	3.9	27
16S07-8	A	3/4	4"	1 1/4" NPT	23.4	10.7	12.7	3.8	3.9	29
16S10-10	A	1	4"	1 1/4" NPT	26.2	11.8	14.4	3.8	3.9	32
16S15-14	A	1 1/2	4"	1 1/4" NPT	32.8	15.1	17.7	3.8	3.9	36
16S20-18	A	2	4"	1 1/4" NPT	36.0	15.1	20.9	3.8	3.9	40
16S30-24	A	3	4"	1 1/4" NPT	46.5	20.6	25.9	3.8	3.9	64
16S50-38	A	5	4"	1 1/4" NPT	61.1	23.6	37.5	3.8	3.9	94
16S75-56DS*	B	7 1/2	6"	1 1/4" MPT	93.0	24.2	68.8	5.4	4.6	220
16S100-75DS*	B	10	6"	1 1/4" MPT	109.9	25.4	84.5	5.4	4.6	245

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs..
* Built into sleeve 1¼" MPT discharge, 6" min. well dia.

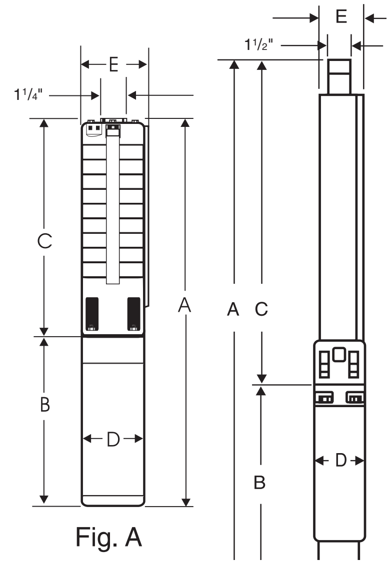


Fig. A

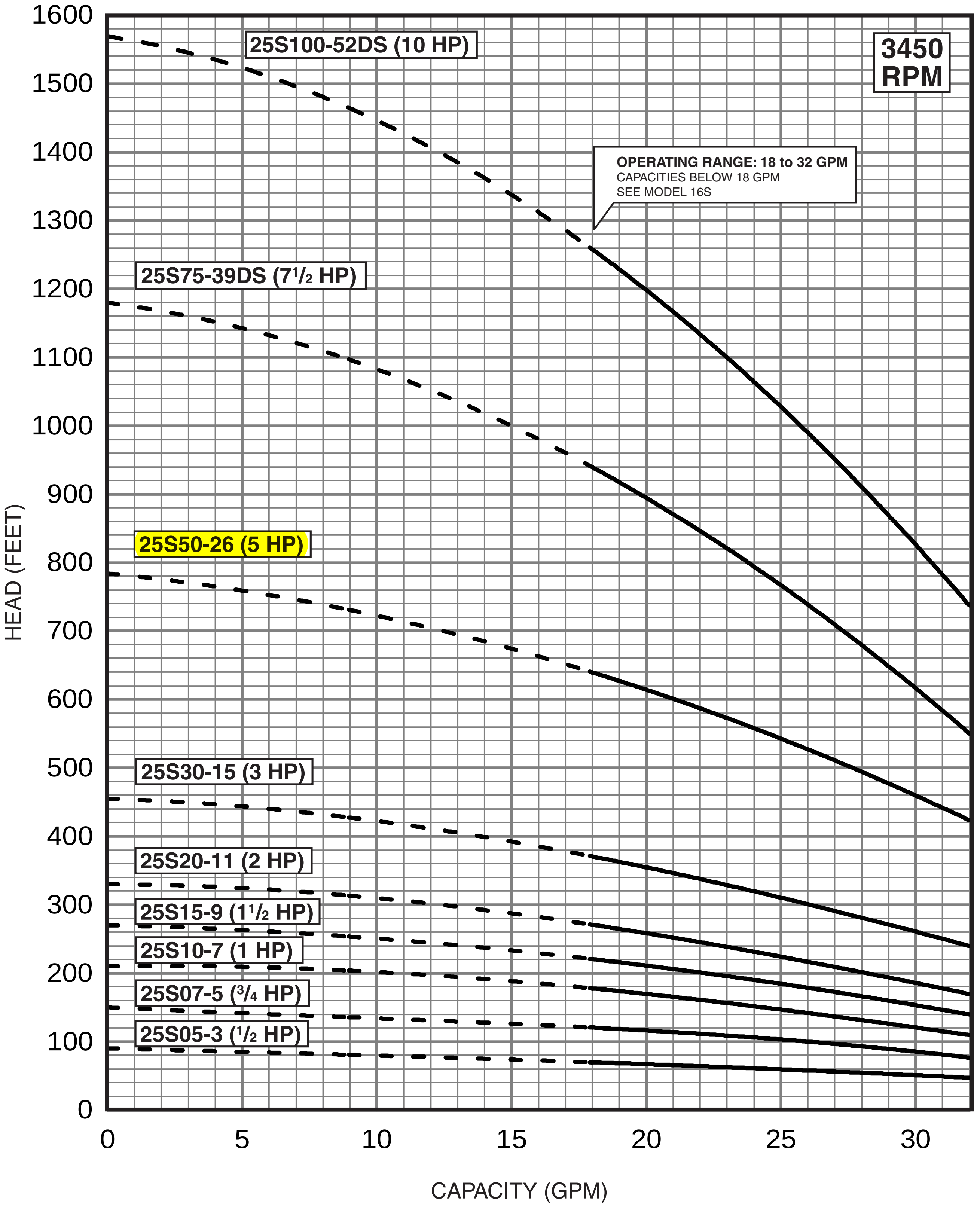
Fig. B

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (5-24 Stgs.)	CYLINDRICAL SHAFT (38 Stgs.)	DEEP SET (56-75 Stgs)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel	316/431 Stainless Steel	329/416 Stainless Steel**
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Not Required	304 Stainless Steel
Coupling Key	Not Required	Not Required	302/304 Stainless Steel**

NOTES: Specifications are subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.
***Stainless Steel option available.**
** If using 4" non-standard motors, refer to 329/420/431 Stainless Steel for coupling.
A coupling key is not required.

FLOW RANGE: 18 -32 GPM **OUTLET SIZE: 1½ " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, .5 -5 HP/3450 RPM.
6" MOTOR STANDARD,7.5 -10HP/3450 RPM.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 2 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
25S05-3	A	1/2	4"	1 1/2" NPT	18.1	9.5	8.6	3.8	3.9	26
25S07-5	A	3/4	4"	1 1/2" NPT	20.9	10.7	10.2	3.8	3.9	28
25S10-7	A	1	4"	1 1/2" NPT	23.7	11.8	11.9	3.8	3.9	29
25S15-9	A	1 1/2	4"	1 1/2" NPT	27.1	13.6	13.5	3.8	3.9	34
25S20-11	A	2	4"	1 1/2" NPT	30.3	15.1	15.2	3.8	3.9	37
25S30-15	A	3	4"	1 1/2" NPT	39.1	20.6	18.5	3.8	3.9	59
25S50-26	A	5	4"	1 1/2" NPT	51.2	23.6	27.6	3.8	3.9	76
25S75-39DS	A	7 1/2	6"	1 1/2" NPT	66.8	24.2	42.6	5.4	4.6	168
25S100-52DS*	B	10	6"	1 1/2" MPT	90.9	25.4	65.5	5.4	5.4	226

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Built into sleeve 1 1/2" MPT discharge, 6" min. well dia.

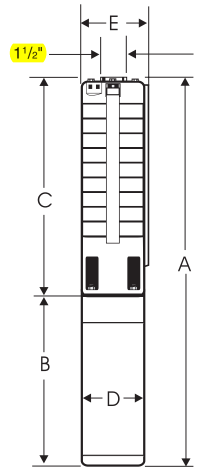


Fig. A

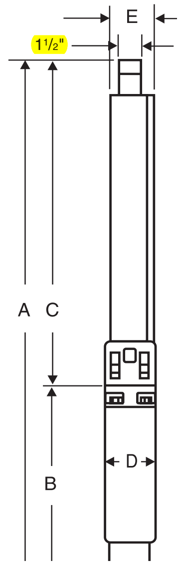


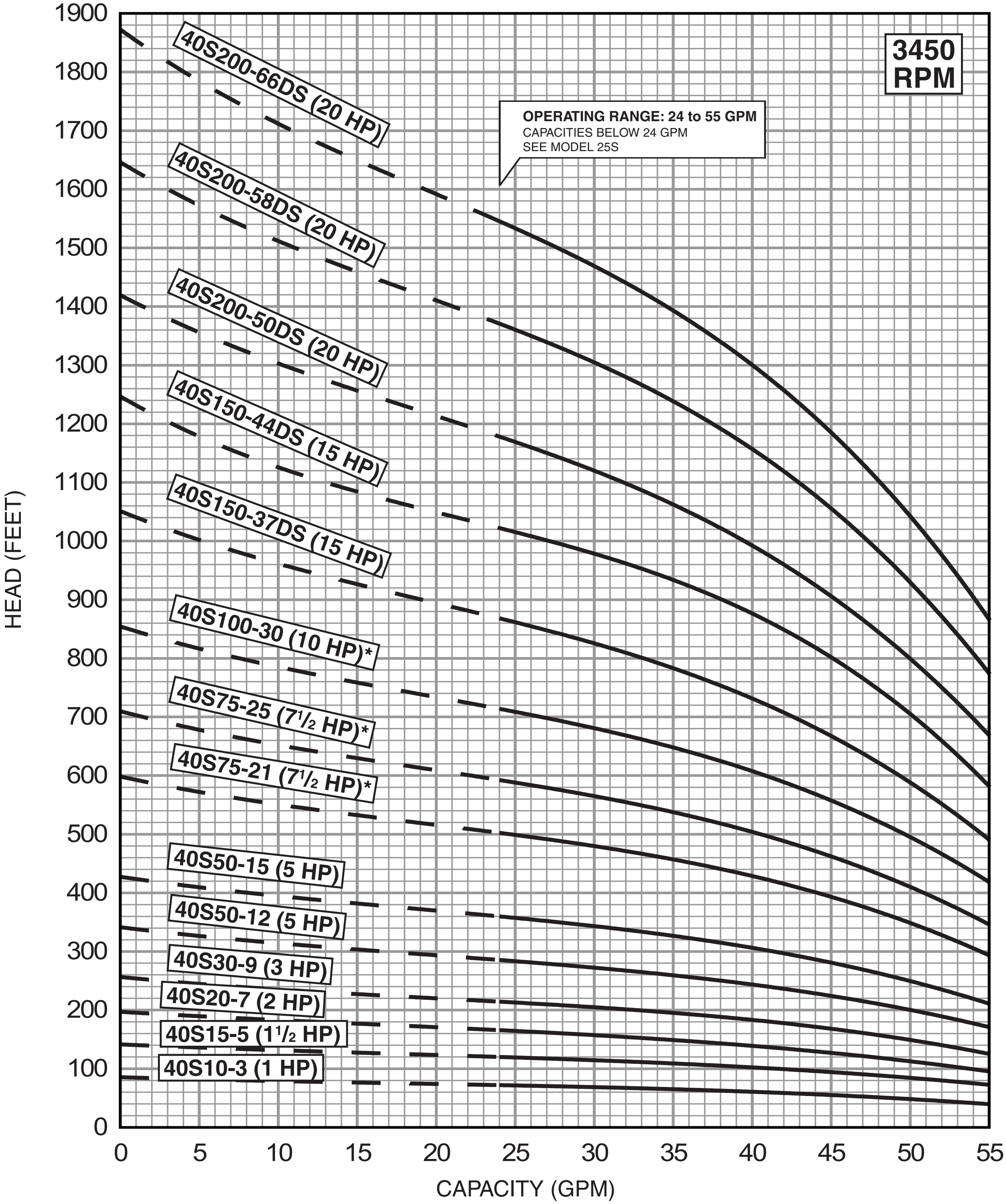
Fig. B

MATERIALS OF CONSTRUCTION

COMPONENT	SPLINED SHAFT (3-26 Stgs.)	CYLINDRICAL SHAFT (39 Stgs.)	DEEP SET (52 Stgs)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Pump Shaft	304 Stainless Steel	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel	316/431 Stainless Steel	329/416 Stainless Steel**
Check Valve Seat	NBR/304 Stainless Steel	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/PBT (Valox®)	NBR/PPS (Ryton®)	NBR/PPS (Ryton®)
Intermediate Bearings	NBR	304 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	Not Required	LCP (Vectra®)	LCP (Vectra®)
Split Cone	Not Required	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	Not Required	316 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Not Required	304 Stainless Steel
Coupling Key	Not Required	Not Required	302/304 Stainless Steel**

NOTES: Specifications are subject to change without notice.
Valox® is a registered trademark of General Electric Co.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
Ryton® is a registered trademark of Phillips 66.
***Stainless Steel option available.**
** If using 4" non-standard motors, refer to 329/420/431 Stainless Steel for coupling.
A coupling key is not required.

FLOW RANGE: 24 - 55 GPM **OUTLET SIZE: 2 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 1-10 HP/3450 RPM.
6" MOTOR STANDARD,15-20 HP/3450 RPM.
* Also available with 6" motor.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
40S10-3	A	1	4"	2" NPT	24.6	11.8	12.8	3.8	3.9	32
40S15-5	A	1 1/2	4"	2" NPT	29.7	13.6	16.1	3.8	3.9	37
40S20-7	A	2	4"	2" NPT	34.5	15.1	19.4	3.8	3.9	41
40S30-9	A	3	4"	2" NPT	43.3	20.6	22.7	3.8	3.9	65
40S50-12	A	5	4"	2" NPT	51.3	23.6	27.7	3.8	3.9	78
40S50-15	A	5	4"	2" NPT	56.2	23.6	32.6	3.8	3.9	84
40S75-21*	A	7 1/2	4"	2" NPT	74.6	29.6	45.0	3.8	3.9	120
40S75-25*	A	7 1/2	4"	2" NPT	81.2	29.6	51.6	3.8	3.9	124
40S100-30*	A	10	4"	2" NPT	103.7	43.9	59.8	3.8	3.9	181
40S150-37DS	A	15	6"	2" NPT	99.5	28.0	71.5	5.4	5.4	244
40S150-44DS	A	15	6"	2" NPT	111.0	28.0	83.0	5.4	5.4	340
40S200-50DS**	B	20	6"	2" MPT	136.0	30.6	105.4	5.4	5.5	319
40S200-58DS**	B	20	6"	2" MPT	149.2	30.6	118.6	5.4	5.5	334
40S200-66DS**	B	20	6"	2" MPT	162.4	30.6	131.8	5.4	5.5	394

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Also available with 6" motor.
** Built into sleeve 2" MPT discharge, 6" min. well dia.

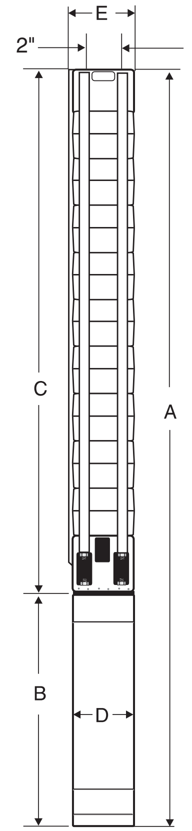


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (3-44 Stgs.)	DEEP SET (50-66 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel
Pump Shaft	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel **	329/ 416 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)	LCP (Vectra®)
Split Cone	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	304 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra® is a registered trademark of Hoechast Calanese Corporation.
***Stainless Steel option available.**

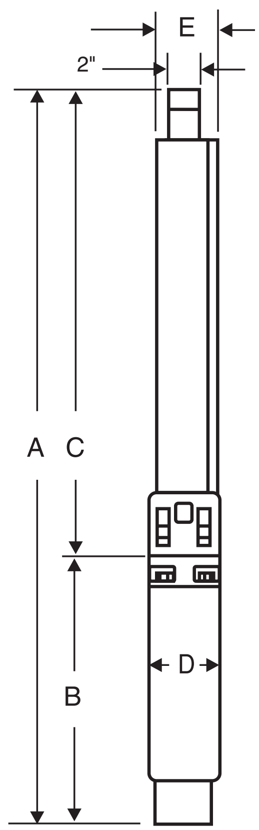
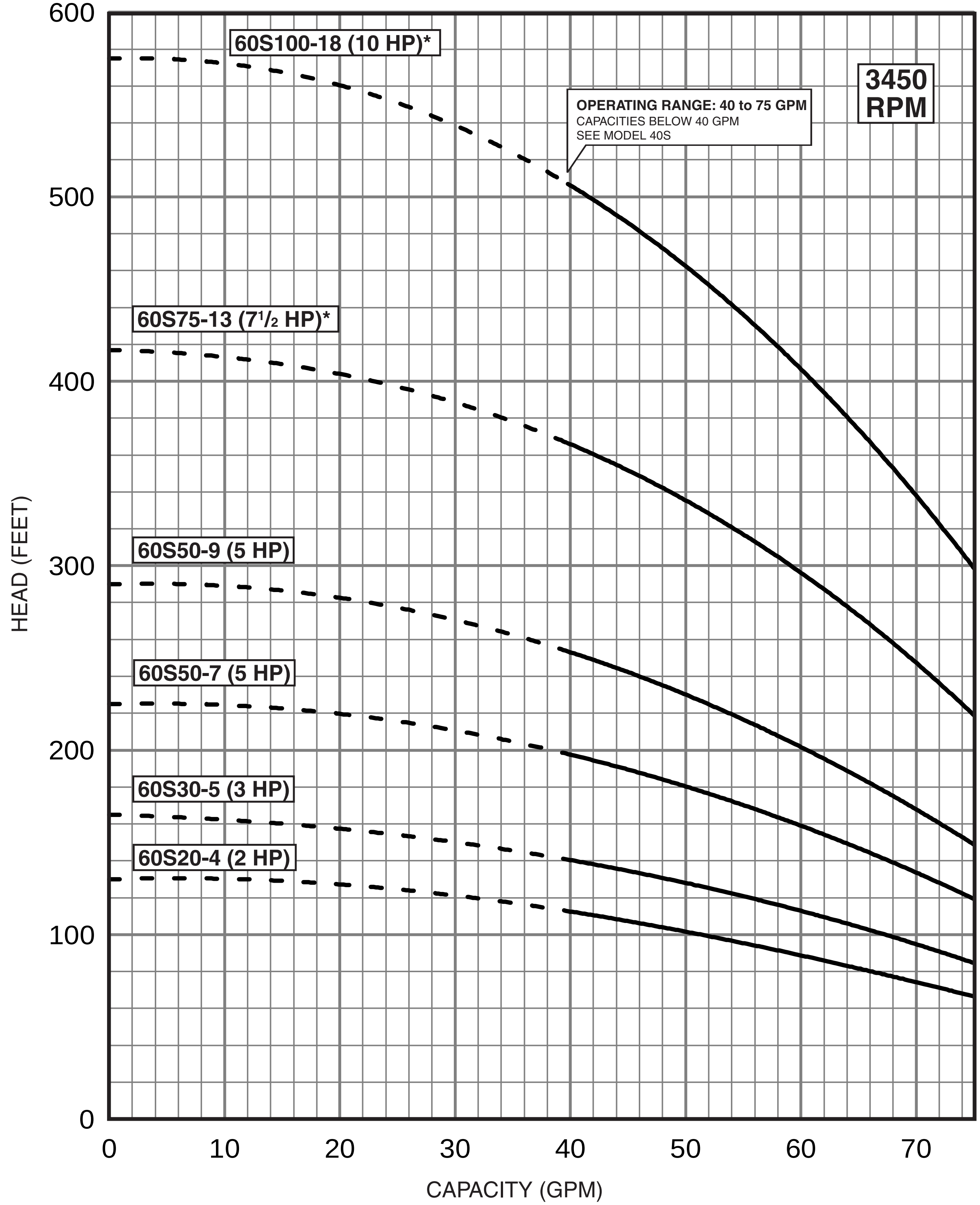


Fig. B

FLOW RANGE: 40 -75 GPM **OUTLET SIZE: 2 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 3450 RPM.
* Also available with 6" motor.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
60S20-4	A	2	4"	2" NPT	32.6	15.1	17.5	3.8	3.9	39
60S30-5	A	3	4"	2" NPT	40.7	20.6	20.1	3.8	3.9	64
60S50-7	A	5	4"	2" NPT	48.8	23.6	25.2	3.8	3.9	75
60S50-9	A	5	4"	2" NPT	53.9	23.6	30.3	3.8	3.9	80
60S75-13*	A	7 1/2	4"	2" NPT	70.1	29.6	40.5	3.8	3.9	105
60S100-18*	A	10	4"	2" NPT	97.3	43.9	53.4	3.8	3.9	160

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs..
* Also available with 6" motor.

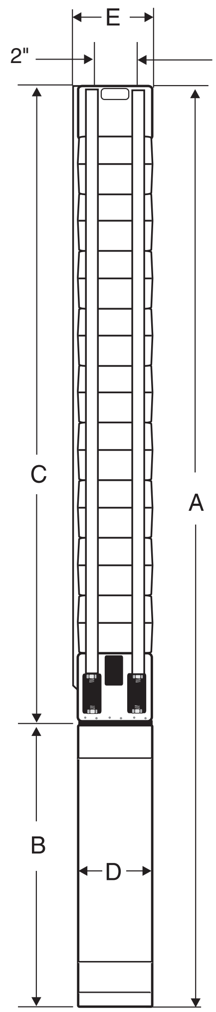


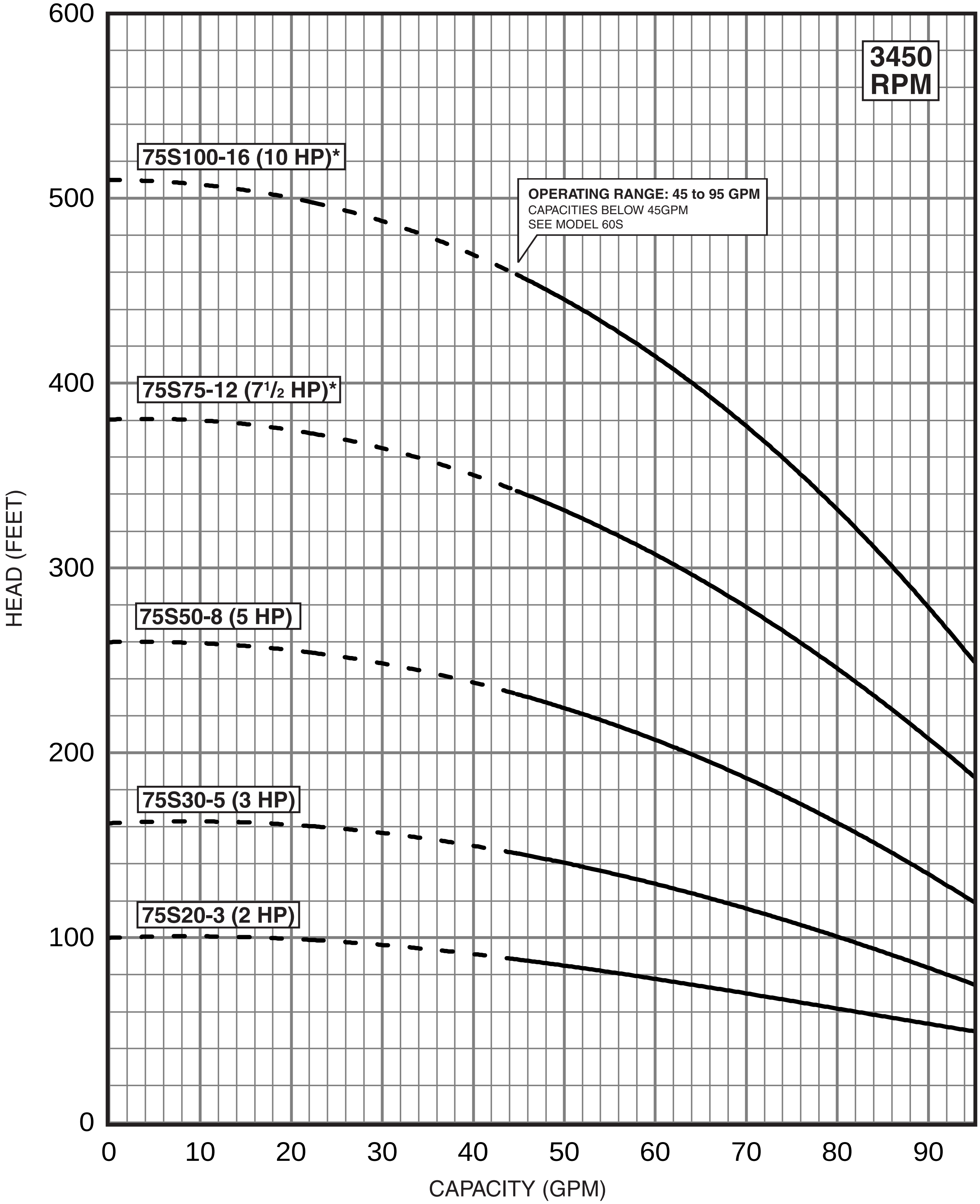
Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (4-18 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	431 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/431 Stainless Steel**
Check Valve Seat	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)
Split Cone	304 Stainless Steel
Split Cone Nut	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra® is a registered trademark of Hoechast Calanese Corporation.

FLOW RANGE: 45 - 95 GPM **OUTLET SIZE: 2" NPT** **NOMINAL DIA.: 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD,2-10 Hp 3450 RPM.
* Also available with 6" motor, performance is the same only at Best Effeciency point.
Consult factory for actual performance.

Performance conforms to ISO 9906. 1999 (E) Annex A
Minimum submergance is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
75S20-3	A	2	4"	2" NPT	30.0	15.1	14.9	3.8	3.9	38
75S30-5	A	3	4"	2" NPT	40.7	20.6	20.1	3.8	3.9	64
75S50-8	A	5	4"	2" NPT	51.4	23.6	27.8	3.8	3.9	78
75S75-12*	A	7 1/2	4"	2" NPT	67.5	29.6	37.9	3.8	3.9	100
75S100-16*	A	10	4"	2" NPT	92.1	43.9	48.2	3.8	3.9	155

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Also available with 6" motor, performance is the same only at Best Efficiency point. Consult factory for actual performance.

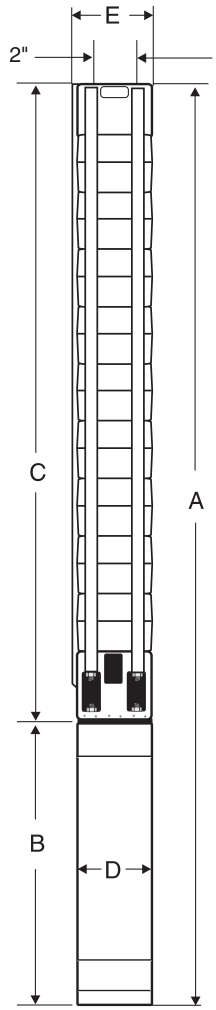


Fig. A

MATERIALS OF CONSTRUCTION

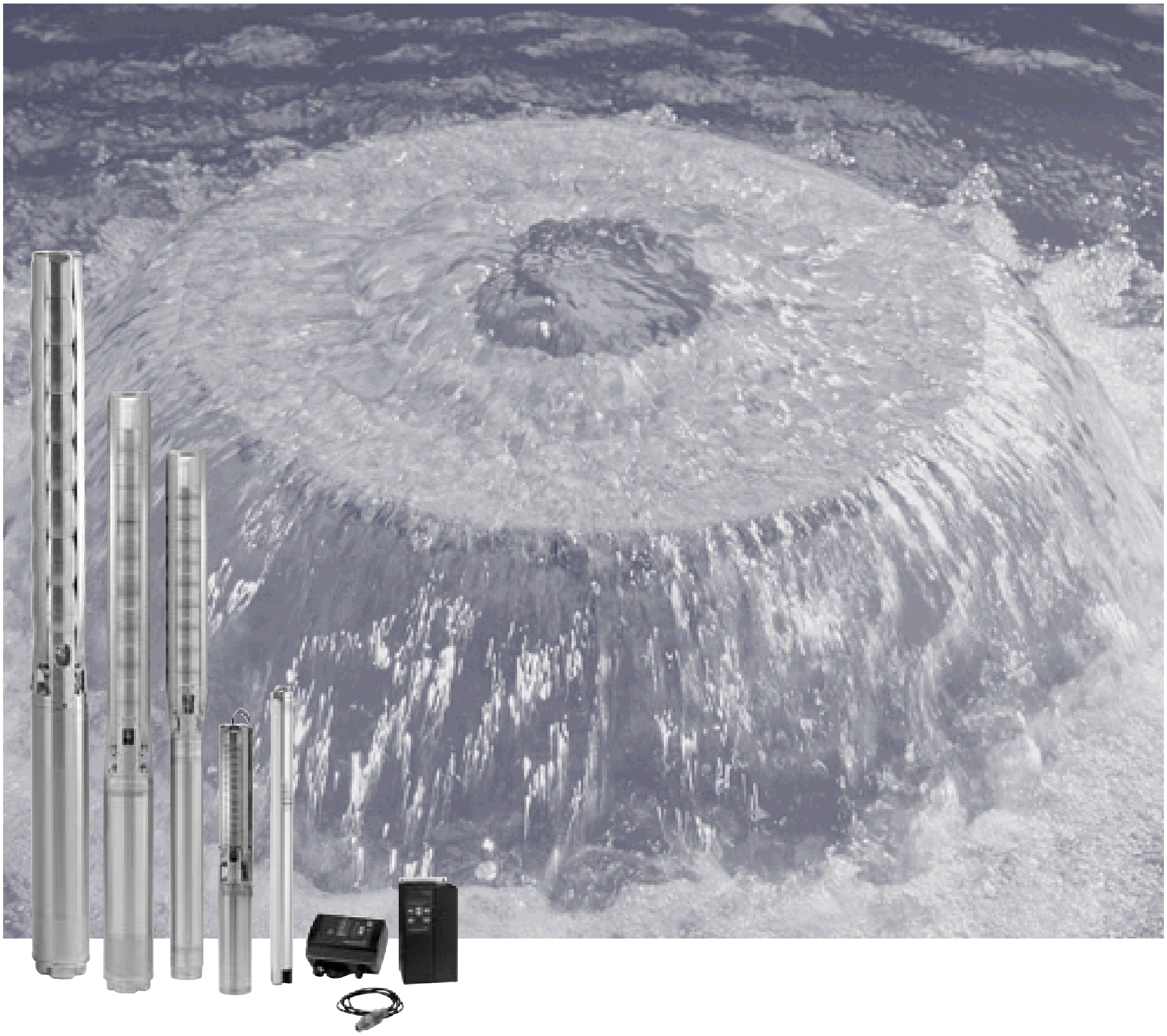
COMPONENT	CYLINDRICAL SHAFT (3-16 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	431 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Coupling	316/431 Stainless Steel**
Check Valve Seat	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)
Split Cone	304 Stainless Steel
Split Cone Nut	304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra® is a registered trademark of Hoechast Calanese Corporation.

GRUNDFOS **PRODUCT GUIDE**

SQ, SQE, SP

Stainless steel submersible pumps and accessories
60 Hz



BE > THINK > INNOVATE >

GRUNDFOS®

Mission

- to successfully develop, produce, and sell high quality pumps and pumping systems worldwide, contributing to a better quality of life and healthier environment


Bjerringbro, Denmark


Fresno, California


Olathe, Kansas

Monterrey, Mexico


Allentown, Pennsylvania


Oakville, Ontario

- One of the 3 largest pump companies in the world with over 11,000 employees worldwide
- World headquarters in Denmark
- North American headquarters in Kansas City - Manufacturing in Fresno, California
- 60 companies in 40 countries
- More than 10 million pumps produced annually worldwide
- North American companies operating in USA, Canada and Mexico
- Continuous reinvestment in growth and development enables the company to **BE** responsible, **THINK** ahead, and **INNOVATE**

Submittal Data Sheet

GRUNDFOS

Company name: ______________________
Prepared by: ______________________
Phone number: (   )   -
Fax number: (   )   -
Date: __________ Page 1 of: __________
Quote number: ______________________

Client Information

Project title:	Client name:
Reference number:	Client number:
Client contact:	Client phone no: ( ) -

Location Information

For:	Unit:		
Site:	Service:		
Address:	City:	State:	Zip Code:

Technical Data

Flow (GPM) ______________________
Head (Ft) ______________________
Motor ______________________
Max Fluid Temp ______________________
Min Fluid Temp ______________________
Max Working Pressure ______________________
Min Required Inlet Pressure ______________________
Connection Type and Size ______________________

Motor Information

HP: ______________________
Phase: ______________________
Voltage: ______________________
Enclosure: ______________________

Pump Information

Model Information from Type Key and Codes: ______________________

Quantity Required: ______________ Example: SP 150S

Minimum required flow: ______________ NPSH required at duty point: ______________

Product Guide additional information pages

Materials page number: ______________ Performance curve page number: ______________

Technical data page number: Motor data page number:

Custom-built pump information (optional): ______________________

Additional Information ______________________

TABLE OF CONTENTS

STAINLESS STEEL CONSTRUCTION

Grundfos submersibles feature rugged and durable stainless steel construction for all vital pump components. Impellers, diffusers, shafts, vanes, cable guards, couplings...even the nuts and bolts are stainless steel. Grundfos' 4-inch pump systems include the stainless steel pump, motor, and control box and are delivered ready to install.

Computer-aided design and manufacturing techniques ensure that each *pump* is built to exacting tolerance and performs to industry-leading standards. Grundfos state-of-the-art production equipment includes extensive use of robotics and advanced quality assurance procedures. You can rely on quality Grundfos' groundwater products for outstanding pump performance and best value.

SUBMERSIBLES

4-INCH and LARGER WELLS
The 4-inch submersibles line covers all flow requirements from 1.2 to 95 gpm and heads to 2000 feet. This broad range ensures proper pump selection for all domestic groundwater system applications.

6, 8, & 10-INCH and LARGER WELLS
For high flow requirements, this submersible line includes 6, 8, and 10-inch models for flows up to 1,400 gpm and heads to 2100 feet.

Grundfos offers 18 models of submersible pumps designed for domestic and industrial applications with flow rates from five to 1,400 gpm. Horsepower range extends from 1/3 hp to 250 hp. These pumps are marketed through more than 300 distributors and nearly 2,000 dealers nationwide.

THE STAINLESS STEEL ADVANTAGE

TOP PUMP PERFORMANCE
Grundfos pumps are built to work hard with every component designed for maximum hydraulic efficiency. With the inherently smooth surfaces of fabricated stainless steel, peak performance is maintained over many years of service.

RELIABLE OPERATION
Highly advanced design and manufacturing techniques minimize the number of moving parts. This, plus Grundfos' use of rugged stainless steel construction, make GRUNDFOS groundwater pumps the toughest, most reliable pumps on the market. With Grundfos you can rely on getting the water you need, when you need it.

LONG PUMP LIFE
Stainless steel is the best available material to resist wear and corrosion in water system applications. Compare Grundfos' stainless steel construction to the best the other manufactures have to offer. Grundfos stainless steel pumps are designed to operate efficiently and effectively for a long, long time.

SQ/SQE SUBMERSIBLE PUMPS

3-Inch SQ/SQE Submersible Well Pumps
3-Inch and Larger Wells

SQ/SQE pumps are suitable for both continuous and intermittent operation for a variety of applications:

- Domestic water supply
- Small waterworks
- Irrigation
- Tank applications

SQ, SQE pumps offer the following features:

- Dry-Run protection
- High efficiency pump and motor
- Protection against up-thrust
- Soft-start
- Over-voltage and under-voltage protection
- Overload protection
- Over-temperature protection
- High starting torque

Additionally, the SQE pumps offer:

- Constant pressure control
- Variable speed
- Electronic control and communication

The SQ and SQE pump models incorporate an innovative motor design. With the use of permanent-magnet technology within the motor, the SQ/SQE pumps deliver unmatched performance. By combining permanent-magnet motors and Grundfos's own micro frequency converter, we are now able to control and communicate with the pump in ways never before possible. A few of the features that come out of this combination are Constant Pressure Control, Soft-Start, and integrated Dry-Run protection. These are just a few of the many features that the SQ/SQE pumps can offer.

The SQ pump models operate at a constant speed much like today's conventional pumps. The difference between it and traditional pumps is you get all the benefits of an electronically controlled permanent-magnet motor that cannot be accomplished with a conventional induction motor. The SQ pumps are available for single phase power. They use a simple 2-wire design making installation easy.

The SQE uses the Grundfos "Smart Motor". Like the SQ model, we still use the high efficiency permanent magnet motor, but we give this motor the ability to communicate. The "Smart Motor" communicates via the CU301 status box through the power leads. It is not necessary to run any additional wires down the well. By being able to communicate with the pump you can have Constant Pressure Control and the ability to change the pump performance while the pump is installed in the well. Like the SQ motor, this is also a 2-wire motor designed for single-phase operation.

TYPE KEYS

SP Example 10 S 05 - 9

- Rated gallons per minute — 10
- Material of construction — S
- Horsepower — 05
- Number of pump stages — 9

SQ/SQE Example 10 SQ E 05 - 160

- Rated gallons per minute — 10
- Basic version (without communication) — SQ
- Electronic communication — E
- Horsepower — 05
- Total Dynamic Head in (ft) at rated flow — 160

GRUNDFOS **INSTRUCTIONS**

SP4"

4-Inch Stainless Steel Submersible Pumps

US Installation and operating instructions

WATER QUALITY
DRINKING WATER
SYSTEM COMPONENTS
ANSI/NSF 61
65 GM
30°C/86°F
PUMP END ONLY

Please leave these instructions with the pump for future reference.

BE > THINK > INNOVATE >

GRUNDFOS

SAFETY WARNING

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

NOTICE: This product is designes for pumping water only. Third party agency evalustions are based on pumping water only.

Pre-Installation Checklist

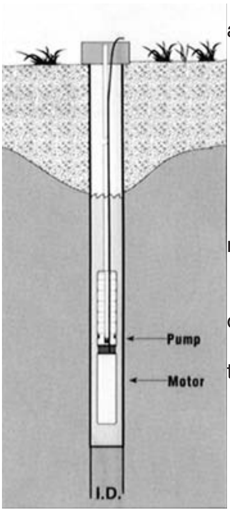
1. Well Preparation

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

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

2. Make Sure You Have The Right Pump

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



3. Pumped Fluid Requirements

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

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

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

Minimum Water Flow Requirements for Submersible Pump Motors

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

NOTES: For proper motor cooling, 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. The minimum water velocity past 4" motors is 0.25 feet per second.

PRE-INSTALLATION CHECKLIST

4. Splicing the Motor Cable

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

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

INSTALLATION PROCEDURES

1. Attach the Pump to the Motor

When attaching the pump to the motor we recommend the pump be bolted down in a cross pattern around the four bolts. Starting from the back (opposite the cable opening) and using a cross pattern, tighten the motor bolts to 13.5 ft-lbs, using progressive tightening until torque is met. (See figure 1 for example).

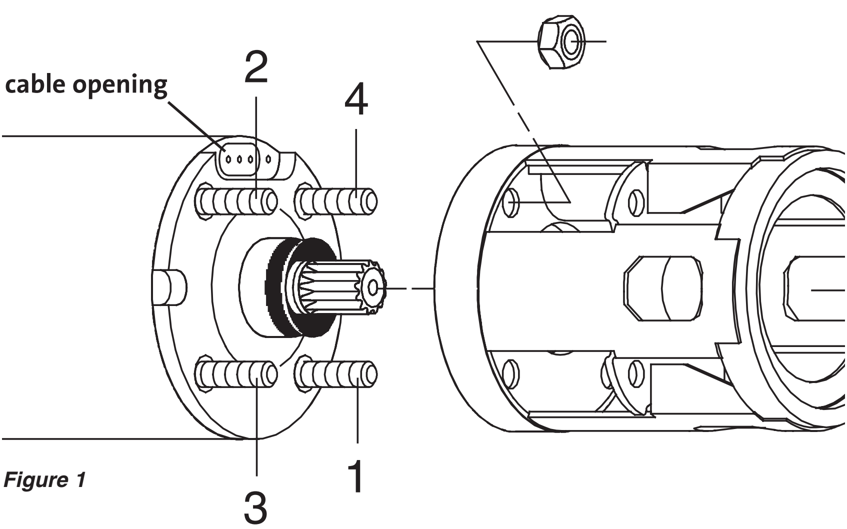


Figure 1

INSTALLATION PROCEDURES

2. Attach the Pump to the Pipe

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

3. Lower the Pump Into the Well

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

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

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

Figure 2

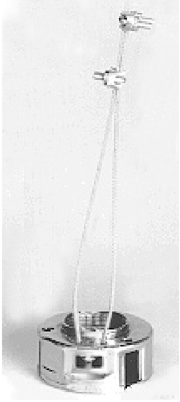


Figure 3

IMPORTANT: *Plastic pipe tends to stretch under load. This stretching must be taken into account when securing the cable to the riser pipe. Leave three to four inches of slack between clips or taped points. This tendency for plastic pipe to stretch will also affect the calculation of the pump setting depth. As a general rule, you can estimate that plastic pipe will stretch to approximately 2% of its length. When plastic riser pipe is used, it is recommended that a safety cable be attached to the pump to lower and raise it. The discharge chamber of GRUNDFOS 4-inch submersibles is designed to accommodate this cable. (See Figures 2 & 3.)*

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

4. Electrical Connections

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

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

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

The correct voltage-rated surge arrestor should be installed on the supply (line) side of the control box or starter (See Figure 4a & 4b). The arrestor must be grounded in accordance with the National Electric Code and local governing regulations.

PUMPS SHOULD NEVER BE STARTED UNLESS THE PUMP IS TOTALLY SUBMERGED. SEVERE DAMAGE MAY BE CAUSED TO THE PUMP AND MOTOR IF THEY ARE RUN DRY.
The control box shall be permanently grounded in accordance with the National Electric Code and local governing codes or regulations. The ground wire should be a bare stranded copper conductor at least the same size as the drop cable wire size. Ground wire should be as short a distance as possible and securely fastened to a true grounding point. True grounding points are considered to be: a grounding rod driven into the water strata; steel well casing submerged into the water lower than the pump setting level; and steel discharge pipes without insulating couplings. If plastic discharge pipe and well casing are used, a properly sized bare copper wire should be connected to a stud on the motor and run to the control panel. Do not ground to a gas supply line. Connect the grounding wire to the ground point first, then to the terminal in the control box.

Single Phase Hookup

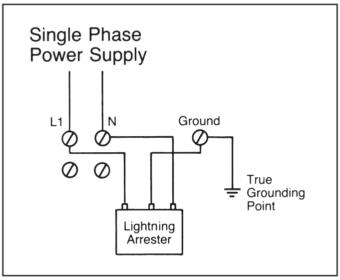


Figure 4a

Three Phase Hookup

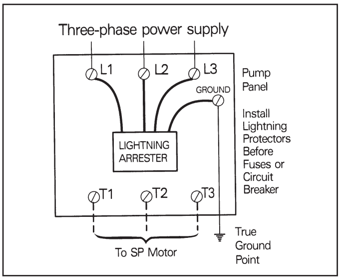
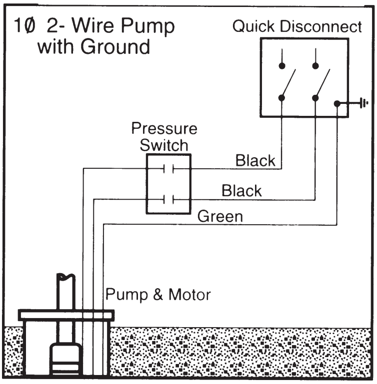


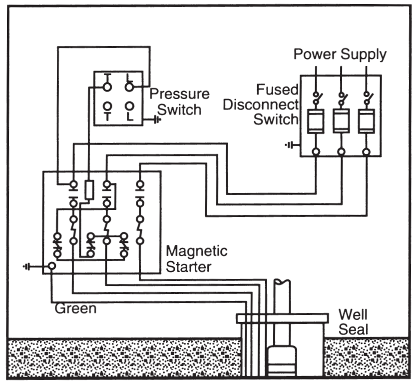
Figure 4b

INSTALLATION PROCEDURES

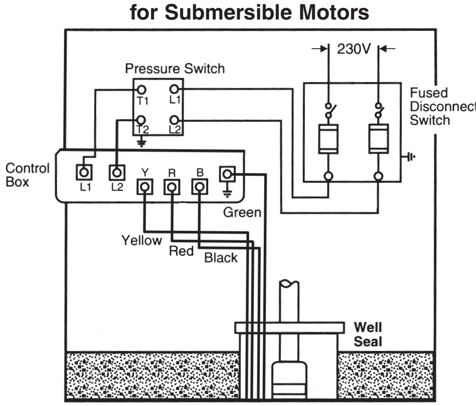
Single-Phase 2-Wire Wiring Diagram for Submersible Motors



Three-Phase Wiring Diagram for Submersible Motors



Single-Phase 3-Wire Control Box for Submersible Motors



4. Starting the Pump for the First Time

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

Grundfos motors specifications

1- Phase motors

HP	Ph	Volt	Service factor	Amperage		Full load		Max. thrust (lbs)	Line-to-Line resistance ( )		KVA code	Nameplate no.
				SF	Start	Eff. (%)	Pwr fact.		Blk-Yel	Red-Yel		
4-inch, single phase, 2-wire motors (control box not required)												
1/3	1	230	1.75	4.6	25.7	59	77	900	6.8-8.2		S	79952101
1/2	1	115	1.60	12.0	55	62	76	900	1.1-1.3		R	79922102
1/2	1	230	1.60	6.0	34.5	62	76	900	5.2-6.3		R	79952102
3/4	1	230	1.50	8.4	40.5	62	75	900	3.2-3.8		N	79952103
1	1	230	1.40	9.8	48.4	63	82	900	2.5-3.1		M	79952104
1 1/2	1	230	1.30	13.1	62	64	85	900	1.9-2.3		L	79952105
4-inch, single phase, 3-wire motors												
1/3	1	115	1.75	9.0	29	59	77	900	1.55-1.9	2.4-3	M	79423101
1/3	1	230	1.75	4.6	14	59	77	900	6.8-8.3	17.3-21.1	L	79453101
1/2	1	115	1.60	12.0	42.5	61	76	900	0.9-1.1	1.9-2.35	L	79423102
1/2	1	230	1.60	6.0	21.5	62	76	900	4.7-5.7	15.8-19.6	L	79453102
3/4	1	230	1.50	8.4	31.4	62	75	900	3.2-3.9	14-17.2	L	79453103
1	1	230	1.40	9.8	37	63	82	900	2.6-3.1	10.3-12.5	K	79453104
1.5	1	230	1.30	11.6	45.9	69	89	900	1.9-2.3	7.8-9.6	H	79453105
2	1	230	1.25	13.2	57	72	86	1500	1.5-1.8	3.4-4.1	G	79454506
3	1	230	1.15	17.0	77	74	93	1500	1.2-1.4	2.45-3	F	79454507
5	1	230	1.15	27.5	110	77	92	1500	0.65-0.85	2.1-2.6	F	79454509

3-Phase motors

HP	Ph	Volt	Service factor	Amperage		Full load		Max. thrust (lbs)	Line-to-Line resistance ( )		KVA code	Nameplate no.
				SF	Start.	Eff. (%)	Pwr fact.		Blk-Yel	Red-Yel		
4-inch, three phase, 3-wire motors												
1 1/2	3	230	1.30	7.3	40.3	75	72	900	3.9		K	79302005
		460	1.30	3.7	20.1	75	72	900	15.9		K	79362005
		575	1.30	2.9	16.1	75	72	900	25.2		K	79392005
3	3	230	1.25	8.7	48	76	75	900	3.0		J	79302006
		460	1.25	4.4	24	76	75	900	12.1		J	79362006
		575	1.25	3.5	19.2	76	75	900	18.8		J	79392006
3	3	230	1.15	12.2	56	77	75	900	2.2		H	79302006
		460	1.15	6.1	28	77	75	900	9.0		H	79362007
		575	1.15	4.8	22	77	75	900	13.0		H	79395507
5	3	208/230	1.15	18.6/17.4	108	80	82	1500	1.2		H	79304509
		440/460	1.15	8.65/8.65	54	80	82	1500	5.0		H	79354509
		575	1.15	7.9	54	80	82	1500	7.3		H	79394509
7 1/2	3	208/230	1.15	27.0/25.0	130	81	82	1500	0.84		H	79305511
		440/460	1.15	12.8/12.6	67	81	82	1500	3.24		J	79355511
		575	1.15	10.6	53	81	82	1500	5.2		J	79395511
10	3	440/460	1.15	18.0/18.6	90	81	80	1500	1.16		H	79355512
		575	1.15	14.4	72	81	80	1500	1.84		H	79395512

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

GRUNDFOS Control Box SA-SPM5

RATING		GRUNDFOS MOTOR MODEL	GRUNDFOS CONTROL BOX	GRUNDFOS STANDARD #’s	GRUNDFOS RUN CAP/DELUXE #’s
HP	VOLT				
1/3	115	MS402B	SA-SPM5	91126150	–
1/3	230	MS402B	SA-SPM5	91126151	–
1/2	115	MS402B	SA-SPM5	91126152	–
1/2	230	MS402B	SA-SPM5	91126153	–
3/4	230	MS402B	SA-SPM5	91126154	–
1	230	MS402B	SA-SPM5	91126155	91126211
1.5	230	MS402B	SA-SPM5	91126212	91126213
2	230	MS4000	SA-SPM5	91126214	91126215
3	230	MS4000	SA-SPM5	91126216	91126217
5	230	MS4000	SA-SPM5	91126218	91126219

MOTOR INFORMATION

The key to long submersible motor life is good cooling. Most submersible pumps rely on moving heat away from the motor by forced convection. The ambient/produced fluid is typically drawn by the motor in the course of pumping to accomplish this task. Submersible motors used in the water supply industry are typically designed to operate at full load in water up to 30°C (86°F), provided the flow velocity can be maintained at a minimum of 0.5 feet per second (fps).

Required Cooling Flow and Velocity

AWWA specifications state the maximum motor diameter and the minimum inside diameter of the well shall be in such relationship that under any operating condition the water velocity past the motor shall not exceed 12 fps (3.7 m/s) nor be less than 0.5 fps (0.15 m/s). The AWWA specification are principally applicable to motors 6-inch and larger, as most 4-inch motor designs are based on a minimum cooling flow velocity of 0.25 fps (0.08 m/s) at rated ambient temperature. Table 8 relates flow, casing and motor size requirements to accomplish minimum cooling velocity.

Table 8: Minimum Submersible Cooling Flow Requirements

Casing/Sleeve I.D. (inches)	4” Motor (0.25 fps)	6” Motor (0.5 fps)
	(gpm)	
4	1.2	–
5	7.0	–
6	13	9
7	20	25
8	30	45
10	50	90
12	80	140
14	110	200
16	150	280
18	–	380

Notes:
1. Minor irregularities associated with motor shape and diameter variations between manufactures are not accounted for in the table.
2. At the velocity specified in the table the temperature differential between the motor surface and ambient water will range from 5° - 15°C (10-30°F).

Some submersible motor manufactures require no cooling fluid flow past the motor, when the produced fluid temperature is 20°C (68°F) or less. Cooling by free convection in such cases, is only permitted in the vertical position and is contingent on no adverse operating conditions present such as; poor power, high stop/start frequency, presence of incrustating deposits on the motor surface, etc. Detramental operating conditions are difficult to identify or predict, and for this reason, the minimum cooling flow should be provided whenever possible - regardless of the ambient fluid temperature.

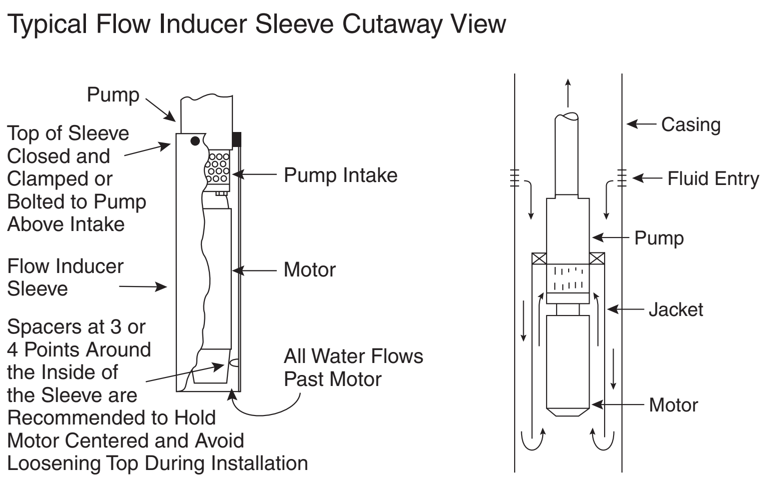
Typical Motor Jacket/Shroud Configurations.

The motor shroud is generally of the next nominal diameter of standard pipe larger than the motor or the pump, depending on the shroud configuration used. The tubular/pipe material can be plastic or thin walled steel (corrosion resistant materials preferred). The cap/top must accommodate power cable without damage and provide a snug fit, so that only a very small amount of fluid can be pulled through the top of the shroud. The fit should not be completely water tight as ventilation is often required to allow escape of the air or gas that might accumulate. The shroud body should be stabilized to prevent rotation and maintain the motor centered within the shroud. The shroud length should extend to a length of 1-2 times the shroud diameter beyond the bottom of the motor when possible. Shrouds are typically attached immediately above the pump intake or at the pump/column correction.

A typical motor sleeve/shroud selection example is sited below and illustrated in Figure 8:

If a well feeds water from above the pump, has a casing/chamber too small to allow a motor jacket/sleeve on the pump, and does not have adequate level and flow to allow raising the pump above the inflow, it is difficult to properly cool the motor. When possible, the casing depth should be increased to allow flow to come from below the motor. If this is not practical, adequate flow past the motor can usually be attained by employing a motor jacket with a stringer pipe or by using a jet tube.

Figure 8: Typical Motor Jacket Installation Scenarios



MOTOR INFORMATION

Single-Phase 60 Hz

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

Three-Phase 60 Hz

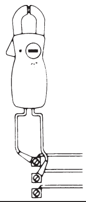
MOTOR RATIN		COPPER WIRE SIZE (AWG)						
VOLTS	HP	14	12	10	8	6	4	2
208	1-1/2	310	500	790	1260			
	2	240	390	610	970	1520		
	3	180	290	470	740	1160	1810	
		5170	280	4690	1080			1660
230	1-1/2	360	580	920	1450			
	2	280	450	700	1110	1740		
	3	210	340	540	860	1340	2080	
	5		200	320	510	800	1240	1900
460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

FOOTNOTES:

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

TROUBLESHOOTING

SUPPLY VOLTAGE



How to Measure

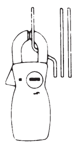
By means of a voltmeter, which has been set to the proper scale, measure the voltage at the control box or starter. On single-phase units, measure between line and neutral.

What it Means

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

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

CURRENT MEASUREMENT



How to Measure

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

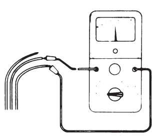
Current should be measured when the pump is operating at a constant discharge pressure with the motor fully loaded.

What it Means

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

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

WINDING RESISTANCE



How to Measure

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

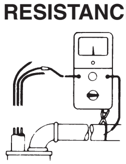
Zero-adjust the meter and measure the resistance between leads. Record the values. Motor resistance values can be found on page 6.

What it Means

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

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

INSULATION RESISTANCE



How to Measure

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

What it Means

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

OHM VALUE	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 - 500,000	0.02 - 0.5	A motor which may have been damaged by lightning or with damaged leads. Do not pull the pump for this reason.
10,000 - 20,000	0.01 - 0.02	A motor which definitely has been damaged or with damaged cable. The pump should be pulled and repairs made to the cable or the motor replaced. The motor will still operate, but probably not for long.
less than 10,000	0 - 0.01	A motor which has failed or with completely destroyed cable insulation. The pump must be pulled and the cable repaired or the motor replaced. The motor will not run in this condition.

TROUBLESHOOTING

Pump Won't Start

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

Pump Does Not Produce Enough Flow (GPM)

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

Fuses Blow or Heaters Trip

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

Pump Cycles Too Often

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

LIMITED WARRANTY

Products manufactured by GRUNDFOS are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 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.

MANUFACTURER 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. EXCEPT AS EXPRESSLY HEREIN PROVIDED THE GOODS ARE SOLD "AS IS", THE ENTIRE RISK AS TO QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, AND PERFORMANCE OF THE GOODS IS WITH THE BUYER, AND SHOULD THE GOODS PROVE DEFECTIVE FOLLOWING THEIR PURCHASE, THE BUYER AND NOT THE MANUFACTURER, DISTRIBUTOR, OR RETAILER ASSUMES THE ENTIRE RISK OF ALL NECESSARY SERVICING OR REPAIR.

Some jurisdictions do not allow the exclusion or limitation of implied warranties of merchantability and fitness for a particular purpose, of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last or require you to pay certain expenses as set forth above. 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.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

U.S.A.
Grundfos Pumps Corporation
17100 W. 118th Terrace
Olathe, KS 66061
Telephone (913) 227-3400
Fax: (913) 227-3500

Canada
Grundfos Canada, Inc.
2941 Brighton Road
Oakville, Ontario L6H 6C9, Canada
Telephone: (905) 829-9533
Fax: (905) 829-9512

Mexico
Bombas Grundfos de Mexico, S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. Mexico
C.P. 66600 Apodaca, N.L. Mexico
Telephone: 011-52-81-8144-4000
Fax: 011-52-81-8144-4010

L-SP-TL-048 Rev. 2/06(US)

AC Motors | Pump |

Specifications: JMWDM3711T

Catalog Number:	JMWDM3711T
Specification Number:	37H883T968
Horsepower:	10
Voltage:	208-230/460
Hertz:	60
Phase:	3
Full Load Amps:	26.2-23.8/11.9
Usable at 208 Volts:	N/A
RPM:	3450
Frame Size:	215JM
Service Factor:	1.15
Rating:	40C AMB-CONT
Locked Rotor Code:	H
NEMA Design Code:	B
Insulation Class:	F
Full Load Efficiency:	87.5
Power Factor:	90
Enclosure:	TEFC
Baldor Type:	3730M
DE Bearing:	6309
ODE Bearing:	6206
Electrical Specification Number:	37WGT968
Mechanical Specification Number:	37H883
Base:	RG
Mounting:	F1

* For certified information, contact your local Baldor office.

Performance Data: JMWDM3711T

Product Nameplate Data :					
Rated Output	10 HP	Hertz	60	NEMA Nom. Eff.	87.5
Volts	208-230/460	Phase	3	Power Factor	90
Full Load Amps	26.2-23.8/11.9	NEMA Design Code	B	Service Factor	1.15
Speed	3450	LR KVA Code	H	Rating - Duty	40C AMB-CONT

(Typical performance - Not guaranteed values)

General Characterstics at 460 V, 60 Hz, 10 HP			
Full Load Torque	15.1 LB-FT	Starting Current	87.2 Amps
Start Configuration	DOL	No-Load Current	3.5 Amps
Break Down Torque	57.2 LB-FT	Line-line Resistance @ 25° C	1.04 Ohms
Pull-Up Torque	29.5 LB-FT	Temperature Rise, C @ FL (in deg)	65
Locked-Roter Torque	34.2 LB-FT	Temp. Rise @ S.F. Load (in deg)	76

Load Characteristics at 460 V, 60 Hz , 10 HP							
% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor	67	82	88	90	91	91	91
Efficiency	75.6	84.2	87.3	87.8	87.4	86.2	87.6
Speed (rpm)	3570	3546	3521	3493	3462	3427	3474
Line Amperes	4.76	6.87	9.33	11.9	14.7	17.7	13.6

* For certified information, contact your local Baldor office.

JMWDM3711T Replacement Parts List

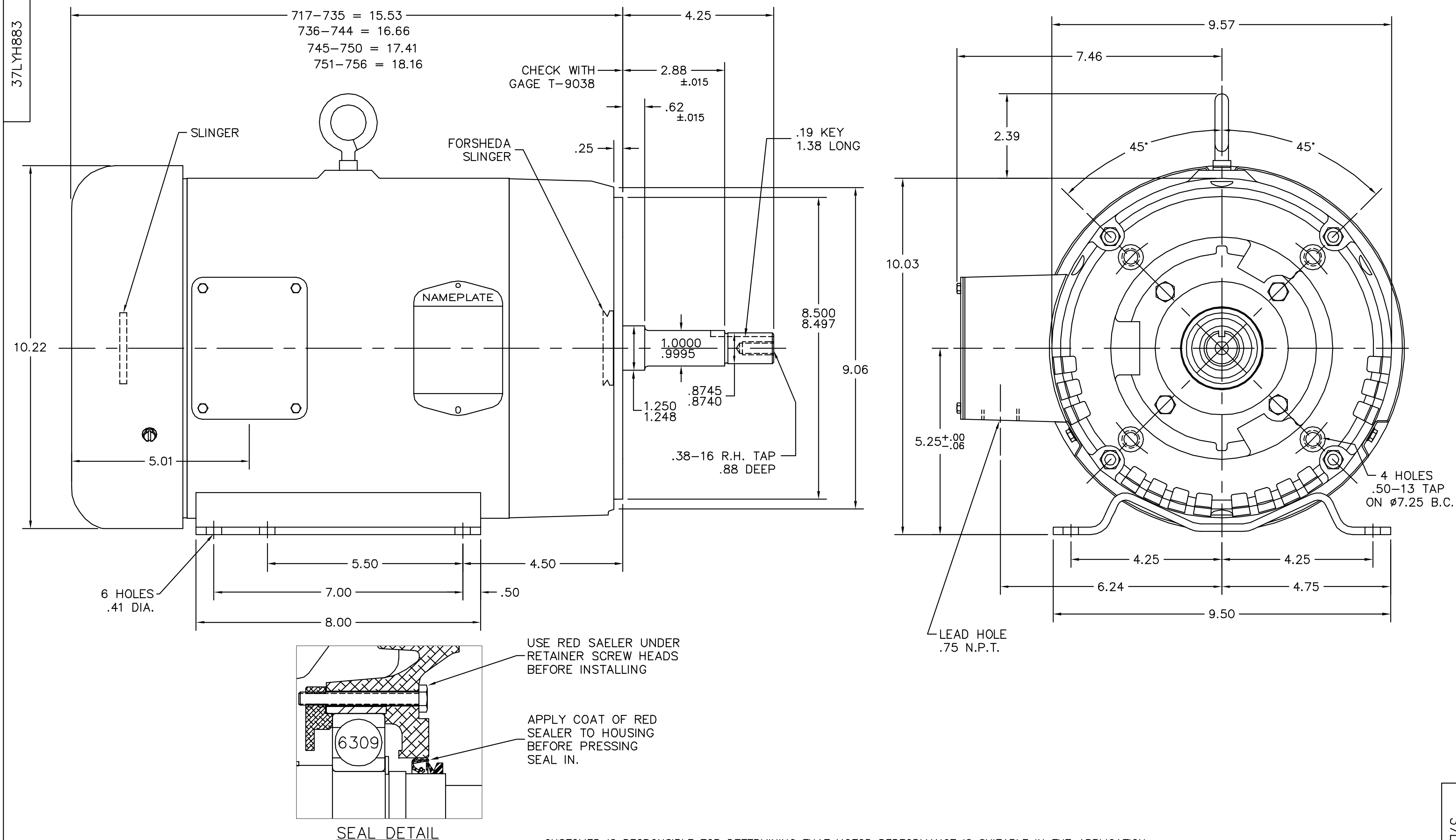
Print Page | Close Window

Catalog Number	JMWDM3711T
Specification Number	37H883T968
Description	10HP,3450RPM,3PH,60HZ,215,JM,3730M,TEFC
Plant	BALDOR FT SMITH/REC WHSE #5

Replacement Parts

Material Number	Description	Qty.	List Price	Units
37FN3002A01	EXT FAN, PLASTIC	1	$ 24.00	EA
37CB1001A01W	WHITE EPOXY CONDUIT BOX, MACH	1	$ 45.00	EA
37CB1001W	37CB1001 W/WHITE EPOXY	1	$ 45.00	EA
37GS1016A01	NEOPRENE KOBX GASKET W/LIP (WHITE)	1	*CALL	EA
37EP3101A94MW	FRONT TEFC L&M 206 BRG W/O GRSR (WHITE)	1	$ 120.00	EA
37EP3101A94DW	FRONT TEFC L&M 206 BRG W/O GRSR	1	$ 149.00	EA
37EP3401T08MW	FACE MT EP, ENCL, 213TC-215TC, W/WHITE E	1	$ 108.00	EA
37EP3401T08DW	DRILLED EP W/WHITE EPOXY	1	$ 109.00	EA
07FH4011	WASHDOWN IEC FH W/AUTOPHORETIC PRIMER	1	$ 17.00	EA
36CB4518	36 LIPPED CB LID AUTOPHORETIC	1	$ 3.00	EA
37GS3010	1/16"WHITE LID GASKET	1	$ 2.00	EA
HA3104S14	THRUBOLT 12.125LG SS	4	$ 12.00	EA

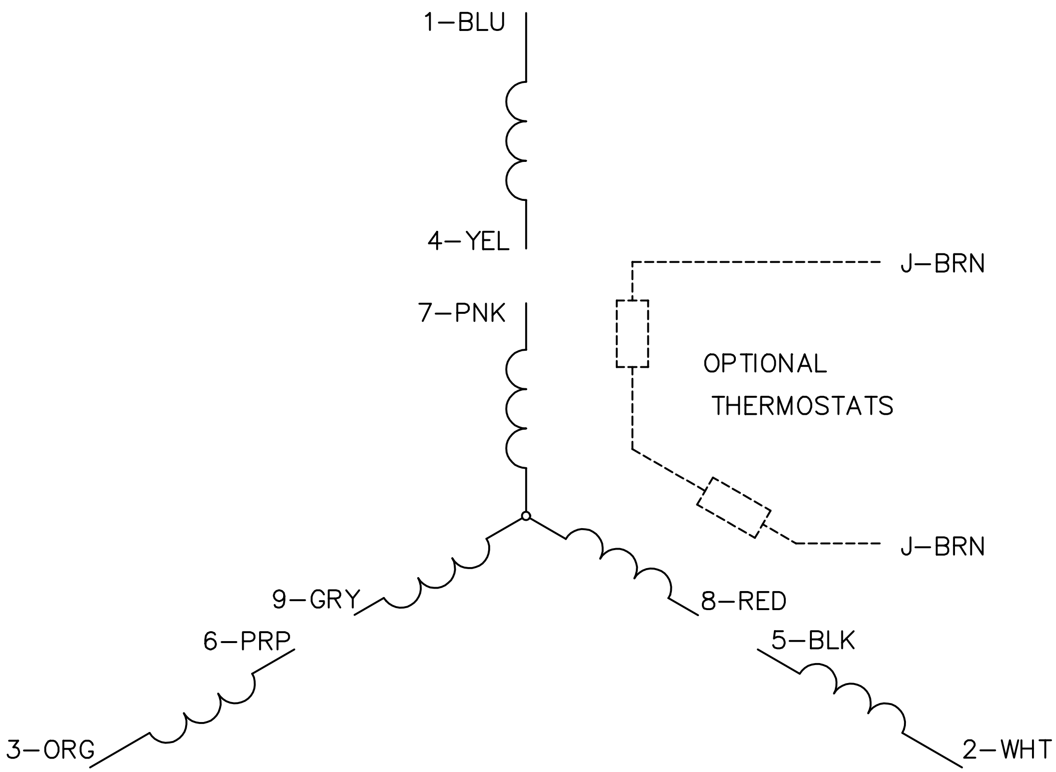
* Please contact your **nearest Baldor Sales Office** to obtain price on these items.

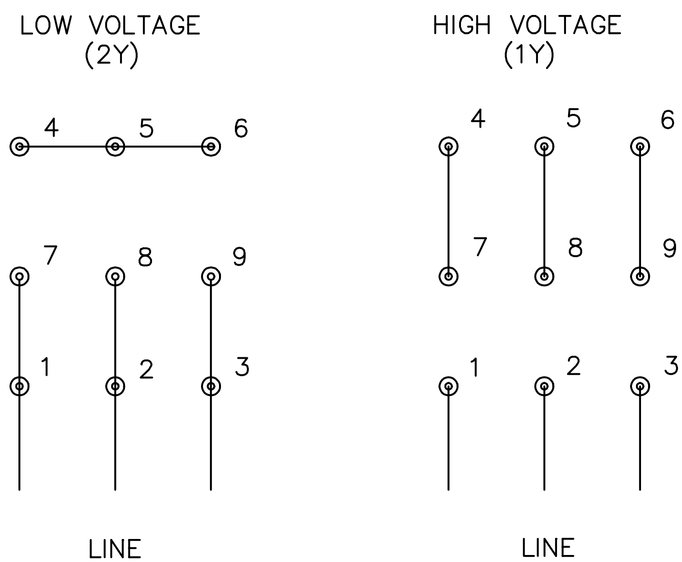


CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT MOTOR PERFORMANCE IS SUITABLE IN THE APPLICATION.

REV. DESC: CORRECT GRAPHICS FOR SLINGER ON FR.END PER BOM			BALDOR ELECTRIC Co.
REV. LTR: A	VERSION: 01	TDR: 000000402212	
FILE: \AAA\00093\192	REVISED: 10:45:29 07/13/2006	BY: ENODIDO	HOR 213-5JM TEFC 37M WD
MTL: –			

37LYH883





NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0005

REV. DESC: REVISE TO SHOW OPTIONAL COLORS			BALDOR ELECTRIC Co.
REV. LTR: E	BY: JLP	REVISED: 01/19/99 10:15	TDR: 0171435
CD0005	FILE: AAA00005140	MDL: –	3PH, DV, 9 LEADS
	MTL: –		

Appendix C

Product Information

Price ® Pump Co. XT150 Centrifugal Pump and Baldor Pump Motor

General Terms Of Sale For Products

1. GENERAL

A. Seller's price is based on these sales terms and conditions. This contract shall represent the final, complete and exclusive statement of the agreement between the parties and may not be modified, supplemented, explained or waived by parol evidence, any Terms and Conditions contained in Buyer's purchase order or request for quotation, any course of dealings between the parties, Seller's performance or delivery, or in any other way. The Terms and Conditions of this contract may only be modified or waived in a written document signed by an Officer of Seller. These terms are intended to cover all activity of Seller and Buyer hereunder, including sales and use of products, parts and work and all related matters (references to products include parts and references to work include construction, installation and start-up). Any reference by Seller to Buyer's specifications and similar requirements are only to describe the products and work covered hereby and no warranties or other terms therein shall have any force of effect. Any information provided by Seller, including but not limited to suggestions as to specific equipment does not imply any guarantee of specific suitability and/or material compatibility in a particular application since many factors outside the control of Seller may affect the suitability of products in a particular application. Catalogs, circulars and similar pamphlets of the Seller are issued for general information purposes only and shall not be deemed to modify the provisions hereof.

B. The agreement formed hereby and the language herein shall be construed and enforced under the Uniform Commercial Code as in effect in the State of California on the date hereof.

2. TAXES

Any sales, use or other similar type taxes imposed on this sale or on this transaction are not included in the price. Such taxes shall be billed separately to the Buyer. Seller will accept a valid exemption certificate from the Buyer if applicable; however, if an exemption certificate previously accepted is not recognized by the governmental taxing authority involved and the Seller is required to pay the tax covered by such exemption certificate. Buyer agrees to promptly reimburse Seller for the taxes paid.

3. PERFORMANCE, INSPECTION AND ACCEPTANCE

A. Unless Seller specifically assumes installation, construction or start-up responsibility, all products shall be finally inspected and accepted within thirty (30) days after arrival at point of delivery. Products not covered by the foregoing and all work shall be finally inspected and accepted with thirty (30) days after completion of the applicable work by Seller. All claims whatsoever by Buyer (including claims for shortages) excepting only those provided for under the WARRANTY AND LIMITATION OF LIABILITY and PATENTS Clauses hereof must be asserted in writing by Buyer within said thirty (30) day period or they are waived. If this contract involves partial performance, all such claims must be asserted within said thirty- (30) day period for each partial performance. There shall be no revocation of acceptance. Rejection may be only for defects substantially impairing the value of products or work and Buyer's remedy for lesser defects shall be those provided for under the WARRANTY AND LIMITATION OF LIABILITY Clause.

B. Seller shall not be responsible for non-performance or for delays in performance occasioned by any causes beyond Seller's reasonable control, including, but not limited to, labor difficulties, delays of vendors or carriers, fires, governmental actions, or shortages of material, components, labor, or manufacturing facilities. Any delays so occasioned shall affect a corresponding extension of Seller's performance dates, which are, in any event, understood to be approximate. In no event shall Buyer be entitled to incidental or consequential damages for late performance or for a failure to perform. Seller reserves the right to make partial shipments and to ship products, parts or work which may be completed prior to the scheduled performance date.

C. In the event that Seller has agreed to mount motors, turbines, gears, or other products which are not manufactured by Seller and which are not an integral part of Seller's manufactured product, and a delay in the delivery of such products to Seller occurs that will cause a delay in Seller's performance date, Seller reserves the right to ship its product upon completion of manufacture and to refund an equitable portion of the amount originally included in the purchase price for mounting without incurring liability for non-performance.

D. Seller reserves to itself the right to change its specifications, drawings and standards if such changes will not impair the performance of its products, and parts, and further that such products, and parts, will meet any of Buyer's specifications and other specific product requirements which are a part of this agreement.

E. The manufacture and inspection of products and parts shall be to Seller's Engineering and Quality Assurance standards plus such other inspections, tests of documentation as are specifically agreed to by Seller. Requirements for any additional inspection, tests, documentation, or Buyer witness of manufacture, test, and/or inspection shall be subject to additional charges.

4. TITLE AND RISK OF LOSS

Title and risk of loss shall pass to buyer upon delivery of products at the designated Ex Works place (Incoterms 1990) unless other wise agreed by the parties.

5. EROSION AND CORROSION

It is specifically understood that products and parts sold hereunder are not warranted for operation with erosive or corrosive fluids. No product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action of any fluid and Buyer shall have no claim whatsoever against Seller therefore.

6. WARRANTY AND LIMITATION OF LIABILITY

A.Seller warrants only that its product and parts, when shipped, will be free from defects in materials and workmanship. With respect to products and parts not manufactured by Seller, Seller's only obligation shall be to assign to Buyer, to the extent possible, whatever warranty Seller requires from the manufacturer. All claims for defective products or parts under this warranty must be made in writing immediately upon discovery and, in any event, within one (1) year after initial start-up or eighteen (18) months after shipment, whichever first occurs, and all claims for defective work must be made in writing immediately upon discovery and in any event, within one (1) year of completion thereof by Seller.

Defective items must be held for Seller's inspection and returned to the original f.o.b. point upon request.

THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING WITHOUT LIMITATION, THE IMPLIED, WARRANTIES OF MERCHANTABILITY AND FITNESS.

B. ANY PRODUCT (S) SOLD HEREUNDER WHICH IS NOT MANUFACTURED BY SELLER IS NOT WARRANTED BY SELLER and shall be covered only by the express warranty, if any, of the manufacturer thereof.

C. Upon Buyer's submission of a claim as provided above and its substantiation, Seller shall at its option either (i) repair or replace its product, part or work at the original place of delivery, or (ii) refund an equitable portion of the purchase price.

D. THE FOREGOING IS SELLER'S ONLY OBLIGATION AND BUYER'S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY AND, EXCEPT FOR GROSS NEGLIGENCE, WILLFUL MISCONDUCT, AND REMEDIES PERMITTED UNDER THE PERFORMANCE, INSPECTION AND ACCEPTANCE AND THE PATENTS CLAUSES HEREOF, THE FOREGOING IS BUYER EXCLUSIVE REMEDY AGAINST SELLER FOR ALL CLAIMS ARISING HEREUNDER OR RELATING HERETO WHETHER SUCH CLAIMS ARE BASED ON BREACH OF CONTRACT. TORT (INCLUDING NEGLIGENCE) OR OTHER THEORIES. BUYER'S FAILURE TO SUBMIT A CLAIM AS PROVIDED ABOVE SHALL SPECIFICALLY WAIVE ALL CLAIMS FOR DAMAGES OR OTHER RELIEF, INCLUDING BUT NOT LIMITED TO CLAIMS BASED ON LATENT DEFECTS. IN NO EVENT SHALL BUYER BE ENTITLED TO INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, NOR FOR DAMAGES FOR LOSS OF USE, LOST PROFITS OR REVENUE, INTEREST, LOST GOODWILL, WORK OR PRODUCTION STOPPAGE, IMPAIRMENT OF OTHER GOODS, INCREASED EXPENSES OF OPERATION, OR THE COST OF PURCHASING REPLACEMENT POWER OR OTHER SERVICES BECAUSE OF SERVICE INTERRUPTIONS. FURTHERMORE, IN NO EVENT SHALL SELLER'S TOTAL LIABILITY FOR DAMAGES OF BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS OR PARTS MANUFACTURED BY SELLER AND UPON WHICH SUCH LIABILITY IS BASED. ANY ACTION ARISING HEREUNDER RELATED HERETO, WHETHER BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHER THEORIES, MUST BE COMMENCED WITHIN ONE (1) YEAR AFTER THE CAUSE OF ACTION ACCRUES OR IT SHALL BE BARRED.

7. PURCHASER'S REPRESENTATIONS & WARRANTIES

Purchaser represents and warranties that the products(s) covered by this contract shall not be used in or in connection with a nuclear facility or application. The parties agree that this representation and warranty is material and is being relied on by seller. This provision may be modified in a separate writing signed by an officer of PPC.

8. PATENTS

Seller agrees to assume the defense of any suit for infringement of any patents brought against Buyer to the extent of such suit charges infringement of an apparatus or product claim by Seller's product in and of itself, provided (i) said product is built entirely to Seller's design, (ii) Buyer notifies Seller in writing of the filing of such suit within ten (10) days after the service of process thereof, and (iii) Seller is given complete control of the defense of such suit, including the right to defend, settle and make changes in the product for the purpose of avoiding infringement of any process or method claims, unless infringement of such claims is the result of following specific instruction furnished by Seller.

9. EXTENT OF SUPPLY

Only products as listed in Seller's proposal are included in this agreement. It must not be assumed that Seller has included anything beyond same.

10. MANUFACTURING SOURCES

To maintain delivery schedules, Seller reservplants on a world-wide basis.

11. TERMS OF PAYMENT

Net 30 days from date of invoice.

Effective: January 1, 1999

Price® Pump Company

Type XT/XL

Installation, Operating and Maintenance Manual

<u>Caution:</u>
Before installing, repairing or performing maintenance on this pump, read these instructions completely.

If pump has been used to pump hazardous materials be certain that all materials have been removed prior to working on the pump.

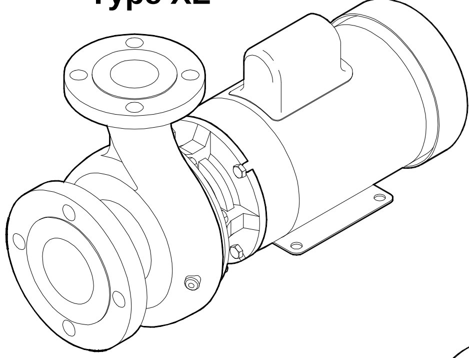
<u>Warning!!</u>
Ground motor before connection to electrical power supply!! Failure to ground motor can cause severe or fatal electrical shock hazard!!

Do not ground to gas supply line!!

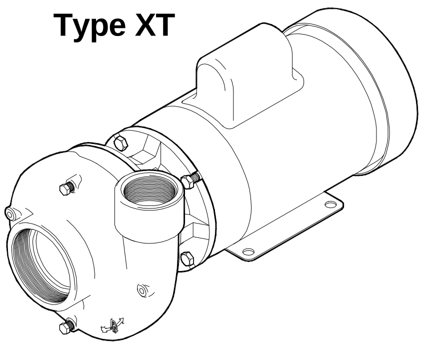
Match voltage to nameplate voltage on motor. Incorrect voltage can cause fire or seriously damage motor, voiding warranty.

Before disassembling be certain all liquid is removed from the pump.

Type XL



Type XT



Close Coupled <u>Motor Pumps</u>

These pumps require no special care in mounting, although it is suggested that they be firmly bolted to a level surface. Adequate air movement over motor will help prevent overloads.

Power Frame <u>Mounted Pumps</u>

These pumps must be mounted on a rigid steel base that will not warp or flex. Each pump must be mounted such that **the pump shaft centerline is on center with the driver shaft centerline.** Pad and/or shims will be required on either pump, driver or both. The two shafts should not touch each other and the distance between them depends on the coupling used to connect them. **Misalignment will cause bearing failure and void warranty. Pumps are rough aligned at the factory but must be realigned after shipment and installation.** Pulley driven pump must have pulleys inline and good belt tightness practices followed.

Direction of Rotation

Note: Motor shaft rotation is viewed from the suction end of pump. A rotational arrow is shown on the front of the pump volute casing. Incorrect rotation can cause pump damage, failure or reduced performance, voiding warranty. It is best to check rotation by momentarily energizing or jogging the motor prior to filling pump with liquid.

Warning! Do not operate pump without liquid for more than a few seconds, as damage will result to mechanical seal.

PLUMBING

All piping should be supported independently of the pump. Piping should not exert any stress on the pump connections.

Suction Piping <u>Horizontal Pumps</u>

Suction line must provide adequate suction pressure and smooth liquid flow for proper pump operation. Air entrapment in the suction line because of leaks or improper design may cause the pump to lose prime and fail. This pump is not self-priming, therefore the suction must be flooded at start up. Also, the suction line must provide sufficient pressure and smooth flow to pump inlet to prevent pump cavitation. A length of straight pipe a minimum of 5 times the pump inlet diameter and preferably 10 times the diameter should be installed in the suction line where it enters the pump. Elbows, fittings or valves installed close to the suction can disrupt liquid flow and cause malfunction. Suction lines must be at least the same size as the pump inlet or larger if possible.

Visit Our Web Site
www.pricepump.com

* Check out The Centrifugal Pump University and take the Interactive Pump Test.
* Find technical information for all Price Pump models.
* Locate a local distributor at www.pumpnet.com
* Printable I&O Manuals in PDF Format.

Parts List Type XT/XL Cont.

	All Models	
H2.	T.9 Teflon® Single Seal/Seat (opt)	0123
	Seat Pin T.9 (not shown)	0890
H3.	T.21 Double Seal/Seat (opt)	Specify P/N
	Double Seal Plate (2 rqd)	0309
	Plate Gasket, Teflon® (2 rqd)	0505
	Plate Bolts (6 rqd)	0977
H4.	Seal Quench (opt):	
	Buna Lip Seal	0756
	Viton® Lip Seal	0757
	Teflon® Lip Seal	0758
	Lip Seal Plate	0309-2
	Plate Gasket, Teflon®	0505
	Plate Bolts (3 rqd)	0977
H5.	T.9 Teflon® Double Seal/Seat (opt)	0670
	Double Seal Plate (2 rqd)	0309-1
	Plate Gasket, Teflon® (2 rqd)	0505
	Plate Bolts (6 rqd)	0977
	Seat Pin T.9 (2 rqd not shown)	0890

	All Models	
J.	Impeller Lockdown	0978
K.	Lockdown Gasket, Teflon®	0245
L.	Motor Bolts	
	All Bronze pumps (4 rqd)	0587
	Stainless Steel pumps (4 rqd)	0593
	AI & CIBF pumps (4 rqd) and	0593
	order Washers (4 rqd)	1137
M.	Sleeve Gasket, Teflon®	0245
N.	Impeller Shaft Key	0135
P1.	JM Motor	Specify P/N
P3.	Air Motor	Specify P/N
P4.	Power Frame	5480

Price Pump Co. recommends against using foot valves in the suction line to maintain liquid in the pump when it's not operating. If foot valves are used due to suction lift conditions they must be properly maintained to avoid leaks resulting from wear or fouling. Suction piping must be designed to prevent air from being trapped in high spots in the piping. This condition may cause the pump to vapor lock as the air bubble moves into the pump.

Discharge Piping

For flow and discharge head control it is advisable to install a valve (globe, ball, or other adjustable and non-leak type) in the discharge line close to the pump. The valve may be closed during system repairs to prevent backflow. By installing a check valve in the discharge line backflow can also be prevented during maintenance or during periods of pump stoppage.

OPERATION

Priming-

All centrifugal pumps must be filled with liquid prior to start up. For the pump illustrated in this manual completely fill the volute and suction lines prior to operation. It is suggested that during initial start up the discharge valve be closed and then opened as the motor develops full rpm's. If pump does not build up pressure as motor speed increases, shut down and make sure that liquid flow into pump is not restricted (see "Troubleshooting").

Note: A centrifugal pump's flow and head (pressure) will vary with the amount of resistance (friction and flow restrictions) in the discharge line. As a valve on the discharge line opens the flow and motor amp draw will increase and head will drop. As a valve on the discharge is closed the flow and amp draw will decrease and the head will increase. If resistance in the discharge line is not sufficient the pump will operate at a condition of maximum (or "choked") flow, also sometimes called "end of performance curve." Maximum horsepower is required to operate at this point and motor overload may result. If excessive amp draw and motor overload is recurring, reduce the system flow by installing a valve on the discharge line and restricting flow. Alternatively, reduce pump head by trimming impeller to a smaller diameter. Consult local Price Pump dealer for assistance.

TROUBLESHOOTING

1. Pump fails to build pressure:
Check for:
a. Pump not primed.
b. Incorrect rotation.
c. Driver speed too low.
d. Suction line restricted.
e. Driver failure.
f. Plugged or damaged impeller.
g. Pump or impeller undersized.
h. Pump cavitation.
i. Improper impeller clearance.

2. Pump fails to provide enough flow.
Check for:
a. System resistance too high.
b. Pump undersized.
c. Pump not primed.
d. Driver speed too low.
e. Poor suction conditions.
f. Improper impeller clearance.

3. Excessive noise or vibration during operation.
Check for:
a. Motor bearing failing.
b. Pump cavitating.
c. Improper impeller clearance.

4. Leaking mechanical seal.
Check for:
a. Improper assembly.
b. Worn or cracked seal faces.
c. Abrasive material in fluid.
d. Liquid flashing at seal faces (fluid temperature too high).
e. Seal pressure rating too low for the service.
f. Chemical attack of seal parts.
g. Seal operated dry or with a liquid having poor lubricating properties.

5. Pump gradually loses pressure and head.
Check for:
a. Increasing temperature causing cavitation or liquid vaporization.
b. Driver failure.
c. Suction lift too high.
d. Air entering suction line.

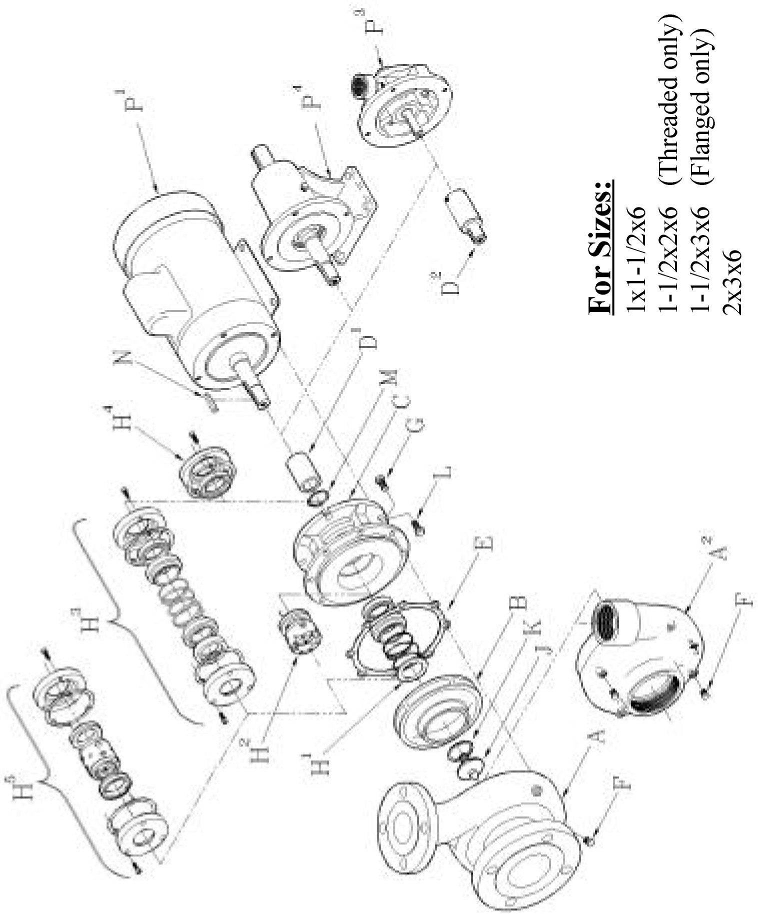
6. Motor/pump overheating.
Check for:
a. Excessive flow and amp draw (Throttle discharge).
b. Low voltage or frequency.
c. Flow too low with resulting heat rise.
d. Bearing failure.
e. System temperature too high.

Parts List Type XT/XL

		AI Threaded	BF Threaded	AB Threaded	SS Threaded	SS Flanged
A.	Volute					
	XT/XL 100	2601	2601	2603	2629	2605
	XT/XL 150	2607	2607	2609	2626	2611
	XT/XL200	2613	2613	2615	2627	2617
B.	Impeller Specify diameter					
	XT/XL100	2602-dia	2604-dia	2604-dia	2606-dia	2606-dia
	XT/XL150	2608-dia	2610-dia	2610-dia	2612-dia	2612-dia
	XT/XL200	2614-dia	2616-dia	2616-dia	2618-dia	2618-dia
	Note: For Dbl seal add DS (Sample: 2614DS-dia)					
C.	Bracket (std)	0131	0131	0132	0979	0979
	Double Seal	0131-1	0131-1	N/A	0979-1	0979-1
	Single Flush	0131-2	0131-2	0132-2	0979-2	0979-2
	Quench	0131-3	0131-3	N/A	0979-3	0979-3
	Internal Flush	0131-4	0131-4	N/A	0979-4	0979-4
D1.	Shaft Sleeve	0127	0126	0126	0127	0127
D2.	Stub Shaft 5/8" ID	0329-1	0329-1	0329-1	0329-1	0329-1
D3.	Stub Shaft 7/8" ID	0328-1	0328-1	0328-1	0328-1	0328-1
E.	Volute Gasket	0124	0124	0124	0301	0301
F.	Pipe Plug	0557	0557	0558	0559	0559
G.	Volute Bolts	0583	0583	0587	0724	0724
H1.	T.21 Seal/Seat	0121	0121	0121	0122	0122

Continued on next page

Type XT/XL Parts List



For Sizes:
1x1-1/2x6
1-1/2x2x6 (Threaded only)
1-1/2x3x6 (Flanged only)
2x3x6

AI = All Iron
BF = Bronze Fitted
AB = All Bronze
SS = Stainless Steel

TYPE XT/XL MAINTENANCE AND REPAIR

DISASSEMBLY

1. Disconnect power source from motor.

2. Disconnect electrical connections, tagging wires carefully to preserve correct rotation. Loosen pump base.

3. Remove pump and motor assembly to repair area. Observe position of all parts prior to disassembly.
   (Note: volute may be left in piping.)

4. Remove 8 volute bolts and remove volute from pump.

5. Remove impeller. Remove impeller lockdown by turning CCW. Slide impeller off of the shaft. Save shaft key.

6. Remove seal head from the shaft. On type 9 seal, loosen set screws and slide seal from shaft. On type 21, remove seal by sliding it off of the shaft.
7. Remove the four motor bolts and remove bracket from motor.

8. Remove seal seat from bracket. Use wooden or plastic dowel to tap the seat from the bracket. Diagram A

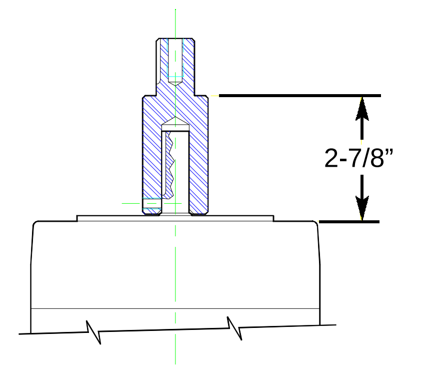
9. Remove shaft or shaft sleeve. Heat shaft sleeve to approximately 300^{o}F and use a bearing puller to remove the sleeve.

REASSEMBLY

1. Clean seal cavity of the bracket thoroughly.

2. Thoroughly clean pump shaft. Assure that the shaft is not grooved and that there is no evidence of pitting or fretting. Polish the shaft with extra fine emery cloth and clean the keyway.

3a. On 56C motors, (stub shaft pumps only), ensure all debris and burrs are removed from the motor shaft. Align halfdog setscrew with motor keyway while sliding stub shaft over the motor shaft. Set height (diagram A). Tighten all set screws.



Reassembly Instructions continued on next page →

3b. On JM style motors, apply Loctite RC/609 to inside diameter of shaft sleeve. Install shaft sleeve onto motor shaft making sure that the groove for the Teflon® sleeve gasket is facing the pump end. Clean excess Loctite from shaft. Be sure sleeve is seated against motor shaft shoulder.

4. For Type 21, 8, and 9 seals: Place the bracket on a firm surface with the seat cavity (pump end) up. Then place a small amount of vegetable oil on the seat cup or "O" ring seat. Place the seat in the seal cavity with the polished face up toward the pump end. Evenly push seat into seat cavity with fingers, then then gently tap seat into place with a wooden dowel or plastic rod (2" outside diameter). To help ensure the seat is not damaged, place the cardboard disk supplied with the seal under the end of the dowel to prevent damaging the seat face.

5. Place bracket on motor (aligning the base if applicable). Secure bracket to motor with four motor bolts and washers.

6. Install seal head assembly:

For Type 21:

a. Lubricate shaft and elastomer with vegetable oil.

b. Install rotary seal head onto pump shaft and slide toward seat using a twisting motion until carbon face touches seal seat.

c. For 145JM through 215JM frame pumps, install new sleeve gasket into shaft sleeve. For 254JM through 256JM, install new gasket into hub of impeller.

d. Install seal spring and retainer over shaft sleeve.

e. Install impeller onto motor shaft being careful to align keyway of impeller with keyway in motor shaft. Push impeller on until impeller bottoms out on shaft sleeve. Install key in keyway.

f. Install impeller lockdown gasket and impeller lockdown. Tighten securely.

For Type 8 or Type 9:

a. Do not remove metal clips from seal head assembly. Place seal on shaft sleeve sliding gently past shoulder.

b. Slide seal head toward seat until carbon face contacts ceramic seat. Tighten seal head setscrews to shaft sleeve using short arm allen wrench supplied with seal or repair kit. Remove clips in seal head and discard.

c. For 145JM through 215JM frame pumps, install new sleeve gasket into shaft sleeve. for 254JM through 256JM, install new gasket into hub of impeller.

d. Install impeller onto motor shaft, being careful to align keyway of impeller with keyway in motor shaft. Push impeller on until impeller bottoms out on shaft sleeve. Install key in keyway.

e. Install impeller lockdown gasket and impeller lockdown. Tighten securely.

7. Install new volute gasket. Ensure that all of the mating surfaces of the gasket joint are cleaned to bare metal.
8. Install volute and secure with 8 bolts and tighten evenly.

9. Rotate pump shaft by hand to ensure impeller does not rub against volute.

10. Return pump to installation, reconnect electric connections.

11. Start pump momentarily to observe shaft rotation. If rotation corresponds to the rotation arrow on the pump, it may be put into service. If rotation is incorrect, switch any two leads on 3-phase motors to change rotation. Check wiring diagram of motor for single phase rotation correction.

12. Remove top pipe plug (if applicable) from the front of volute and prime pump thoroughly, making sure all air is purged. Turn shaft one revolution and then refill. Replace the pipe plug.

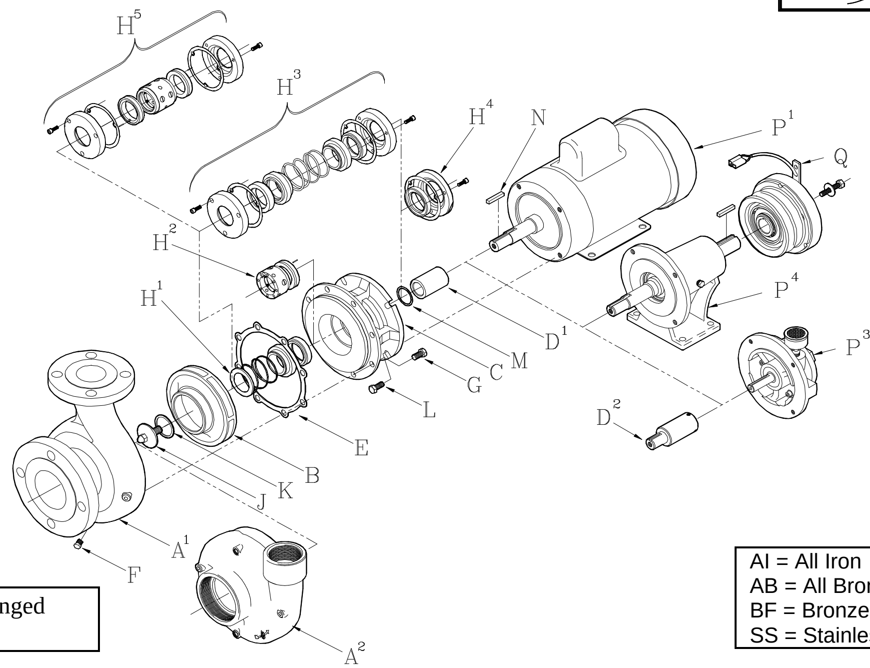
13. Start pump allowing adequate time to purge all air from system. Observe any gauges, flow meters, etc., to see if pump performs properly.

(Xtxlparts.doc) rev A

PRICE PUMP CO.

XT/XL PARTS LIST

Effective: May 17, 2001



For Sizes:

1 x 1½ - 6
1½ x 2 - 6 (Threaded Only)
1½ x 3 - 6 (Flanged Only)
2 x 3 - 6

Note: Pumps available in Threaded or Flanged Connections as noted below

AI = All Iron
AB = All Bronze
BF = Bronze Fitted
SS = Stainless Steel

		AI Threaded	BF Threaded	AB Threaded	SS Threaded	SS Flanged
A.	Volute					
	1 x 1-1/2 - 6 (XT100 Threaded, XL100 Flanged)	2601	2601	2603	2629	2605
	1-1/2 x 2 - 6 (XT150 Threaded)	2607	2607	2609	2626	
	1/2 x 3 - 6 (XL150 Flanged)					2611
	2 x 3 - 6 (XT200 Threaded, XL200 Flanged)	2613	2613	2615	2627	2617
B.	Impeller Specify diameter **					
	1 x 1-1/2 - 6 (XT100 Threaded, XL100 Flanged)	2602-dia	2604-dia	2604-dia	2606-dia	2606-dia
	1-1/2 x 2 - 6 (XT150 Threaded)	2608-dia	2610-dia	2610-dia	2612-dia	
	1-1/2 x 3 - 6 (XL150 Flanged)					2612-dia
	2 x 3 - 6 (XT200 Threaded, XL200 Flanged)	2614-dia	2616-dia	2616-dia	2618-dia	2618-dia
	Note: For Dbl seal add DS (Sample: 2614**DS**-dia)					
C.	Bracket (std)	0131	0131	0132	0979	0979
	Double Seal	0131-1	0131-1	N/A	0979-1	0979-1
	Single Flush	0131-2	0131-2	0132-2	0979-2	0979-2
	Quench	0131-3	0131-3	N/A	0979-3	0979-3
	Internal Flush	0131-4	0131-4	N/A	0979-4	0979-4
	Bracket for 213/215 JM	3405	3405	N/A	3388	3388
	O-ring	3405-0	3405-0	N/A	N/A	N/A
	Double Seal	2405-1	3405-1	N/A	3388-1	3388-1
	Single Flush	3405-2	3405-2	N/A	3388-2	3388-2
	Quench	3405-3	3405-3	N/A	3388-3	3388-3
	Internal Flush	3405-4	3405-4	N/A	3388-4	3388-4
	Internal Flush w/ Quench	3405-5	3405-5	N/A	3388-5	3388-5
D^1.	Shaft Sleeve (for std JM motor)	0127	0126	0126	0127	0127
D^2.	Stub Shaft 5/8" ID (56C) opt	0329-1	0329-1	0329-1	0329-1	0329-1
D^3.	Stub Shaft 7/8" ID (143TC/145TC/182C/184C) option (Not Shown)	0328-1	0328-1	0328-1	0328-1	0328-1
E.	Volute Gasket	0124 (Syn Fiber)	0124 (Syn Fiber)	0124 (Syn Fiber)	0301 (PTFE)	0301 (PTFE)
F.	Pipe Plug (2 rqd Threaded, 1 rqd Flanged)	0557	0557	0558	0559	0559
G.	Volute Bolts (8 rqd)	0583	0583	0587	0724	0724
H^1.	T.21 Single Seal/Seat	0121 (std B*)	0121 (std B*)	0121 (std B*)	0122 (std V*)	0122 (std V*)

B* = Buna V* = Fluorocarbon

**For Double Seal Impellers (add "DS"to Impeller P/N For Example: 2602DS)

Continued on Back…

Price® Pump Company

21775 8th Street East ◆ P.O. Box Q ◆ Sonoma, CA 95476-0329 ◆ (707) 938-8441 ◆ Fax (707) 938-0764

XT/XL PARTS LIST

Effective: May 17, 2001
Continued

		All Models
H^2.	T.9 PTFE Single Seal/Seat (opt)	0123
	Seat Pin T.9 (not shown)	0890
H^3.	T.21 Double Seal/Seat (opt)	Specify P/N
	Double Seal Plate (2 rqd)	0309
	Plate Gasket, PTFE (2 rqd)	0505
	Plate Bolts (6 rqd)	0977
H^4.	Seal Quench (opt):	
	Buna Lip Seal	0756
	Fluorocarbon Lip Seal	0757
	PTFE Lip Seal	0758
	Lip Seal Plate	0309-2
	Plate Gasket, PTFE	0505
	Plate Bolts (3 rqd)	0977
H^5.	T.9 PTFE Double Seal/Seat (opt)	0670
	Double Seal Plate (2 rqd)	0309-1
	Plate Gasket, PTFE (2 rqd)	0505
	Plate Bolts (6 rqd)	0977
	Seat Pin T.9 (2 rqd not shown)	0890
J.	Impeller Lockdown	0978
K.	Lockdown Gasket, PTFE	0245

		All Models
L.	Motor Bolts	
	All Bronze pumps (4 rqd)	0587
	Stainless Steel pumps (4 rqd)	0593
	AI & BF pumps (4 rqd) and	0593
	order Washers (4 rqd)	1137
	Motor Bolts for 3405 & 3388 brackets	
	All Bronze pumps	N/A
	Stainless Steel pumps (4req)	1189
	AI & BF pumps (4 req) and	1189
	order Washers (4 req)	1199
M.	Sleeve Gasket, PTFE	0245
N.	Impeller Shaft Key	0135
P^1.	JM Motor	Specify P/N
P^2.	‘C’ Face Motor (not shown)	Specify P/N
	Base Plate (not shown)	0199
P^3.	Air Motor	Specify P/N
P^4.	Power Frame	5480
Q.	12 Volt Clutch (opt)	1983
	Key for Clutch (2 ea)	0136
	Lockbolt for Clutch	0567
	Lockbolt Washer for Clutch	0564

XL/XT Repair Parts Kits

All Iron	P/N 0659	Syn. Fiber Gasket - SS Shaft Sleeve - Sleeve Gasket - Loctite - Imp. Lockdown Gasket
CIBF	P/N 0658	Syn. Fiber Gasket - BR Shaft Sleeve - Sleeve Gasket - Loctite - Imp. Lockdown Gasket
SS	P/N 1019	PTFE Gasket - SS Shaft Sleeve - Sleeve Gasket - Loctite - Imp. Lockdown Gasket

Note: Seal/seat must be ordered in addition to repair kit.
Options: 1½” T.21 & T.9 Single & Double.

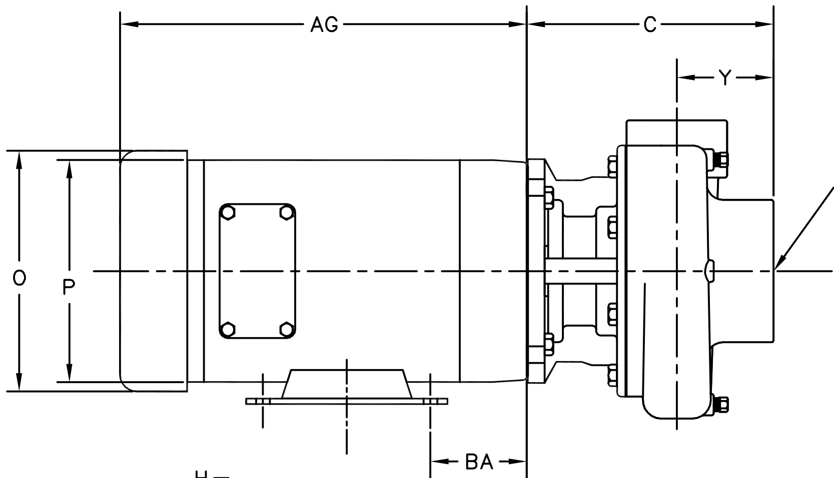
Price® Pump Company
21775 8th Street East ◆ P.O. Box Q ◆ Sonoma, CA 95476-0329 ◆ (707) 938-8441 ◆ Fax (707) 938-0764

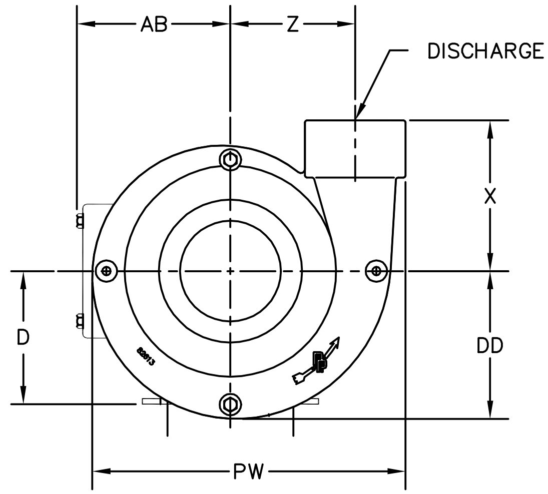
DESCRIPTION	REF. NO.	DATE	REV.
XTCIJM CLOSE COUPLED MOTOR PUMP ASSEMBLY	O-XTCIJM	1/28/93	C

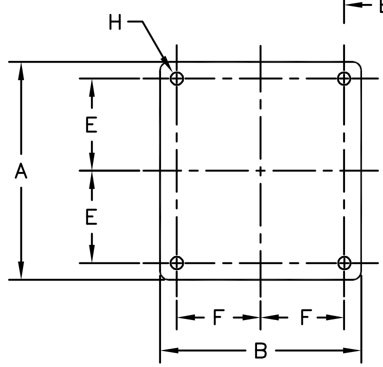
PRICE PUMP CO.

FACTORY FAX TRANSMITTAL DRAWING

#1 Pump Way P.O. Box Q
Sonoma, CA 95476 (707) 938-8441
707-FAX 938-0764







	PUMP END DIMENSIONS						PIPE THREAD – NPT	
MODEL	C	DD	PW	X	Y	Z	DISCHARGE	SUCTION
XT 1x1½x6	6 5/8	4"	8 3/8	4"	2 3/8	3 1/2	1" x 11 ½	1½ x 11 ½
XT 1½x2x6	7 9/16	4 1/8	8 3/4	4 1/4	3 1/4	3 5/8	1½ x 11 ½	2" x 11 ½
XT 2x3x6	7 5/16	4 7/16	9 5/16	4 1/2	2 7/8	3 3/4	2" x 11 ½	3" x 8

NOTES
ALL DIMENSIONS ARE ROUNDED TO THE NEAREST 1/8 INCH.

			JM MOTOR END DIMENSIONS									ODP		TEFC & EXP. PRF	
HP	RPM	FRM	A	B	D	E	F	H	BA	O	P	AB	AG	AB	AG
1 1/2	3600	143JM	6-1/2	5-15/16	3-1/2	2-3/4	2	11/32	2-7/8	6-7/8	6-5/8	5-1/4	8-3/4	6-3/4	11-1/4
2	3600	145JM					2-1/2								
3	3600	145JM													
5	3600	182JM	8-1/2	6-1/2	4-1/2	3-3/4	2-1/4	13/32	3-1/2	8-7/16	7-7/8	5-7/8	11-1/8	7-3/8	14-3/4
7 1/2	3600	184JM					2-3/4								
10	3600	213 (W/ 184 FACE)	9-1/2	8	5-1/4	4-1/4	3-1/2	13/32	3-1/8	10-1/16	9-9/16	N/A		7-3/8	14-7/16
15	3600	213 (W/ 184 FACE)													

NOTE: MOTOR DIMENSIONS WILL VARY BY MODEL AND MAKE. DIMENSIONS ARE TO BE USED FOR REFERENCE ONLY.

60 Hz

PRICE PUMP CO.
SONOMA, CALIFORNIA

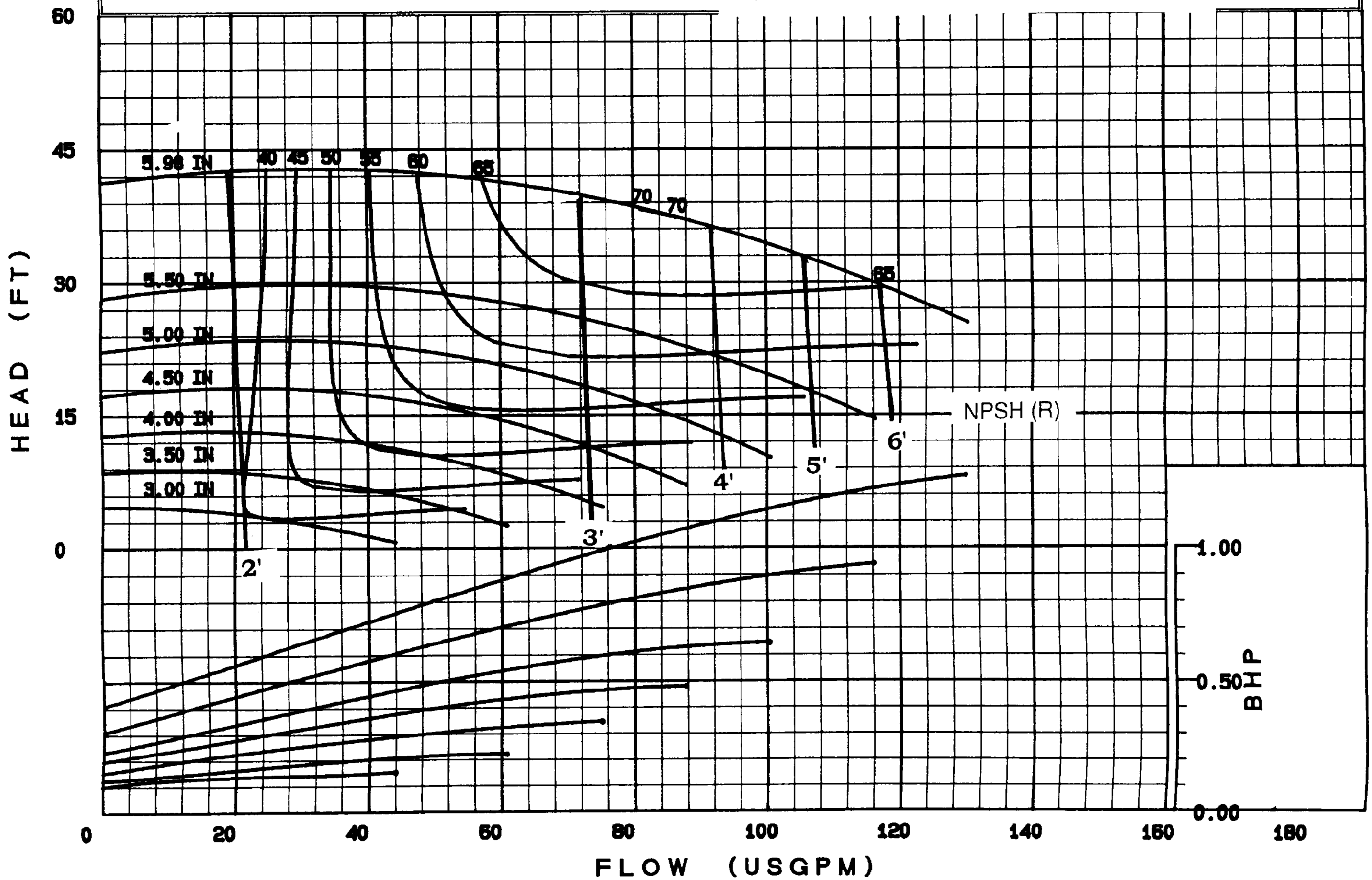
Ph. (707) 938-8441 Fax (707) 938-0764

CURVE NUMBER: X000033-57-1 MODEL: XL/XT150 SIZE: *1-1/2x3x6 **1-1/2x2x6 RPM: 1750

IMPELLER DIA: VARIOUS MIN. IMPELLER DIA: 3.00" MAX. IMPELLER DIA: 5.98" MAX. SOLIDS: .19"

CUSTOMER: CUSTOMER'S P.O.:

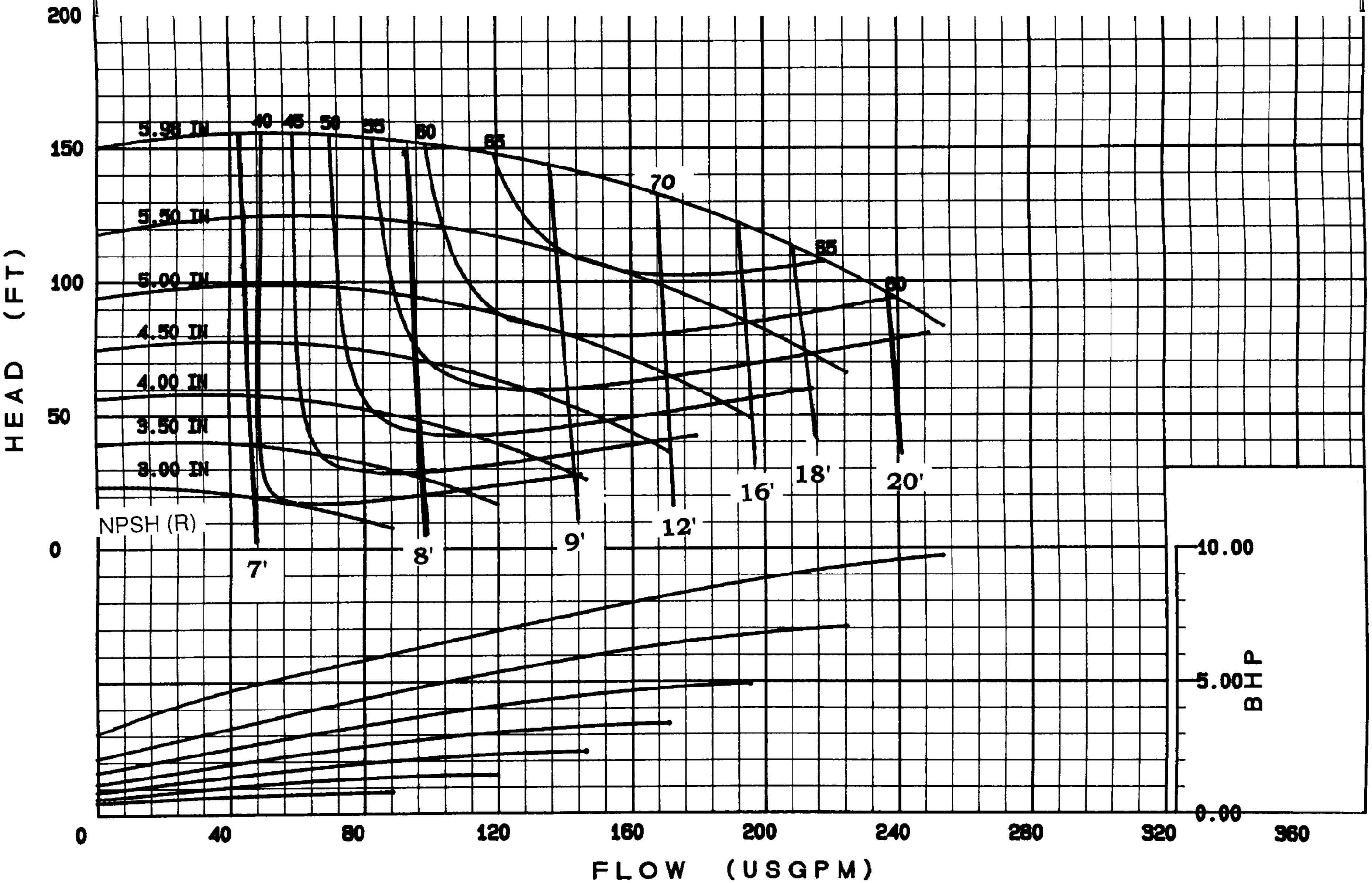
TEST DATE: 8/01/94 VERIFIED: 5/24/01 REMARKS: *XL150=FLANGED PORTS **XT150=THREADED PORTS



60 Hz

PRICE PUMP CO.
SONOMA, CALIFORNIA
Ph. (707) 938-8441 Fax (707) 938-0764

CURVE NUMBER: X000031-55-1 MODEL: XL/XT150 SIZE: *1-1/2x3x6 **1-1/2x2x6 RPM: 3500
IMPELLER DIA: VARIOUS MIN. IMPELLER DIA: 3.00” MAX. IMPELLER DIA: 5.98” MAX. SOLIDS: .19”
CUSTOMER: CUSTOMER'S P.O.:
TEST DATE: 8/01/94 VERIFIED: 5/24/01 REMARKS: *XL150=FLANGED PORTS **XT150=THREADED PORTS



Appendix D

Product Information

Krystil Klear Filtration ® Model 88 Bag Filter

Model 88 Single Liquid Bag Housing

Features and Options	Housing Operation	Vessel Construction
Specifications	Build a Part Number	Schematics and Dimensions

Krystil Klear's model 88 Single Series of Liquid Bag Housings offer two depths, a 15" and a 30" housing depending upon the needed surface area and volume of fluid to be filtered.

Contact a Sales Representative About this Product

FEATURES

- **Carbon, 304, or 316 stainless steel material**
- **150 PSI pressure rating**
- **Low pressure drop**
- **Quick swing closure with eye nuts**
- **Viton seals - lid & basket**
- **Differential, drain, and vent ports**
- **Adjustable support legs**
- **316 stainless steel strainer basket**
- **2-part epoxy finish on carbon vessels**

Our 88 series effectively removes dirt, pipe scale, and other contaminants from process liquids such as water, chemical, and petroleum products. Quality construction and design assure protection for all down-stream equipment.

SPECIFICATIONS

Housing lid has a 3-bolt swing closure with a vent port. Connections are (__) inch (NPT) (FLG) with a (side inlet and bottom outlet)(side inlet and side outlet)(side inlet and 90 degree bottom outlet). Housing is supplied with two differential pressure ports to measure the differential pressure across the filter bag. A two-part epoxy finish is applied on the carbon steel vessels to maximize the life of the housing; stainless steel vessels are supplied with a satin finish. Basket material is constructed of 316 stainless steel with 9/64" perforations to act as a strainer or to accept a #1 or #2 size liquid bag. Basket seals onto a Viton o-ring in the basket support. Adjustable tripod leg assembly is supplied with housing. Vessels are rated at a 150 pounds per square inch design.

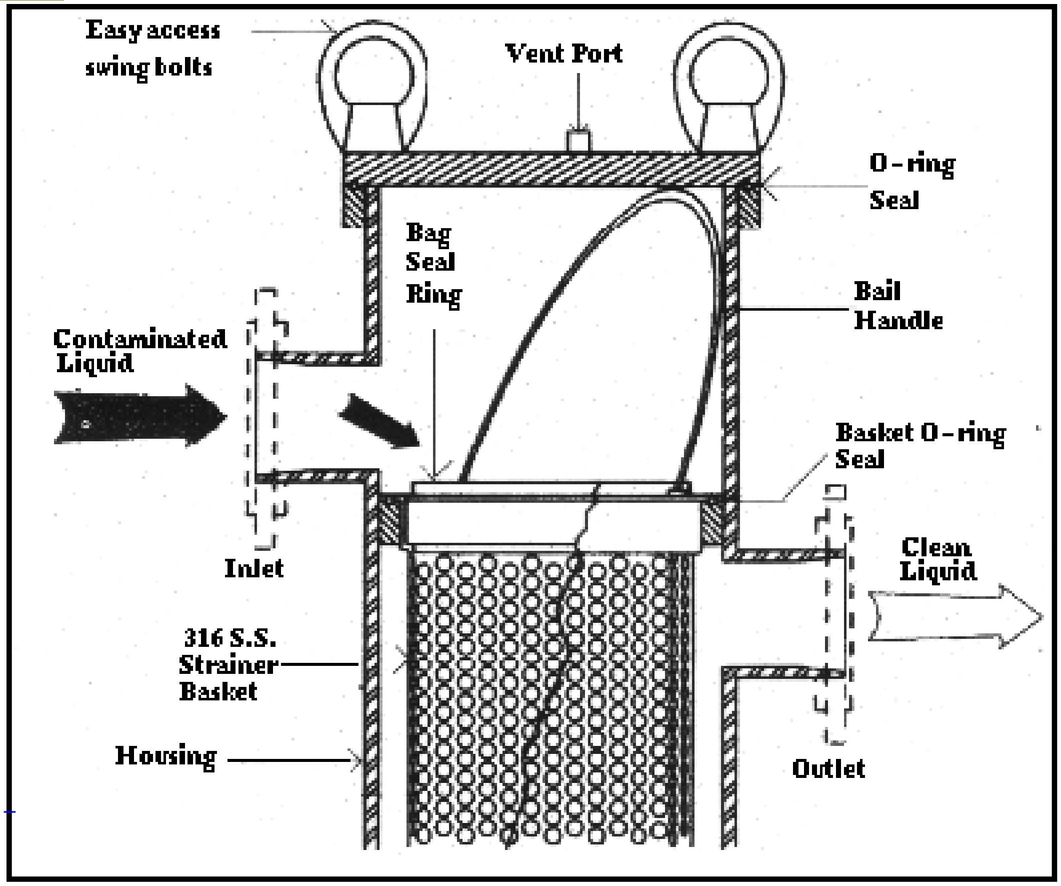
Contact a Sales Representative
About this Product

Basket Data for Model 88 with flow rates to 220 gpm

Depth Nominal (inches)	Diameter (inches)	Surface Area (sq. ft.)	Volume (cu. in.)
15	6.7	2.3	500
30	6.7	4.4	1000

Housing Operation Diagram

Unfiltered liquid enters the housing above the filter bag or strainer basket; flows down into the housing; and continues through the element. Solids are trapped inside the filter bag or strainer and easily removed when the housing is serviced. Our standard o-ring seal between the basket and the housing ensures a postive seal to prevent bypass.



Contact a Sales Representative About this Product

Basket Data for Model 88 with flow rates to 220 gpm

Depth Nominal (inches)	Diameter (inches)	Surface Area (sq. ft.)	Volume (cu. in.)
15	6.7	2.3	500
30	6.7	4.4	1000

VESSEL CONSTRUCTION

Our model 88 single vessels are designed for operating up to 150 PSI at 300 degrees Fahrenheit. The housing design provides a large sump area at the bottom of the basket for particulate accumulation. This design utilizes the filter more efficiently and prolongs the element life.

The **316 S.S. basket** seals onto a viton o-ring to eliminate particulate bypass between the basket and seat. Optional **mesh-lined strainer baskets** and **o-rings** are available. Please refer to their individual brochures in our liquid catalog.

Contact a Sales Representative
About this Product

A **vent** in the housing lid and a **drain port** in the housing speed evacuation and filling. **Gauge ports** are located on the body of the housing to install gauges for monitoring the differential pressure across the bag. Permanently piped housings are opened with simple tools without disturbing the piping. **Swing bolts** with eye-nuts allow easy opening and closing of the swing-lid. No need to remove any hardware.

As a standard finish, all vessels are blast cleaned and painted inside and out with a **2-part epoxy**. Stainless steel vessels are supplied with a satin finish.

Dimensions

All dimensions are approximate...

88-15

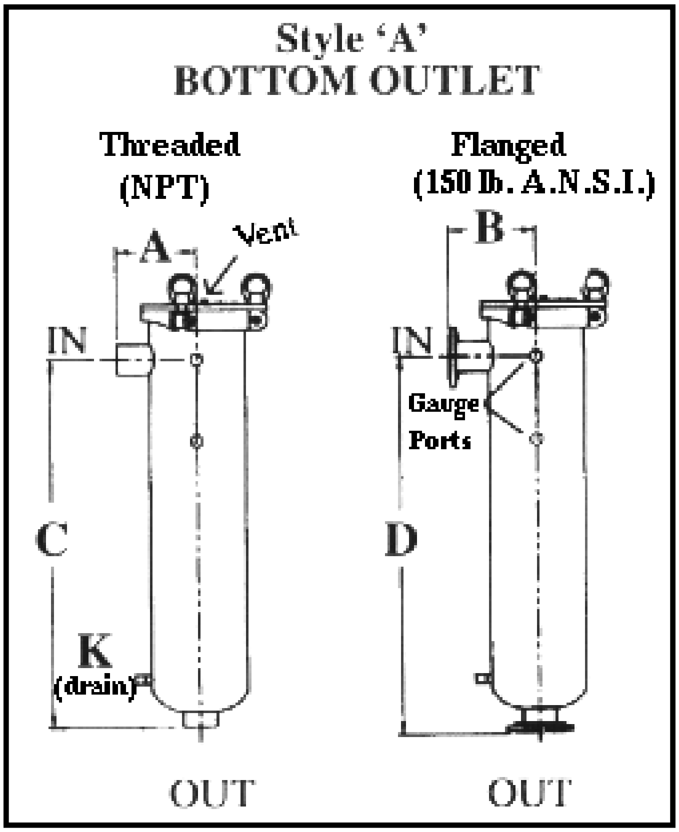
Pipe Size	A	B	C	D	E	F	G	H	I	J	K	wt.
2	5.3	6.7	24.7	25.9	7.0	24.7	26.2	3.4	25.7	2.3	1	105-125# skid wt.
3	5.4	7.1	24.7	26.5	7.0	24.7	26.5	5.0	26.3	3.1		
4	5.4	7.1	24.7	26.6	7.0	24.7	29.1	6.3	26.9	3.8		

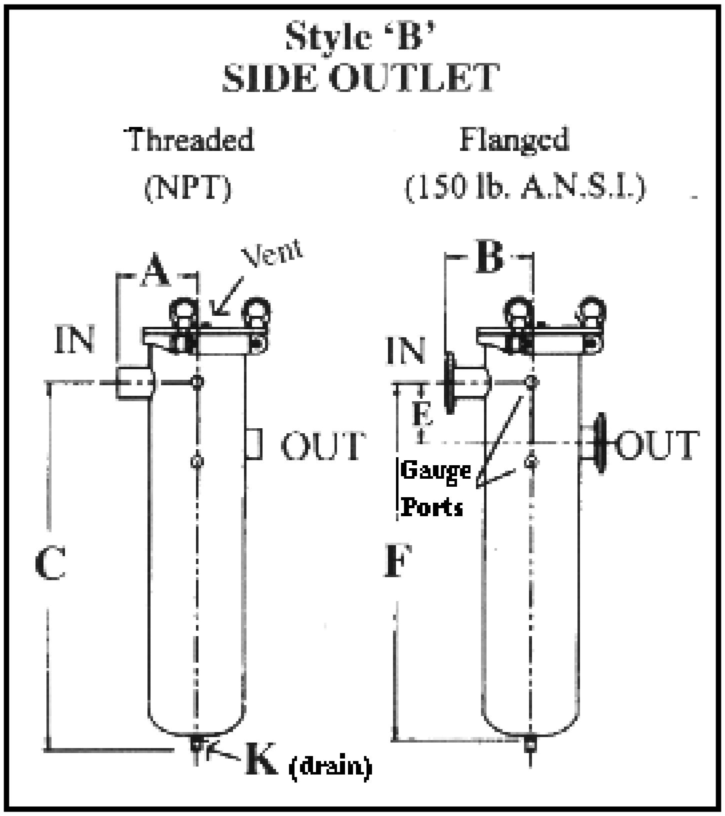
Contact a Sales Representative About this Product

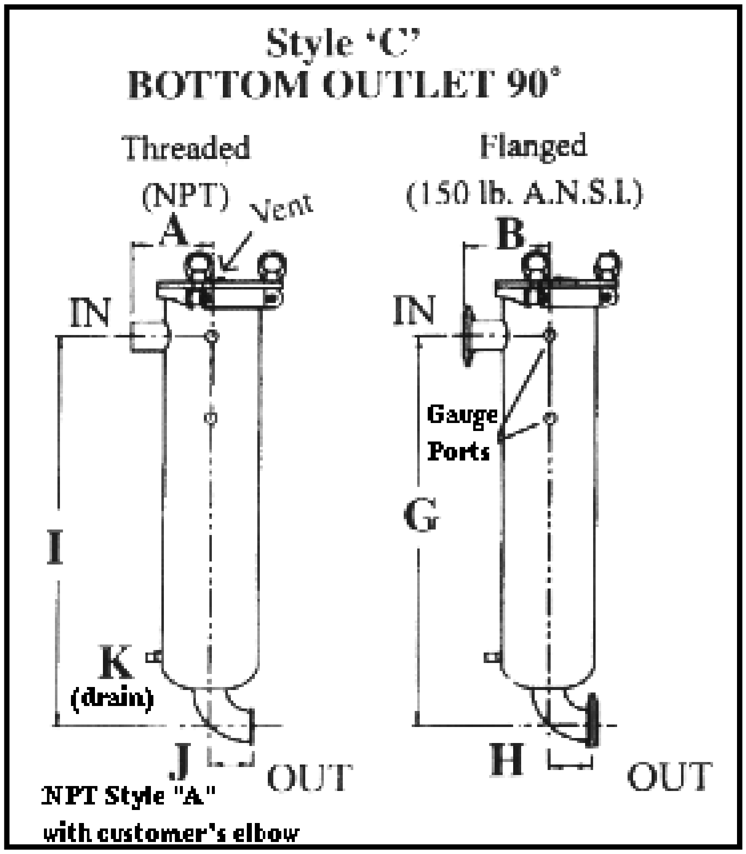
88-30

Pipe Size	A	B	C	D	E	F	G	H	I	J	K	wt.
2	5.3	6.7	36.2	37.4	7.0	36.2	37.7	3.4	37.2	2.3	1	125-145# skid wt.
3	5.4	7.1	36.2	38.0	7.0	36.2	39.2	5.0	38.7	3.1		
4	5.4	7.1	36.2	38.1	7.0	36.2	40.6	6.3	38.9	3.8		

Adjustable support legs have 12" bolt circle and a 16" height adjustment.


Style 'A'
BOTTOM OUTLET
Threaded
(NPT)
Flanged
(150 lb. A.N.S.I.)
A
Vent
B
IN
IN
Gauge
Ports
C
D
K
(drain)
OUT
OUT


Style 'B'
SIDE OUTLET
Threaded
(NPT)
Flanged
(150 lb. A.N.S.I.)
A
Vent
IN
OUT
C
K (drain)
B
IN
E
OUT
Gauge
Ports
F

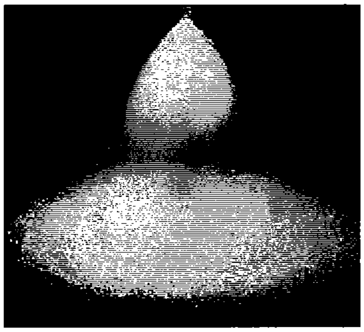

Style 'C'
BOTTOM OUTLET 90°
Threaded
(NPT)
Vent
Flanged
(150 lb. A.N.S.I.)
A
B
IN
IN
Gauge
Ports
I
G
K
(drain)
J
OUT
H
OUT
NPT Style "A"
with customer's elbow

Appendix E

Product Information

FullJet ® Standard Type G Spray Nozzles

B3 - FullJet® Spray Nozzles, Standard Spray



Features and Benefits

- Solid cone-shaped spray pattern with round impact area.
- Uniform distribution over a wide range of flow rates and pressures.
- Medium- to large-sized drops.
- Unique vane design with large flow passages provides superior control and uniform distribution.
- Removable caps and vanes for easy inspection and cleaning on most models.
- Removable vane has location marks for proper positioning after cleaning.
- Set screws in some models secure the vane in the nozzle to prevent dislocation caused by vibration.
- Polypropylene material option offers exceptional chemical and corrosion resistance and resists caking and buildup.
- Wall-mounted options for installation on room exterior, vessel or pipeline.
- For installations with space limitations, right-angle mounting options allow for mounting at a 90° angle.

G

Removable cap and vane
1/8" to 1/2" NPT or BSPT (F)

GG

Removable cap and vane
1/8" to 1/2" NPT or BSPT (M)

H

One-piece body
3/4" to 1" NPT or BSPT (F)

H

Removable vane/cast body
1-1/4" to 8" NPT or BSPT (F)

H

Removable vane/Polypropylene
1-1/2" to 2" NPT or BSPT (F)
Maximum temperature rating is
150°F (66°C)

HF

Removable vane/cast body
4" to 10" flange connection

HH

One-piece body
1/8" to 1" NPT or BSPT (M)

GD

Wall-mounted
Removable cap and vane
1/8" to 1/2" NPT or BSPT (F)

Catalog 70 US Section B B5

B5 - FullJet® Spray Nozzles, Standard Spray

Performance Data

*At the stated pressure in psi.

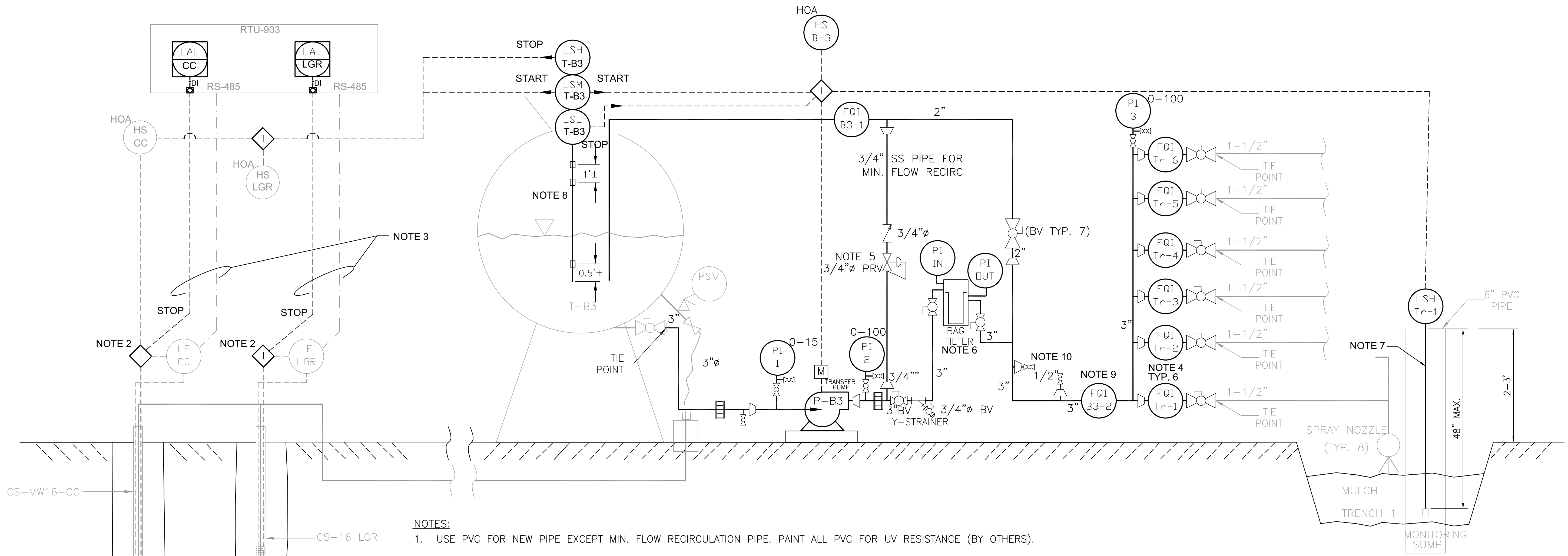
Inlet Conn. (in.)	Nozzle Type: Standard Type G	GG	H	HH	Wall Mounted GD	HD	GGD	Angle GA	GGA	Capacity Size	Orifice Dia. Nom. (in.)	Max. Free Passage Dia. (in.)	Capacity (gallons per minute)* 5	7	10	20	30	40	60	80	100	150	Spray Angle (°)* 7	20	80
1/8	•	•		•	•		•			1	.031	.025	.07	.08	.10	.14	.17	.19	.23	.26	.29	.35	–	58	53
	•	•		•						1.5	.047	.025	.11	.13	.15	.21	.25	.28	.34	.39	.43	.52	52	65	59
	•	•		•	•		•	•	•	2	.047	.040	.15	.17	.20	.28	.33	.38	.46	.52	.58	.70	43	50	46
	•	•		•	•		•	•	•	3	.063	.040	.22	.25	.30	.41	.50	.57	.68	.78	.87	1.0	52	65	59
	•	•		•	•		•	•	•	3.5	.063	.050	.25	.30	.35	.48	.58	.66	.80	.91	1.0	1.2	43	50	46
								•	•	3.9	.078	.040	.28	.33	.39	.54	.65	.74	.89	1.0	1.1	1.4	77	84	79
	•	•		•	•		•	•	•	5	.078	.050	.36	.42	.50	.69	.83	.95	1.1	1.3	1.4	1.7	52	65	59
								•	•	6.1	.094	.050	.44	.52	.61	.84	1.0	1.2	1.4	1.6	1.8	2.1	69	74	68
1/4	•	•		•	•		•	•	•	6.5	.094	.063	.47	.55	.65	.89	1.1	1.2	1.5	1.7	1.9	2.3	45	50	46
	•	•		•	•		•	•	•	10	.109	.063	.73	.85	1.0	1.4	1.7	1.9	2.3	2.6	2.9	3.5	58	67	61
								•	•	12.5	.125	.063	.91	1.1	1.3	1.7	2.1	2.4	2.9	3.3	3.6	4.3	69	74	68
3/8	•	•		•	•		•	•	•	9.5	.109	.094	.69	.81	.95	1.3	1.6	1.8	2.2	2.5	2.7	3.3	45	50	46
	•	•		•	•		•	•	•	15	.141	.094	1.1	1.3	1.5	2.1	2.5	2.8	3.4	3.9	4.3	5.2	64	67	61
								•	•	20	.156	.109	1.5	1.7	2.0	2.8	3.3	3.8	4.6	5.2	5.8	7.0	76	80	73
	•	•		•				•	•	22	.188	.109	1.6	1.9	2.2	3.0	3.6	4.2	5.0	5.7	6.3	7.6	87	90	82
1/2	•	•			•		•	•	•	16	.141	.125	1.2	1.4	1.6	2.2	2.7	3.0	3.6	4.2	4.6	5.6	48	50	46
	•	•		•	•		•	•	•	25	.188	.125	1.8	2.1	2.5	3.4	4.1	4.7	5.7	6.5	7.2	8.7	64	67	61
	•	•						•	•	32	.203	.141	2.3	2.7	3.2	4.4	5.3	6.1	7.3	8.3	9.2	11.1	72	75	68
	•	•		•				•	•	40	.250	.141	2.9	3.4	4.0	5.5	6.6	7.6	9.1	10.4	11.5	13.9	88	91	83
								•	•	50	.266	.156	3.6	4.2	5.0	6.9	8.3	9.5	11.4	13.0	14.4	17.4	91	94	86
3/4			•	•		•				2.5	.188	.172	2.1	2.5	2.9	4.1	4.9	5.6	6.7	7.7	8.5	10.2	48	50	46
			•	•		•				4.0	.250	.172	3.4	4.0	4.7	6.5	7.8	8.9	10.7	12.3	13.6	16.4	67	70	63
			•	•		•				7.0	.375	.203	6.0	7.0	8.2	11.3	13.7	15.6	18.8	21	24	29	89	92	84
1			•	•		•				4.2	.234	.219	3.6	4.2	4.9	6.8	8.2	9.4	11.3	12.9	14.3	17.2	48	50	46
			•	•		•				7.0	.328	.219	6.0	7.0	8.2	11.3	13.7	15.6	18.8	21	24	29	67	68	62
			•	•						8.0	.375	.219	6.9	8.0	9.4	13.0	15.6	17.8	21	25	27	33	72	81	82
			•	•						10	.469	.219	8.6	10.0	11.8	16.2	19.5	22	27	31	34	41	78	90	94
			•	•						12	.469	.250	10.3	12.0	14.1	19.4	23	27	32	37	41	49	89	92	84

Maximum Free Passage Diameter is the maximum diameter as listed of foreign matter that can pass through the nozzle without clogging.

Appendix F

Product Information

SWMU B-3 Instrument Controls



CS-MW16-CC

CS-16 LGR

299' BGS

405' BGS

SUBMERSIBLE PUMP

NOTES:

1. USE PVC FOR NEW PIPE EXCEPT MIN. FLOW RECIRCULATION PIPE. PAINT ALL PVC FOR UV RESISTANCE (BY OTHERS).
2. ADD 12 VDC INTERPOSING RELAYS TO PUMP CONTROLS FOR LSL STOP COMMAND. INCLUDE 20-MINUTE TIME DELAY IN SCADA SYSTEM (OR BY OTHER MEANS) TO PREVENT WELL PUMP FROM EXCESSIVE CYCLING.
3. INSTALL 16 GA. TSP CABLES IN SAME CONDUIT WITH RS-485 CABLE FOR LAL STOP COMMAND SIGNAL
4. PROVIDE 6 SEAMETRICS (OR EQUAL) MODEL# FT415M/IP81Y-60-1.5" BATTERY-POWERED TOTALIZING FLOW INDICATORS.
5. ADJUSTABLE BACKPRESSURE REGULATOR (40 TO 60 PSIG RANGE) FISHER SERIES 98H OR EQUAL.
6. INSTALL CONTRACTOR SUPPLIED CARBONAIR KRYSTAL KLEER INLINE BAG FILTER, MODEL 88-30 STYLE B (BY OTHERS).
7. PROVIDE SINGLE POINT FLOAT LEVEL SWITCH MAGNETROL T20-DB2A-AAQ OR EQUAL.
8. PROVIDE MULTIPOINT DISPLACER TYPE FLOAT LEVEL SWITCH MAGNETROL C10 SERIES OR EQUAL AND INSTALL IN APPROPRIATE SIZED STILLING WELL.
9. PROVIDE TWO SEAMETRICS (OR EQUAL) FLOWMETERS, ONE EACH OF THE FOLLOWING MODELS: FT415M/IP81Y-60-3" AND FT415M/IP81Y-60-2" BATTERY-POWERED TOTALIZING FLOW INDICATORS. (866) 542-9641.
10. INSTALL 1/2" ISOLATION VALVES FOR FUTURE AMENDMENT ADDITION (BY OTHERS).
11. LABEL TANK WITH STENCIL OR PLACARD "CS-16 NON-POTABLE WATER"
12. INSTALL CONTRACTOR SUPPLIED HORIZONTAL END-SUCTION CENTRIFUGAL, CLOSE-COUPLED PUMP P-B3 WITH A CAPACITY OF 120 GPM @ 145 FT (BY OTHERS).

LEGEND

EXISTING

NEW

REDUCER

Y-STRAINER

EXPANSION JOINT OR FLEXIBLE COUPLING

STATE OF TEXAS
HENRY C. DRESS
81023
REGISTERED PROFESSIONAL ENGINEER

REV.	DESCRIPTION	BY:	DATE:
0	ISSUED FOR CONSTRUCTION	HCD	1/2007
B	ISSUED FOR BID	HCD	12/2006
A	ISSUED FOR CSSA REVIEW AND APPROVAL	HCD	10/2006

R E V I S I O N S

SCALES SHOWN ON THIS DRAWING ARE APPLICABLE ONLY TO B SIZE DRAWING

CAMP STANLEY STORAGE ACTIVITY
FACILITY UPGRADES

Contract No. FA-8903-04-D-8675 Task Order No. 006

CONTRACTOR :

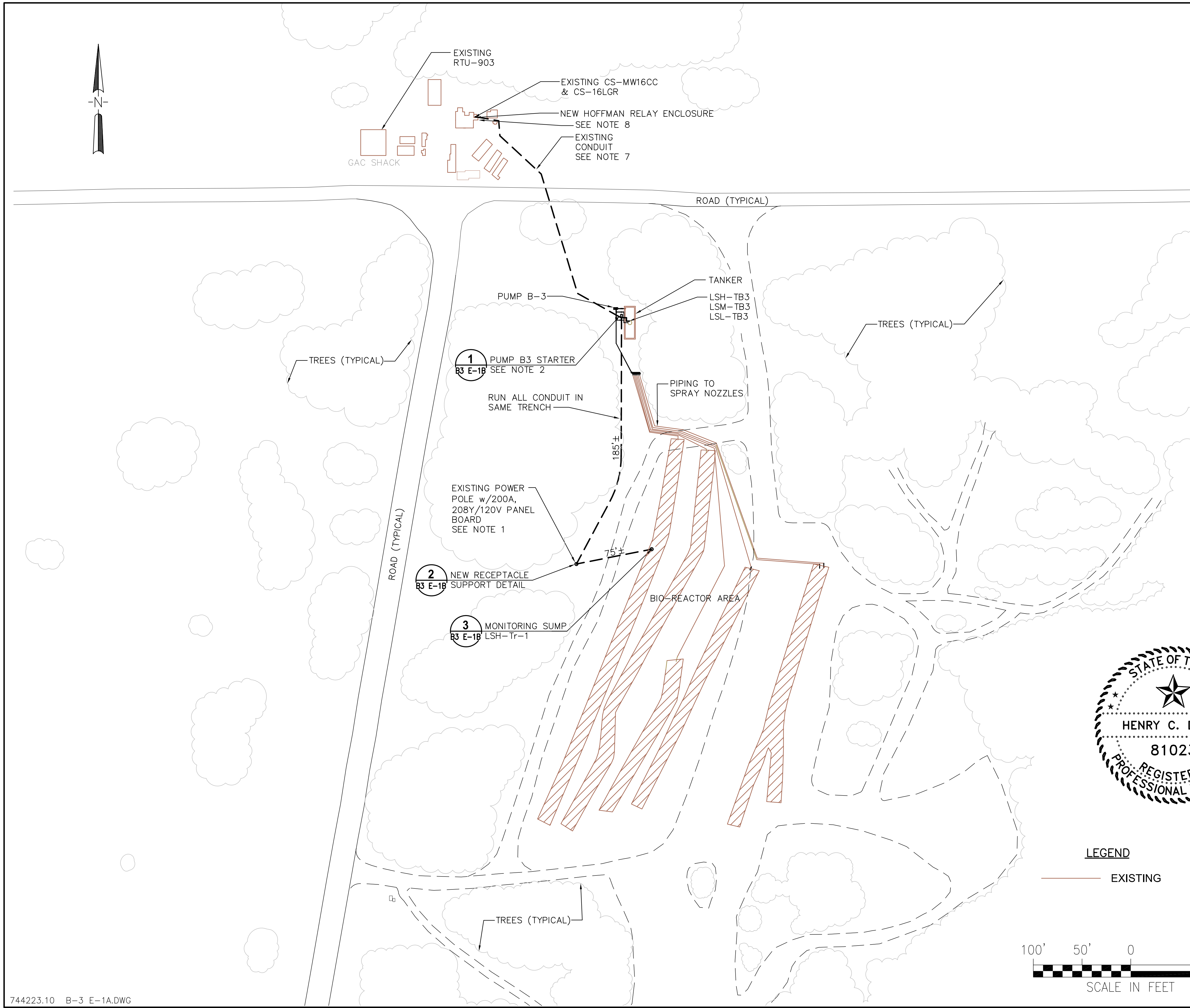
PARSONS Job No. 744223 WBS 10000

Drawing Title :

CSSA SWMU B3
BIOREACTOR PUMPING SYSTEM
PROCESS DIAGRAM

Designed : RH	Drawn : HCD	Rev: 0
Checked : KL	Approved : KRR	
Scale : NONE	Date : SEPTEMBER 2006	Drawing No. : B3 P-1

744223.10 B3 P-1.DWG



STATE OF TEXAS
HENRY C. DRESS
81023
REGISTERED PROFESSIONAL ENGINEER

LEGEND

EXISTING

100' 50' 0 100'

SCALE IN FEET

NOTES:

1. INSTALL 1-70A, 3P AND 4-15A, 1P CIRCUIT BREAKERS IN EXISTING 200A, 208Y/120V, 3PH, 4W CUTLER HAMMER PANELBOARD. PANELBOARD INTERIOR SHALL BE THROUGHLY CLEANED & ALL DEBRIS SHALL BE REMOVED. REFURBISH PANELBOARD BY INSTALLING NEUTRAL & GROUND BUSSES. INSTALL COVER PLATES FOR ALL EXPOSED LIVE PARTS. INSTALL IN THE VICINITY OF PANELBOARD 3/4"ø×10'-0" COPPERCLAD STEEL GROUND ROD AND CONNECT WITH #4 AWG BARE COPPER GROUNDING ELECTRODE CONDUCTOR TO PANELBOARD. BOND NEUTRAL & GROUND BUS.

2. INSTALL CIRCUIT BREAKER COMBINATION STARTER FOR PUMP B-3 IN THE VICINITY OF TANKER TRUCK NEAR PUMP B-3. COMBINATION C.B STARTER SHALL BE FVNR TYPE, RATED FOR 208V, 3PH, 60HZ, OPERATION AND SHALL BE COMPLETE WITH HOA SELECTOR SWITCH AND START BUTTON ON ITS COVER. STARTER SHALL BE NEMA SIZE 2 IN NEMA 4 ENCLOSURE AND FURNISHED WITH A 208Y-120V CONTROL POWER TRANSFORMER AND THERMAL UNITS. SQD. CLASS 8539 OR EQUAL.

3. INSTALL 3#6 AND 1#8G IN EXISTING 1" PVC CONDUIT FROM 208Y/120V, 3PH, 4W PANELBOARD TO PUMP B-3 STARTER.

4. PAINT ALL EXPOSED PVC CONDUIT WITH UV RESISTANT PAINT. ALL TRENCHING, BACKFILL AND UNDERGROUND CONDUIT BY OTHERS.

5. INSTALL 4#14 IN 3/4" SCH 40 MIN. PVC CONDUIT FROM TRUCK TANKER LSH/LSM/LSL-T-B3 FLOAT SWITCHES TO PUMP P-B3 STARTER.

6. INSTALL 2#10 IN EXISTING 1" PVC CONDUIT FROM LSH TR-1 TO PUMP P-B3 STARTER. ALSO INSTALL 2#10 AND 1#10G FROM EXISTING POWER PANEL TO PUMP P-B3 STARTER IN EXISTING 1" SIGNAL WIRE CONDUIT AT POWER POLE.

7. USE EXISTING CONDUIT TO ROUTE 6#14 FROM NEW HOFFMAN RELAY ENCLOSURE TO NEW LEVEL SWITCHES AT TANKER MANHOLE VIA PUMP STARTER. PULL OUT EXISTING SOLID CORE WIRES FROM EXISTING CONDUIT. EXTEND CONDUIT TO P-B3 STARTER. RUN NEW CONDUITS (6#14 3/4"C AND 4#14 3/4"C) FROM P-B3 STARTER TO LEVEL SWITCHES AT TANKER MANHOLE. EXTEND CONDUIT ON OPPOSITE END TO HOFFMAN RELAY ENCLOSURE.

8. INSTALL 1-15A, 1-P, 120VAC POWER CIRCUIT TO HOFFMAN RELAY ENCLOSURE FROM WELL 16 AREA POWER DISTRIBUTION PANEL, 2#12, 1#12G 3/4" RGS CONDUIT.

REV.	DESCRIPTION	BY:	DATE:
0	ISSUED FOR CONSTRUCTION	HCD	1/2007
B	ISSUED FOR BID	HCD	12/2006
A	ISSUED FOR CSSA REVIEW AND APPROVAL	HCD	11/2006

REVISIONS

SCALES SHOWN ON THIS DRAWING ARE APPLICABLE ONLY TO B SIZE DRAWING

CAMP STANLEY STORAGE ACTIVITY
FACILITY UPGRADES

Contract No. FA-8903-04-D-8675 Task Order No. 006

CONTRACTOR :

PARSONS Job No. 744223 WBS 10000

Drawing Title :

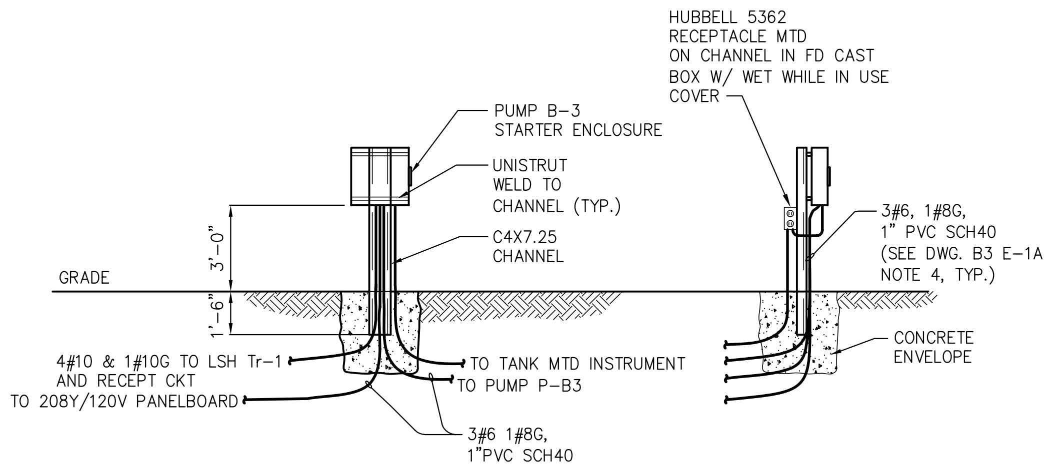
CSSA SWMU B3
BIOREACTOR PUMPING SYSTEM
ELECTRICAL PLAN AND OVERVIEW

Designed : PS	Drawn : PS	Rev: 0	
Checked : HCD	Approved : KRR		
Scale : NONE	Date : AUGUST 2006	Drawing No. : B3 E-1A	

744223.10 B-3 E-1A.DWG

NOTES:

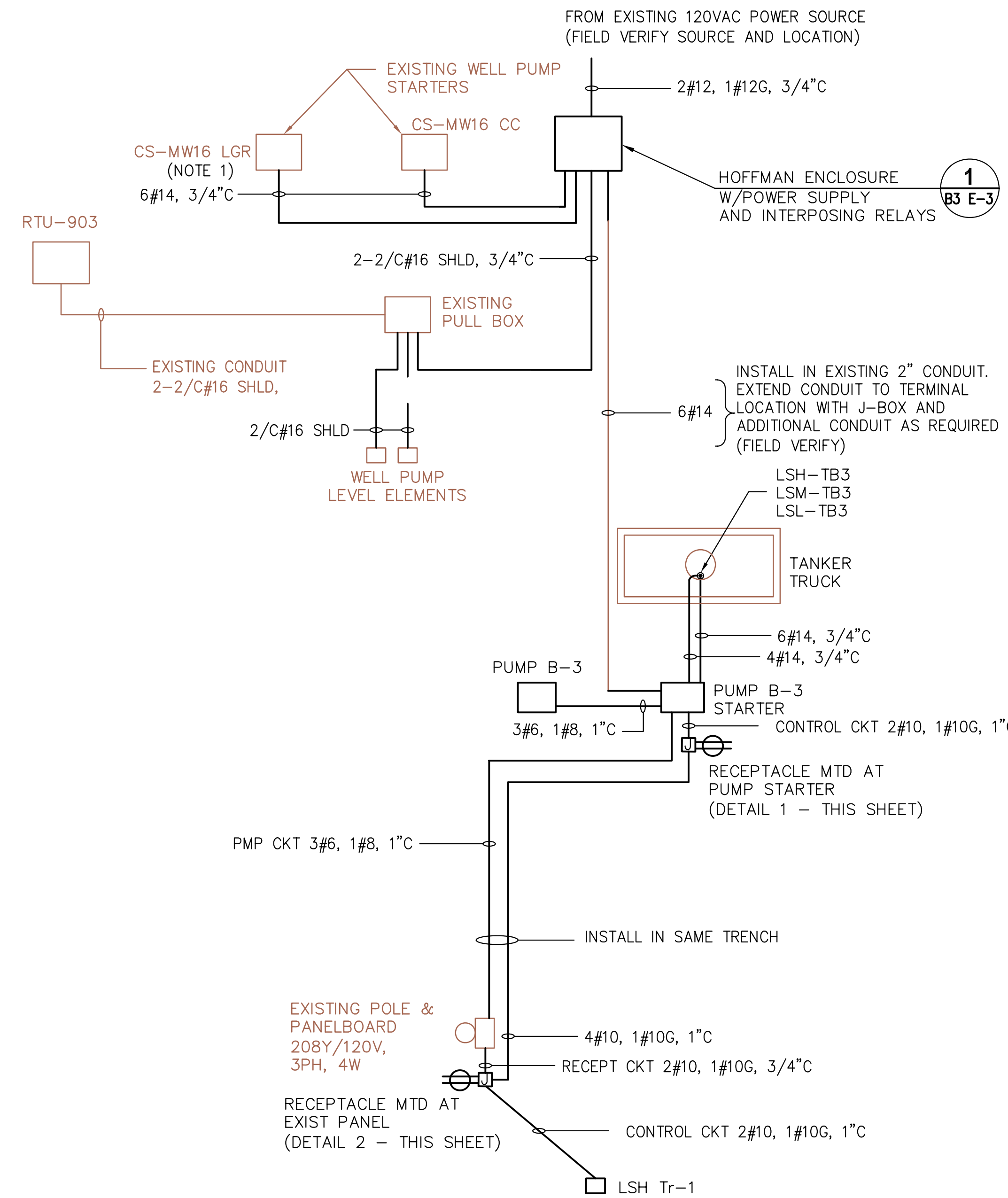
1. INSPECT AND CLEAN EXISTING PUMP 16 LGR CONTACTOR.
2. STANCHION HOLES, TRENCHING, BACKFILL AND UNDERGROUND CONDUIT BY OTHERS. STANCHION, CONCRETE ENVELOPE AND ALL CONDUCTORS AND SIGNAL WIRE IN BOTH ABOVEGROUND AND UNDERGROUND CONDUIT SHALL BE INCLUDED IN THE WORK.
3. INSTALL SIGNAL TO LSH Tr-1 FROM SWITCH TO PUMP STARTER.
4. ALL RACEWAY BELOW GRADE SHALL BE SCHEDULE 40 PVC CONDUIT. WHERE RACEWAY TRANSITIONS TO ABOVE GRADE AND ALL RACEWAY INSTALLED ABOVE GRADE SHALL BE RIGID GALVANIZED STEEL CONDUIT.

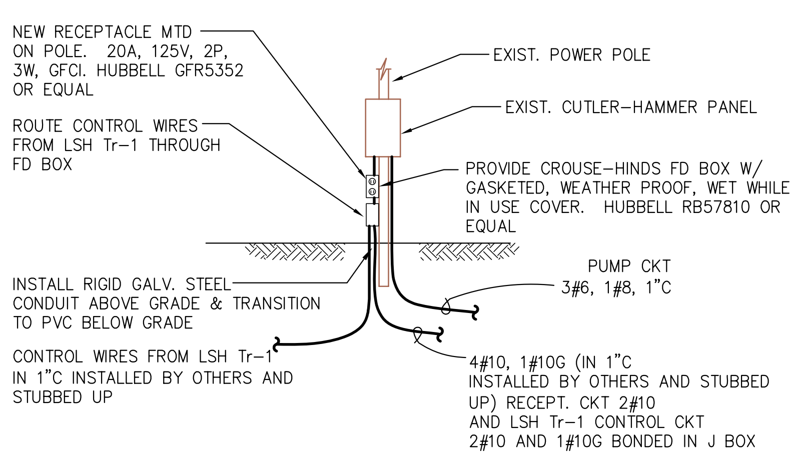


FRONT VIEW

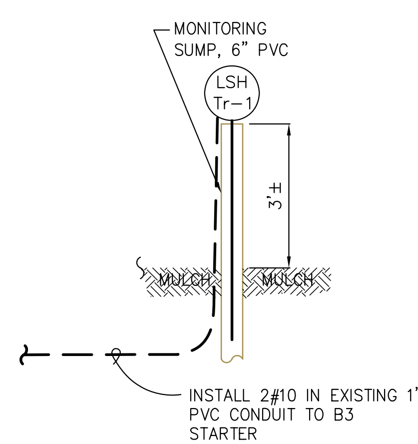
SIDE VIEW

1 B3 E-1A PUMP B-3 STARTER SUPPORT DETAIL
SCALE: NOT TO SCALE





2 B3 E-1A NEW RECEPTACLE SUPPORT DETAIL
SCALE: NOT TO SCALE



3 B3 E-1A LSH MOUNTING DETAILS
SCALE: NOT TO SCALE

BIOREACTOR SYSTEM INTERCONNECTION DIAGRAM
SCALE: NOT TO SCALE

LEGEND

EXISTING

REV.	DESCRIPTION	BY:	DATE:
0	ISSUED FOR CONSTRUCTION	HCD	1/2007
B	ISSUED FOR BID	HCD	12/2006
A	ISSUED FOR CSSA REVIEW AND APPROVAL	HCD	11/2006

REVISIONS

SCALES SHOWN ON THIS DRAWING ARE APPLICABLE ONLY TO B SIZE DRAWING

CAMP STANLEY STORAGE ACTIVITY
FACILITY UPGRADES

Contract No. FA-8903-04-D-8675 Task Order No. 006

CONTRACTOR :

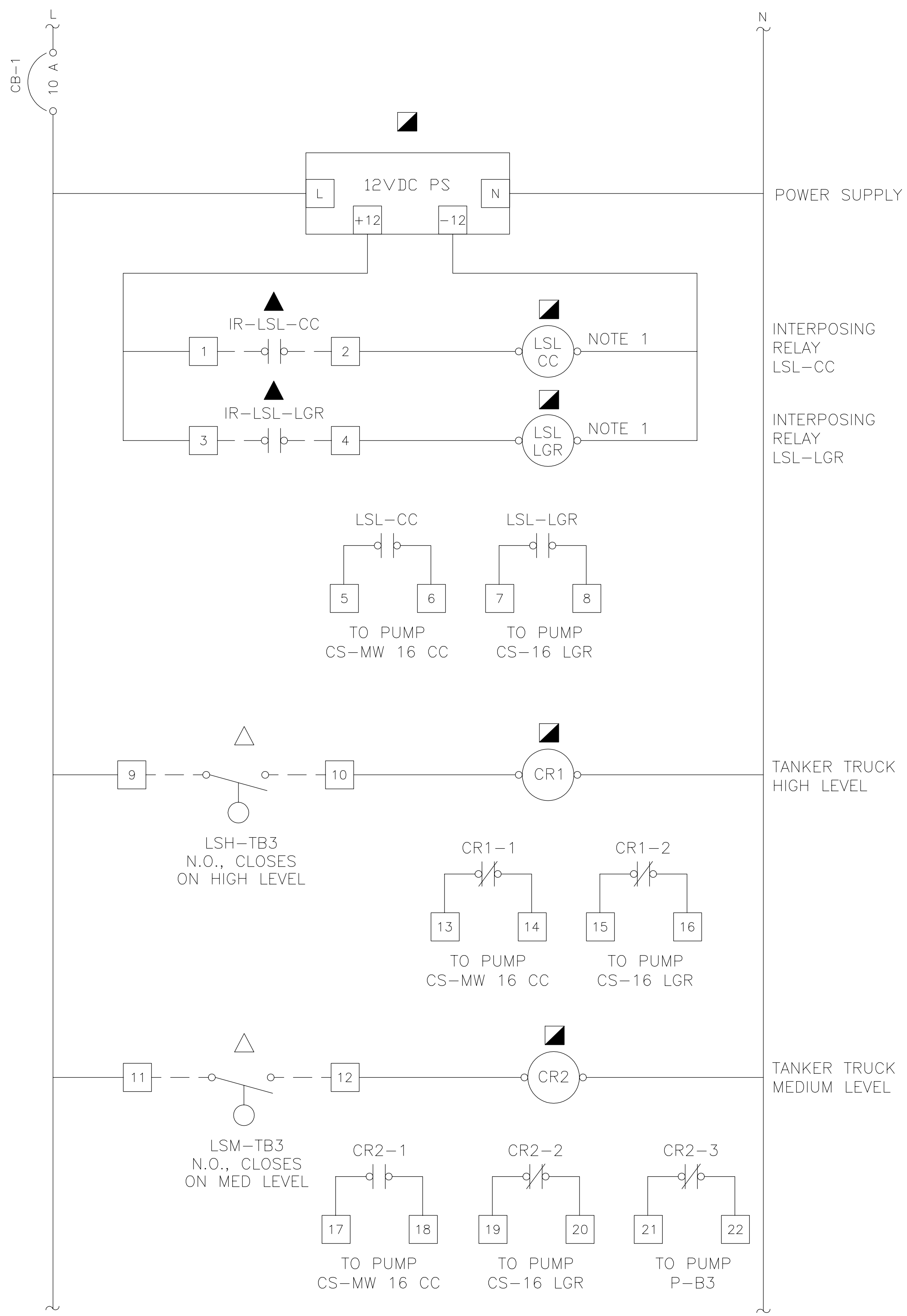
PARSONS Job No. 744223 WBS 10000

Drawing Title :

CSSA SWMU B3
BIOREACTOR PUMPING SYSTEM
ELECTRICAL INTERCONNECTION
DIAGRAM AND DETAILS

Designed : RH		Drawn : BH		Rev: 0
Checked : KL		Approved : KRR		
Scale : NONE	Date : SEPTEMBER 2006	Drawing No. : B3 E-1B		

744223.10 B3 E-1B.DWG



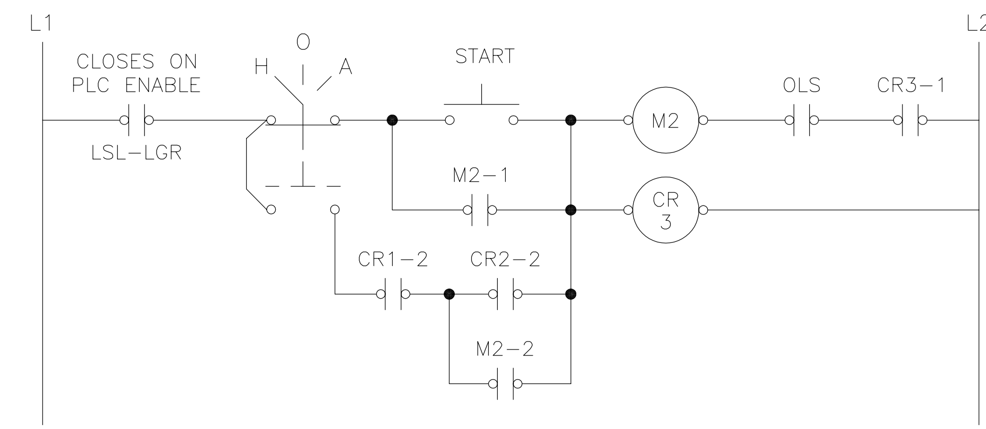
NOTE 1:

1. CONFIGURE A MINIMUM 20-MINUTE TIME DELAY ON WELL PUMP LOW LEVEL USING SCADA OR OTHER MEANS TO PREVENT SHORT CYCLING

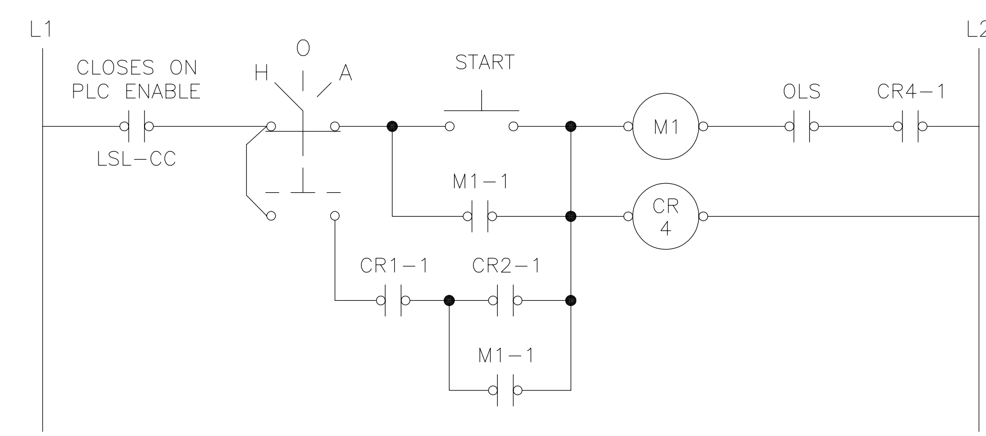
LEGEND:

- COMPONENT OR CONTACT LOCATED IN NEMA 4 HOFFMAN RELAY ENCLOSURE SEE DWG. B3 E-3 DETAIL 1
- CONTACT OR DEVICE IS LOCATED IN RTU-903
- LOCATED AT TANKER TRUCK

CS-16 LGR



CS-MW 16 CC



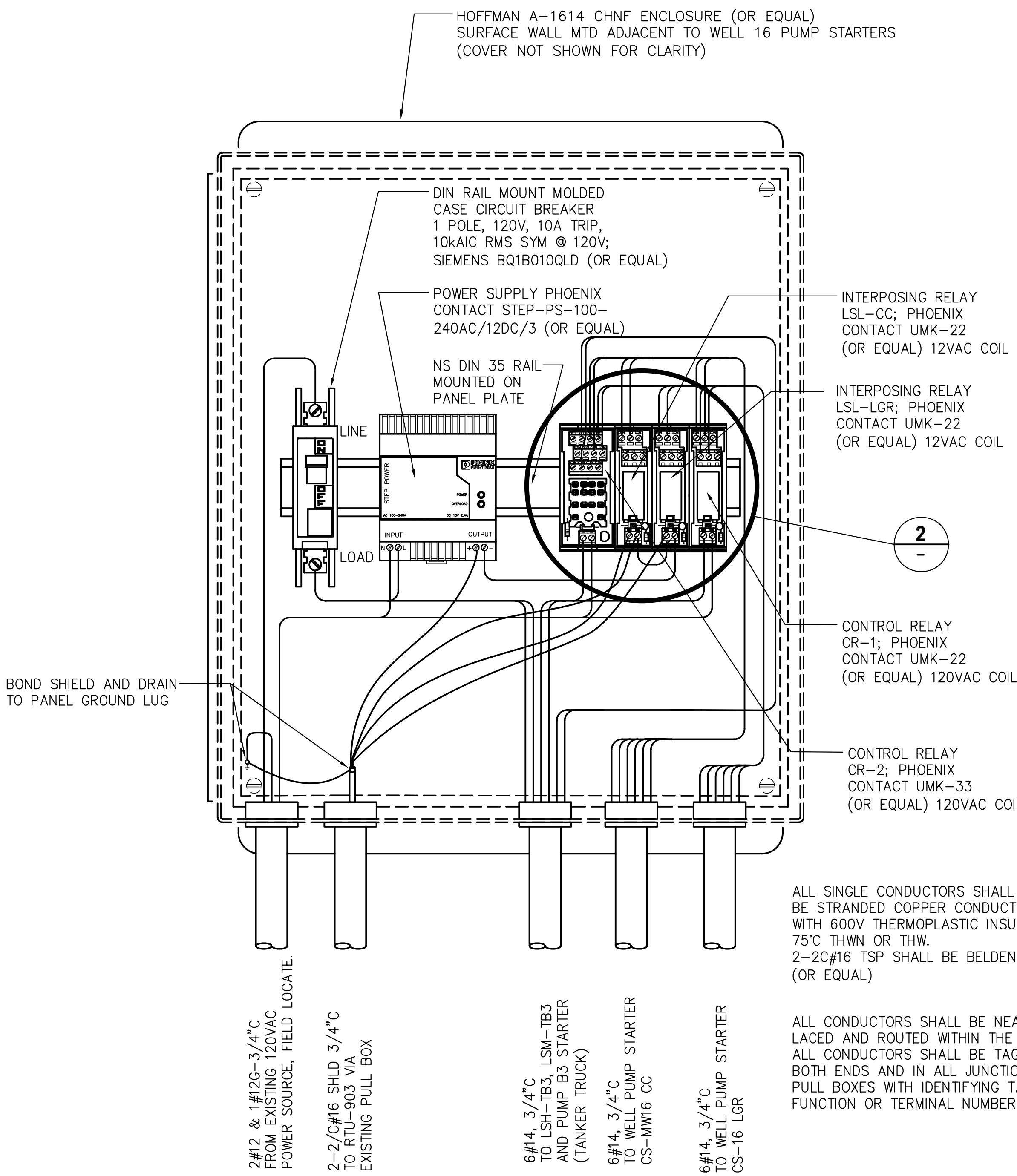
REV #	DATE	REVISION

SYSTEM CONTROLS & INSTRUMENTATION

11218 IH-10 EAST
CONVERSE, TEXAS 78109
PHONE (210)-666-8628

ENGINEER	PROJECT TITLE	SHEET TITLE
PARSONS	CSSA FACILITY UPGRADES	RELAY ENCLOSURE CONTROL SCHEMATIC

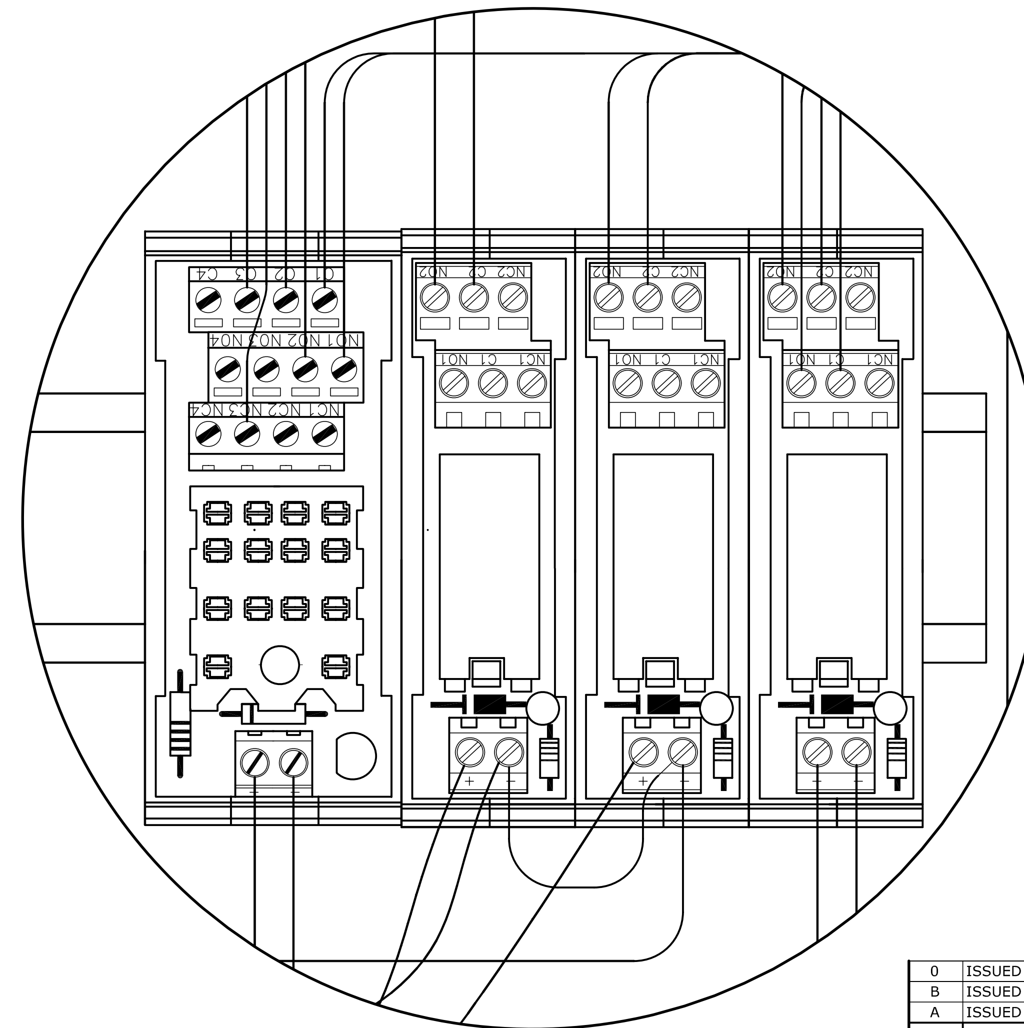
DATE:	4/20/2007
SCALE:	NTS
DRAWN BY:	Mark Southwell
CAD FILE	RELAY ENCLOSURE CONTROL SCHEMATIC.DWG
DWG. NO.	Schematic
SH	2
OF	2



ALL SINGLE CONDUCTORS SHALL BE STRANDED COPPER CONDUCTOR WITH 600V THERMOPLASTIC INSULATION 75°C THWN OR THW. 2-2C#16 TSP SHALL BE BELDEN 22409 (OR EQUAL)

ALL CONDUCTORS SHALL BE NEATLY LACED AND ROUTED WITHIN THE ENCLOSURE. ALL CONDUCTORS SHALL BE TAGGED ON BOTH ENDS AND IN ALL JUNCTION AND PULL BOXES WITH IDENTIFYING TAGS AS TO FUNCTION OR TERMINAL NUMBER

1 B3 E-1B **RELAY ENCLOSURE DETAIL**
SCALE: NOT TO SCALE



2 - **CONNECTION DETAIL**
SCALE: NOT TO SCALE

STATE OF TEXAS
HENRY C. DRESS
81023
REGISTERED PROFESSIONAL ENGINEER

REV.	DESCRIPTION	BY:	DATE:
0	ISSUED FOR CONSTRUCTION	HCD	1/2007
B	ISSUED FOR BID	HCD	12/2006
A	ISSUED FOR CSSA REVIEW AND APPROVAL	HCD	11/2006

R E V I S I O N S

SCALES SHOWN ON THIS DRAWING ARE APPLICABLE ONLY TO B SIZE DRAWING

CAMP STANLEY STORAGE ACTIVITY
FACILITY UPGRADES

Contract No. FA-8903-04-D-8675 Task Order No. 006

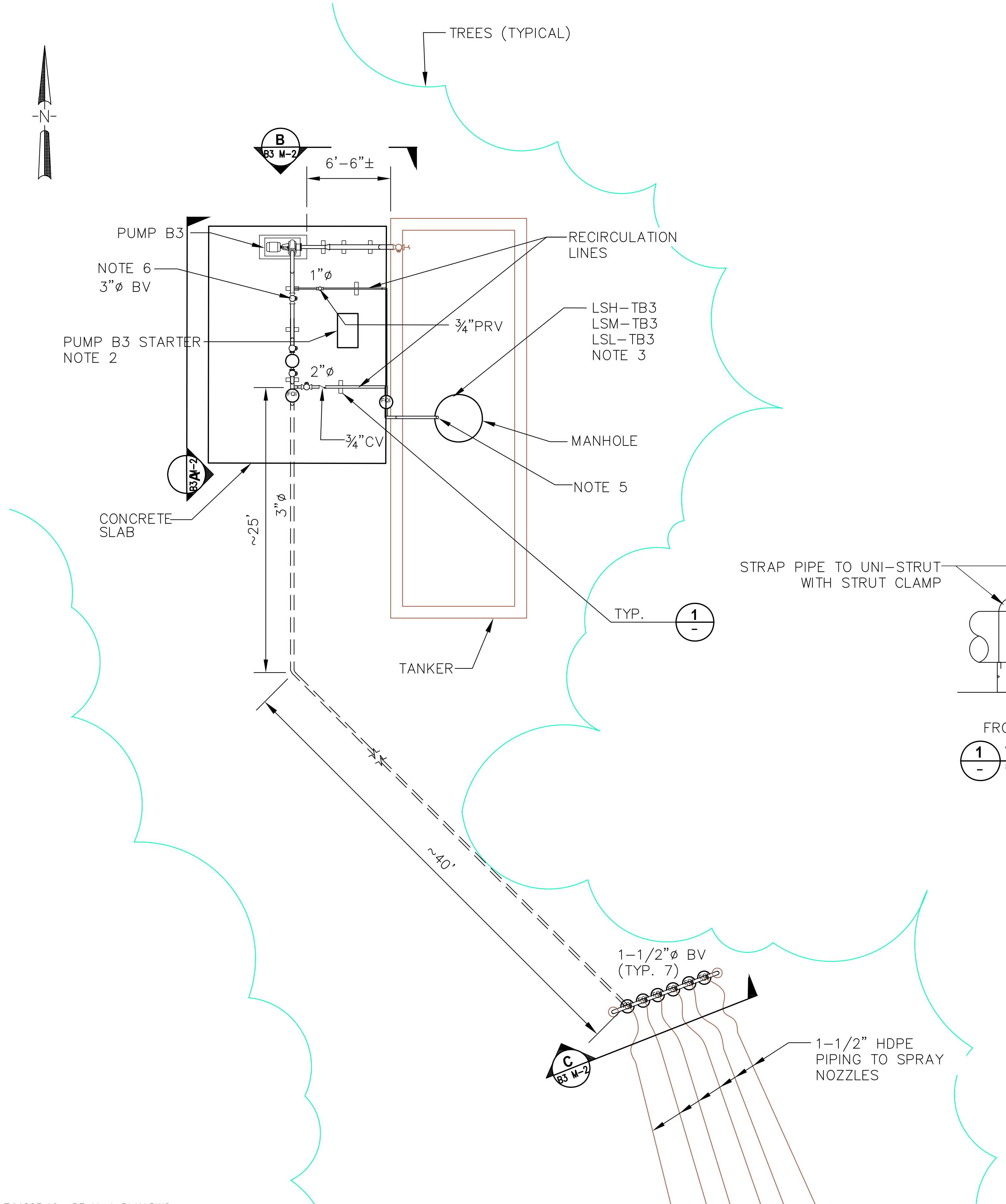
CONTRACTOR :

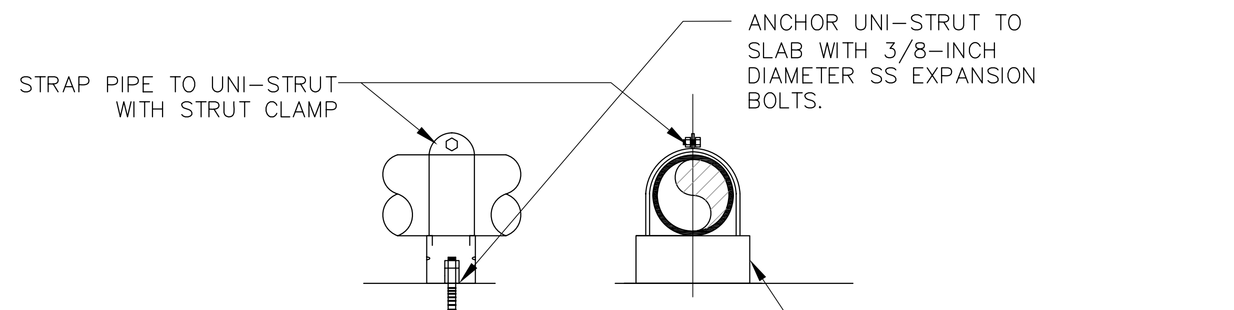
PARSONS Job No. 744223 WBS 10000

Drawing Title :

CSSA SWMU B3
BIOREACTOR PUMPING SYSTEM
ELECTRICAL CONNECTION DETAILS

Designed : RL	Drawn : BH		Rev: 0
Checked : KL	Approved : KRR		
Scale : NONE	Date : SEPTEMBER 2006	Drawing No. : B3 E-3	





1 - **TYPICAL PIPE SUPPORT (NOTE 6)**
SCALE: NOT TO SCALE

NOTES:

1. FIELD ROUTE PIPE TO APPROXIMATE LAYOUT SHOWN.
2. STANCHON MOUNT CIRCUIT BREAKER COMBINATION STARTER FOR PUMP B-3 IN THE VICINITY OF TANKER TRUCK NEAR PUMP B-3.
3. MOUNT T-B3 LEVEL SWITCHES IN STILLING WELL, 3-INCH DIAMETER PIPE ATTACHED TO MANHOLE PENETRATION.
4. USE CLASS 200 (SDR 21 OR THICKER) SOLVENT WELDED PVC PIPE. PAINT ALL EXPOSED PVC PIPE WITH UV RESISTANT PAINT.
5. SECURE RECIRCULATION PIPE TO MANHOLE RING AND EXTEND PIPE INTO TANK SAME DEPTH AS LSL-TB3(APPROXIMATELY 6 FEET).
6. USE TYPICAL STRUT STRAP OR EQUAL WITH SUPPORT SPACING NO GREATER THAN 5 FEET APART.
7. CONSTRUCT VALVE AND METER MANIFOLD USING UNI-STRUT OR EQUAL TO ARRANGE VALVES AND METERS IN ORGANIZED MANNER TO FACILITATE METERING READING AND VALVE OPERATION.

STATE OF TEXAS
HENRY C. DRESS
81023
REGISTERED PROFESSIONAL ENGINEER

LEGEND

EXISTING

10' 5' 0 10'
SCALE IN FEET

REV.	DESCRIPTION	BY:	DATE:
0	ISSUED FOR CONSTRUCTION	HCD	1/2007
B	ISSUED FOR BID	HCD	12/2006
A	ISSUED FOR CSSA REVIEW AND APPROVAL	HCD	11/2006

REVISIONS

SCALES SHOWN ON THIS DRAWING ARE APPLICABLE ONLY TO B SIZE DRAWING

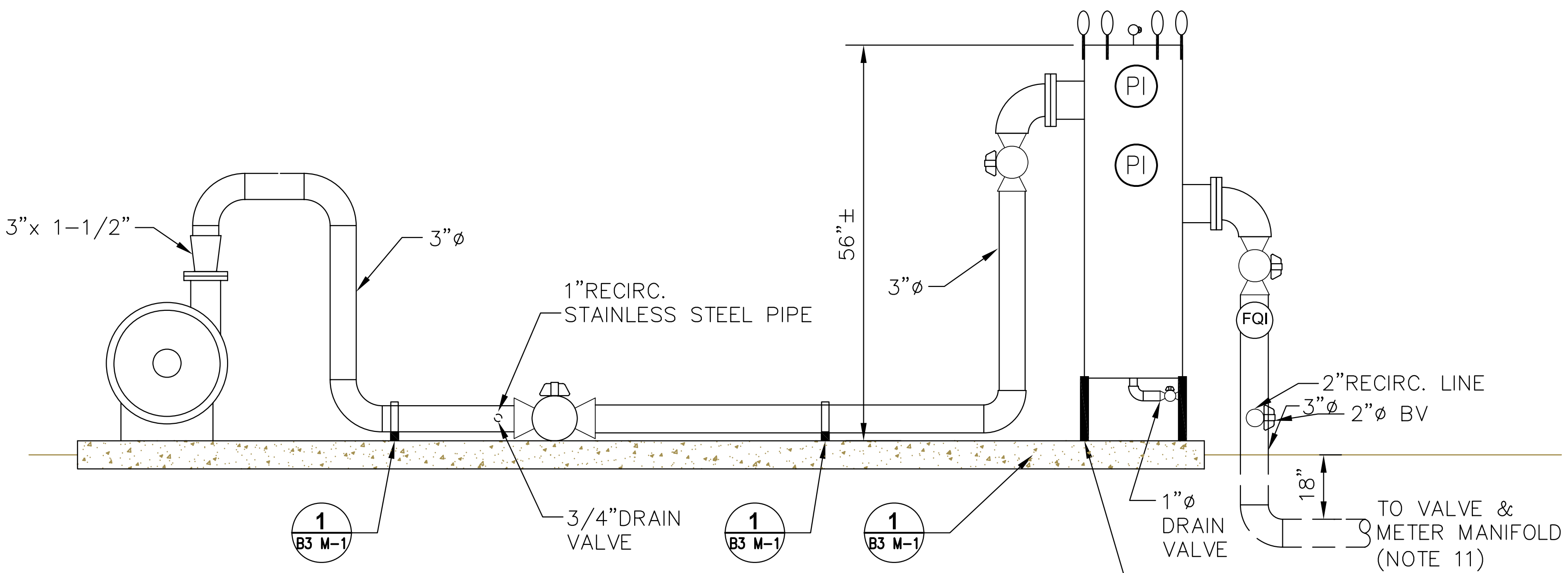
CAMP STANLEY STORAGE ACTIVITY
FACILITY UPGRADES

Contract No. FA-8903-04-D-8675 Task Order No. 006

CONTRACTOR :
PARSONS Job No. 744223 WBS 10000

Drawing Title :
CSSA SWMU B3
BIOREACTOR PUMPING SYSTEM
MECHANICAL PLAN

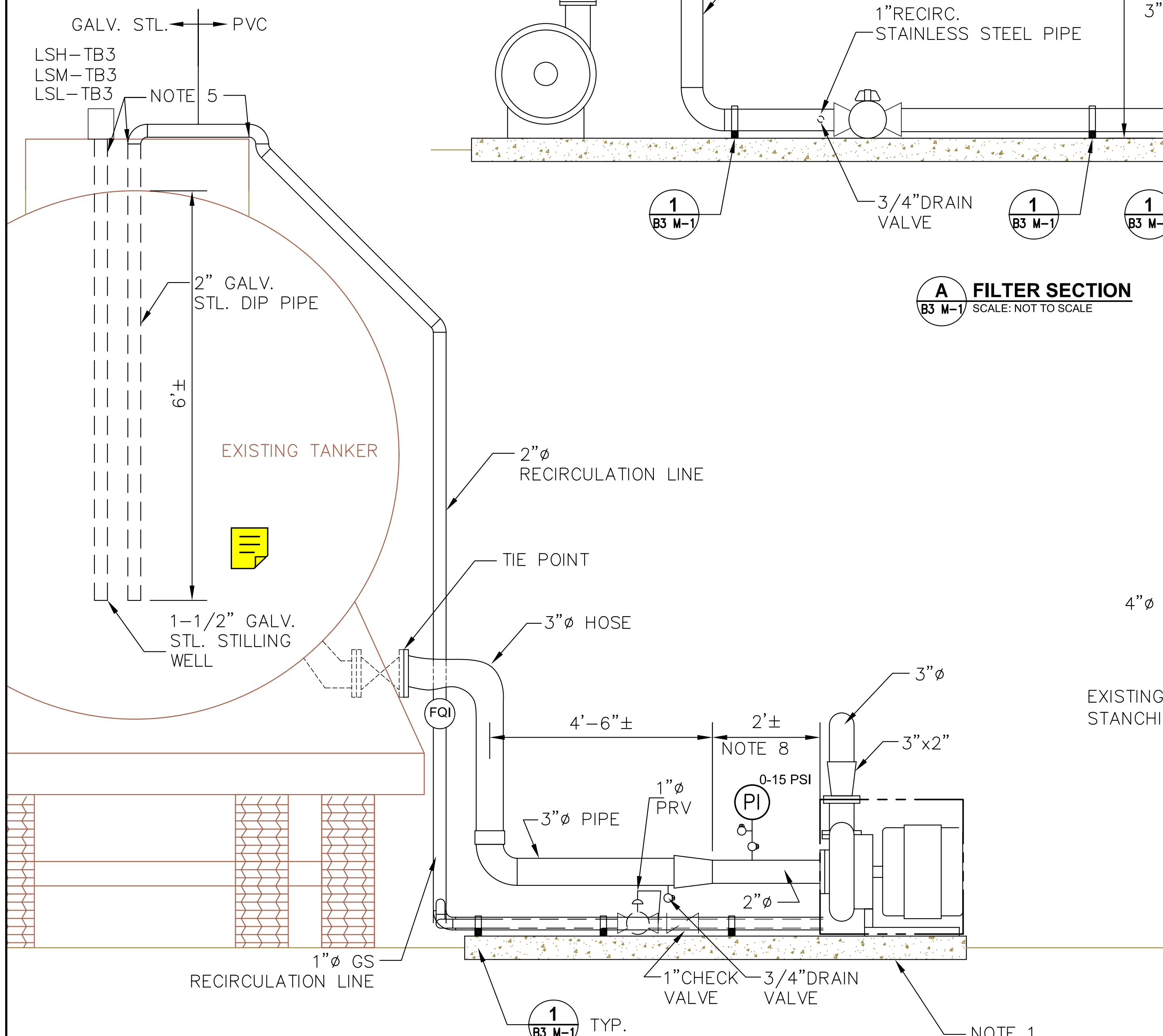
Designed : RH	Drawn : HCD	Rev: 0
Checked : KL	Approved : KRR	
Scale : NONE	Date : AUGUST 2006	Drawing No. : B3 M-1



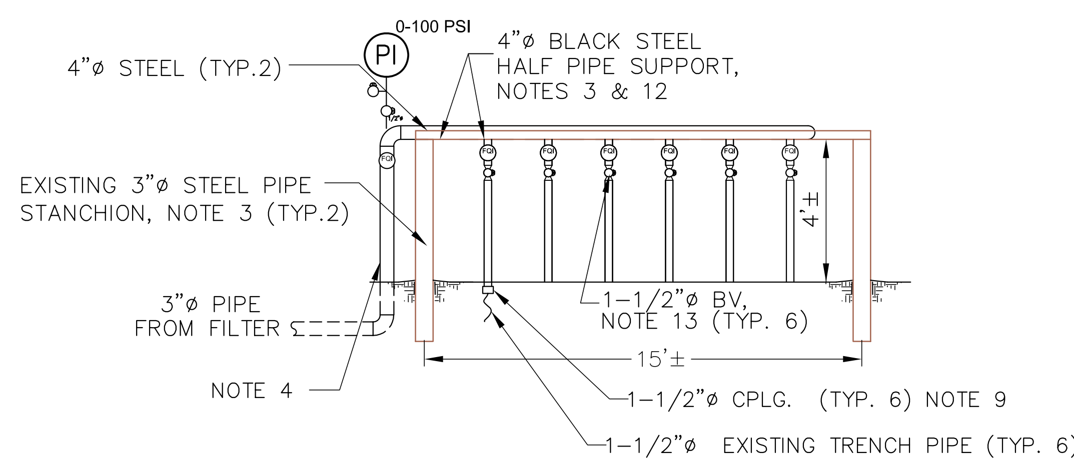
A B3 M-1 **FILTER SECTION**
SCALE: NOT TO SCALE

NOTES:

1. 6-INCH THICK CAST IN PLACE CONCRETE SLAB. ANCHOR PUMP SECURELY TO CONCRETE BASE USING 3/8" DIAMETER SS EXPANSION BOLTS.
2. INSTALL PIPE SUPPORTS ON PVC PIPE SO MAXIMUM HORIZONTAL SPAN IS < 5 FEET.
3. PRIME AND PAINT ALL CARBON STEEL SURFACES.
4. PAINT ALL EXPOSED PVC PIPE WITH UV RESISTANT PAINT.
5. USE PIPE STRAPS OR OTHER MEANS OF SUPPORT TO RIGIDLY ATTACH, SECURE AND ANCHOR PVC PIPE TO TANKER.
6. PROCURE AND SECURELY ATTACH 8' STEP LADDER TO TANKER OR FABRICATE WOODEN STAIRS TO ALLOW EASY ACCESS TO MANHOLE LADDER.
7. PRESSURE INDICATING GAUGE, ASHCROFT TYPE 1259 WITH 316SS TUBE, TIP AND SOCKET, 1/2" NPT WITH 4-1/2" DIAL. BLOCK AND BLEED VALVES SHALL BE BRASS BALL VALVES WITH 1/2"NPT ENDS.
8. MAINTAIN MINIMUM STRAIGHT RUN PIPE UPSTREAM OF PUMP.
9. CONNECT PVC DROP PIPES TO EXISTING HDPE TRENCH PIPES.
10. PLUG ALL DRAINS VALVES WITH THREAD PLUG.
11. FIELD ROUTE UNDERGROUND LINE TO VALVE & METER MANIFOLD LOCATION. SEE CONTINUATION IN SECTION C.
12. USE 4-INCH DIAMETER HALF STEEL PIPE SUPPORT FOR FULL LENGTH OF PVC PIPE BETWEEN STANCHIONS. WELD HALF PIPE SUPPORT TO 3-INCH STANCHION AND DRILL 2" HOLES IN NEW HALF PIPE SUPPORT FOR DROP LEG TO EACH METER VALVE AND BRANCH PIPE TO THE INDIVIDUAL TRENCHES.
13. USE PVC BALL VALVES AND EQUALLY SPACE DROP PIPES, 2'±



B B3 M-1 **PUMP SECTION**
SCALE: NOT TO SCALE



C B3 M-1 **VALVE & METER SECTION**
SCALE: NOT TO SCALE

LEGEND

EXISTING

REV.	DESCRIPTION	BY:	DATE:
C	ISSUED FOR CONSTRUCTION	HCD	1/2007
B	ISSUED FOR BID	HCD	12/2006
A	ISSUED FOR CSSA REVIEW AND APPROVAL	HCD	11/2006

REVISIONS

SCALES SHOWN ON THIS DRAWING ARE APPLICABLE ONLY TO B SIZE DRAWING

CAMP STANLEY STORAGE ACTIVITY
FACILITY UPGRADES

Contract No. FA-8903-04-D-8675 Task Order No. 006

CONTRACTOR :
PARSONS Job No. 744223 WBS 10000

Drawing Title :
CSSA SWMU B3
BIOREACTOR PUMPING SYSTEM
MECHANICAL SECTION & DETAILS

Designed : HCD	Drawn : HCD	Rev: 0
Checked : KL	Approved : KRR	
Scale : NONE	Date : AUGUST 2006	Drawing No. : B3 M-2

STATE OF TEXAS
HENRY C. DRESS
81023
REGISTERED PROFESSIONAL ENGINEER

744223.10 SWMU B3 M-2 SECTION.DWG

SECTION 16010
GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. The electrical work covers the new equipment and modifications to implement the Camp Stanley Storage Activity SWMU Bioreactor pumping system. Work includes furnishing all material, equipment, components, tools and labor for a complete electrical installation.

B. This section summarizes the general requirements for all electrical work.

1.2 DEFINITIONS

A. Provide: Furnish and completely install, and connect.

B. Product Data: Catalog cuts and descriptive literature.

C. Shop Drawings: Factory prepared specific to the installation.

D. Indicated: Shown on the Contract Drawings.

E. Noted: Indicated or specified elsewhere.

1.3 LOCAL CONDITIONS

A. Power will be supplied from an existing distribution network at the site.

1.4 QUALITY ASSURANCE

A. Provide complete electrical installation in accordance with the latest revised edition of National Electrical Code (NFPA 70), Life Safety Code (NFPA 101), and in accordance with all applicable state and local laws, ordinances and codes. Obtain all necessary permits and have all work inspected by appropriate authorities having jurisdiction (AHJ).

B. Qualifications of Manufacturers. Furnish manufacturer's electrical equipment of the types and sizes specified which have successfully operated for not less than the past two years except where specific types are named by manufacturer and catalog number or designation.

C. Codes and Standards. Provide electrical equipment and materials, including installation, conforming to the following codes and standards as applicable. The equipment and materials shall bear labels to indicate manufacturing conformance to the specified standards or equal. Where two or more codes or standards are at variance, conform to the more restrictive requirement.

1. NFPA 70; National Electrical Code (NEC).
2. American National Standards Institute (ANSI).
3. American Society for Testing and Materials (ASTM).
4. Institute of Electrical and Electronics Engineers (IEEE).
5. Insulated Cable Engineers Association (ICEA).
6. National Electrical Manufacturers Association (NEMA).
7. National Electrical Testing Association (NETA), Section 16T, Electrical Acceptance Tests.
8. National Fire Protection Association (NFPA).

9. Occupational Safety and Health Act (OSHA).
10. Underwriters' Laboratories, Inc. (UL).
11. NFPA 101, Life Safety Code.

1.5 SUBMITTALS

A. Shop Drawings

1. Submit, for the Contractor's approval, shop drawings to the extent required in this Section.
2. Complete equipment descriptive, operation and installation data shall be submitted with the shop drawings. Shop drawings shall be clear, neat, orderly, legible and in the final format. Hand drawn sketches, redrawn copies of contract drawings and other preliminary type drawings are not acceptable and will be rejected without review. Shop drawings shall include the following.
    a. Dimensions and weights of equipment.
    b. Nameplate data including the nameplate material, heights of letters, inscriptions and method of mounting.
    c. Details showing enlarged views of small parts when required.
    d. Arrangements of equipment and nameplates.
    e. Plans showing the equipment assembly, space requirements, conduit hub sizes, clearances and locations for conduits and anchor bolts.
    f. Elevations showing all parts, devices, components and nameplates, positions and arrangements of the equipment. Show as many elevations as necessary to clearly depict component and device arrangements.
    g. Schematic and elementary wiring diagrams, of each unit of each equipment, showing numbered terminal points, numbered wires and numbered interconnections to other equipment and remote devices.
    h. Connection wiring diagrams, of each unit of each equipment, showing numbered terminal points, numbered wires and numbered interconnections to other equipment and remote devices.
    i. Include numbering of external wiring in the instruction manual.
    j. Complete catalog information of all parts and components of electrical equipment.
    k. Symbols and Legend sheet to describe all symbols used on shop drawings.

B. Resubmittals. When a resubmittal is required the Manufacturer shall submit all previously accepted material in addition to the corrected or added information. Corrected and/or additional information shall be clearly identified. It is intended that each resubmittal be a complete and stand-alone document.

C. Materials List. Submit material lists, for the Contractor's review and approval, within 30 days of Notice to Proceed. Include all products electrical products described in the contract documents, including the equipment described in shop drawings. List only those products named in the Contract Documents or approved substitutions.

D. Technical Data. Submit descriptive and instruction manuals to the extent required under this Section .

E. Manufacturers' Certified Reports. The equipment manufacturer, or his authorized representative shall submit a written report with respect to his equipment certifying that (1) the equipment has been properly installed, wired and connected under his supervision, (2) the equipment is in accurate alignment, (3) he was present when the equipment was placed in operation, (4) he has checked, inspected and adjusted the equipment as necessary, (5) the equipment has been operated under full load conditions and operated satisfactorily and (6) the equipment is fully covered under the terms of the guarantee. Reports shall be submitted for the following equipment: Instruments, Relays, and Power Supplies.

F. Accessory and Maintenance Materials. Furnish items as specified herein. Deliver to Contractor as directed with an itemized list in a letter of transmittal accompanying each shipment.

1. Special Tools and Accessories. Furnish special tools, instruments and accessories for maintaining equipment requiring periodic repair and adjustment. Also, furnish special lifting and handling devices for equipment requiring such devices.
2. Maintenance Materials and Spare Parts. Deliver in manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery. Deliver electrical materials and equipment in manufacturers' original cartons or containers with seals intact, as applicable.

1.7 GUARANTEE AND WARRANTEES

A. Guarantee all work of Division 16 in accordance with Subcontract Warranty requirements.

PART II - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Provide new materials and equipment as required to complete all indicated and specified electrical work, including incidental items inferable from the contract documents that are necessary to complete the work. Provide materials and equipment of latest design, standard products of established manufacturers. For uniformity, only one manufacturer is acceptable for each type of product. Manufacture individual parts to standard sizes and gauges so that repair parts can be installed in the field. Make like parts of duplicate units interchangeable.

B. Prohibited Materials. Aluminum conductors are not acceptable.

C. Indoor Equipment. Enclosures for electrical equipment installed indoors shall be rated NEMA 1.

D. Outdoor Equipment. Outdoor electrical equipment shall be weatherproof, NEMA 4 or as indicated.

E. Factory Finishes. Unless otherwise specified, the sheet metal surfaces of equipment enclosures shall be phosphatized and coated with a rust resisting primer. Over the primer, apply a corrosion resistant baked enamel finish on the interior and exterior metal surfaces. The color shall be ANSI No. 49 medium light gray. Furnish hardware with a corrosion resistant finish. Finish cast iron outlet bodies, boxes, covers and fittings with cadmium zinc electroplate covered with aluminum cellulose lacquer.

2.2 SOURCE QUALTIY CONTROL

A. Factory Tests. Factory tests are required for all electrical equipment and assemblies. Perform tests in accordance with codes and standards specified as applicable to the equipment.

PART III – EXECUTION

3.1 INSTALLATION

A. The complete installation is to be accomplished by skilled electrical tradesmen, with certified or suitably qualified individuals performing all special systems installation and testing. All workmanship shall be of the highest quality, sub-standard work will be rejected. Any portions of the work rejected as above shall be immediately repaired and/or replaced as required to satisfy the contractor and the requirements of the contract.

B. Schedule the work and cooperate with all trades to avoid delays, interferences, and unnecessary work. If any conflicts occur, necessitating departures from the Contract Drawings and Specifications, details of departures and reasons therefore shall be submitted immediately for the Contractor's consideration.

3.2 CERTIFICATION AND TESTING

A. Prior to request for final review, test all systems and repair or replace all defective work. Submit, with request for final review, written certification that all electrical systems are complete and operational.

B. At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for system demonstration.

C. After final review and acceptance, turn over to the Contractor all keys for electrical equipment locks. Present to the Contractor or the Contractor's designated representative, demonstrations and oral instructions for proper operation and maintenance of the electrical equipment and systems.

END OF SECTION 16010

Appendix G

Product Information

FT415 Flow Computer

FT400-Series

FLOW COMPUTER INSTRUCTIONS

- [redacted]
- FT420

FT400-SERIES FLOW COMPUTER INSTRUCTIONS

ISO 9001:2000 CERTIFIED

SeaMetrics

The Leader in Flow Meter Value

TABLE OF CONTENTS

TABLES AND DIAGRAMS

GENERAL INFORMATION

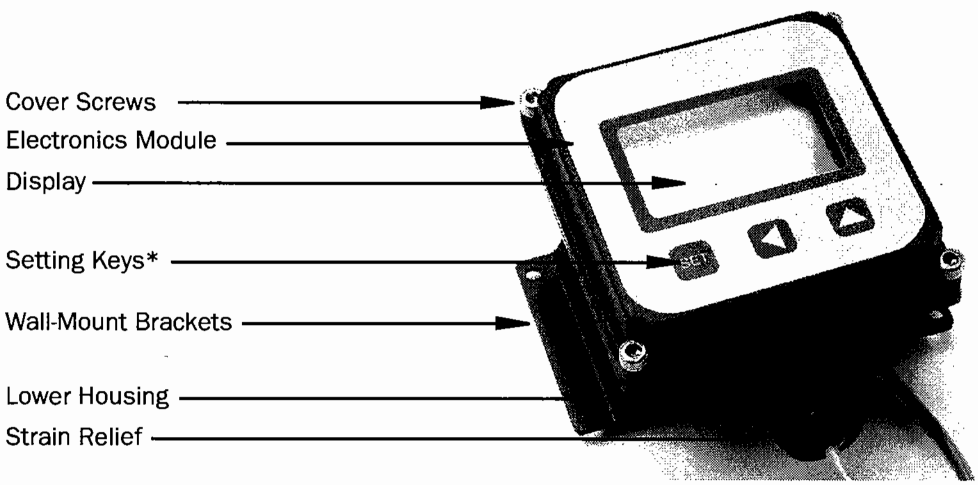
The FT400-Series flow computers are microcontroller-based indicator/transmitters that display flow rate and total and provide output signals. The FT415 is battery-powered and provides a scalable pulse output. The FT420 is powered by external DC voltage and has both pulse and 4-20 mA analog outputs. The FT420 is a "two-wire" or "loop-powered" device, meaning that the 4-20 mA output signal doubles as its power supply. Because of this, it is designed to operate on less than 4 mA of current.

The addition of a dual-relay output board allows for certain applications requiring dry contact output (e.g., certain metering pumps and water treatment controls). Dual relays provide exactly the same pulse output as the standard unit, and each can signal one external device. A non-resettable total is also available. The FT420 can be ordered in a plastic enclosure with a 115 Vac power supply for use with mechanical meters, or with a built-in 115 Vac/12-24 Vdc dual power supply for magmeters.

Both the FT415 and the FT420 can be factory-mounted on the meter (-M) or remotely wall mounted with the brackets provided (-W). The FT420 is also available as a panel mount (-P) with an open back for easy installation in the user's own electrical enclosure. Most FT400's can be converted from wall-to-meter or meter-to-wall mount configurations after installation if needed.

Housings for the -W and -M models are rugged cast aluminum, gasketed for maximum environmental protection. A membrane keypad allows settings to be changed without removing the cover. (Password protection, a standard feature, can be used to prevent settings from being changed.)

FEATURES



*Includes password protection for tamper prevention when needed

SPECIFICATIONS		FT415	FT420
Power		Lithium "C", 3.6 Vdc, replaceable, 3-5 year life	4 mA DC (4-20 mA loop), 12-32 Vdc
Display	**Rate**	6-digit autorange, 1/2" character height	6-digit autorange, 1/2" character height
	Total	8-digit, 5/16" character height	8-digit, 5/16" character height
Output	**Pulse**	0.1 second open collector pulse (scaled) Sensor pulse (unscaled) High alarm or low alarm	0.1 second open collector pulse (scaled) Sensor pulse (unscaled) High alarm or low alarm
	Analog	None	4-20 mA loop; 24-32 Vdc
Pulse Output Range		0.1 - 9999999.9 units/pulse	0.1 - 9999999.9 units/pulse
Input		Micropower GMR Sensor (square wave)	Open collector/switch @ 5 Vdc
Input Range		1.0 - 2,500 pulses/second	1.0 - 10,000 pulses/second
K-Factor Range		.001 - 99999.999	.001 - 99999.999
Flow Alarm Output Range		.01 - 999999.99	.01 - 999999.99
Temperature		0° C - 70° C (32° - 158° F)	0° C - 70° C (32° - 158° F)
Environmental		NEMA 4X	NEMA 4X

Wall Mount. To mount an FT400-Series indicator to the wall, hold the unit in the desired position, mark the holes in the mounting feet, drill and mount with screws. With the FT420W-65 option, first remove the front cover to gain access to the mounting screw holes.

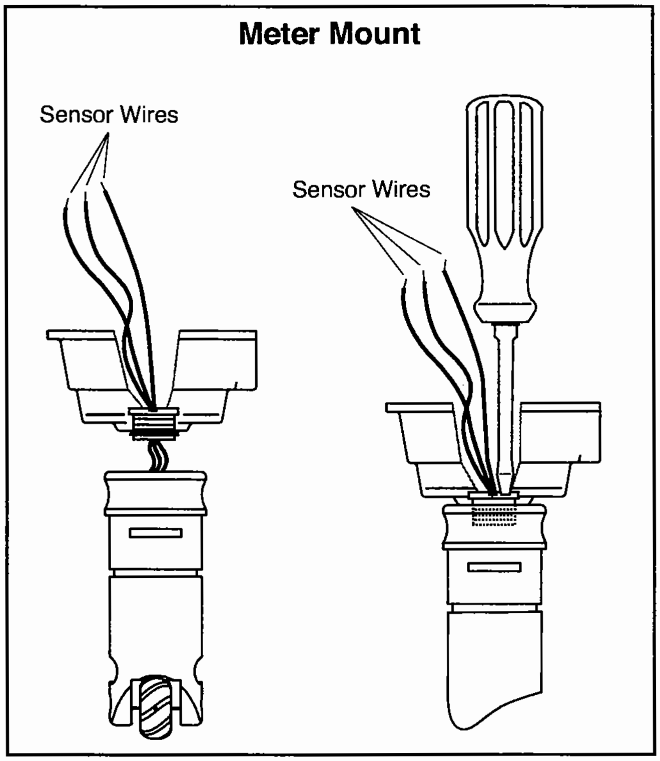
A meter-mounted FT400-Series can be converted to a wall mount using an MK20 mounting kit.

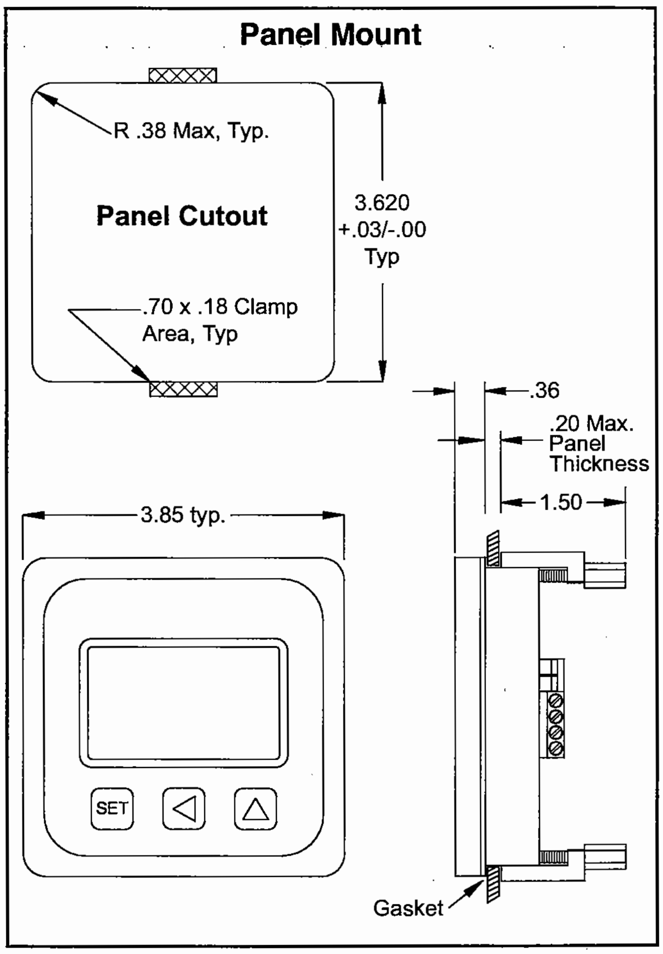
Meter Mount. If the FT400-Series indicator was ordered as an -M model, the housing is already directly mounted to the flow sensor and needs no further installation.

An FT400-Series module can be converted from a wall-to a meter-mount using the MK10 adapter kit that includes a lower housing and associated hardware as follows:

1) Remove the strain relief through which the flow sensor cable runs.
2) Cut the cable to about 6" in length. Carefully strip the cable jacket to expose the three colored wires (red, white, and black) inside.
3) Route the wires through the threaded connector pre-installed in the bottom of the housing.
4) Start the threaded connector into the female thread on the top of the flow sensor. Be sure to match the oblong shape on the bottom of the housing to the depression on the top of the flow sensor.
5) Using an ordinary screwdriver inserted in one side of the slot (see drawing), tighten the screw as much as possible.
6) Strip the wire ends, make the connections to the FT400-Series indicator as shown in Connections Diagrams, and then use the cover screws to attach the indicator to the top of the housing.

Panel Mount (FT420 Only). Using the "Panel Cutout" drawing as a guide, cut a square hole in the panel. Remove the clamps from the back of the FT420P and insert the indicator unit through the cutout, taking care that the panel sealing gasket is in place between the front of the panel and the flange of the indicator. Hold the indicator in place while starting the screw of one of the two clamps. Finger tighten the screw, then install the other clamp. When both are in place, firmly tighten the clamps with a small wrench or nut driver.





Connections. To connect the FT400-Series flow computer to a flow sensor or an external device such as a chemical metering pump, follow the Standard Connections diagrams on pages 4-6.

If the FT420's 4-20 mA current signal is not required, connect the power terminals to any Vdc current source.

Dual Relay Output (Option -98). If you purchase the FT420 with option 98, the required component will come preinstalled, and no extra procedures are required.

If you are retrofitting an existing installation of an FT420 with the dual relay board, please follow the instructions below:

1) Peel the backing off of the double-stick tape and affix it to the bottom of the relay board (part #30221).
2) Carefully attach the board to the FT420 as shown in the FT420-98 Connection diagram on page 5. Be sure that the red wire faces the "Sensor Input" side of the FT420, and that the white wire faces the "Pulse Output" side.
3) Connect the white wire to the "Pulse Scaled" positive terminal, and the red wire to the "Power 4-20 mA" positive terminal.
4) Connect devices to the relays as desired.

-98 Relay Board Specifications

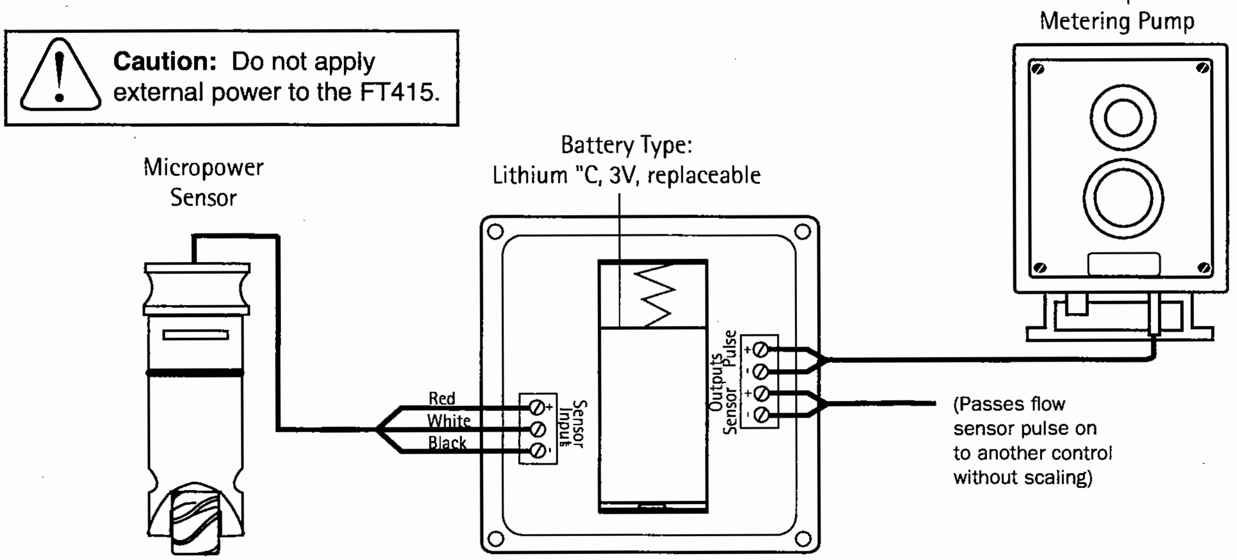
Input Voltage	7-30 Vdc	
Output Current (both outputs)		
Input Voltage	50 C	85 C
12 Vdc	120 mA	70 mA
24 Vdc	120 mA	80 mA
Max Pulses/Second		5
Contact Time Per Output		100 ms

Caution: If output is being used to control an external device, such as a metering pump, do not connect the device until programming is completed. If malfunction or incorrect programming of the output could cause personal injury or property damage, separate safeguards must be installed to prevent such injury or damage.

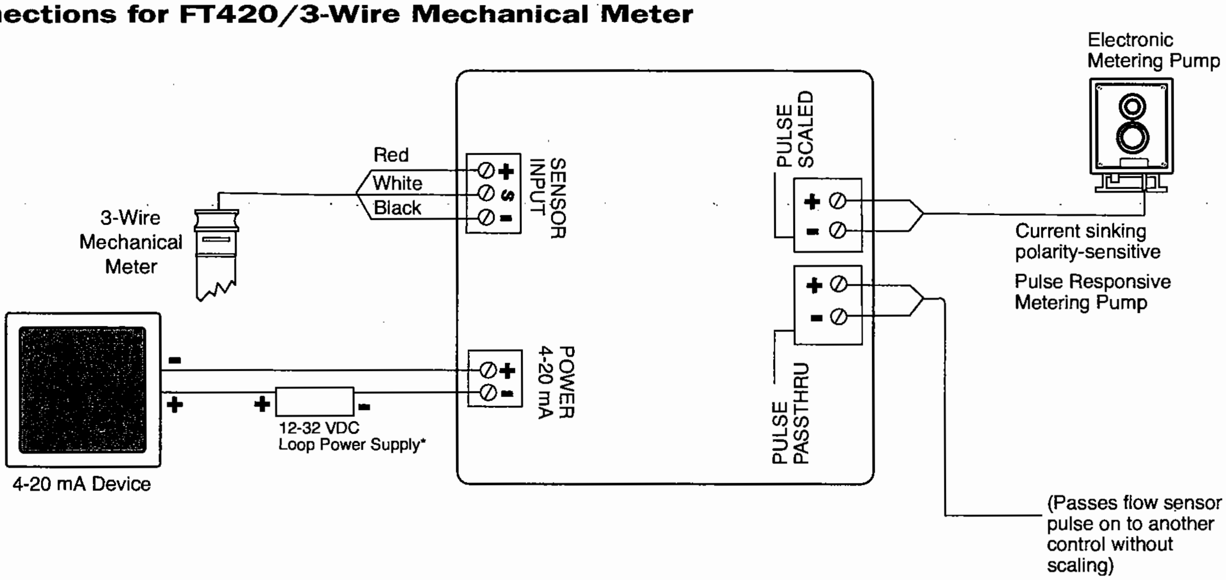
CONNECTION DIAGRAMS

FT415 Standard Connections

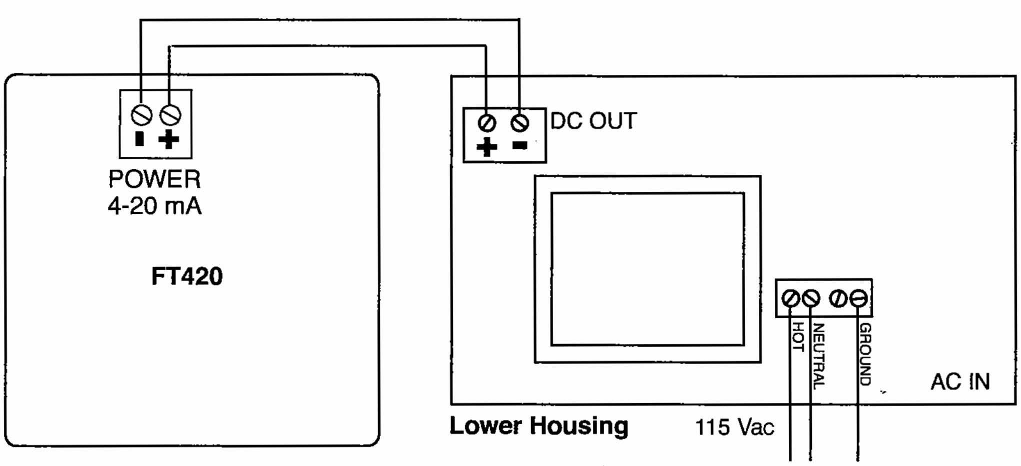
Caution: Do not apply external power to the FT415.



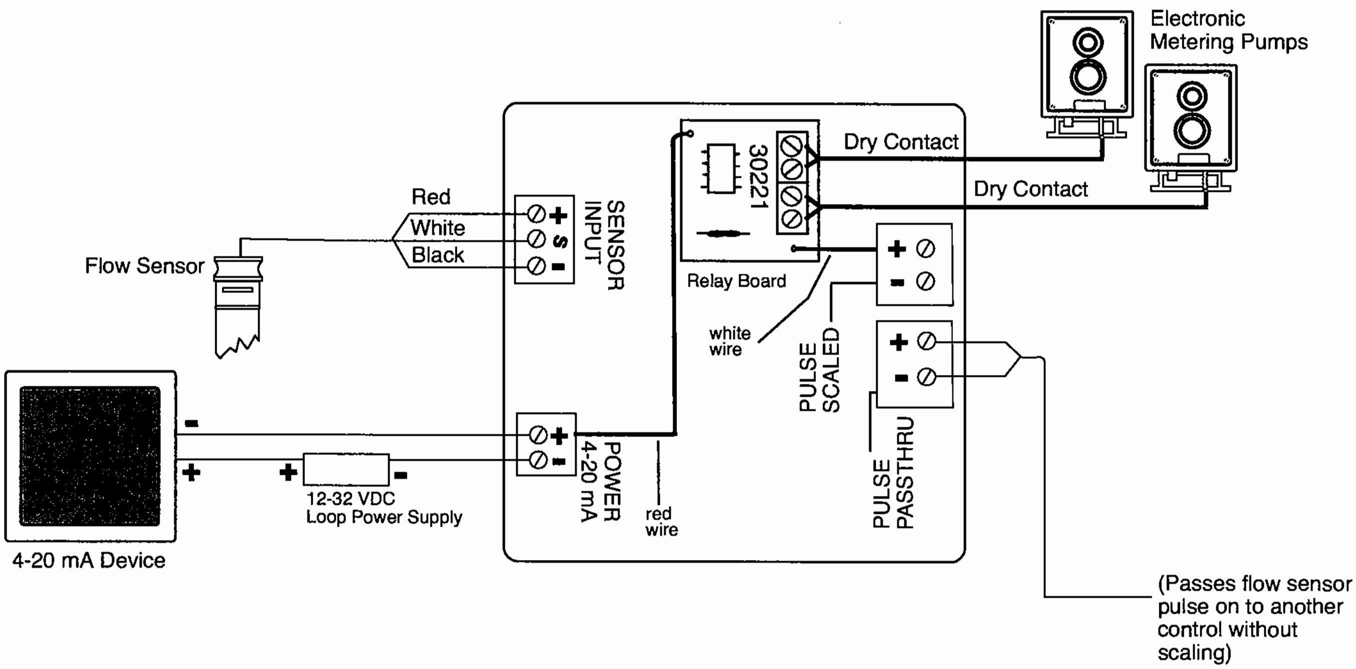
Connections for FT420/3-Wire Mechanical Meter



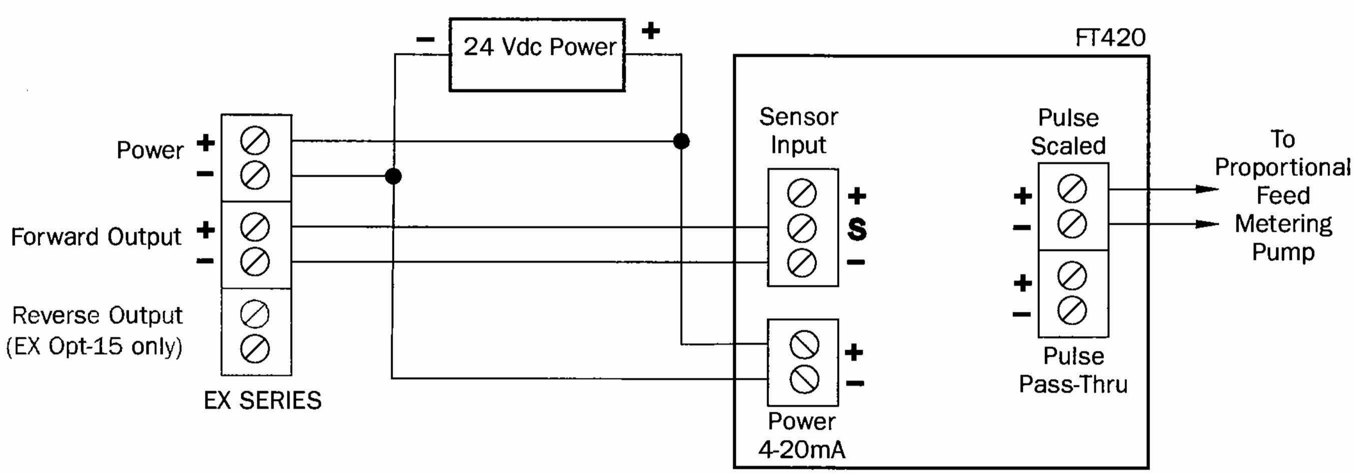
Connections for FT420-65 (115 Vac Option)



Connections for FT420-98 (Dual Relay Output Option)



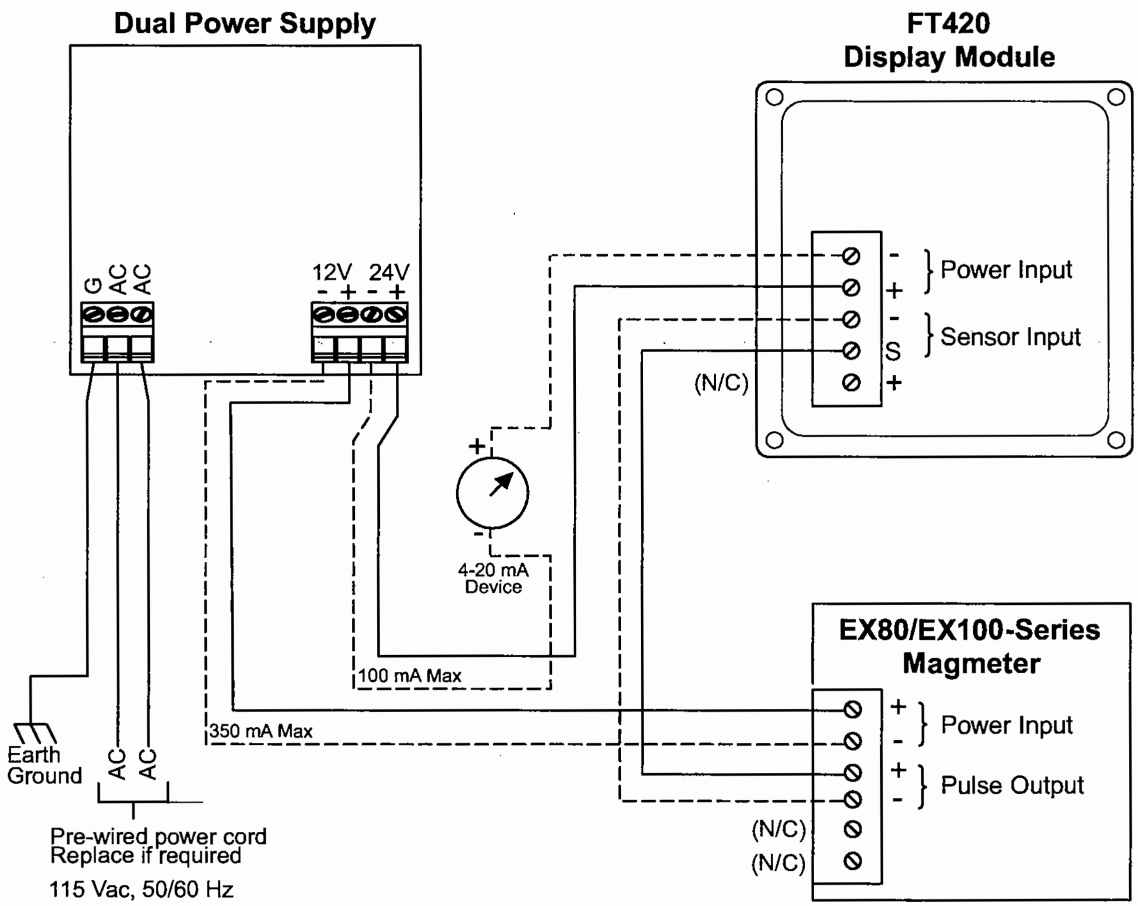
Connections for FT420/EX Magmeter



Connections for FT420/EX Magmeter/Dual Power Supply

A dual power supply is required when a 4-20 mA output is needed.

> **Caution 1:** Important! Do not connect power to the power supply until all connections have been made and confirmed correct, and the cover has been put back into place.
>
> **Caution 2:** It is essential for safety and proper operation to use a ground connection for the 115 Vac power. Do not use this power supply without proper grounding.



QUICK SETTINGS OVERVIEW

See following page for step-by-step instructions on changing these settings

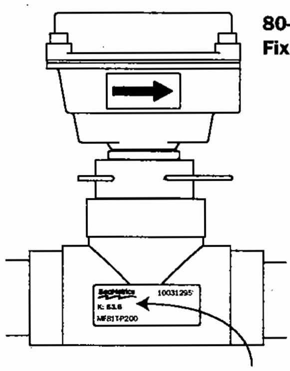
PRESS	DISPLAY	
	0.00 MIN 209.8 RESET START UP DISPLAY	Large digits display instantaneous flow rate (GPM). Small digits display total flow (since last reset).
SET	00001.000 SET K	K is the number of pulses the flow sensor provides for every gallon of flow. Find it on the fitting (80-Series) or chart (100/200-Series) or on the SeaMetrics website.
SET	0000010.0 SET P	P is the number of gallons per pulse desired on the scalable pulse output. (Example: P=1 is one pulse per gallon.) Skip without changing if you are not using the pulse output.
SET	0001000.0 SET 20	20 is the 20 mA maximum analog output. Set the flow rate you want to match maximum output. Example: 250 gpm maximum expected flow, "set 20" to 250. The analog output will scale to 4 mA at zero flow, 20 mA at 250 gpm*. **This setting appears on the FT420 ONLY.**
SET	d 209.8	d is the decimal point. It toggles back and forth with the ▲. Set as many decimal places as needed. For higher flows, no decimal allows maximum number of whole digits.
SET	MIN	MIN is the time base, for example, gallons *per minute*. Use the ▲ to select sec/min/hour/day.

***NOTE:** Use the up arrow key to reach your desired digit. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered.

K-FACTOR

At a minimum, every FT400-Series flow computer must be programmed with the "K-factor". (This is the number of pulses that the meter produces per gallon of flow.) If you wish the FT400 to read in units other than gallons, see below.

The K-factor on any SeaMetrics flow sensor fitting or in-line meter can be found on the model-serial label. The line reading K = xxxx gives the desired number. For depth-adjustable sensors (101,201,115,215 models), look in the instruction manual under your pipe size. For EX meters, use the calculator on our website.



80-Series
Fixed Depth Meter

Find Your K-Factor Here

READING IN OTHER UNITS

Changing Volume Units. The default K-factor units are pulses per gallon. To read your total in metric or other units instead, the standard K-factor must be converted to the desired volume units. For example, to read in pulses per liter, the K-factor must be multiplied by the applicable number shown below.

NOTE: Both rate & total will read in whatever units you choose.

To Convert K to:	Multiply by:
Liters	.26418
Cubic Meters	264.18
Fluid Ounces	.0078
Cubic Feet	7.48

Changing Time Units: To read your rate in liters per second (for example), convert the K-factor volume units as shown above and change the time units to Seconds, using the Set Time Unit instructions at right.

Set K. Begin by pressing the SET key once. The prompt SET K should appear on the display. The digit to the far right will be blinking. Use the up arrow key to reach your desired value. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered. (Note that the decimal is fixed at three places. If you only have two decimal places for your K-factor, enter a zero for the third digit.) Press SET to advance. (**Note:** If unable to set K-factor, the unit is "locked" to prevent tampering. Please contact your Distributor for assistance.)

Set P/Flow Alarm. At this screen you may select between pulse output (P) or flow alarm (A) functions. If the pulse output and flow alarm features are not being used, this step can be skipped. The P (pulse output) setting does not affect anything if it is not being used.

Set P is the default that appears on a new FT400-Series. On an FT400 that has been previously set up with flow alarm function, an A will appear on this screen. To move between P and A screens, firmly press all three keys for 5-10 seconds, then use the up arrow to scroll through the three options: P, AL HI (high flow alarm) and AL LO (low flow alarm).

Set P. From this screen, follow the same process as for Set K to enter the desired pulse rate. This is the number of gallons (or whatever units are programmed) between pulses. (**Note:** Using the pulse output function disables the high and low flow alarm functions.)

Set Flow Alarm. From the A screen, use the up arrow key to choose either AL HI or AL LO and then press the SET key to set the alarm rate. Use the up arrow and left arrow as above to reach the desired digits. (**Note:** Using the flow alarm function disables the pulse output function.)

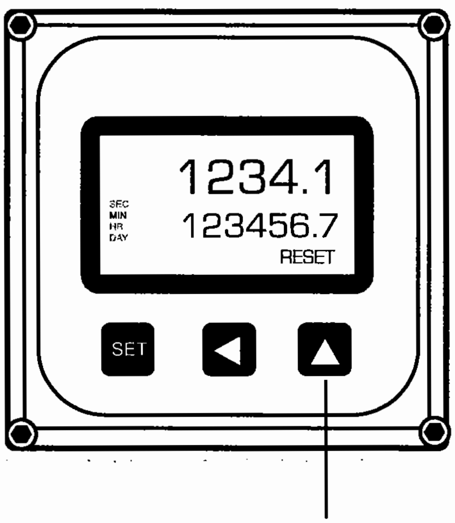
Set 20 mA (FT420 Only). Press the SET key to advance to SET 20, to set the flow rate, in volume units per time unit, at which 20 mA is desired. Use the up arrow key to reach your desired value. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered. The processor will automatically scale the 4-20 mA loop accordingly, with 4 mA at zero flow.

Set Decimal Point. Press the SET key again for the D prompt. Pressing the up arrow key switches among no decimal place, one decimal place and two decimal places.

Set Time Unit. When the SET key is pressed again, a blinking time unit appears. Press the up arrow key to select SEC (seconds), MIN (minutes), HR (hours) or DAY (days) (for example, gal/min, or gal/hr).

To return to normal operation after entering settings, press SET again. When the unit is connected to an operating flow sensor, the rate (larger digits) and total (smaller digits) indicator numbers should appear in the display.

Resettable/Non-Resettable Totalizer. Unless the unit has been ordered with the non-reset option, a RESET prompt is visible in the lower right corner above the up arrow key, when the display is in use. Press the up arrow key at any time to reset the totalizer to zero. (**Note:** If you need to reset a unit that has been ordered with a non-resettable totalizer, contact your distributor.)



This key resets total to zero when in normal run mode.

CAUTION: Do not touch up Arrow button unless you intend to RESET Total to Zero. TOTAL IS NOT RECOVERABLE.

Operation of 4-20 mA Output (FT420 Only). If the 4-20 mA output is in use and is correctly connected, the signal should vary between 4 mA and 20 mA in proportion to the flow, with the top flow rate set by the user (see Settings, page 8). At no time should the signal drop below 4 mA. A reading between 0 and 4 mA indicates a fault of some type, typically in the loop power supply or the connections (see Troubleshooting, back page). In the rare instance that the 4-20 signal fluctuates excessively ("paints") it may need to be damped by additional averaging. Contact Seametrics for information on how to increase filtering.

Operation of the Pulse Output. If the pulse output is being used (either standard electronic or relay-type), it should pulse for 0.1 second every time the set number of gallons has been totalized. If a pulse-responsive metering pump is properly connected to this output, it should stroke periodically. If this does not occur, see Troubleshooting, back page.

FT415 Battery Change. The expected average life of the battery ranges between 3-5 years depending on the frequency of the input. The battery is easily pulled and replaced. When the battery is removed, all of the settings will be retained.

CAUTION: During a battery change, the totalizer will reset to a previous total, which represents the last auto-backup (auto backups occur at approximately 4 minute intervals). If it is necessary to save the exact current total at the time of the battery change, save before removing the battery as follows:

1) Simultaneously press the SET and up arrow keys
2) Press SET again
3) Again simultaneously press the SET and up arrow keys

TROUBLESHOOTING

Problem	Probable Cause	Try...
Display blank	No power to the unit	Check for minimum 12 Vdc at power terminals
	Short in sensor circuit	Disconnect sensor, see if display returns (zero flow rate)
	Battery dead or loose (FT415 only)	Wiggle battery, replace if over three years old
Display missing segments	Damaged display module	Contact distributor for return/replacement
Display reading meaningless characters	Unit's microcontroller crashed	Disconnect and reconnect power, if problem repeats, contact distributor for return/replacement
	Battery nearly dead	Replace battery if over three years old
Display reads normally, flow rate incorrect	Wrong K-factor or time base entered	Enter correct K-factor from meter, fitting, or manual
Display reads normally, incorrect pulse output	Wrong pulse output setting	Use "Set P" to correct pulse output setting
	Polarity reversed on pulse output terminals	Reverse leads
Display reads normally but no (or incorrect) 4-20 mA output (FT420 only)	Wrong 20 mA setting	Use "Set 20" to correct target top flow rate
	Inadequate loop power supply voltage	Check voltage (For 4-20 mA applications, 24 Vdc recommended)
	Polarity incorrect in 4-20 mA loop circuit	Compare to Connections diagram
Display reads zero when there is flow	Flow sensor failed	Consult flow sensor manual for how to test
	Break in flow sensor circuit	Check for continuity with multimeter
	Flow sensor not battery-compatible	Check flow sensor model number for "micropower option"
Display reads flow rate when there is none	Long flow sensor wire, running parallel to power wires	Reroute wire or change to shielded wire
	Flow sensor malfunction	See flow sensor manual to check
	Flow "jitter" (oscillating slosh) reads as flow	Consult factory for "anti-jitter" setting

SeaMetrics

SeaMetrics Incorporated • 19026 72nd Avenue South • Kent, Washington 98032 • USA
(P) 253.872.0284 • (F) 253.872.0285 • 1.800.975.8153 • www.seametrics.com

LT-13314-B
10/9/06

SeaMetrics

IP80 Series Flow Sensor Instructions

General Information

The IP80 Series are impeller-type insertion meters designed for use in pipe sizes 1/2" to 8". High-quality jewel bearings and nickel-bound tungsten carbide shaft are used for maximum life and extreme low friction. Bodies are machined from solid rod for maximum precision. Low-flow performance is superior. The rotation of the rotor is detected by a non-drag Hall-effect sensor. Output is a pulse-type square wave, which can be sent long distances (up to 2,000 feet) without a transmitter. This signal can be connected directly to SeaMetrics controls, as well as PLC's, counters, and computer cards.

SeaMetrics IP meters are ideal for chemical proportioning applications. If no display is required, a simple divider such as the PD10 provides adjustable pump pacing. For rate and total display, as well as pump pacing, the FT415/420 flow indicator can be mounted directly on the IP80 Series, or remotely on a wall or panel.

The IP80 Series require special fittings, since they are not depth-adjustable as are the IP 100/200 series meters. Installation in the fitting ensures correct depth placement in the pipe. Fittings are available in PVC, brass, and stainless steel. Sensors are available in brass, 316 stainless steel, PVC, and polypropylene. In plastic pipe 3"-8", use an IP82 sensor, which is 1.00" longer than the IP81 to accommodate the larger fittings.

Specifications

Sensor		
	Hall Effect Sensor	12 VDC current sinking pulse
Materials		
	Sensor Body	PVC, Polypro, Brass, or 316 SS
	Rotor	Kynar
	Shaft	Nickel-bound tungsten carbide, ceramic optional
	Bearings	Ruby jewel
Maximum Pressure		
	PVC	175 PSI (12 bar) at 75° *
	Polypro	175 PSI (12 bar) at 75° *
	Brass	200 PSI (14 bar)
	316 SS	250 PSI (17 bar)
Maximum Temperature		
	PVC,Polypro	130° F (55° C)*
	Brass, SS	200° F (93° C)
Accuracy		1-1/2% FS

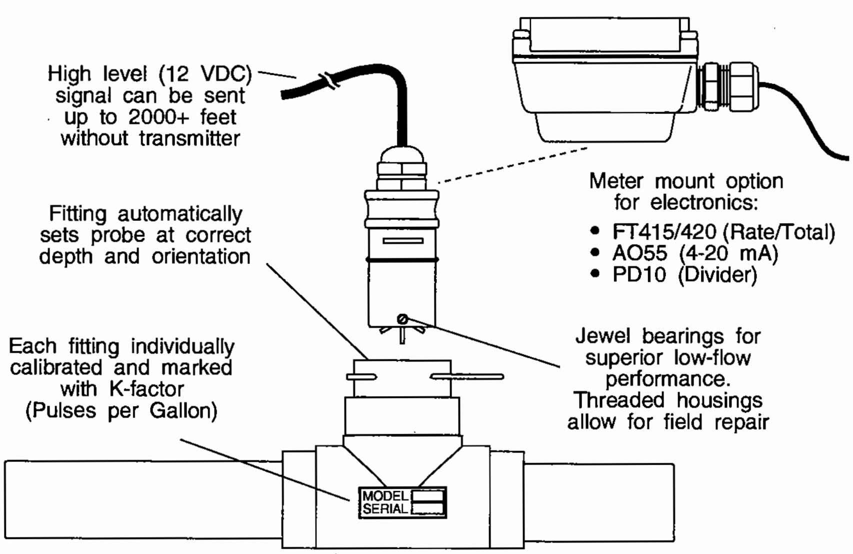
Flow Range (GPM)

	1/2"	3/4"	1"	1-1/2"	2"	3"	4"	6"	8"
Min	0.28	0.5	0.8	1.9	3.1	6.9	12	27	47
Max	28	50	80	190	314	691	1200	2700	4700

Cable #22 AWG 3-con, 18'

* (see Pressure vs. Temperature chart)

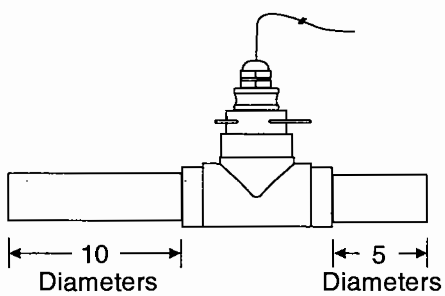
Features



Installation

> These water meters are not recommended for installation downstream of the boiler feedwater pump where installation fault may expose the meter to boiler pressure and temperature. Maximum recommended temperature is 130°F (Plastic), 200°F (Metal).

Fitting Installation. IP80 Series meters require special fittings. The meter fitting must first be installed in the pipeline. Straight pipe of at least ten times the diameter upstream of the meter and five diameters downstream are strongly recommended. Inadequate straight pipe, especially downstream of an elbow, change in pipe diameter, or partially-opened valve, can result in significant inaccuracy. Typically this inaccuracy is in the form of the meter reading high. Some IP80 Series meter fittings are supplied with upstream straight pipe.

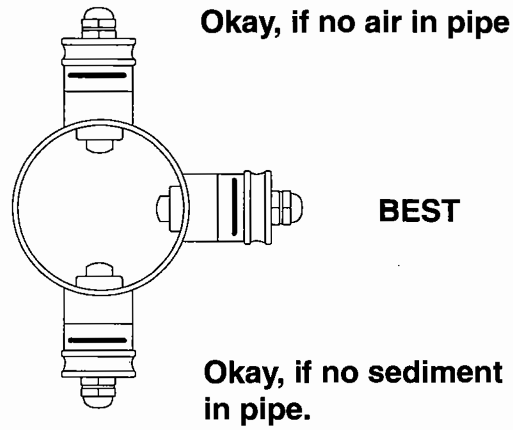


In the larger sizes, the length provided is less than ten diameters upstream and five downstream. It is not advisable to connect directly to the end of these fittings with a flow-disturbing device such as a valve or elbow. If possible, straight pipe should be added to these fittings.

> **Caution: Never remove the u-clip retainer when the pipe is under pressure. Always remove pressure from the pipe before attempting to remove the meter. Removal under pressure may result in damage or serious injury.**

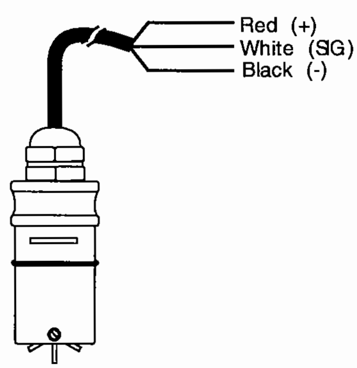
A PVC fitting is usually installed by solvent welding. The stainless steel and brass meter fittings have female pipe threads, requiring the appropriate male threaded fittings. Saddle fittings (size 3" and above) require a hole to be cut in the pipe. The recommended hole size is 1-3/4".

Meter Installation. After the meter fitting is installed in the pipeline, the meter can be installed in the fitting. Press the meter into the fitting as far as it will go. Then retain the meter in place by inserting the u-pin. This pin can be installed from either side. It is sometimes necessary to rotate the probe back and forth slightly to start the pin into the slots on the probe. Slide the pin in as far as it will go.



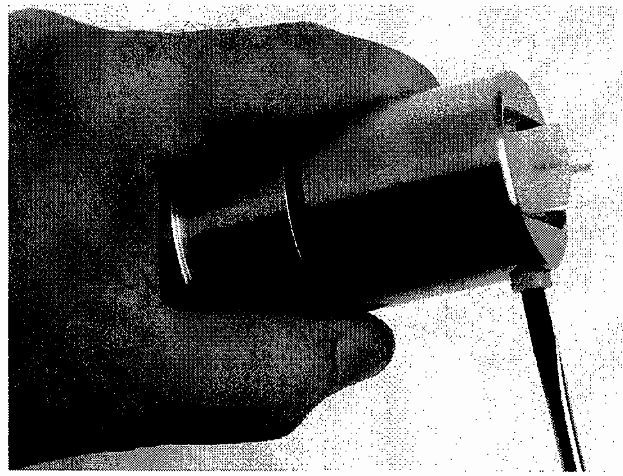
Meter Connection. See the "IP80 Series Connections" diagram for meter connections. Unless the meter is supplied pre-connected to a meter-mounted FT415/420 flow indicator, three leads must be connected. These three leads are color coded. The red wire is 6-24 VDC positive, the black is negative, and the white wire is the signal lead.

IP80 Series Connections



K-factor. If the IP80 Series meter is ordered with its fitting, the meter is factory calibrated in the fitting. A K-factor (meter factor) is indicated on the side of the fitting. This represents the actual number of pulses per gallon the meter produced during the factory flow test. This number can entered into an FT415/420 or FT5210 flow indicator to make it read properly. If a pulse divider is being used, the K-factor is the starting point for calculating the divider number.

Maintenance and Repair



Rotor Replacement. Rotors are easily field-replaced. Shaft and rotor are a single unit, and are not replaced separately. If replacement is due only to normal shaft wear, bearing replacement is probably not necessary. If the rotor has been damaged by impact, the bearings should also be replaced. Rotor and bearings can be ordered as a kit, Part No.25901. Follow these steps:

1. Unscrew the threaded bearing housings to expose the shaft ends. If bearings are being replaced, back them completely out.

2. Remove the rotor. Put the new rotor in its place.

3. Thread in one bearing housing part way, then the other. Take care to start the end of the shaft into the bearing hole before tightening further.

4. Screw in bearing housings until they bottom. **Note: Do not use excessive force.**

5. Check for free spin. Blowing lightly on the rotor should result in it spinning rapidly and coasting to a smooth stop.

Sensor Replacement. It is very unusual for a sensor to require replacement in normal use. The primary cause of sensor failure is overvoltage (inadvertent connection of line voltage, for example) or incorrect polarity on hookup. The sensor is replaced by removing the the strain relief, then threading out the sensor retainer plug. Remove the entire sensor capsule by pulling on the cable. The new sensor capsule can then be installed. It is important to orient the sensor capsule properly. Replace the retainer plug, and then replace and tighten the strain relief.

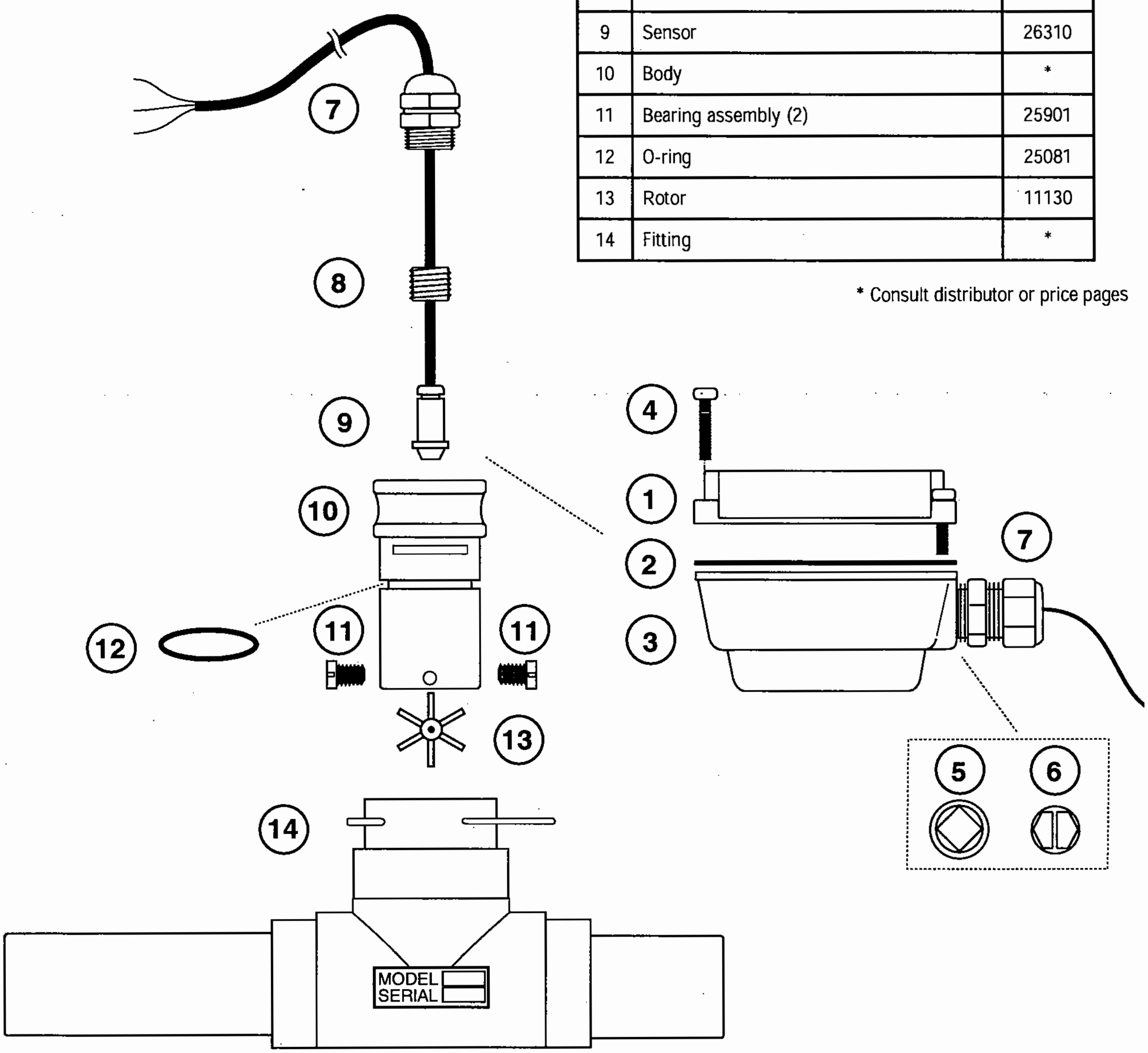
Troubleshooting Guide

Problem	Probable Cause	To Check	To Repair
No signal after installation	Insufficient flow	See Min. GPM for size	Contact SeaMetrics
	Bad connections to control electronics	Check connections at control. Check polarity: red (+), black (-), white (signal)	Re-connect if necessary
	Incompatible control	Does control: 1) provide 6-24VDC power; 2) accept current sinking inputs	Contact SeaMetrics
	Damaged or missing rotor	Remove meter and check visually for free spinning	Obtain new rotor and replace
Inaccurate metering	Not enough straight pipe between meter and flow disturbance	See recommendations, measure	Move meter away from flow disturbance or field calibrate

Fittings Compatibility Chart		
Material	[redacted]	**IP82**
Bronze	1"- 4" Tee	3"- 8" Braze fitting
PVC	1/2"- 2" Tee	3"- 8" Saddle
Polypro	N/A	3"- 8" Tee
Stainless steel	1/2"- 2" Tee	3"- 8" Weld fitting
Carbon steel	1/2"- 2" Tee	3"- 8" Weld fitting

IP80 Series Parts Listing		
1	Upper housing	26181
2	Gasket	26211
3	Lower housing	29930
4	Housing screw	26229
5	Plug, steel	26073
6	Plug, plastic	26079
7	Strain Relief	7655
8	Sensor Retainer	25321
9	Sensor	26310
10	Body	*
11	Bearing assembly (2)	25901
12	O-ring	25081
13	Rotor	11130
14	Fitting	*

* Consult distributor or price pages



SeaMetrics
20419 80th Ave. So., Kent, WA 98032 USA
Phone: 253-872-0284 Fax: 253-872-0285
www.seametrics.com 1-800-975-8153

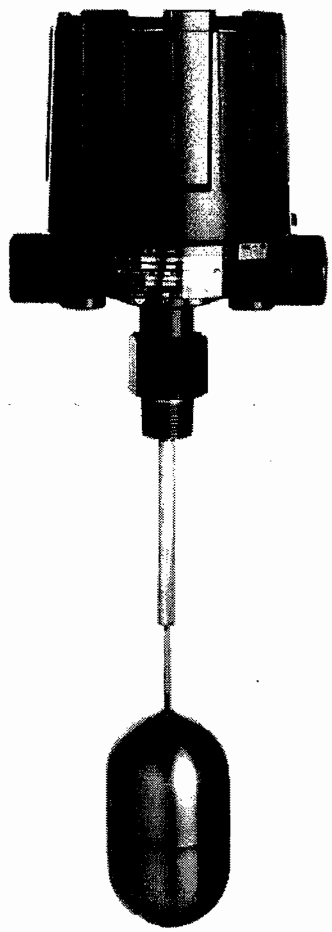
Appendix H

Product Information

Magnetrol Liquid Level Switch model C10 and T20

Top Mounting

Installation and Operating Manual



Liquid

Level

Switches

Models [redacted] & T21

Magnetrol®

STI

Read this Manual Before Installing

This manual provides information on the Top Mounting Liquid Level Switch. It is important that all instructions are read carefully and followed in sequence. Detailed instructions are included in the Installation section of this manual.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

NOTES

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNINGS

Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

Safety Messages

Follow all standard industry procedures for servicing electrical equipment when working with or around high voltage. Always shut off the power supply before touching any components.

WARNING! Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Low Voltage Directive

For use in Category II installations. If equipment is used in a manner not specified by manufacturer, protection provided by equipment may be impaired.

Notice of Trademark, Copyright, and Limitations

Magnetrol and Magnetrol logotype and STI and STI logotype are registered trademarks of Magnetrol International.

Performance specifications are effective with date of issue and are subject to change without notice. Magnetrol reserves the right to make changes to the product described in this manual at any time without notice. Magnetrol makes no warranty with respect to the accuracy of the information in this manual.

Warranty

All Magnetrol/STI mechanical level and flow controls are warranted free of defects in materials or workmanship for five full years from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Magnetrol/STI will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

Magnetrol/STI shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some Magnetrol/STI products.

Quality Assurance

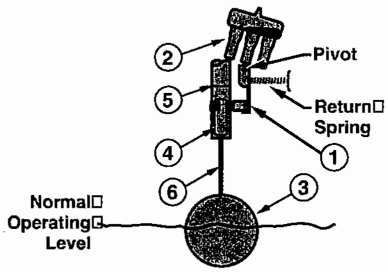
The quality assurance system in place at Magnetrol/STI guarantees the highest level of quality throughout the company. Magnetrol/STI is committed to providing full customer satisfaction both in quality products and quality service.

Magnetrol's quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

Top Mounting Liquid Level Switches

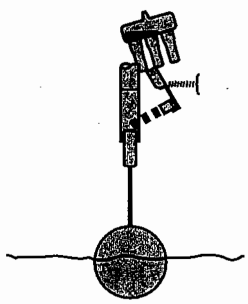
1.0 Introduction

[redacted] and T21 level switches are float operated units designed for top mounting to a tank or vessel by means of threaded or flanged pipe connections. T20 standard units are equipped with a single switch mechanism for high or low level alarm or control applications. T21 tandem units are equipped with two switch mechanisms, each operated by a separate float, for applications requiring widely spaced separate high and low level switch actuation.



Rising Level

Figure 1



Falling Level

Figure 2

1.1 Principle of Operation

The simple and foolproof operation of the top mounted float switches is illustrated in figures 1 and 2.

A magnetic attraction sleeve ④ is fixed at the top of a rigid float stem ⑥. As the float and stem assembly ③ ⑥ move s with the level of the liquid, the attraction sleeve is moved into or out of the field of the switch magnet ①. The presence or the absence of the attraction sleeve causes the switch magnet and attached switch ② to move and change state. A non-magnetic barrier tube ⑤ isolates the process media from the switch without interfering with the field of the switch magnet and provides a static pressure boundary to the process.

[illegible]

This section provides detailed procedures for properly installing top mounted level switches.

Caution: If equipment is used in a manner not specified by the manufacturer, protection provided by the equipment may be impaired.

2.1 Unpacking

Unpack the instrument carefully. Inspect all units for damage. Report any concealed damage to carrier within 24 hours. Check the contents of the packing slip against purchase order. Check and record the model number against serial number for future reference when ordering parts.

Model Number: ______________________

Serial Number: ______________________

It is recommended that for critical alarm functions, an additional level switch be installed as a high–high or low–low level alarm for maximum protection.

Caution: Operation of all buoyancy type level devices should be done in such a way as to minimize the action of dynamic forces on the float or displacer sensing element. Good practice for reducing the likelihood of damage to the control is to equalize pressure across the device very slowly.

Ensure that no tubes, rods, or other obstacles in the tank or vessel which could interfere with the operation of float(s).

Caution: This instrument is intended for use in Installation Category II, Pollution Degree 2.

Adjust the process connection as required to bring control to a vertical position. Magnetrol controls must be mounted within three degrees (3°) of vertical in all directions. A three degree slant is noticeable by eye, but installation should be checked with a spirit level on top and/or sides of float stem or enclosing tube.

NOTE: Do not insulate switch mechanism housing.

On controls equipped with pneumatic switch assemblies, consult bulletin on mechanism furnished for air (or gas) piping instructions.

Switch Series Letter	Description	Bulletin No.
A	Standard Mercury Switch	42-683
B, C, D	Dry Contact Switch	
E	Vibration Resistant Mercury Switch	
F	Hermetically Sealed Snap Switch	
HS	Hermetically Sealed Snap Switch	42-694
J	Bleed Type Pneumatic Switch	42-685
K	Non-Bleed Type Pneumatic Switch	42-686

[illegible]

Caution: All Top Mounting units are shipped from the factory with the enclosing tube tightened and the switch housing set screw locked to the enclosing tube. Failure to loosen the set screw prior to repositioning the supply and output connections may cause the enclosing tube to loosen, resulting in possible leakage of the process liquid or vapor.

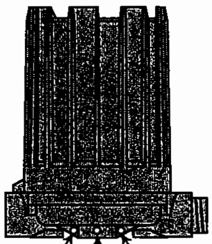


Figure 3
Housing Set Screws

Top mounting controls are shipped with the conduit entry of the switch housing placed 180° opposite the tank connections to simplify installation in most cases. If the location of the conduit entry on the level switch is appropriate to the installation, proceed to Step 4 to begin wiring the unit. If another configuration is desired, the switch housing can be easily rotated by first following Steps 1, 2, and 3.

NOTE: A switch or circuit breaker shall be installed in close proximity to equipment and within easy reach of operator. It shall be marked as the disconnecting device for the equipment.

1. Loosen set screw(s) at base of switch housing. Refer to Figure 3.
2. Switch housing may be rotated 360° to allow correct positioning of conduit outlet.
3. Tighten set screw(s) at base of switch housing.
4. Unscrew and remove switch housing cover. The threads have been lubricated to facilitate removal.

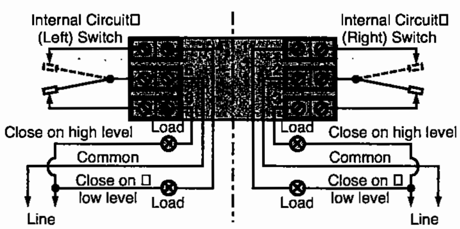


Figure 4
Terminal Connections
DPDT Switch Mechanism
Series A, B, C, D, and E

NOTE: For supply connections use wire with a minimum rating of 75° C, as required by process conditions. Use a minimum of 14 AWG wire for power and ground field wires. On high temperature applications (above 250° F [121° C] at mounting flange or bushing), high temperature wire should be used between control and first junction box located in a cooler area. On non-hazardous applications, flexible conduit may be used between the control and the first junction box.

5. The switch terminals are located next to the conduit outlet to facilitate wiring. Bring supply wires through conduit outlet. Route extra wire around enclosing tube under the baffle plate, and connect them to the proper terminals. Refer to the wiring diagram, Figure 4, or your switch bulletin for this information.

6. Dress wiring to ensure no interference or contact with tilt of switch, or replacement of switch housing cover.

NOTE: Observe all applicable electrical codes and proper wiring procedures.

Prevent moisture seepage into the enclosure by installing approved seal-drain fittings in the conduit run leading into the unit.

Caution: In hazardous areas, do not power the unit until the conduit is sealed and the enclosure cover is screwed down securely.

7. Replace housing cover.
8. If control has been furnished with an explosion proof or moisture proof switch housing, it must be sealed at the conduit outlet with a suitable compound or non-hardening sealant to prevent entrance of air.
9. Test switch action by varying liquid level in the tank or vessel. The upper switch on Model T21 units is actuated by movement of the lower float, while the lower switch is actuated by the upper float.

NOTE: If switch mechanism fails to function properly, check vertical alignment of control housing and consult installation bulletin on switch mechanism furnished.

10. Check cover to base fit to be certain gasketed joint is tight. A positive seal is necessary to prevent infiltration of moisture laden air or corrosive gasses into switch housing.

The standard differential of the single float Model T20 may be field adjusted. Adjustment may be necessary if a wider differential needs to be set to overcome switch chatter caused by the process.

The differential, or the amount of level travel between switch-on and switch-off, may be adjusted by repositioning the lower jam nuts on the float stem. The standard factory setting is for a minimum amount of play (gap) between the top jam nuts and the attraction sleeve as shown in Figure 6.

NOTE: For assistance in computing level differential change for a specific control, consult the factory giving the model and serial numbers of the control.

Caution: Maximum differential adjustment is 0.50 inch.

NOTE: To widen the differential 0.50 inch, the lower jam nuts must be set proportionately lower on the stem (i.e. in this example 0.50 inch).

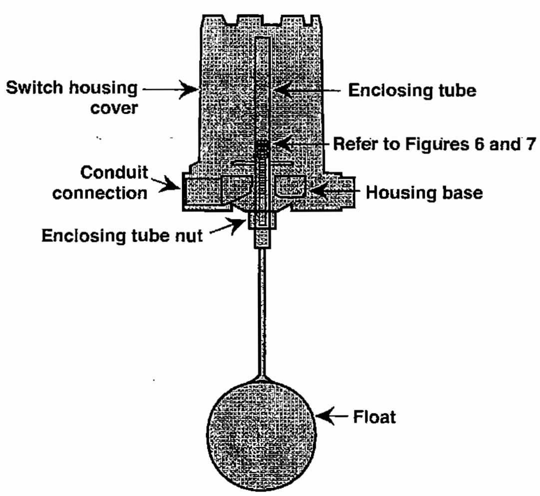


Figure 5

Caution: Before attempting any work on the control, pull disconnect switch, or otherwise assure that electrical circuit(s) through the control is deactivated. Close operating medium supply valve on controls equipped with pneumatic switch mechanisms.

1. Determine what change in differential is necessary.
2. Make sure power source is turned off.
3. Unscrew and remove switch housing cover.
4. Disconnect power supply wires from switch mechanism. Pull wires out of conduit connection opening in housing base. Refer to Figure 5.
5. Perform system shut-down procedures as required to relieve pressure from tank or vessel and drain off liquid head, if required. Allow unit to cool.

NOTE: The amount of level travel between switch-on and switch-off actuation (differential) may be field adjusted by repositioning the lower jam nuts on the float stem. The standard factory setting is for a minimum amount of play (gap) between the top jam nuts and the attraction sleeve, as shown in Figure 6. This setting may be increased to a maximum of 0.50" (13 mm), as shown in Figure 7.

6. Remove switch housing assembly by loosening the enclosing tube nut, which is located immediately below housing base. Refer to Figure 5.

7. With switch housing and enclosing tube removed, jam nuts and attraction sleeve are accessible. Measure position of upper jam nuts from stem end; then loosen and remove upper jam nuts, guide washer, and attraction sleeve.
8. Loosen and adjust lower jam nuts to desired position. Make certain jam nuts are retightened securely.

NOTE: Use new enclosing tube gasket in assembly of switch housing to the mounting bushing or flange. Refer to **Sections 5.4.1.1** and **5.4.2.1** for enclosing tube gasket part numbers.

9. Test switch actuation by varying liquid level in tank or vessel.

Caution: Instructions given are for standard base model units which use a single magnet switch mechanism only. No differential adjustment should be attempted on tandem float models in the field. Switch actuation levels have been set at the factory to meet specific customer specifications. Variations in actual conditions from design conditions usually requires special control modifications. Consult with the factory or local representative for assistance.

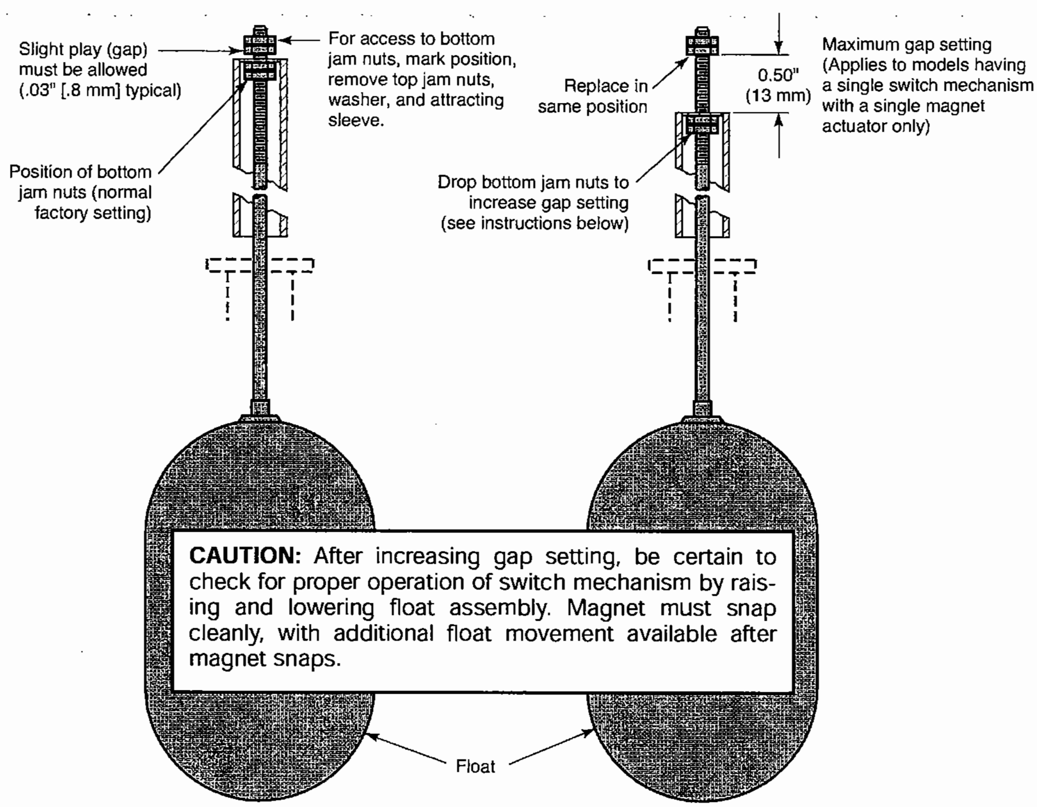


Figure 6
Normal Factory Setting (minimum differential)

Figure 7
Differential adjustment

4.0 Preventive Maintenance

Periodic inspections are a necessary means to keep your level control in good working order. This control is a safety device to protect the valuable equipment it serves. Therefore, a systematic program of "preventive maintenance" must be implemented when the control is placed into service. If the following sections on "what to do" and "what to avoid" are observed, your control will provide reliable protection of your equipment for many years.

4.1 What to do

4.1.1 Keep control clean

Be sure the switch housing cover is always in place on the control. This cover is designed to keep dust and dirt from interfering with switch mechanism operation. In addition, it protects against damaging moisture and acts as a safety feature by keeping bare wires and terminals from being exposed. Should the housing cover or any seals become damaged or misplaced, obtain a replacement immediately.

4.1.2 Inspect switch mechanisms, terminals, and connections monthly

1. Mercury switches may be visually inspected for short circuit damage. Check for small cracks in the glass tube containing the mercury. Such cracks can allow entrance of air into the tube causing the mercury to "oxidize". This is noticeable as the mercury will appear dirty or dull, and will not break into clean, round pools. If these conditions exist, replace the mercury switch immediately.
2. Dry contact switches should be inspected for excessive wear on actuating lever or misalignment of adjustment screw at point of contact between screw and lever. Such wear can cause false switch actuating levels. See switch mechanism bulletin supplied with control should switch adjustment or replacement be necessary.
3. DO NOT operate your control with defective or maladjusted switch mechanisms (refer to bulletin on switch mechanisms furnished for service instructions.)

4. Level controls may sometimes be exposed to excessive heat or moisture. Under such conditions, insulation on electrical wiring may become brittle, eventually breaking or pealing away. The resulting "bare" wires can cause short circuits.

NOTE: Check wiring carefully and replace at the first sign of brittle insulation.

5. Vibration may sometimes cause terminal screws to work loose. Check all terminal connections to be certain that screws are tight.
6. On units with pneumatic switches, air (or gas) lines subjected to vibration, may eventually crack or become loose at connections causing leakage. Check lines and connections carefully and repair or replace, if necessary.

NOTE: As a matter of good practice, spare switches should be kept on hand at all times.

4.1.3 Inspect entire unit periodically

Isolate control from vessel. Raise and lower liquid level to check for switch contact and reset.

[illegible]

1. Never leave switch housing cover off the control longer than necessary to make routine inspections.
2. Never place a jumper wire across terminals to "cut-out" the control. If a "jumper" is necessary for test purposes, be certain it is removed before placing control into service.
3. Never attempt to make adjustments or replace switches without reading instructions carefully. Certain adjustments provided for in level controls should not be attempted in the field. When in doubt, consult the factory or your local representative.
4. Never use lubricants on pivots of switch mechanisms. A sufficient amount of lubricant has been applied at the factory to ensure a lifetime of service. Further oiling is unnecessary and will only tend to attract dust and dirt which can interfere with mechanism operation.

5.0 Reference Information

5.1 Troubleshooting

Usually the first indication of improper operation is failure of the controlled equipment to function, i.e.: pump will not start (or stop), signal lamps fail to light, etc. When these symptoms occur, whether at time of installation or during routine service thereafter, check the following potential external causes first.

a. Fuses may be blown.

b. Reset button(s) may need resetting.

c. Power switch may be open.

d. Controlled equipment may be faulty.

e. Wiring leading to control may be defective.

If a thorough inspection of these possible conditions fails to locate the trouble, proceed next to a check of the control's switch mechanism.

5.1.1 Check switch mechanism

1. Pull disconnect switch or otherwise disconnect power to the control.
2. Remove switch housing cover.
3. Disconnect power wiring from switch assembly.
4. Swing magnet assembly in and out by hand to check carefully for any sign of binding. Assembly should require minimal force to move it through its full swing.
5. If binding exists, magnet may be rubbing enclosing tube. If magnet is rubbing, loosen magnet clamp screw and shift magnet position. Retighten magnet clamp screw.
6. If switch magnet assembly swings freely and mechanism still fails to actuate, check installation of control to be certain it is within the specified three (3°) degrees of vertical. (Use spirit level on side of enclosing tube in two places, 90° apart.

7. If mechanism is equipped with a mercury switch, examine glass mercury tube closely as previously described in **Section 4.0 Preventive Maintenance**. If switch is damaged, replace it immediately. If microswitch, check continuity with ohmmeter.
8. If switch mechanism is operating satisfactorily, proceed to check sensing unit.

5.1.2 Check complete unit

1. Reconnect power supply and carefully actuate switch mechanism manually (using a non-conductive tool) to determine whether controlled equipment will operate.

Caution: With electrical power on, care should be taken to avoid contact with switch leads and connections at terminal block.

2. If controlled equipment responds to manual actuation test, trouble may be located in the level sensing portion of the control–float(s), stem(s), and magnetic attraction sleeve(s).

NOTE: Ensure that liquid is entering the storage tank or vessel. A valve may be closed or a pipe line plugged.

Caution: Be certain to pull disconnect switch or otherwise ensure that electrical circuit(s) through control is deactivated. Close operating medium supply valve on controls equipped with pneumatic switch mechanisms.

3. With liquid in tank or vessel, raise the liquid level above the set points. Magnets should "pull-in" on rising level. On Model T21 the lower float actuates the upper switch, and the upper float actuates the lower switch. If magnets fail to "pull-in", lower the level and purge pressure.
   a. Disconnect wiring from supply side of switch mechanism(s) and remove electrical conduit or operating medium line connections to switch housing.
   b. Remove switch housing assembly by loosening hex nut, which is located immediately below housing base.
4. With switch housing assembly removed, inspect attraction sleeve(s) and inside of enclosing tube for excessive corrosion or solids buildup, which could restrict movement, preventing sleeve(s) from reaching field of switch magnet(s).
5. If differential has been changed in the field by repositioning the lower jam nuts on the float stem, check tightness and position of the jam nuts. Refer to Figure 6.

NOTE: Differential adjustment affects a change in the amount of level travel between switch-on and switch-off actuation. Do not attempt adjustment without first consulting factory for assistance in computing level differential change for your control.

6. Check float to be certain it is buoyant in the liquid (tank or vessel must have adequate liquid level). If float is determined to be filled with liquid, or it is collapsed, it must be replaced immediately. Do not attempt to repair a float.

   If all components in the control are in operating condition, the trouble must be (and should be) located external to the control. Repeat inspection of external conditions previously described.

   When communicating about your control, be certain to always specify the complete Model and Serial numbers.

5.5 Agency Approvals

AGENCY	MODEL APPROVED	APPROVAL CLASSES
FM APPROVED	All with an electric switch mechanism and a housing listed as NEMA 4X/7/9	Class I, Div 1, Groups C & D Class II, Div 1, Groups E, F & G
	All with an electric switch mechanism and a housing listed as NEMA 4X/7/9 Class I, Div 1, Group B	Class I, Div 1, Groups B, C & D Class II, Div 1, Groups E, F & G
CSA	All with a Series A, E, F, HS or H1 electric switch mechanism and a housing listed as CSA TYPE 4X	Class I, Div 2, Groups B, C & D
	All with an electric switch mechanism and a housing listed as NEMA 4X/7/9	Class I, Div 1, Groups C & D Class II, Div 1, Groups E, F & G
	All with an electric switch mechanism and a housing listed as NEMA 4X/7/9 Class I, Div 1, Group B	Class I, Div 1, Groups B, C & D Class II, Div 1, Groups E, F & G
ATEX / IEC Ex ②	All with an electric switch mechanism and an ATEX housing①	ATEX II 2 G EEx d IIC T6 IEC Ex Ex d IIC T6
CE	Low Voltage Directives 73/23/EEC & 93/68/EEC Per Harmonized Standard: EN 61010-1/1993 & Amendment No. 1	Installation Category II Pollution Degree 2

① Dual stage units with 'HS' switches are not ATEX approved.

② IEC Installation Instructions:

The cable entry and closing devices shall be Ex d certified suitable for the conditions of use and correctly installed.

For ambient temperatures above +55° C or for process temperatures above +150° C, suitable heat resistant cables shall be used.

Heat extensions (between process connection and housing) shall never be insulated.

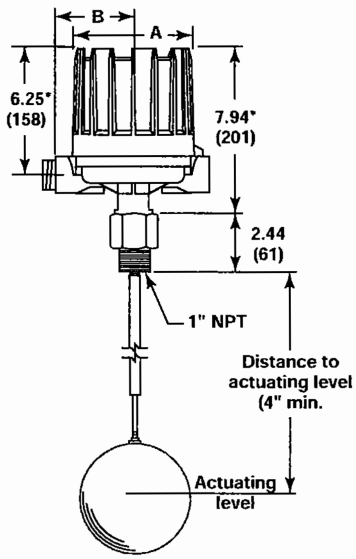
Special conditions for safe use:

When the equipment is installed in process temperatures higher than +85° C the temperature classification must be reduced according to the following table as per IEC60079-0.

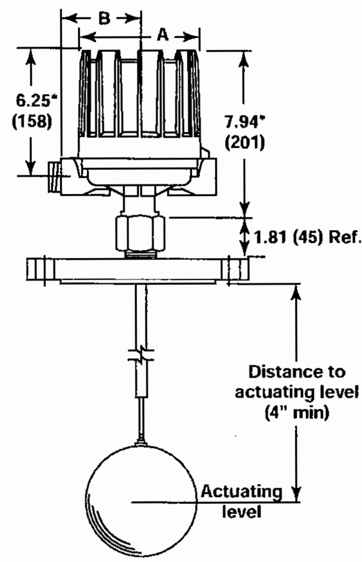
Maximum Process Temperature	Temperature Classification
< 85° C	T6
< 100° C	T5
< 135° C	T4
< 200° C	T3
< 300° C	T2
< 450° C	T1

These units are in comformity with IECEx KEM 05.0020X
Classification Ex d IIC T6
$T_{ambient}$ -40° C to +70° C

5.3.1 Physical inches (mm)

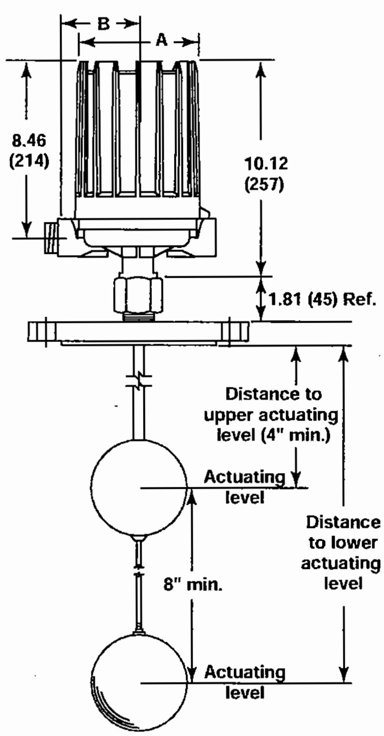


Model T20 with 1" NPT



Model T20 with flange

* These dimensions increase by 2.19 (55) when unit is supplied with an HS switch with terminal block.



Model T21 with flange

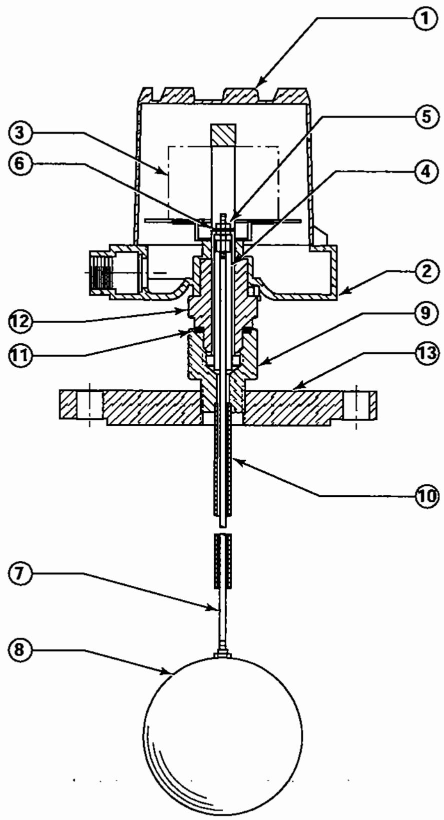
Housing ①	A	B	Conduit Connections
NEMA 4X/7/9, Group B	5.93 (151)	3.87 (98)	1" NPT dual entry
NEMA 1 ② Pneumatics	4.70 (119)	5.00 (127)	¼" NPT single entry

① All housings rotatable 360°.
② Pneumatic switches available with Series T20 units only.

Distance To	Maximum	Minimum
Upper level	40" (1016)	4" (102)
Lower level	48" (1219)	12" (305)

NOTE: On Model T21 the lower float actuates upper switch mechanism. The upper float actuates the lower switch mechanism.

5.4 Replacement Parts



5.4.1 Model T20 Parts Identification

Item	Description
1	Housing cover
2	Housing base
3	Switch mechanism
4	Attraction sleeve
5	Jam nuts
6	Guide washer(s)
7	Float stem
8	Float
9	Adaptor bushing
10	Stem guide tube
11	Enclosing tube gasket
12	Enclosing tube
13	Mounting flange

5.4.1.1 Model T20

	T20-1	T20-4
Housing cover	See below	
Housing base	See below	
Switch mechanism	See below	
Stem kit, includes items 4, 5, 6 & 7	Consult factory	
Float: 3" x 5"	Z07-1202-003	
4.00"	Z07-1102-008	
4.50"	Z07-1102-009	
Adaptor bushing	004-5734-110	004-5734-123
Float stem	Consult factory	
Stem guide tube	Consult factory	
Enclosing tube gasket	012-1301-002	
Enclosing tube	Z32-6325-001	Z32-6326-002
Mounting flange	See below	

5.4.1.2 Mounting flanges

	125 lb cast iron	150 lb forged steel	300 lb forged steel	150 lb forged 304	150 lb forged 316
4" flange	Z04-5840-001	Z04-5840-011	Z04-5840-016	004-5840-021	004-5840-026
5" flange	Z04-5840-002	Z04-5840-012	Z04-5840-017	004-5840-022	004-5840-027
6" flange	Z04-5840-003	Z04-5840-013	Z04-5840-018	004-5840-023	004-5840-028
8" flange	Z04-5840-004	Z04-5840-014	Z04-5840-019	004-5840-024	004-5840-029

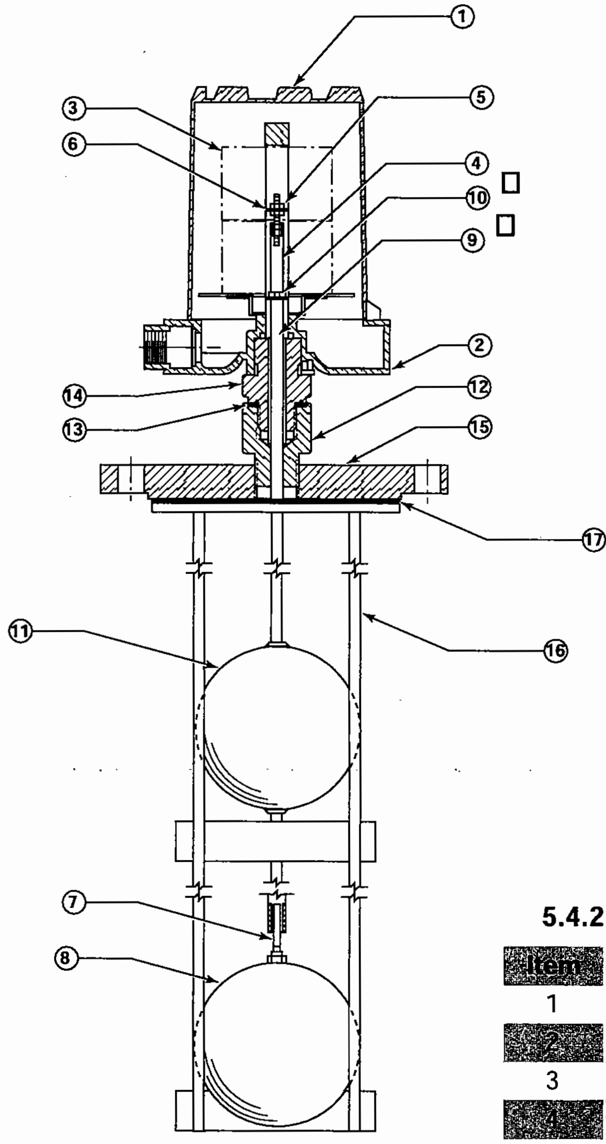
5.4.1.3 Switch and housing reference

	Series Type	Bulletin #
Mercury	A, 3	42-683
Anti-vibration mercury	E, 2	42-683
Dry contact	B, C, D	42-683
Hermetically sealed	F	42-683
Hermetically sealed	HS	42-694
Bleed type pneumatic	J	42-685
Non-bleed type pneumatic	K	42-486

Important: When ordering spare parts, please specify:
A. Model and serial numbers.
B. Name and part number of replacement part or assembly.

All replacement parts are for standard models only. Consult your local representative for ordering assistance on all specially modified models (model numbers preceded by an X).

5.4 Replacement Parts



5.4.2 Model T21 Parts Identification

Item	Description
1	Housing cover
2	Housing base
3	Switch mechanism
4	Upper attraction sleeve
5	Jam nuts
6	Guide washer(s)
7	Upper stem assembly
8	Lower float
9	Lower attraction sleeve, stop tube, and washers
10	Retaining nuts
11	Upper float and tube assembly
12	Adaptor bushing
13	Enclosing tube gasket
14	Enclosing tube
15	Mounting flange
16	Float guide cage (optional)
17	Float guide cage gasket (optional)

5.4.2.1 Model T21

	T21-1	T21-4
Housing cover	See below	
Housing base	See below	
Switch mechanism	See below	
Float stem kit includes items 4, 5, 6, & 7	Consult factory	
Lower float: 3" x 5"	Z07-1201-003	Z07-1202-003
4.00"	Z07-1101-015	Z07-1102-008
4.50"	Z07-1102-009	
Upper float and tube assembly kit includes items 9, 10, & 11	Consult factory	
Adaptor bushing	Z04-5734-110	004-5734-123
Enclosing tube gasket	012-1301-002	
Enclosing tube	Z32-6325-004	Z32-6325-005
Guide cage kits includes items 17 & 18	Consult factory	
Mounting flange	See below	

5.4.2.2 Mounting flanges

	125 lb cast iron	150 lb forged steel	300 lb forged steel	150 lb forged 304	150 lb forged 316
4" flange	Z04-5840-001	Z04-5840-011	Z04-5840-016	004-5840-021	004-5840-026
5" flange	Z04-5840-002	Z04-5840-012	Z04-5840-017	004-5840-022	004-5840-027
6" flange	Z04-5840-003	Z04-5840-013	Z04-5840-018	004-5840-023	004-5840-028
8" flange	Z04-5840-004	Z04-5840-014	Z04-5840-019	004-5840-024	004-5840-029

5.4.2.3 Switch and housing reference

	Series type	Bulletin#
Mercury	A, 3	42-683
Anti-vibration mercury	E, 2	42-683
Dry contact	B, C, D	42-683
Hermetically sealed	F	42-683
Hermetically sealed	HS	42-694
Bleed type pneumatic	J	42-685
Non-bleed type pneumatic	K	42-486

Important: When ordering spare parts, please specify:
A. Model and serial numbers.
B. Name and part number of replacement part or assembly.

All replacement parts are for standard models only. Consult your local representative for ordering assistance on all specially modified models (model numbers preceded by an X).

5.5 Model Numbers

5.5.1 Model T20

IMPORTANT: Actuating level(s), in either the rising or falling state, and specific gravity must be provided upon placement of order.

MODEL NUMBER CODE AND MATERIALS OF CONSTRUCTION

Model No.	Set Points	Tank Connection	Float and Trim	Sleeve
T20-1	1—Single float	Carbon steel	300 Series SS	400 Series SS
T20-4		316 SS	316 SS	316 SS

IMPORTANT: The maximum available insertion depth is governed by the liquid specific gravity and selected float size as given in the table below. The minimum insertion depth is four inches.

MAXIMUM INSERTION LENGTH inches (mm)

Liquid Specific Gravity	Float Size		
	3.00 x 5.00 (76 x 127)	**4.00 (102)**	**4.50 (114)**
1.00	39 (991)	48 (1219)	48 (1219)
0.90	20 (508)	33 (838)	48 (1219)
0.80	—	11 (279)	48 (1219)
0.70	—	—	38 (965)
0.60	—	—	6 (152)

FLOAT PRESSURE RATINGS

Float Size	Pressure Rating psig (bar)	
	@ 100° F (38° C)	**@ Maximum Temperature**
3.00 x 5.00 (76 x 127)	500 psig (34 bar)	300 psig @ +750° F (21 bar @ +399° C)
4.00 (102) Diameter	600 psig (41 bar)	400 psig @ +750° F (28 bar @ +399° C)
4.50 (114) Diameter	500 psig (34 bar)	340 psig @ +750° F (23 bar @ +399° C)

TANK CONNECTION AND FLOAT SIZE

Tank Connection ①	Float Diameter		
	3.00 x 5.00 (76 x 127)	**4.00 (102)**	**4.50 (114)**
1" NPT	B2A	B2B	B2C
4" 125 lb. C.I. flange ② ③	H2A	—	—
4" 150 lb. F.S. flange	H3A	—	—
5" 125 lb. C.I. flange ② ③	J2A	J2B	J2C
5" 150 lb. F.S. flange	J3A	J3B	J3C
6" 125 lb. C.I. flange ② ③	K2A	K2B	K2C
6" 150 lb. F.S. flange	K3A	K3B	K3C
6" 300 lb. F.S. flange	—	—	K4C
8" 125 lb. C.I. flange ② ③	L2A	L2B	L2C
8" 150 lb. F.S. flange	L3A	L3B	L3C

5.5.1 Model T20 (continued)

ELECTRIC SWITCH MECHANISM AND ENCLOSURE

			T20-1 Models		T20-4 Models	
			NEMA 4X/7/9 Aluminum Enclosure ⑤⑥			
Switch Description	Maximum Process ④ Temperature ° F (° C)	One Set Point	Class I, Div. 1, Groups C & D	Class I, Div. 1, Group B	Class I, Div. 1, Groups C & D	Class I, Div. 1, Group B
Series A Mercury	550 (288)	SPDT DPDT	AKP ANP	AKT ANT	AKQ ANQ	AKS ANS
Series 3 Mercury with Beaded Leads	750 (399)	SPDT DPDT	3KP 3NP	3KT 3NT	3KQ 3NQ	3KS 3NS
Series B Snap	250 (121)	SPDT DPDT	BKP BNP	BKT BNT	BKQ BNQ	BKS BNS
Series C Snap	450 (232)	SPDT DPDT	CKP CNP	CKT CNT	CKQ CNQ	CKS CNS
Series D Snap for DC Current	250 (121)	SPDT DPDT	DKQ DNQ	DKS DNS	DKQ DNQ	DKS DNS
Series E Mercury Vibration Resistant	550 (288)	SPDT DPDT	EKP ENP	EKT ENT	EKQ ENQ	EKS ENS
Series 2 Mercury Vibration Resistant	750 (399)	SPDT DPDT	2KP 2NP	2KT 2NT	2KQ 2NQ	2KS 2NS
Series HS Snap Hermetically Sealed w/Wiring Leads	550 ⑦ (288)	SPDT DPDT	HMC HMF	HEK ⑧ HET ⑧	HMC HMF	HEK ⑧ HET ⑧
Series HS Snap Hermetically Sealed w/Term. Block	550 ⑦ (288)	SPDT DPDT	HM3 HM7	HM4 HM8	HM3 HM7	HM4 HM8

PNEUMATIC SWITCH MECHANISM AND ENCLOSURE

Switch Description	Maximum Supply Pressure	Maximum Process Temperature	Bleed Orifice Diameter	NEMA 1
Series J Bleed Type	100 psig (7 bar)	400° F (204° C)	.063 (1.6 mm)	JDE
	60 psig (4 bar)		.094 (2.4 mm)	JEE
	100 psig (7 bar)	700° F (371° C)	.055 (1.4 mm)	JFE
Series K Non-Bleed	100 psig (4 bar)	400° F (204° C)	—	KOE
	40 psig (3 bar)		—	KOG

① Flanges are ANSI standard. Forged steel flanges have standard raised face.

② Not available with Model T20-4.

③ Available only in cast iron.

④ Process temperature based on +100° F (+38° C) ambient.

⑤ Uncontrolled housing heater or drain available in NEMA 4X/7/9 enclosure.

⑥ Consult factory for NEMA 4X/7/9 cast iron housings.

⑦ On steam applications, temperature down-rated to +400° F (+204° C) process at +100° F (+38° C) ambient.

⑧ CSA approval does not apply to Series HE switches.

5.5.2 Model T21

IMPORTANT: Actuating level(s), in either the rising or falling state, and specific gravity must be provided upon placement of order.

MODEL NUMBER CODE AND MATERIALS OF CONSTRUCTION

Model No.	Set Points	Tank Connection	Float and Trim	Sleeve
T21-1	2—Tandem float	Carbon steel	300 Series SS	400 Series SS
T21-4		316 SS	316 SS	316 SS

IMPORTANT: The maximum available insertion depth is governed by the liquid specific gravity and selected float size as given in the table below. The minimum insertion depth is four inches. The minimum distance between the top and bottom insertion depths is eight inches.

MAXIMUM INSERTION LENGTH inches (mm)

Liquid Specific Gravity	Float Size					
	3.00 x 5.00 (76 x 127)		4.00 (102)		4.50 (114)	
	Upper	Lower	Upper	Lower	Upper	Lower
1.00	21 (533)	48 (1219)	32 (813)	48 (1219)	40 (1016)	48 (1219)
0.90	9 (229)	30 (762)	18 (457)	44 (1118)	40 (1016)	48 (1219)
0.80	—	—	4 (102)	21 (533)	40 (1016)	48 (1219)
0.70	—	—	—	—	21 (533)	48 (1219)

FLOAT PRESSURE RATINGS

Float Size	Pressure Rating psig (bar)	
	@ 100° F (38° C)	@ Maximum Temperature
3.00 x 5.00 (76 x 127)	500 psig (34 bar)	300 psig @ +750° F (21 bar @ +399° C)
4.00 (102) Diameter	600 psig (41 bar)	400 psig @ +750° F (28 bar @ +399° C)
4.50 (114) Diameter	500 psig (34 bar)	340 psig @ +750° F (23 bbar @ +399° C)

TANK CONNECTION AND FLOAT SIZE

Tank Connection ①	Float Diameter		
	3.00 x 5.00 (76 x 127)	4.00 (102)	4.50 (114)
4" 125 lb. C.I. flange ② ③	H2A	—	—
4" 150 lb. F.S. flange	H3A	—	—
5" 125 lb. C.I. flange ② ③	J2A	J2B	J2C
5" 150 lb. F.S. flange	J3A	J3B	J3C
6" 125 lb. C.I. flange ② ③	K2A	K2B	K2C
6" 150 lb. F.S. flange	K3A	K3B	K3C
6" 300 lb. F.S. flange	—	—	K4C
8" 125 lb. C.I. flange ② ③	L2A	L2B	L2C
8" 150 lb. F.S. flange	L3A	L3B	L3C

① Flanges are ANSI standard. Forged steel flanges have standard raised face.

② Not available with -4 Materials of Construction.

③ Available only in cast iron.

④ Process temperature based on +100° F (+38° C) ambient.

⑤ Uncontrolled housing heater or drain available in NEMA 4X/7/9 enclosure.

⑥ Consult factory for NEMA 4X/7/9 cast iron housings.

⑦ On steam applications, temperature down-rated to +400° F (+204° C) process at +100° F (+38° C) ambient.

ELECTRIC SWITCH MECHANISM AND ENCLOSURE

Switch Description	Maximum Process ④ Temperature ° F (° C)	One Set Point	T21-1 Models		T21-4 Models	
			NEMA 4X/7/9 Aluminum Enclosure ⑤⑥			
			Class I, Div. 1, Groups C & D	Class I, Div. 1, Group B	Class I, Div. 1, Groups C & D	Class I, Div. 1, Group B
Series A Mercury	550 (288)	SPDT DPDT	ALA AOA	ALJ AOJ	ALB AOB	ALK AOK
Series 3 Mercury with Beaded Leads	750 (399)	SPDT DPDT	3LA 3OA	3LJ 3OJ	3LB 3OB	3LK 3OK
Series B Snap	250 (121)	SPDT DPDT	BLA BOA	BLJ BOJ	BLB BOB	BLK BOK
Series C Snap	450 (232)	SPDT DPDT	CLA COA	CLJ COJ	CLB COB	CLK COK
Series D Snap for DC Current	250 (121)	SPDT DPDT	DLB DOB	DLK DOK	DLB DOB	DLK DOK
Series E Mercury Vibration Resistant	550 (288)	SPDT DPDT	ELA EOA	ELJ EOJ	ELB EOB	ELK EOK
Series 2 Mercury Vibration Resistant	750 (399)	SPDT DPDT	2LA 2OA	2LJ 2OJ	2LB 2OB	2LK 2OK
Series HS Snap Hermetically Sealed w/Wiring Leads	550 ⑦ (288)	SPDT DPDT	HMN HMY	HMP HMZ	HMN HMY	HMP HMZ

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of Magnetrol controls may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. Magnetrol will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory, prior to the material's return. This is available through Magnetrol's local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

Magnetrol®

5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4000 • Fax 630-969-9489 • www.magnetrol.com
145 Jardin Drive, Units 1 & 2 • Concord, Ontario Canada L4K 1X7 • 905-738-9600 • Fax 905-738-1306
Heikensstraat 6 • B 9240 Zele, Belgium • 052 45.11.11 • Fax 052 45.09.93
Regent Business Ctr., Jubilee Rd. • Burgess Hill, Sussex RH15 9TL U.K. • 01444-871313 • Fax 01444-871317

STI®

5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4028 • Fax 630-969-9489 • www.sticontrols.com

BULLETIN: 44-604.12
EFFECTIVE: November 2006
SUPERSEDES: January 2005

Displacer Type

Installation and Operating Manual

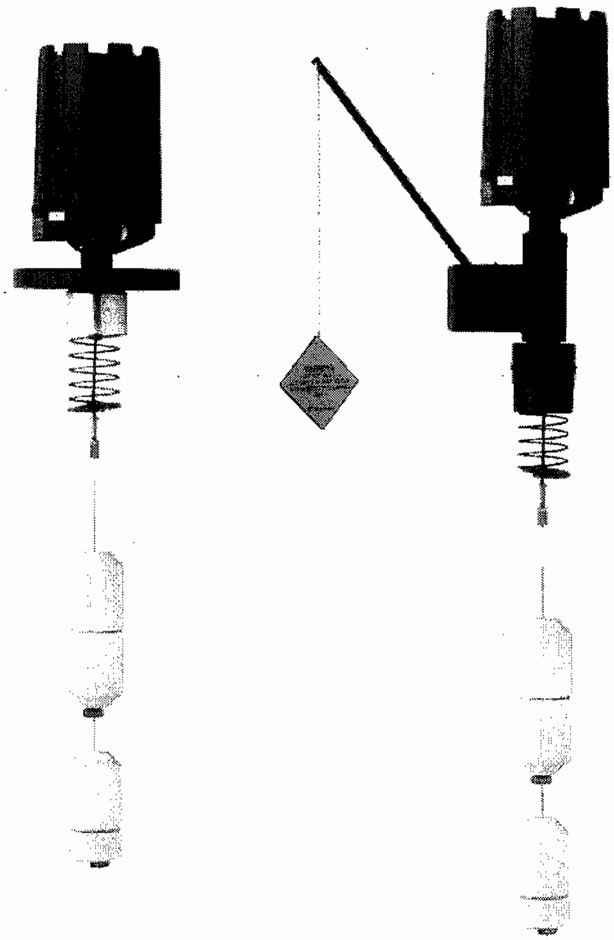
Liquid

Level

and

Proof-er®

Switches



Magnetrol®

STI®

Read this Manual Before Installing

This manual provides information on the External Cage Displacer Liquid Level Switch. It is important that all instructions are read carefully and followed in sequence. Detailed instructions are included in the Installation section of this manual.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

Notes

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Warnings

Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

Safety Messages

Follow all standard industry procedures for servicing electrical equipment when working with or around high voltage. Always shut off the power supply before touching any components.

WARNING! Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Low Voltage Directive

For use in Installation Category II, Pollution Degree 2. If equipment is used in a manner not specified by the manufacturer, protection provided by the equipment may be impaired.

Notice of Trademark, Copyright, and Limitations

Magnetrol reserves the right to make changes to the product described in this manual at any time without notice. Magnetrol makes no warranty with respect to the accuracy of the information in this manual.

Warranty

All Magnetrol/STI mechanical level and flow controls are warranted free of defects in materials or workmanship for five full years from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Magnetrol/STI will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

Magnetrol/STI shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some Magnetrol/STI products.

Quality Assurance

The quality assurance system in place at Magnetrol/STI guarantees the highest level of quality throughout the company. Magnetrol/STI is committed to providing full customer satisfaction both in quality products and quality service.

Magnetrol's quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

Magnetrol® STI®

Displacer Type Liquid Level and Proof-er® Switches

1.0 [illegible]

Displacement type level switches offer the industrial user a wide choice of alarm and control configurations. These units utilize simple buoyancy principle and are well suited for simple or complex applications.

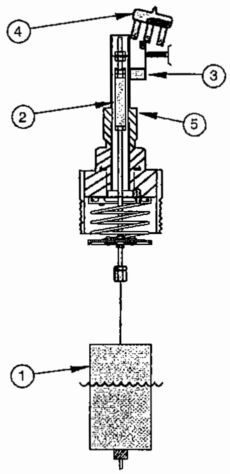


Figure 1
Switch position on rising level

1.1 Principle of Operation

1.1.1 Displacer Controls

The design of displacer operated level switches is based upon the principle that a magnetic field will not be affected by non-magnetic materials such as 316 stainless steel. In this case, the displacer moves a magnetic attraction sleeve within a non-magnetic enclosing tube and actuates a magnetic switch mechanism. The enclosing tube provides a pressure seal to the chamber and, therefore, to the process.

1.2 [illegible]

A spring is loaded with a weighted displacer ① which is heavier than the liquid. Immersion of the displacers caused by rising liquid level imparts buoyancy forces on the displacer allowing the spring to compress. The attraction sleeve ② attached to the spring, moves upward into the field of a permanent magnet ③. The movement of the magnet toward the sleeve causes the switch ④ to actuate. A non-magnetic barrier tube ⑤ provides a static pressure boundary between the switch mechanism and the displacer assembly. As the liquid level falls, the displacer lowers, causing the spring to extend, and moving the attraction sleeve out of the magnetic field of the switch mechanism. This allows the switch to again change position and to break or make. See Figures 1 and 2.

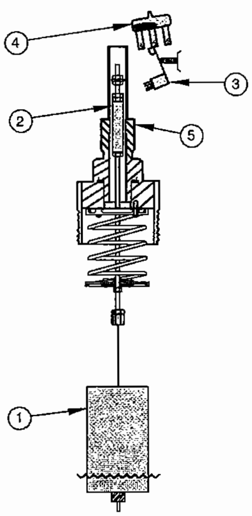


Figure 2
Switch position on falling level

1.3 [illegible]

The purpose of the Proof-er is to check the operation of a displacer control without having to raise the level in the tank. This is accomplished by pulling downward on the Proof-er cable. This causes the spring loaded lever arm to lift the switch actuator, simulating a high or high–high level condition. When the cable is released, the Proof-er returns the actuator to its original position resuming normal operation.

Caution: If equipment is used in a manner not specified by manufacturer, protection provided by equipment may be impaired.

Top mounting displacer units are shipped from the factory with the displacer and cable assembly removed from the head assembly and packed separately in the same container.

Caution: If reshipping to another location, displacer assembly must again be removed from the control to prevent damage.

Unpack the instrument carefully. Inspect all units for damage. Report any concealed damage to carrier within 24 hours. Check the contents of the packing slip and purchase order. Check and record the serial number for future reference when ordering parts.

Caution: The threaded connection link and stem protruding from the head assembly are extremely fragile. DO NOT handle or place control in a position so that any amount of force is placed on the stem. Proper operation of the control requires that the stem is not damaged or bent.

Caution: Displacer spring and stem are fragile. DO NOT drop displacers into tank. Hand feed cable into position to avoid bending stem.

Caution: This instrument is intended for use in Installation Category II, Pollution Degree 2.

Adjust the displacers on the displacer cable for the desired switch actuating levels (instruction tag is attached to cable). Screw displacer cable fitting to threaded connection link protruding from the underside of control.

Be sure there are no tubes, rods, or other obstacles in the tank or vessel to interfere with the operation of the displacers. No guides into the tank are necessary unless liquid turbulence is excessive, in which case a guide pipe or tube should be at least 1 inch larger than the displacer diameter, open at the bottom end, and with several vent holes located above the maximum high level of the liquid.

Check the installation of pipe or tube to be certain it is plumb.

Caution: Before attaching Magnetrol control to tank or vessel, using a level, check to see that tank mounting flange is within 3° of horizontal in all directions. Proper operation of the control depends on the switch housing being plumb.

[illegible]

Caution: Level controls are shipped from the factory with the enclosing tube tightened and the middle set screw, on the housing base, locked to the enclosing tube. Failure to loosen the set screw prior to repositioning the conduit connection may cause the enclosing tube to loosen, resulting in the possible leakage of the process liquid or vapor.

NOTE: If control is equipped with pneumatic switch mechanism, disregard these instructions and refer to instruction bulletin on mechanism furnished for air (or gas) connections.

Most switch enclosures are designed to provide 360° positioning of the conduit outlet by loosening the set screw(s) located at the bottom of the switch housing base. To rotate conduit entry:

1. Loosen set screw(s) at base of switch housing. Refer to Figure 2.
2. Rotate switch housing so that conduit entry is positioned as desired.
3. Tighten set screws at base of housing.

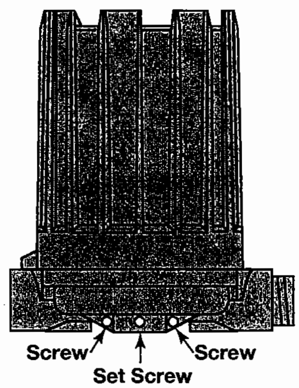


Figure 2
NEMA 4X, NEMA 4X/7/9, NEMA 4X/7/9 Group B

At the factory, terminal blocks are positioned next to the conduit entry to facilitate wiring. If repositioning of the switch mechanisms is desired:

1. Unscrew and remove switch housing cover. The threads have been lubricated to facilitate removal.
2. Loosen the frame mounting screw on each switch mechanism. Refer to Figure 3.
3. Carefully rotate the baffle plate and all switch mechanisms together until the terminal blocks are in the desired position.

NOTE: On dual and triple stage controls the correct spacing of the mechanisms is maintained using brackets that connect the mechanisms. Take care when rotating the baffle plate and mechanisms to rotate them as a unit and not one at a time. This will ensure that the brackets and mechanisms will not be damaged during repositioning.

4. Ensure that the terminal blocks are aligned vertically to prevent stress on the brackets and mechanisms.
5. Tighten the frame mounting screw on each switch mechanism.

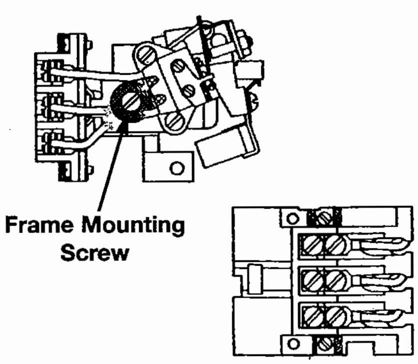
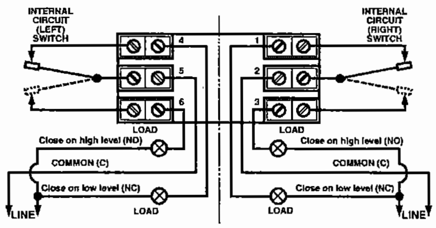
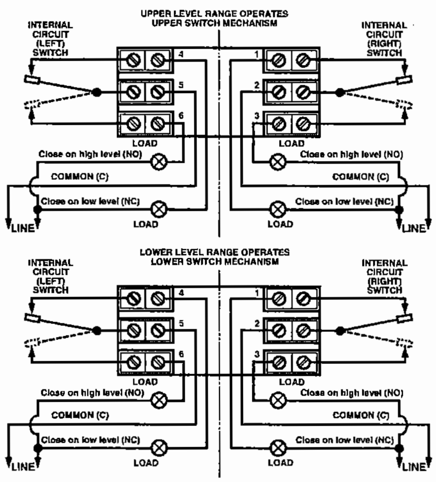


Figure 3
Switch Mechanism



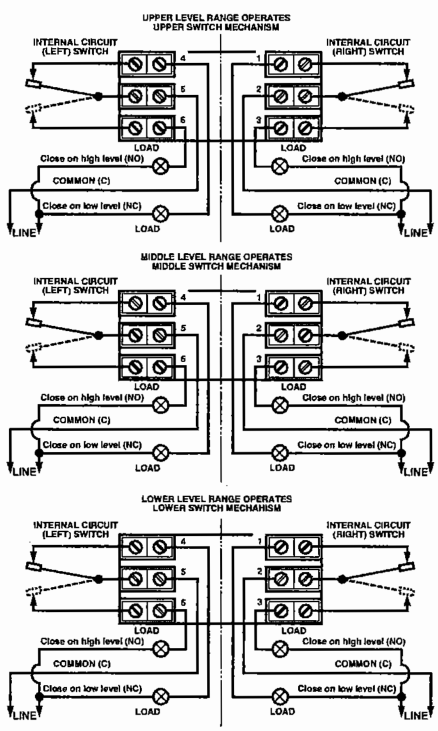
NOTES: 1. Double pole action is obtained by simultaneous operation of the right and left side single pole switches.
2. Rising Level Closes Contacts 5 & 6 and 2 & 3.
3. Falling Level Closes Contacts 4 & 5 and 1 & 2.

Figure 4 – Single Stage with DPDT contacts



NOTES: 1. Double pole action is obtained by simultaneous operation of the right and left side single pole switches.
2. Rising Level Closes Contacts 5 & 6 and 2 & 3.
3. Falling Level Closes Contacts 4 & 5 and 1 & 2.

Figure 5 – Dual Stage with DPDT contacts



NOTES: 1. Double pole action is obtained by simultaneous operation of the right and left side single pole switches.
2. Rising Level Closes Contacts 5 & 6 and 2 & 3.
3. Falling Level Closes Contacts 4 & 5 and 1 & 2.

Figure 6 – Triple Stage with DPDT contacts

NOTE: On high temperature applications above +250° F (+121° C), high temperature wire should be used between control and first junction box located in a cooler area. On non-hazardous applications, flexible conduit may be used between the control and the first junction box.

6. Bring supply wires through conduit entry. Route extra wire around enclosing tube under baffle plate, and connect then to the appropriate terminals. Refer to Figures 4–9 for wiring diagrams, or refer to wiring information in specific switch manuals. Switch instruction manual numbers are as follows:

Switch Series Letter	Description	Bulletin No.
A, T	Standard Mercury Switch	42-683
B, C, D, O, Q	Dry Contact Switch	
E, N	Vibration Resistant Mercury Switch	
HS	Hermetically Sealed Snap Switch	42-694
J	Bleed Type Pneumatic Switch	42-685
K	Non-Bleed Type Pneumatic Switch	42-686

NOTE: For models with a Series HS switch with high temperature lead wire, the leads are routed out through the conduit opening by the factory. A suitable conduit box should be provided for the connection of the leads to the control wiring.

7. Dress wiring to ensure no interference or contact with tilt of switch, or replacement of switch housing cover.

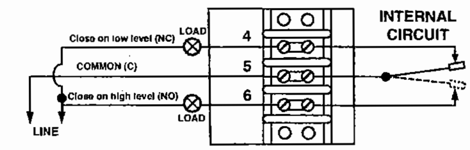
NOTE: Observe all applicable electrical codes and proper wiring procedures.

Prevent moisture seepage into the enclosure by installing approved seal-drain fittings in the conduit run leading into the unit.

Caution: In hazardous areas, do not power the unit until the conduit is sealed and the enclosure cover is screwed down securely.

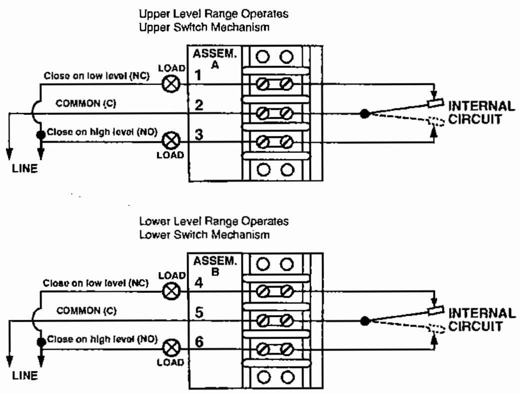
8. Test switch action by varying liquid level or manually moving displacers.
9. Replace housing cover.
10. If control has been furnished with an explosion proof or moisture proof (gasketed) switch housing, it must be sealed at the conduit outlet with a suitable compound or non-hardening sealant to prevent entrance of air.

NOTE: If switch mechanism fails to function properly, check vertical alignment of control housing and consult installation bulletin on switch mechanism furnished.



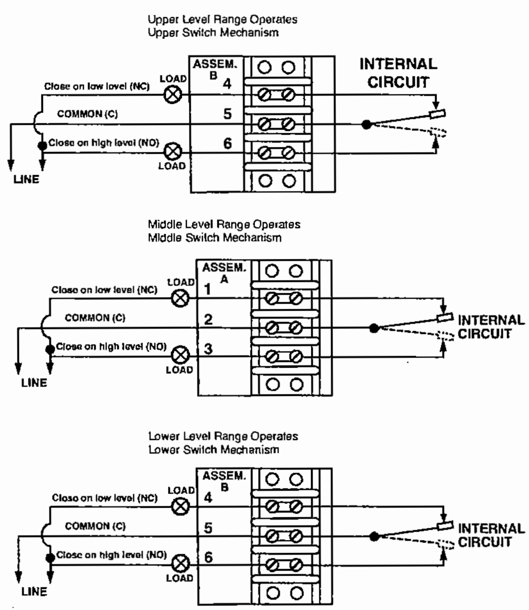
NOTES: 1. Rising level closes contacts 5 & 6.
2. Falling level closes contacts 4 & 5.

Figure 7 – Single Stage with SPDT contacts



NOTES: 1. Rising level closes contacts 5 & 6 and 2 & 3.
2. Falling level closes contacts 4 & 5 and 1 & 2.

Figure 8 – Dual Stage with SPDT contacts



NOTES: 1. Rising level closes contacts 5 & 6 and 2 & 3.
2. Falling level closes contacts 4 & 5 and 1 & 2.

Figure 9 – Triple Stage with SPDT contacts

11. Check cover to base fit to be certain gasketed joint is tight. A positive seal is necessary to prevent infiltration of moisture laden air or corrosive gasses into switch housings.

3.0 Preventive maintenance

Periodic inspections are a necessary means to keep your level control in good working order. This control is a safety device to protect the valuable equipment it serves. A systematic program of "preventive maintenance" must be implemented when the control is placed into service. If the following sections on "What to do" and "What to avoid" are observed, your control will provide reliable protection of your equipment for many years.

3.1 What to do

3.1.1 Keep control clean

Be sure the switch housing cover is always in place on the control. This cover is designed to keep dust and dirt from interfering with switch mechanism operation. It protects against damaging moisture and acts as a safety feature by keeping bare wires and terminals from being exposed. Should the housing cover or any seal become damaged or misplaced, obtain a replacement immediately.

3.1.2 Inspect switch mechanisms, terminals, and connections monthly

1. Mercury switches may be visually inspected for short circuit damage. Check for small cracks in the glass tube containing the mercury. Such cracks can allow entrance of air into the tube causing the mercury to "oxidize". This is noticeable as the mercury will appear dirty or dull, and will not break into clean, round pools. If these conditions exist, replace the mercury switch immediately.
2. Dry contact switches should be inspected for excessive wear on actuating lever or misalignment of adjustment screw at point of contact between screw and lever. Such wear can cause false switch actuating levels. See switch mechanism bulletin supplied with control should switch adjustment or replacement be necessary.
3. DO NOT operate your control with defective or maladjusted switch mechanisms (refer to bulletin on switch mechanisms furnished for service instructions.)

4. Level controls may sometimes be exposed to excessive heat or moisture. Under such conditions, insulation on electrical wiring may become brittle, eventually breaking or pealing away. The resulting "bare" wires can cause short circuits.

NOTE: Check wiring carefully and replace at the first sign of brittle insulation.

5. Vibration may sometimes cause terminal screws to work loose. Check all terminal connections to be certain that screws are tight.

6. On units with pneumatic switches, air (or gas) lines subjected to vibration, may eventually crack or become loose at connections causing leakage. Check lines and connections carefully and repair or replace, if necessary.

NOTE: As a matter of good practice, spare switches should be kept on hand at all times.

1. Never leave switch housing cover off the control longer than necessary to make routine inspections.

2. Never place a jumper wire across terminals to "cut-out" the control. If a "jumper" is necessary for test purposes, be certain it is removed before placing control into service.

3. Never attempt to make adjustments or replace switches without reading instructions carefully. Certain adjustments provided for in level controls should not be attempted in the field. When in doubt, consult the factory or your local representative.

4. Never use lubricants on pivots of switch mechanisms. A sufficient amount of lubricant has been applied at the factory to ensure a lifetime of service. Further oiling is unnecessary and will only tend to attract dust and dirt which can interfere with mechanism operation.

5. Never attempt to readjust magnetic attraction sleeve. It is factory set, and tampering may cause failure of control while in service, even if manual operation activates switch.

[illegible]

[illegible]

Usually the first indication of improper operation is failure of the controlled equipment to function, i.e., pump will not start (or stop), signal lamps fail to light, etc. When these symptoms occur, whether at time of installation or during routine service thereafter, check the following potential external causes first.

a. Fuses may be blown.

b. Reset button(s) may need resetting.

c. Power switch may be open.

d. Controlled equipment may be faulty.

e. Wiring leading to control may be defective.

If a thorough inspection of these possible conditions fails to locate the trouble, proceed next to a check of the control's switch mechanism.

4.1.1 Check switch mechanism

1. Pull disconnect switch or otherwise disconnect power to the control.
2. Remove switch housing cover.
3. Disconnect power wiring from switch assembly.
4. Swing magnet assembly in and out by hand to check carefully for any sign of binding. Assembly should require minimal force to move it through its full swing.
5. If binding exists, magnet may be rubbing enclosing tube. If magnet is rubbing, loosen magnet clamp screw and shift magnet position. Retighten magnet clamp screw.
6. If switch magnet assembly swings freely and mechanism still fails to actuate, check installation of control to be certain it is within the specified three degrees of vertical. (Use spirit level on side of enclosing tube in two places, 90° apart.)

7a. If mechanism is equipped with a mercury switch, examine glass mercury tube closely as previously described in Section 3.0 Preventive Maintenance. If switch is damaged, replace it immediately.

7b. If mechanism is equipped with a microswitch, check continuity with ohmmeter.

NOTE: As a matter of good practice, spare switches should be kept on hand at all times.

8. If switch mechanism is operating satisfactorily, proceed to check sensing unit.

4.1.2 Test control's performance

1. Reconnect power supply and carefully actuate switch mechanism manually, using a non-conductive tool on electrical switch mechanism, to determine whether controlled equipment will operate.

Caution: With electrical power on, care should be taken to avoid contact with switch leads and connections at terminal block.

2. If controlled equipment responds to manual actuation test, trouble may be located in level sensing portion of the control (displacers, spring, stem, and magnetic attracting sleeve).

NOTE: Check first to be certain liquid is entering tank or vessel. A valve may be closed or pipe line plugged.

3. With liquid in tank or vessel, proceed to check level sensing action by removing switch housing assembly.

Caution: Be certain to pull disconnect switch or otherwise assure that electrical circuit(s) through control is deactivated. Close operating medium supply valve on controls equipped with pneumatic switch mechanisms

   a. Disconnect wiring from supply side of switch mechanism(s) and remove electrical conduit or operating medium line connections to switch housing.
   b. Relieve pressure from vessel and allow unit to cool.
   c. Remove switch housing assembly by loosening set screws located at the bottom of the housing base.

4. With switch housing assembly removed, inspect attraction sleeve and inside of enclosing tube for excessive corrosion or solids buildup which could restrict movement, preventing sleeve from reaching field of switch magnet.
5. Inspect displacer stem and spring assembly to assure it is not damaged. If stem or spring is bent or otherwise damaged, movement of the attraction sleeve inside the e-tube will be restricted, preventing proper function of the control.
6. If trouble is still not located, proceed to remove the entire sensing unit from the tank or vessel by unbolting head flange or unscrewing mounting bushing. Inspect displacer assembly and all internal parts for any signs of damage. Check assembly for binding by supporting head flange or mounting bushing over the edge of a bench and move displacer assembly by hand.

NOTE: When in doubt about the condition or performance of a control, contact the factory or consult your local representative.

4.1.3 Proof-er

If the Proof-er is not functioning properly, listed below are potential problems and corrective action.

1. Proof-er does not return to the down position after it is activated.

CAUSE	REMEDY
Defective return spring.	Replace Spring.
Buildup between the shaft and housing restricting movement.	Clean Proof-er to remove buildup.
Handle stops are not adjusted properly.	Adjust handle stop screws in or out to allow the handle to move to the proper position.

2. Switch will not trip when Proof-er is activated.

CAUSE	REMEDY
The switch mechanism is defective and not the Proof-er.	Check switch mechanism.
Handle stops are not adjusted properly.	Adjust handle stop screws in or out to allow the handle to move to the proper position.

Agency Approvals

AGENCY	APPROVED MODEL	APPROVAL CLASSES
FM FM APPROVED	All with an electric switch mechanism and a housing listed as Type 4X/7/9	Class I, Div 1, Groups C & D Class II, Div 1, Groups E, F & G
	All with an electric switch mechanism and a housing listed as Type 4X/7/9 Class I, Div 1, Group B	Class I, Div 1, Groups B, C & D Class II, Div 1, Groups E, F & G
CSA	All with a Series A, E, 2, 3 or HS electric switch mechanism and a housing listed as CSA Type 4X	Class I, Div 2, Groups B, C & D
	All with an electric switch mechanism and a housing listed as Type 4X/7/9 ①	Class I, Div 1, Groups C & D Class II, Div 1, Groups E, F & G
	All with an electric switch mechanism and a housing listed as Type 4X/7/9 Class I, Div 1, Group B	Class I, Div 1, Groups B, C & D Class II, Div 1, Groups E, F & G
ATEX / IEC Ex ③	All with an electric switch mechanism and an ATEX housing ②	ATEX II 2 G EEx d IIC T6 IEC Ex Ex d IIC T6
CE	Low Voltage Directives 73/23/EEC & 93/68/EEC Per Harmonized Standard: EN 61010-1/1993 & Amendment No. 1	Installation Category II Pollution Degree 2

① With housing drain, CSA drops Group E and FM drops Group C.

② Models B10 and B15 with 'HS' switches and all Model C10 and C15 are not ATEX approved.

③ IEC Installation Instructions:

The cable entry and closing devices shall be Ex d certified suitable for the conditions of use and correctly installed.

For ambient temperatures above +55° C or for process temperatures above +150° C, suitable heat resistant cables shall be used.

Heat extensions (between process connection and housing) shall never be insulated.

Special conditions for safe use:

When the equipment is installed in process temperatures higher than +85° C the temperature classification must be reduced according to the following table as per IEC60079-0.

Maximum Process Temperature	Temperature Classification
< 85° C	T6
< 100° C	T5
< 135° C	T4
< 200° C	T3
< 300° C	T2
< 450° C	T1

These units are in comformity with IECEx KEM 05.0020X
Classification Ex d IIC T6
$T_{ambient}$ -40° C to +70° C

4.3.1 Basic Electrical Ratings

Displacer	Switch Series and Non-Inductive Ampere Rating									
	A	B	C	D	E	HS	N	O	Q	T
120 VAC	13.00	15.00	15.00	10.00	4.00	5.00	13.00	15.00	15.00	4.00
240 VAC	6.50	15.00	15.00	—	2.00	5.00	6.50	15.00	15.00	2.00
24 VDC	10.00	6.00	10.00	10.00	—	5.00	—	—	6.00	—
120 VDC	10.00	0.50	1.00	10.00	4.00	0.50	10.00	1.00	0.50	4.00
240 VDC	5.00	0.25	0.50	3.00	2.00	0.25	5.00	0.50	0.25	2.00

4.3.2 Pressure/Temperature Ratings

Threaded Models*	800 psig @ +100° F (55 bar @ +38° C) 250 psig @ +400° F (17 bar @ +204° C)
Flanged Models	Limited to the pressure rating of the selected flange or displacer. Cast iron flanges are flat face type conformi ng to ANSI dimensional specifications
Low Pressure Proof-er Models	25 psig @ +200° F (1.7 bar @ +93° C)
Medium Pressure Proof-er Models	125 psig @ +300° F (8.6 bar @ +149° C)

*Models with stainless steel displacers are rated 720 psig @ +100° F (50 bar @ +38° C)

4.3.3 Model A10 Dimensional Data and Actuating Levels

Inches (mm)

Model A10

Displacer Type	Outline Dimensions			
	Threaded Mounting		Flanged Mounting	
	A	B	A	B
Porcelain	5.00 (127)	122.00 (3098)	7.00 (177)	124.00 (3149)
Stainless Steel or Karbate	4.75 (120)	122.00 (3098)	6.75 (171)	124.00 (3149)

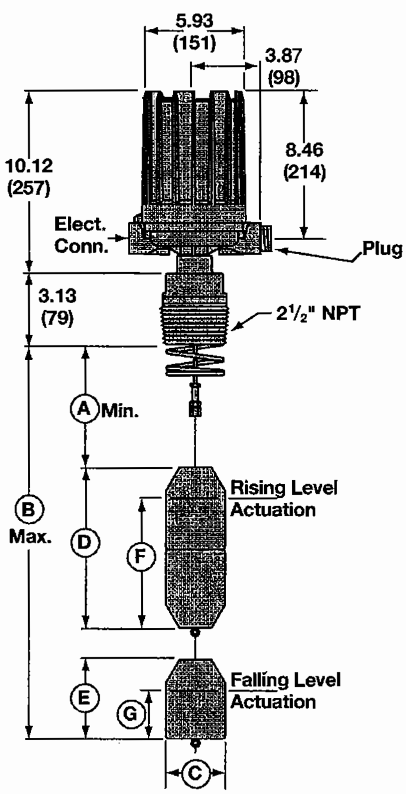
Displacer Type	C	D	E
Porcelain	2.56 (65)	7.25 (184)	3.62 (91)
Stainless Steel or Karbate	2.50 (63)	9.00 (228)	4.50 (114)

Electrical Connections
NEMA 4X/7/9, Group B: 1" NPT NEMA 1 Pneumatic: ¼" NPT

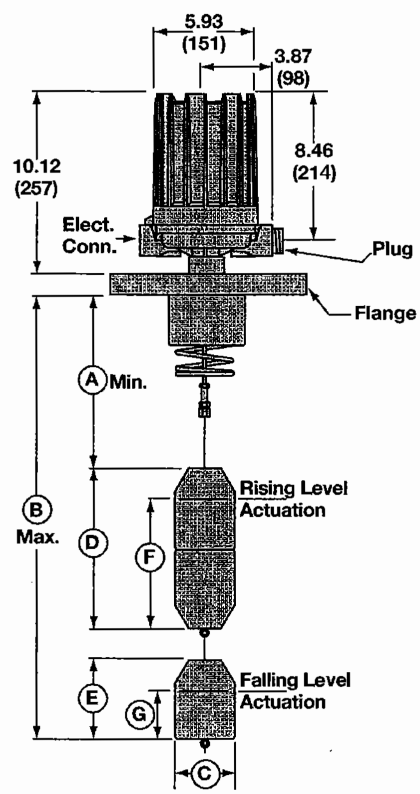
A10 Standard actuating levels and liquid specific gravity

Displacer Type	Liquid Temp. °F	0.60		0.70		0.80		0.90		1.00	
		F	G	F	G	F	G	F	G	F	G
Porcelain	100	5.30 (134)	1.50 (38)	4.10 (104)	1.20 (30)	3.20 (81)	1.10 (27)	2.50 (63)	1.00 (25)	2.00 (50)	0.90 (22)
	200	—	—	4.80 (121)	2.00 (50)	3.80 (96)	1.80 (45)	3.00 (76)	1.60 (40)	2.50 (63)	1.50 (38)
	300	—	—	—	—	4.30 (109)	2.40 (60)	3.40 (86)	2.10 (53)	2.90 (73)	1.90 (48)
	400	—	—	—	—	—	—	3.40 (86)	2.60 (66)	2.90 (73)	2.40 (60)
Stainless Steel or Karbate	100	7.00 (177)	2.40 (60)	5.30 (134)	2.00 (50)	4.10 (104)	1.80 (45)	3.10 (78)	1.60 (40)	2.40 (60)	1.40 (35)
	200	—	—	5.90 (149)	2.80 (71)	4.70 (119)	2.50 (63)	3.60 (91)	2.20 (55)	2.80 (71)	2.00 (50)
	300	—	—	—	—	5.10 (129)	3.10 (78)	4.00 (101)	2.70 (68)	3.20 (81)	2.40 (60)
Stainless Steel	400	—	—	—	—	—	—	4.40 (111)	3.20 (81)	3.60 (91)	2.90 (73)
	500	—	—	—	—	—	—	—	—	3.90 (99)	3.30 (83)

Note: All levels ±0.25" (6).



Model A10
with Threaded Mounting



Model A10
with Flanged Mounting

4.3.4 Model A15 Dimensional Data and Actuating Levels

Inches (mm)

Model A15

Displacer Type	Outline Dimensions			
	Threaded Mounting		Flanged Mounting	
	A	B	A	B
Porcelain	5.62 (142)	122.00 (3098)	7.62 (193)	124.00 (3149)
Stainless Steel or Karbate	5.62 (142)	122.00 (3098)	7.62 (193)	124.00 (3149)

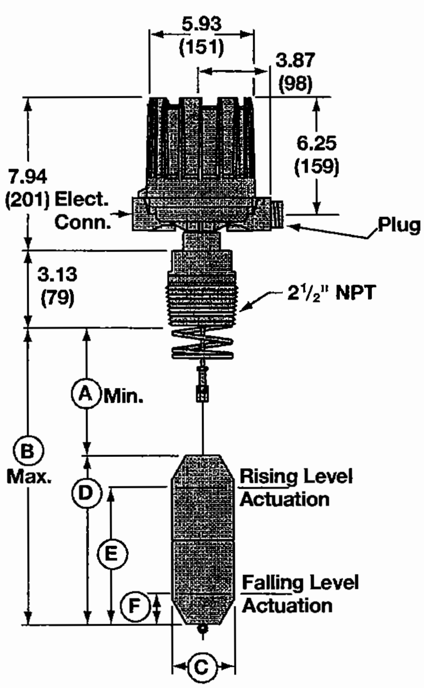
Displacer Type	C	D
Porcelain	2.56 (65)	7.25 (184)
Stainless Steel or Karbate	2.50 (63)	9.00 (228)

Electrical Connections
NEMA 4X/7/9, Group B: 1" NPT NEMA 1 Pneumatic: ¼" NPT

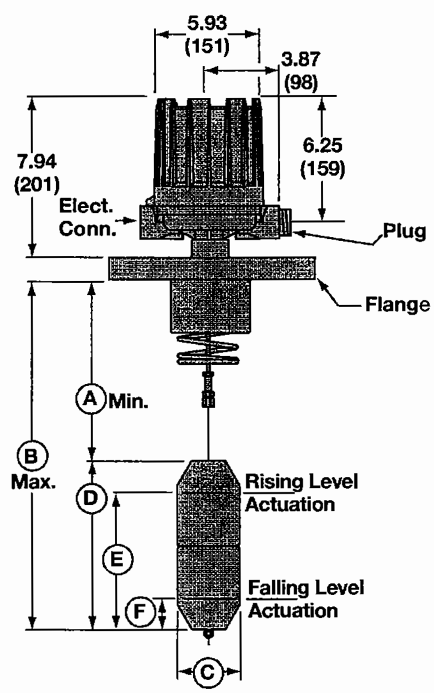
A15 Standard actuating levels and liquid specific gravity

Displacer Type	Liquid Temp. °F	0.50		0.60		0.70		0.80		0.90		1.00	
		E	F	E	F	E	F	E	F	E	F	E	F
Porcelain	100	—	—	5.10 (129)	2.10 (53)	4.50 (114)	1.70 (43)	3.90 (99)	1.70 (43)	3.50 (88)	1.50 (38)	3.20 (81)	1.40 (35)
	200	—	—	5.60 (142)	2.60 (66)	4.90 (124)	2.10 (53)	4.30 (109)	2.10 (53)	3.80 (96)	1.80 (45)	3.50 (88)	1.70 (43)
	300	—	—	—	—	5.20 (132)	2.40 (60)	4.50 (114)	2.30 (58)	4.10 (104)	2.10 (53)	3.70 (93)	1.90 (48)
	400	—	—	—	—	5.60 (142)	2.80 (71)	4.80 (121)	2.60 (66)	4.30 (109)	2.30 (58)	3.90 (99)	2.10 (53)
	500	—	—	—	—	—	—	5.10 (129)	2.90 (73)	4.60 (116)	2.60 (66)	4.20 (106)	2.40 (60)
Stainless Steel or Karbate	100	5.40 (137)	2.00 (50)	4.50 (114)	1.60 (40)	3.90 (99)	1.40 (35)	3.40 (86)	1.20 (30)	3.00 (76)	1.10 (27)	2.70 (68)	1.00 (25)
	200	6.00 (152)	2.60 (66)	5.00 (127)	2.10 (53)	4.30 (109)	1.80 (45)	3.70 (93)	1.60 (40)	3.30 (83)	1.40 (35)	3.00 (76)	1.30 (33)
	300	6.40 (162)	3.00 (76)	5.30 (134)	2.40 (60)	4.60 (116)	2.10 (53)	4.00 (101)	1.80 (45)	3.60 (91)	1.70 (43)	3.20 (81)	1.50 (38)
Stainless Steel	400	6.90 (175)	3.50 (88)	5.70 (144)	2.80 (71)	4.90 (124)	2.40 (60)	4.30 (109)	2.10 (53)	3.80 (96)	1.90 (48)	3.40 (86)	1.70 (43)
	500	—	—	6.10 (154)	3.20 (81)	5.20 (132)	2.80 (71)	4.60 (116)	2.40 (60)	4.10 (104)	2.20 (55)	3.70 (93)	2.00 (50)

Note: All levels ±0.25" (6).



Model A15 with Threaded Mounting



Model A15 with Flanged Mounting

4.3.5 Model B10 Dimensional Data

Inches (mm)

Model B10

Displacer Type	Outline Dimensions			
	Threaded Mounting		Flanged Mounting	
	A	B	A	B
Porcelain	4.88 (123)	122.00 (3098)	6.88 (174)	124.00 (3149)
Stainless Steel or Karbate	4.75 (120)	122.00 (3098)	6.75 (171)	124.00 (3149)

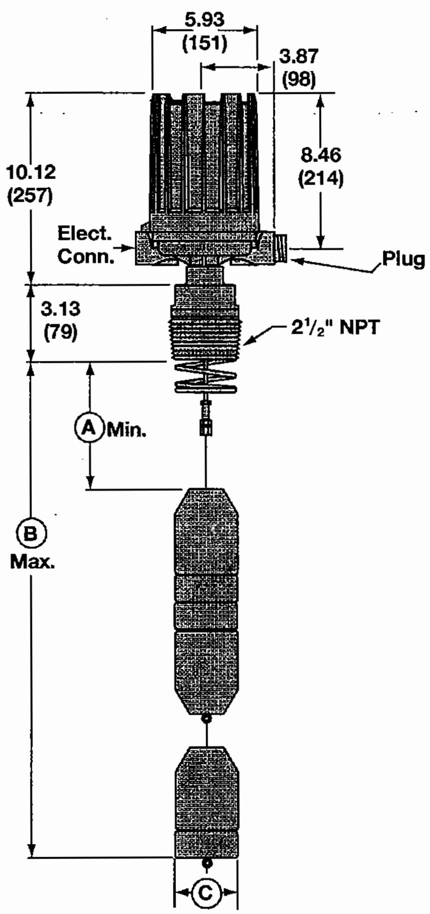
Model B10 with displacer arrangements 1 and 2

Displacer Type	C	D	E
Porcelain	2.56 (65)	10.04 (255)	5.02 (127)
Stainless Steel or Karbate	2.50 (63)	12.00 (304)	6.00 (152)

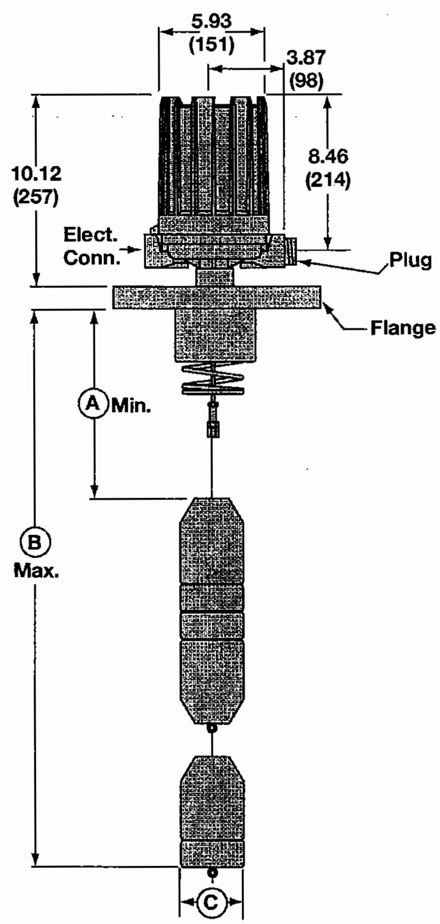
Model B10 with displacer arrangements 3, 4, and 5

Displacer Type	C	D	E	F
Porcelain	2.56 (65)	5.02 (127)	5.02 (127)	5.02 (127)
Stainless Steel or Karbate	2.50 (63)	6.00 (152)	6.00 (152)	6.00 (152)

Electrical Connections
NEMA 4X/7/9 Group B: 1" NPT



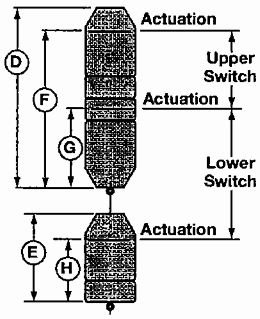
Model B10
with Threaded Mounting



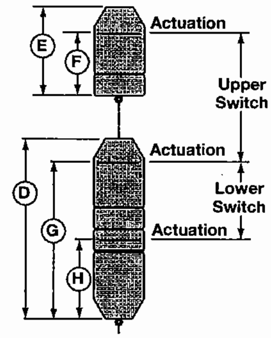
Model B10
with Flanged Mounting

4.3.6 Model B10 Actuating Levels

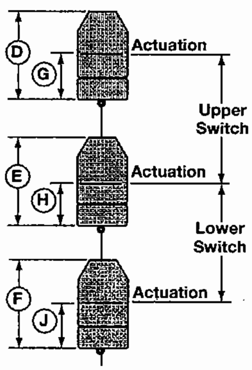
Inches (mm)



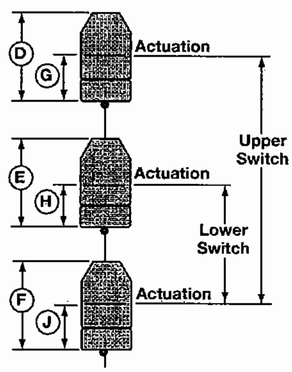
Model B10
Displacer Arrangement 1



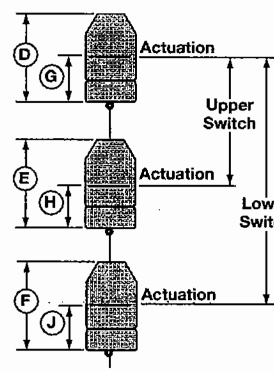
Model B10
Displacer Arrangement 2



Model B10
Displacer Arrangement 3



Model B10
Displacer Arrangement 4



Model B10
Displacer Arrangement 5

B10 Standard actuating levels and liquid specific gravity with displacer arrangement 1

Displacer Type	Liquid Temp. ° F	Level	0.60 – 0.64	0.65 – 0.71	0.72 – 0.73	0.74 – 0.82	0.83 – 0.92	0.93 – 1.00	1.01 – 1.07
Porcelain	100	F	7.79 – 7.04 (197 – 178)	7.66 – 6.65 (194 – 168)	7.22 – 7.06 (133 – 179)	6.91 – 5.81 (175 – 147)	6.73 – 5.65 (180 – 143)	5.55 – 4.86 (140 – 123)	4.97 – 4.53 (126 – 115)
		G	2.62 – 2.19 (56 – 55)	2.88 – 2.28 (73 – 57)	2.91 – 2.81 (73 – 71)	2.71 – 2.03 (68 – 51)	2.99 – 2.28 (75 – 57)	2.21 – 1.76 (56 – 44)	1.90 – 1.63 (48 – 41)
		H	2.01 – 1.89 (51 – 48)	1.86 – 1.70 (47 – 43)	1.68 – 1.65 (42 – 41)	1.63 – 1.47 (41 – 37)	1.45 – 1.31 (36 – 33)	1.30 – 1.21 (33 – 30)	1.02 – 0.97 (25 – 24)
	200	F	7.91 (200)	7.72 – 6.71 (196 – 170)	6.56 – 6.41 (166 – 162)	6.73 – 5.66 (170 – 143)	6.37 – 5.33 (161 – 135)	6.15 – 5.42 (156 – 137)	5.02 – 4.57 (127 – 116)
		G	3.06 (77)	2.95 – 2.34 (74 – 59)	2.25 – 2.16 (57 – 54)	2.54 – 1.87 (64 – 47)	2.63 – 1.95 (66 – 49)	2.81 – 2.32 (71 – 58)	1.94 – 1.67 (49 – 42)
		H	2.76 (70)	2.72 – 2.49 (69 – 63)	2.45 – 2.42 (62 – 61)	2.39 – 2.15 (60 – 54)	2.13 – 1.92 (54 – 48)	1.90 – 1.77 (48 – 44)	1.58 – 1.49 (40 – 37)
	300	F	—	—	—	7.48 – 6.34 (189 – 161)	7.04 – 5.93 (178 – 150)	6.75 – 5.98 (171 – 151)	5.57 – 5.10 (141 – 129)
		G	—	—	—	3.29 – 2.55 (83 – 64)	3.30 – 2.56 (83 – 65)	3.41 – 2.87 (86 – 72)	2.50 – 2.19 (63 – 55)
		H	—	—	—	3.14 – 2.83 (79 – 71)	2.80 – 2.53 (71 – 64)	2.50 – 2.32 (63 – 58)	2.13 – 2.01 (54 – 51)
	400	F	—	—	—	—	—	—	6.12 – 5.62 (155 – 142)
		G	—	—	—	—	—	—	3.05 – 2.72 (77 – 69)
		H	—	—	—	—	—	—	2.68 – 2.53 (68 – 64)

Note: All levels ±0.25" (6).

4.3.6 Model B10 Actuating Levels (cont.)

Inches (mm)

B10 Standard actuating levels and liquid specific gravity with displacer arrangement 1

Displacer Type	Liquid Temp. ° F	Level	1.08 – 1.12	1.13 – 1.17	1.18 – 1.27	1.28 – 1.30	1.31 – 1.39	1.40 – 1.50
Porcelain	100	F	4.47 – 4.20 (113 – 106)	4.90 – 4.64 (124 – 117)	4.57 – 4.05 (116 – 102)	3.99 – 3.89 (101 – 98)	4.23 – 3.82 (107 – 97)	3.77 – 3.33 (95 – 84)
		G	1.59 – 1.43 (40 – 36)	2.16 – 1.99 (54 – 50)	1.94 – 1.60 (49 – 40)	1.57 – 1.50 (39 – 38)	1.86 – 1.59 (47 – 40)	1.56 – 1.26 (39 – 32)
		H	0.96 – 0.92 (24 – 23)	0.92 – 0.88 (23 – 22)	0.88 – 0.81 (22 – 20)	0.81 – 0.80 (20 – 20)	0.79 – 0.74 (20 – 18)	0.74 – 0.69 (18 – 17)
	200	F	4.66 – 4.39 (118 – 111)	4.33 – 4.08 (109 – 103)	4.32 – 3.81 (109 – 96)	4.29 – 4.18 (108 – 106)	4.13 – 3.73 (104 – 94)	3.93 – 3.47 (99 – 88)
		G	1.79 – 1.62 (45 – 41)	1.58 – 1.43 (40 – 36)	1.69 – 1.36 (42 – 34)	1.87 – 1.80 (47 – 45)	1.76 – 1.49 (44 – 37)	1.71 – 1.40 (43 – 35)
		H	1.48 – 1.42 (37 – 36)	1.41 – 1.36 (35 – 34)	1.35 – 1.25 (34 – 31)	1.24 – 1.23 (31 – 31)	1.22 – 1.15 (30 – 29)	1.14 – 1.06 (28 – 26)
	300	F	5.18 – 4.89 (131 – 124)	4.82 – 4.56 (122 – 115)	4.79 – 4.25 (121 – 107)	4.73 – 4.61 (120 – 117)	4.56 – 4.13 (115 – 104)	4.32 – 3.84 (109 – 97)
		G	2.31 – 2.12 (58 – 53)	2.08 – 1.91 (52 – 48)	2.16 – 1.80 (54 – 45)	2.31 – 2.23 (58 – 56)	2.19 – 1.90 (55 – 48)	2.11 – 1.78 (53 – 45)
		H	1.99 – 1.92 (50 – 48)	1.90 – 1.84 (48 – 46)	1.82 – 1.69 (45 – 42)	1.68 – 1.66 (42 – 42)	1.64 – 1.55 (41 – 39)	1.54 – 1.43 (39 – 36)
	400	F	5.70 – 5.39 (144 – 136)	5.32 – 5.04 (135 – 128)	5.26 – 4.69 (133 – 119)	5.17 – 5.04 (131 – 128)	4.98 – 4.53 (126 – 115)	4.72 – 4.22 (119 – 107)
		G	2.82 – 2.62 (71 – 66)	2.57 – 2.39 (65 – 60)	2.63 – 2.24 (66 – 56)	2.74 – 2.66 (69 – 67)	2.61 – 2.30 (66 – 58)	2.51 – 2.15 (63 – 54)
		H	2.51 – 2.42 (63 – 61)	2.40 – 2.32 (60 – 58)	2.30 – 2.13 (58 – 54)	2.12 – 2.08 (53 – 52)	2.07 – 1.95 (52 – 49)	1.94 – 1.81 (49 – 45)
	500	F	6.22 – 5.89 (157 – 149)	5.81 – 5.52 (147 – 140)	5.74 – 5.13 (145 – 130)	5.60 – 5.47 (142 – 138)	5.41 – 4.93 (137 – 125)	5.12 – 4.59 (130 – 116)
		G	3.34 – 3.12 (84 – 79)	3.07 – 2.86 (77 – 72)	3.11 – 2.68 (78 – 68)	3.18 – 3.09 (80 – 78)	3.04 – 2.70 (77 – 68)	2.91 – 2.52 (73 – 64)
		H	3.03 – 2.92 (76 – 74)	2.89 – 2.79 (73 – 70)	2.77 – 2.57 (70 – 65)	2.55 – 2.51 (64 – 63)	2.50 – 2.35 (63 – 59)	2.33 – 2.18 (59 – 55)

Displacer Type	Liquid Temp. ° F	Level	0.50 – 0.58	0.59 – 0.71	0.72 – 0.79	0.80 – 0.85	0.86 – 1.00	1.01 – 1.03
Stainless Steel and Karbate	100	F	9.91 – 7.72 (251 – 196)	9.19 – 6.62 (233 – 168)	8.44 – 7.16 (214 – 181)	7.66 – 6.86 (194 – 174)	6.71 – 4.93 (170 – 125)	4.82 – 4.61 (122 – 117)
		G	3.46 – 2.16 (86 – 54)	3.72 – 2.08 (94 – 52)	3.96 – 3.07 (100 – 77)	3.63 – 3.07 ((92 – 77)	2.96 – 1.71 (75 – 43)	1.63 – 1.48 (41 – 37)
		H	2.51 – 2.16 (63 – 54)	2.13 – 1.77 (54 – 44)	1.74 – 1.59 (44 – 40)	1.57 – 1.48 (39 – 37)	1.46 – 1.25 (37 – 31)	1.24 – 1.22 (31 – 30)
	200	F	10.22 – 7.98 (259 – 202)	7.74 – 7.44 (196 – 188)	7.50 – 6.30 (190 – 160)	6.15 – 5.44 (156 – 138)	6.97 – 5.15 (177 – 130)	—
		G	3.76 – 2.42 (95 – 61)	2.27 – 1.89 (57 – 48)	3.02 – 2.22 (76 – 56)	2.12 – 1.64 (53 – 41)	3.22 – 1.93 (81 – 49)	—
		H	3.67 – 3.16 (93 – 80)	3.11 – 2.58 (78 – 65)	2.55 – 2.32 (64 – 58)	2.29 – 2.16 (58 – 54)	2.13 – 1.84 (54 – 46)	—
	300	F	—	9.68 – 7.25 (245 – 184)	8.31 – 7.04 (211 – 178)	6.88 – 6.12 (174 – 155)	7.65 – 5.73 (194 – 145)	—
		G	—	4.30 – 2.70 (109 – 68)	3.83 – 2.96 (97 – 75)	2.84 – 2.32 (72 – 58)	3.89 – 2.51 (98 – 63)	—
		H	—	4.03 – 3.40 (102 – 86)	3.36 – 3.06 (85 – 77)	3.02 – 2.84 (76 – 72)	2.81 – 2.42 (71 – 61)	—

continued on page 16

4.3.6 Model B10 Actuating Levels (cont.)

Inches (mm)

B10 Standard actuating levels and liquid specific gravity with displacer arrangement 1 (cont.)

Displacer Type	Liquid Temp. ° F	Level	0.50 – 0.58	0.59 – 0.71	0.72 – 0.79	0.80 – 0.85	0.86 – 1.00	1.01 – 1.03
Stainless Steel	400	F	—	—	9.11 – 7.77 (231 – 197)	7.60 – 6.80 (193 – 172)	8.32 – 6.32 (211 – 160)	—
		G	—	—	4.63 – 3.69 (117 – 93)	3.57 – 3.01 (90 – 76)	4.57 – 3.09 (116 – 78)	—
		H	—	—	4.16 – 3.79 (105 – 96)	3.75 – 3.53 (95 – 89)	3.48 – 3.00 (88 – 76)	—
	500	F	—	—	—	—	9.00 – 6.90 (228 – 175)	—
		G	—	—	—	—	5.24 – 3.67 (133 – 93)	—
		H	—	—	—	—	4.16 – 3.58 (105 – 90)	—

Note: All levels ±0.25" (6).

B10 Standard actuating levels and liquid specific gravity with displacer arrangement 2

Displacer Type	Liquid Temp. ° F	Level	0.60 – 0.64	0.65 – 0.71	0.72 – 0.73	0.74 – 0.82	0.83 – 0.92	0.93 – 1.00	1.01 – 1.07
Porcelain	100	F	2.77 – 2.01 (70 – 51)	2.63 – 1.62 (66 – 41)	2.67 – 2.51 (67 – 63)	2.58 – 1.42 (65 – 36)	3.16 – 1.94 (80 – 49)	1.82 – 1.04 (45 – 26)	1.69 – 1.23 (42 – 31)
		G	7.27 – 6.84 (184 – 173)	7.54 – 6.93 (191 – 176)	7.56 – 7.46 (192 – 189)	7.36 – 6.68 (186 – 169)	7.64 – 6.93 (194 – 176)	6.86 – 6.41 (174 – 162)	5.15 – 4.89 (130 – 124)
		H	2.67 – 2.53 (67 – 64)	3.29 – 3.05 (83 – 77)	3.73 – 3.68 (94 – 93)	3.64 – 3.32 (92 – 84)	4.32 – 3.93 (109 – 99)	3.90 – 3.65 (99 – 92)	2.42 – 2.31 (61 – 58)
	200	F	3.15 (80)	2.96 – 1.93 (75 – 49)	1.77 – 1.62 (44 – 41)	2.64 – 1.47 (67 – 37)	2.79 – 1.61 (70 – 40)	2.79 – 1.94 (70 – 49)	1.56 – 1.11 (39 – 28)
		G	7.71 (195)	7.60 – 6.99 (193 – 177)	6.90 – 6.81 (175 – 172)	7.19 – 6.52 (182 – 165)	7.28 – 6.60 (184 – 167)	7.46 – 6.97 (189 – 177)	5.19 – 4.92 (131 – 124)
		H	3.40 (86)	3.36 – 3.10 (85 – 78)	3.07 – 3.03 (77 – 76)	3.46 – 3.16 (87 – 80)	3.96 – 3.61 (100 – 91)	4.50 – 4.21 (114 – 106)	2.46 – 2.35 (62 – 59)
	300	F	—	—	—	3.39 – 2.15 (86 – 54)	3.47 – 2.22 (88 – 56)	3.39 – 2.50 (86 – 63)	2.11 – 1.63 (53 – 41)
		G	—	—	—	7.94 – 7.20 (201 – 182)	7.95 – 7.21 (201 – 183)	8.06 – 7.53 (204 – 191)	5.75 – 5.45 (146 – 138)
		H	—	—	—	4.21 – 3.84 (106 – 97)	4.63 – 4.21 (117 – 106)	5.10 – 4.77 (129 – 121)	3.02 – 2.87 (76 – 72)
	400	F	—	—	—	—	—	—	2.67 – 2.15 (67 – 54)
		G	—	—	—	—	—	—	6.30 – 5.97 (160 – 151)
		H	—	—	—	—	—	—	3.57 – 3.39 (90 – 86)

Note: All levels ±0.25" (6).

4.3.6 Model B10 Actuating Levels (cont.)

Inches (mm)

B10 Standard actuating levels and liquid specific gravity with displacer arrangement 2 (cont.)

Displacer Type	Liquid Temp. ° F	Level	1.08 – 1.12	1.13 – 1.17	1.18 – 1.27	1.28 – 1.30	1.31 – 1.39	1.40 – 1.50
Porcelain	100	F	1.16 – 0.89 (29 – 22)	2.04 – 1.75 (51 – 44)	1.68 – 1.10 (42 – 27)	1.04 – 0.92 (26 – 23)	2.05 – 1.56 (52 – 39)	1.50 – 0.97 (38 – 24)
		G	4.84 – 4.68 (122 – 118)	5.41 – 5.24 (137 – 133)	5.20 – 4.85 (132 – 123)	4.82 – 4.75 (122 – 120)	5.11 – 4.84 (129 – 122)	4.81 – 4.51 (122 – 114)
		H	2.29 – 2.22 (58 – 56)	2.97 – 2.88 (75 – 73)	2.86 – 2.68 (72 – 68)	2.66 – 2.63 (67 – 66)	3.01 – 2.85 (76 – 72)	2.84 – 2.67 (72 – 67)
	200	F	1.68 – 1.38 (42 – 35)	1.31 – 1.05 (33 – 26)	1.71 – 1.13 (43 – 28)	1.75 – 1.62 (44 – 41)	1.56 – 1.09 (39 – 27)	1.53 – 1.00 (38 – 25)
		G	5.04 – 4.88 (128 – 123)	4.84 – 4.68 (122 – 118)	4.94 – 4.62 (125 – 117)	5.12 – 5.05 (130 – 128)	5.01 – 4.75 (127 – 120)	4.96 – 4.65 (125 – 118)
		H	2.49 – 2.41 (63 – 61)	2.39 – 2.33 (60 – 59)	2.60 – 2.44 (66 – 61)	2.97 – 2.93 (73 – 70)	2.91 – 2.76 (73 – 70)	2.99 – 2.82 (75 – 77)
	300	F	2.19 – 1.88 (55 – 47)	1.81 – 1.52 (45 – 38)	2.19 – 1.57 (55 – 39)	2.18 – 2.05 (50 – 37)	1.98 – 1.49 (50 – 37)	1.93 – 1.37 (49 – 34)
		G	5.56 – 5.37 (141 – 136)	5.33 – 5.16 (135 – 131)	5.41 – 5.06 (137 – 128)	5.56 – 5.48 (138 – 130)	5.44 – 5.15 (138 – 130)	5.36 – 5.03 (136 – 127)
		H	3.01 – 2.91 (76 – 73)	2.89 – 2.80 (73 – 71)	3.07 – 2.88 (77 – 73)	3.40 – 3.36 (84 – 80)	3.33 – 3.16 (84 – 80)	3.39 – 3.19 (86 – 81)
	400	F	2.71 – 2.38 (68 – 60)	2.30 – 2.00 (58 – 50)	2.66 – 2.01 (67 – 51)	2.62 – 2.48 (61 – 48)	2.41 – 1.90 (61 – 48)	2.33 – 1.74 (59 – 44)
		G	6.08 – 5.87 (154 – 149)	5.82 – 5.64 (147 – 143)	5.89 – 5.49 (149 – 139)	5.99 – 5.91 (152 – 150)	5.87 – 5.55 (149 – 140)	5.76 – 5.40 (146 – 137)
		H	3.52 – 3.41 (89 – 86)	3.38 – 3.28 (85 – 83)	3.55 – 3.32 (90 – 84)	3.84 – 3.79 (97 – 96)	3.76 – 3.56 (95 – 90)	3.79 – 3.56 (96 – 90)
	500	F	3.23 – 2.88 (82 – 73)	2.80 – 2.48 (71 – 62)	3.13 – 2.45 (79 – 62)	3.05 – 2.91 (77 – 73)	2.84 – 2.30 (72 – 58)	2.73 – 2.11 (69 – 53)
		G	6.59 – 6.37 (167 – 161)	6.32 – 6.12 (160 – 155)	6.36 – 5.93 (161 – 150)	6.43 – 6.34 (163 – 161)	6.29 – 5.95 (159 – 151)	6.16 – 5.77 (156 – 146)
		H	4.04 – 3.91 (102 – 99)	3.88 – 3.76 (98 – 95)	4.02 – 3.76 (102 – 95)	4.28 – 4.21 (108 – 106)	4.19 – 3.97 (106 – 100)	4.19 – 3.93 (106 – 99)

Note: All levels ±0.25" (6).

4.3.6 Model B10 Actuating Levels (cont.)

Inches (mm)

B10 Standard actuating levels and liquid specific gravity with displacer arrangement 2

Displacer Type	Liquid Temp. ° F	Level	0.50 – 0.58	0.59 – 0.71	0.72 – 0.79	0.80 – 0.85	0.86 – 1.00	1.01 – 1.03
Stainless Steel and Karbate	100	F	3.77 – 1.60 (95 – 40)	4.10 – 1.38 (104 – 35)	4.43 – 2.97 (112 – 75)	4.58 – 3.60 (24 – 91)	3.42 – 1.26 (86 – 31)	1.13 – 0.88 (28 – 22)
		G	9.46 – 8.16 (240 – 207)	9.72 – 8.08 (246 – 205)	9.96 – 9.07 (252 – 230)	9.63 – 9.07 (244 – 230)	8.96 – 7.71 (227 – 195)	7.63 – 7.48 (193 – 189)
		H	3.73 – 3.21 (94 – 81)	4.86 – 4.04 (123 – 102)	5.97 – 5.44 (151 – 138)	6.05 – 5.69 (153 – 144)	5.63 – 4.84 (143 – 122)	4.79 – 4.70 (121 – 119)
	200	F	4.22 – 1.98 (107 – 50)	1.74 – 1.44 (44 – 36)	3.74 – 2.35 (94 – 59)	2.17 – 1.33 (55 – 33)	3.89 – 1.66 (98 – 42)	—
		G	9.76 – 8.42 (247 – 213)	8.27 – 6.88 (210 – 174)	9.02 – 8.22 (229 – 208)	8.12 – 7.64 (206 – 194)	9.22 – 7.93 (234 – 201)	—
		H	4.03 – 3.47 (102 – 88)	3.41 – 2.84 (86 – 62)	5.04 – 4.59 (128 – 116)	4.53 – 4.27 (115 – 108)	5.88 – 5.06 (149 – 128)	—
	300	F	—	4.87 – 2.26 (123 – 57)	4.55 – 3.08 (115 – 78)	2.89 – 2.02 (73 – 51)	4.56 – 2.24 (115 – 56)	—
		G	—	10.30 – 8.70 (261 – 220)	9.83 – 8.96 (249 – 227)	8.84 – 8.32 (224 – 211)	9.89 – 8.51 (251 – 216)	—
		H	—	5.52 – 4.66 (140 – 118)	5.84 – 5.33 (148 – 135)	5.26 – 4.95 (133 – 125)	6.56 – 5.64 (166 – 131)	—
Stainless Steel	400	F	—	—	5.35 – 3.82 (135 – 97)	3.62 – 2.70 (91 – 68)	5.24 – 2.82 (133 – 71)	—
		G	—	—	10.63 – 9.69 (270 – 246)	9.57 – 9.01 (243 – 228)	10.57 – 9.09 (183 – 157)	—
		H	—	—	6.65 – 6.06 (168 – 153)	5.99 – 5.63 (152 – 143)	7.24 – 6.22 (183 – 157)	—
	500	F	—	—	—	—	5.91 – 3.41 (150 – 86)	—
		G	—	—	—	—	11.24 – 9.67 (285 – 245)	—
		H	—	—	—	—	7.91 – 6.80 (200 – 172)	—

Note: All levels ±0.25" (6).

B10 Standard actuating levels and liquid specific gravity with displacer arrangements 3, 4, and 5

Displacer Type	Liquid Temp. ° F	Level	0.60 – 0.64	0.65 – 0.71	0.72 – 0.73	0.74 – 0.82	0.83 – 0.92	0.93 – 1.00	1.01 – 1.07
Porcelain	100	G	2.77 – 2.01 (70 – 51)	2.63 – 1.62 (66 – 41)	2.67 – 2.51 (67 – 63)	2.58 – 1.42 (65 – 36)	3.16 – 1.94 (80 – 49)	1.82 – 1.04 (45 – 26)	1.69 – 1.23 (42 – 31)
		H	2.24 – 1.81 (56 – 45)	2.51 – 1.90 (63 – 48)	2.53 – 2.43 (64 – 61)	2.34 – 1.66 (59 – 42)	2.62 – 1.91 (66 – 48)	1.84 – 1.38 (46 – 35)	1.53 – 1.26 (38 – 32)
		J	2.01 – 1.89 (51 – 48)	1.86 – 1.70 (47 – 43)	1.68 – 1.65 (42 – 41)	1.63 – 1.47 (41 – 37)	1.45 – 1.31 (36 – 33)	1.30 – 1.21 (33 – 30)	1.02 – .097 (25 – 24)
	200	G	3.15 (80)	2.96 – 1.93 (75 – 49)	1.77 – 1.62 (44 – 41)	2.64 – 1.47 (67 – 37)	2.79 – 1.61 (70 – 40)	2.79 – 1.94 (70 – 49)	1.56 – 1.11 (39 – 28)
		H	2.69 (68)	2.57 – 1.96 965 – 49)	1.87 – 1.78 (47 – 45)	2.16 – 1.50 (54 – 38)	2.25 – 1.58 (57 – 40)	2.44 – 1.94 (61 – 49)	1.40 – 1.14 (35 – 28)
		J	2.76 (70)	2.72 – 2.49 (69 – 63)	2.45 – 2.42 (62 – 61)	2.39 – 2.15 (60 – 54)	2.13 – 1.92 (54 – 48)	1.90 – 1.77 (48 – 44)	1.58 – 1.49 (40 – 37)
	300	G	—	—	—	3.39 – 2.15 (86 – 54)	3.47 – 2.22 (88 – 56)	3.39 – 2.50 (86 – 63)	2.11 – 1.63 (53 – 41)
		H	—	—	—	2.92 – 2.18 (74 – 55)	2.93 – 2.18 (74 – 55)	3.04 – 2.50 (77 – 63)	1.95 – 1.66 (49 – 42)
		J	—	—	—	3.14 – 2.83 (79 – 71)	2.80 – 2.53 (71 – 64)	2.50 – 2.32 (63 – 58)	2.13 – 2.01 (54 – 51)
	400	G	—	—	—	—	—	—	2.67 – 2.15 (67 – 54)
		H	—	—	—	—	—	—	2.68 – 2.34 (68 – 59)
		J	—	—	—	—	—	—	2.68 – 2.53 (68 – 64)

4.3.6 Model B10 Actuating Levels (cont.)

Inches (mm)

B10 Standard actuating levels and liquid specific gravity with displacer arrangements 3, 4, and 5 (cont.)

Displacer Type	Liquid Temp. ° F	Level	1.08 – 1.12	1.13 – 1.17	1.18 – 1.27	1.28 – 1.30	1.31 – 1.39	1.40 – 1.50
Porcelain	100	G	1.16 – 0.89 (29 – 22)	2.04 – 1.75 (51 – 44)	1.68 – 1.10 (42 – 27)	1.04 – 0.92 (26 – 23)	2.05 – 1.56 (52 – 39)	1.50 – 0.97 (38 – 24)
		H	1.22 – 1.06 (30 – 26)	1.78 – 1.61 (45 – 40)	1.57 – 1.23 (39 – 31)	1.19 – 1.12 (30 – 28)	1.49 – 1.21 (37 – 30)	1.18 – 0.89 (29 – 22)
		J	0.96 – 0.92 (24 – 23)	0.92 – 0.88 (23 – 22)	0.88 – 0.81 (22 – 20)	0.81 – 0.80 (20 – 20)	0.79 – 0.74 (20 – 18)	0.74 – 0.69 (18 – 17)
	200	G	1.68 – 1.38 (42 – 35)	1.31 – 1.05 (33 – 26)	1.71 – 1.13 (43 – 28)	1.75 – 1.62 (44 – 41)	1.56 – 1.09 (39 – 27)	1.53 – 1.00 (38 – 25)
		H	1.42 – 1.25 (36 – 31)	1.21 – 1.06 (30 – 26)	1.31 – 0.99 (33 – 25)	1.50 – 1.42 (38 – 36)	1.39 – 1.12 (35 – 28)	1.33 – 1.03 (33 – 26)
		J	1.48 – 1.42 (37 – 36)	1.41 – 1.36 (35 – 34)	1.35 – 1.25 (34 – 31)	1.24 – 1.23 (31 – 31)	1.22 – 1.15 (30 – 29)	1.14 – 1.06 (28 – 26)
	300	G	2.19 – 1.88 (55 – 47)	1.81 – 1.52 (45 – 38)	2.19 – 1.57 (55 – 39)	2.18 – 2.05 (50 – 37)	1.98 – 1.49 (50 – 37)	1.93 – 1.37 (49 – 34)
		H	1.93 – 1.75 (49 – 44)	1.70 – 1.53 (43 – 38)	1.79 – 1.43 (45 – 36)	1.93 – 1.85 (49 – 46)	1.81 – 1.52 (45 – 38)	1.73 – 1.40 (43 – 35)
		J	1.99 – 1.92 (50 – 48)	1.90 – 1.84 (48 – 46)	1.82 – 1.69 (45 – 42)	1.68 – 1.66 (42 – 42)	1.64 – 1.55 (41 – 39)	1.54 – 1.43 (39 – 36)
	400	G	2.71 – 2.38 (68 – 60)	2.30 – 2.00 (58 – 50)	2.66 – 2.01 (67 – 51)	2.62 – 2.48 (61 – 48)	2.41 – 1.90 (61 – 48)	2.33 – 1.74 (59 – 44)
		H	2.45 – 2.25 (62 – 57)	2.20 – 2.01 (55 – 51)	2.26 – 1.87 (57 – 47)	2.37 – 2.28 (60 – 57)	2.24 – 1.92 (56 – 23)	2.13 – 1.77 (54 – 44)
		J	2.51 – 2.42 (63 – 61)	2.40 – 2.32 (60 – 58)	2.30 – 2.13 (58 – 54)	2.12 – 2.08 (53 – 52)	2.07 – 1.95 (52 – 49)	1.94 – 1.81 (49 – 45)
	500	G	3.23 – 2.88 (82 – 73)	2.80 – 2.48 (71 – 62)	3.13 – 2.45 (79 – 62)	3.05 – 2.91 (77 – 73)	2.84 – 2.30 (72 – 58)	2.73 – 2.11 (69 – 53)
		H	2.97 – 2.75 (75 – 69)	2.69 – 2.49 (68 – 63)	2.73 – 2.31 (69 – 58)	2.80 – 2.71 (71 – 68)	2.67 – 2.33 (67 – 59)	2.53 – 2.15 (64 – 54)
		J	3.03 – 2.92 (76 – 74)	2.89 – 2.79 (73 – 70)	2.77 – 2.57 (70 – 65)	2.55 – 2.51 (64 – 63)	2.50 – 2.35 (63 – 59)	2.33 – 2.18 (59 – 55)

Note: All levels ±0.25" (6).

4.3.6 Model B10 Actuating Levels (cont.)

Inches (mm)

B10 Standard actuating levels and liquid specific gravity with displacer arrangements 3, 4, and 5

Displacer Type	Liquid Temp. °F	Level	0.50 – 0.58	0.59 – 0.71	0.72 – 0.79	0.80 – 0.85	0.86 – 1.00	1.01 – 1.03
Stainless Steel and Karbate	100	G	3.77 – 1.60 (95 – 40)	4.10 – 1.38 (104 – 35)	4.43 – 2.97 (112 – 75)	4.58 – 3.60 (24 – 91)	3.42 – 1.26 (86 – 31)	1.13 – 0.88 (28 – 22)
		H	3.46 – 2.16 (87 – 54)	3.72 – 2.08 (94 – 52)	3.96 – 3.07 (100 – 77)	3.63 – 3.07 (92 – 77)	2.96 – 1.71 ((75 – 43)	1.45 – 1.31 (36 – 33)
		J	2.51 – 2.16 (63 – 54)	2.13 – 1.77 (54 – 44)	1.74 – 1.59 (44 – 40)	1.57 – 1.48 (39 – 37)	1.46 – 1.25 (37 – 31)	1.24 – 1.22 (31 – 30)
	200	G	4.22 – 1.98 (107 – 50)	1.74 – 1.44 (44 – 36)	3.74 – 2.35 (94 – 59)	2.17 – 1.33 (55 – 33)	3.89 – 1.66 (98 – 42)	—
		H	3.76 – 2.42 (95 – 61)	2.27 – 1.89 (57 – 48)	3.02 – 2.22 (76 – 56)	2.12 – 1.64 (53 – 41)	3.22 – 1.93 (81 – 49)	—
		J	3.67 – 3.16 (93 – 80)	3.11 – 2.58 (78 – 65)	2.55 – 2.32 (64 – 58)	2.29 – 2.16 (58 – 54)	2.13 – 1.84 (54 – 46)	—
	300	G	—	4.87 – 2.26 (123 – 57)	4.55 – 3.08 (115 – 78)	2.89 – 2.02 (73 – 51)	4.56 – 2.24 (115 – 56)	—
		H	—	4.30 – 2.70 (109 – 68)	3.83 – 2.96 (97 – 75)	2.84 – 2.32 (72 – 58)	3.89 – 2.51 (98 – 63)	—
		J	—	4.03 – 3.40 (102 – 86)	3.36 – 3.06 (85 – 77)	3.02 – 2.84 (76 – 72)	2.81 – 2.42 (71 – 61)	—
Stainless Steel	400	G	—	—	5.35 – 3.82 (135 – 97)	3.62 – 2.70 (91 – 68)	5.24 – 2.82 (133 – 71)	—
		H	—	—	4.63 – 3.69 (117 – 93)	3.57 – 3.01 (90 – 76)	4.57 – 3.09 (116 – 78)	—
		J	—	—	4.16 – 3.79 (105 – 96)	3.75 – 3.53 (95 – 89)	3.48 – 3.00 (88 – 76)	—
	500	G	—	—	—	—	5.91 – 3.41 (150 – 86)	—
		H	—	—	—	—	5.24 – 3.67 (133 – 93)	—
		J	—	—	—	—	4.16 – 3.58 (105 – 90)	—

Note: All levels ±0.25" (6).

4.3.7 Model B15 Dimensional Data

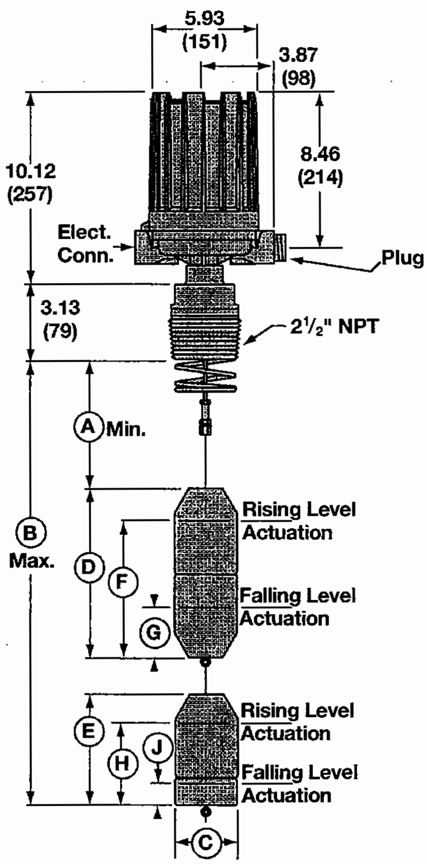
Inches (mm)

Model B15

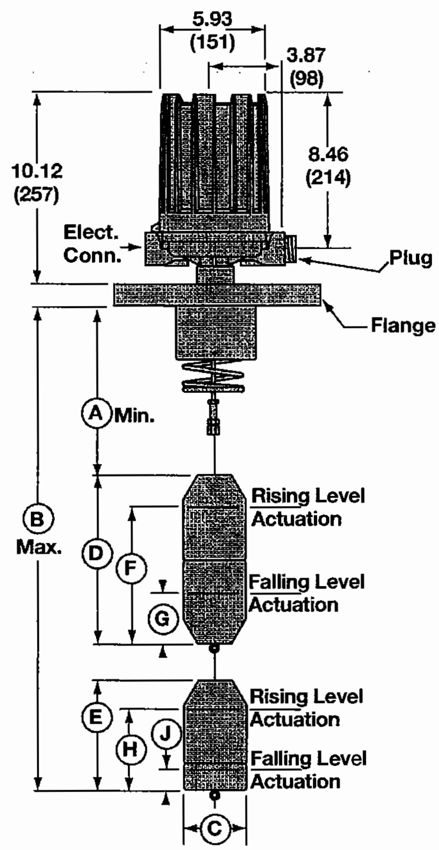
Displacer Type	Outline Dimensions			
	Threaded Mounting		Flanged Mounting	
	A	B	A	B
Porcelain	5.50 (139)	123.00 (3124)	7.50 (190)	125.00 (3175)
Stainless Steel or Karbate	5.88 (149)	123.00 (3124)	7.88 (200)	125.00 (3175)

Displacer Type	C	D	E
Porcelain	2.56 (65)	7.25 (184)	5.02 (127)
Stainless Steel or Karbate	2.50 (63)	10.50 (266)	6.00 (152)

Electrical Connections
NEMA 4X/7/9 Group B: 1" NPT



Model B15
with Threaded Mounting



Model B15
with Flanged Mounting

4.3.8 Model B15 Actuating Levels

Inches (mm)

B15 Standard actuating levels and liquid specific gravity

Displacer Type	Liquid Temp. °F	0.70				0.80			
		F	G	H	J	F	G	H	J
Stainless Steel or Karbate	100	9.50 (241)	5.00 (127)	4.90 (124)	1.30 (33)	7.60 (193)	3.70 (93)	4.30 (109)	1.10 (27)
	200	—	—	—	—	8.20 (208)	4.30 (109)	5.00 (127)	1.80 (45)

Displacer Type	Liquid Temp. °F	0.95				1.00			
		F	G	H	J	F	G	H	J
Porcelain	100	5.50 (139)	2.00 (50)	3.70 (93)	1.00 (25)	5.00 (127)	1.70 (43)	3.50 (88)	0.80 (20)
Stainless Steel	100	5.50 (139)	2.00 (50)	3.70 (93)	1.00 (25)	4.90 (124)	1.70 (43)	3.40 (86)	0.90 (22)
	200	6.00 (152)	2.70 (68)	4.20 (106)	1.50 (38)	5.40 (137)	2.20 (55)	4.00 (101)	1.50 (38)
	300	6.40 (162)	3.10 (78)	4.70 (119)	2.00 (50)	5.70 (144)	2.50 (63)	4.40 (111)	1.90 (48)
	400	—	—	—	—	6.10 (154)	2.90 (73)	4.90 (124)	2.40 (60)
Karbate	100	5.50 (139)	2.00 (50)	3.70 (93)	1.00 (25)	4.90 (124)	1.70 (43)	3.40 (86)	0.90 (22)
	200	6.00 (152)	2.70 (68)	4.20 (106)	1.50 (38)	5.40 (137)	2.20 (55)	4.00 (101)	1.50 (38)
	300	6.40 (162)	3.10 (78)	4.70 (119)	2.00 (50)	5.70 (144)	2.50 (63)	4.40 (111)	1.90 (48)

Note: All levels ±0.25" (6).

4.3.9 Model C10 Dimensional Data

Inches (mm)

Model C10 with all displacer arrangements

Displacer Type	Outline Dimensions			
	Threaded Mounting		Flanged Mounting	
	A	B	A	B
Porcelain	6.38 (965)	123.00 (3124)	8.38 (212)	125.00 (3175)
Stainless Steel or Karbate	5.75 (146)	123.00 (3124)	7.75 (196)	125.00 (3175)

Model C10 with displacer arrangements A, B, and C

Displacer Type	C	D	E	F	G
Porcelain	2.56 (65)	6.42 (163)	5.02 (127)	5.02 (127)	3.62 (91)
Stainless Steel or Karbate	2.50 (63)	6.00 (152)	6.00 (152)	4.50 (114)	4.50 (114)

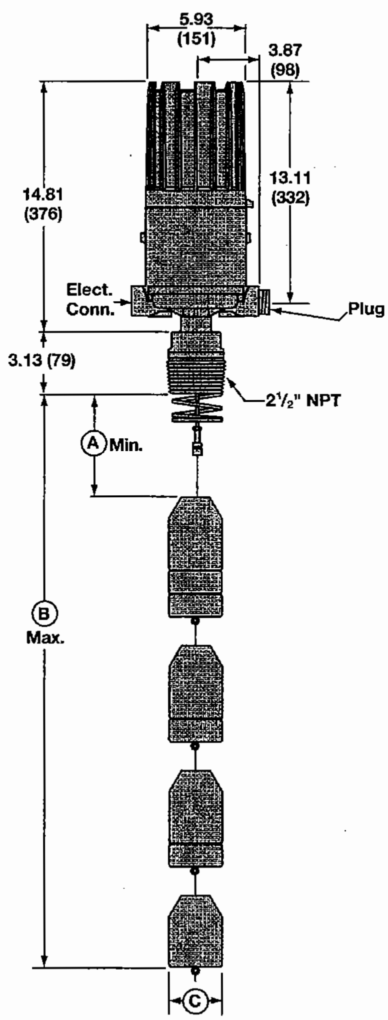
Model C10 with displacer arrangements D and F

Displacer Type	C	D	E	F
Porcelain	2.56 (65)	14.44 (367)	5.02 (127)	3.62 (91)
Stainless Steel or Karbate	2.50 (63)	12.00 (304)	4.50 (114)	4.50 (114)

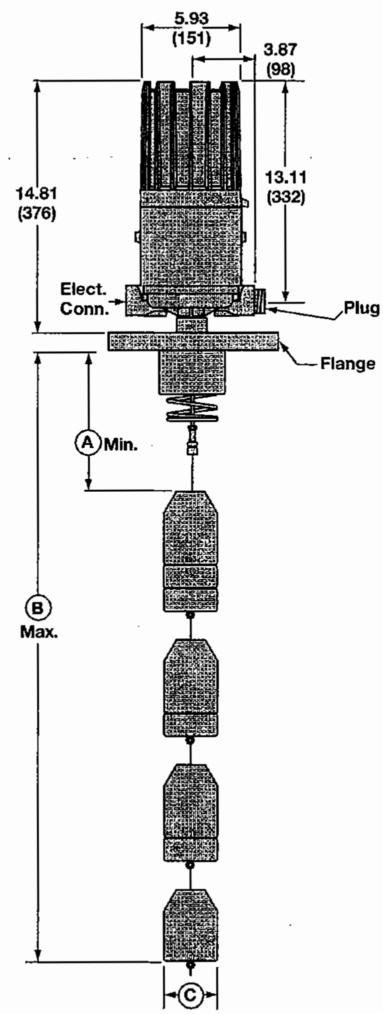
Model C10 with displacer arrangements E and G

Displacer Type	C	D	E	F
Porcelain	2.56 (65)	6.42 (153)	5.02 (127)	8.65 (219)
Stainless Steel or Karbate	2.50 (63)	6.00 (152)	6.00 (152)	9.00 (228)

Electrical Connections
NEMA 4X/7/9 Group B: 1" NPT



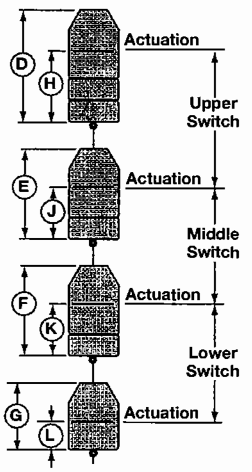
Model C10
with Threaded Mounting



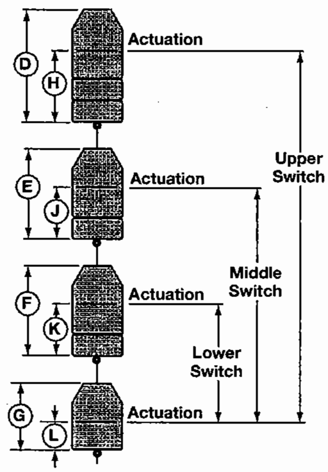
Model C10
with Flanged Mounting

4.3.10 Model C10 Actuating Levels

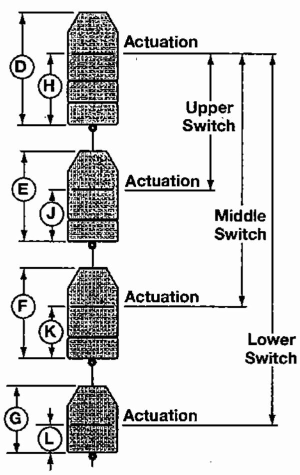
Inches (mm)



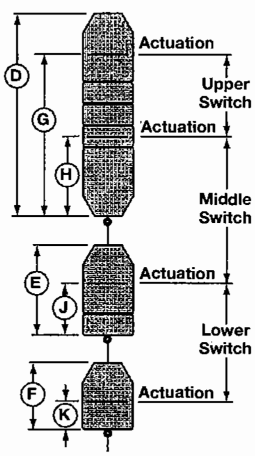
Model C10
Displacer Arrangement A



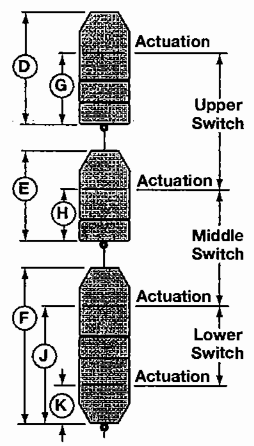
Model C10
Displacer Arrangement B



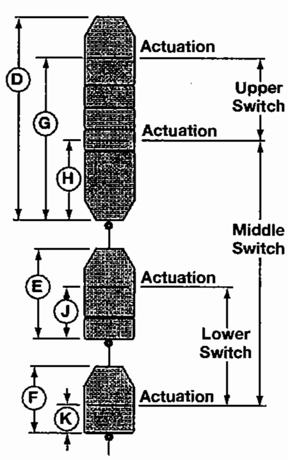
Model C10
Displacer Arrangement C



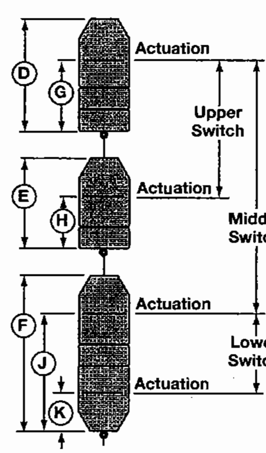
Model C10
Displacer Arrangement D



Model C10
Displacer Arrangement E



Model C10
Displacer Arrangement F



Model C10
Displacer Arrangement G

4.3.10 Model C10 Actuating Levels (cont.)

Inches (mm)

C10 Standard actuating levels and liquid specific gravity with displacer arrangements A, B, and C

Displacer Type	Liquid Temp. ° F	0.58				0.60				0.70				0.80			
		H	J	K	L	H	J	K	L	H	J	K	L	H	J	K	L
Porcelain	100	—	—	—	—	—	—	—	—	2.50 (63)	2.20 (55)	2.20 (55)	2.00 (50)	2.30 (58)	2.00 (50)	1.90 (48)	1.70 (43)
Stainless Steel or Karbate	100	4.50 (114)	3.70 (93)	3.20 (81)	2.30 (58)	3.80 (96)	3.20 (81)	3.00 (76)	2.20 (55)	4.20 (106)	3.80 (96)	2.10 (53)	1.90 (48)	1.80 (45)	2.20 (55)	1.30 (33)	1.70 (43)
	200	—	—	—	—	—	—	—	—	—	—	—	—	3.20 (81)	2.90 (73)	2.50 (63)	2.30 (58)

Displacer Type	Liquid Temp. ° F	0.90				1.00				1.10				1.20			
		H	J	K	L	H	J	K	L	H	J	K	L	H	J	K	L
Porcelain	100	3.0 (76)	2.4 (61)	2.7 (69)	1.5 (38)	1.4 (36)	1.4 (36)	2.1 (53)	1.4 (36)	3.0 (76)	2.6 (66)	2.5 (64)	1.2 (30)	1.7 (43)	1.7 (43)	2.1 (53)	1.1 (28)
	200	—	—	—	—	3.2 (81)	2.7 (69)	2.8 (71)	1.7 (43)	1.7 (43)	1.7 (43)	2.3 (58)	1.6 (41)	—	—	—	—
Stainless Steel or Karbate	100	3.1 (79)	3.2 (81)	2.5 (64)	1.5 (38)	1.3 (33)	1.9 (48)	1.8 (46)	1.3 (33)	3.1 (79)	3.2 (81)	2.5 (64)	1.3 (33)	1.6 (41)	2.2 (56)	1.9 (48)	1.2 (30)
	200	3.6 (91)	3.6 (91)	1.7 (43)	2.0 (51)	1.7 (43)	2.3 (58)	1.1 (28)	1.8 (46)	—	—	—	—	—	—	—	—
	300	3.4 (86)	3.0 (76)	2.4 (61)	2.7 (69)	1.6 (41)	1.8 (46)	1.7 (43)	2.4 (61)	—	—	—	—	—	—	—	—

C10 Standard actuating levels and liquid specific gravity with displacer arrangements D and F

Displacer Type	Liquid Temp. ° F	0.58				0.60				0.70				0.80			
		H	J	K	L	H	J	K	L	H	J	K	L	H	J	K	L
Porcelain	100	—	—	—	—	—	—	—	—	7.50 (190)	2.60 (66)	2.20 (55)	2.00 (50)	6.90 (175)	2.40 (60)	1.90 (48)	1.70 (43)
Stainless Steel or Karbate	100	9.90 (251)	3.70 (93)	3.20 (81)	2.30 (58)	9.20 (233)	3.20 (81)	3.00 (76)	2.20 (55)	8.90 (226)	3.80 (96)	2.10 (53)	1.90 (48)	6.70 (170)	2.20 (55)	1.30 (33)	1.70 (43)
	200	—	—	—	—	—	—	—	—	—	—	—	—	7.40 (187)	2.90 (73)	2.50 (63)	2.30 (58)

Displacer Type	Liquid Temp. ° F	0.90				1.00				1.10				1.20			
		H	J	K	L	H	J	K	L	H	J	K	L	H	J	K	L
Porcelain	100	6.60 (167)	2.80 (71)	2.70 (68)	1.50 (38)	5.20 (132)	1.80 (45)	2.10 (53)	1.40 (35)	6.10 (154)	3.00 (76)	2.50 (63)	1.20 (30)	5.00 (127)	2.10 (53)	2.10 (53)	1.10 (27)
	200	—	—	—	—	6.20 (157)	3.10 (78)	2.80 (71)	1.70 (43)	5.20 (132)	2.10 (53)	2.30 (58)	1.60 (40)	—	—	—	—
Stainless Steel or Karbate	100	7.20 (182)	3.20 (81)	2.50 (63)	1.50 (38)	5.50 (139)	1.90 (48)	1.80 (45)	1.30 (33)	6.40 (162)	3.20 (81)	2.50 (63)	1.30 (33)	5.20 (132)	2.20 (55)	1.90 (48)	1.20 (30)
	200	7.60 (193)	3.60 (91)	1.70 (43)	2.00 (50)	5.90 (149)	2.30 (58)	1.10 (27)	1.80 (45)	—	—	—	—	—	—	—	—
	300	7.00 (177)	3.00 (76)	2.40 (60)	2.70 (68)	5.40 (137)	1.80 (45)	1.70 (43)	2.40 (60)	—	—	—	—	—	—	—	—

Note: All levels ±0.25" (6).

4.3.10 Model C10 Actuating Levels (cont.)

Inches (mm)

C10 Standard actuating levels and liquid specific gravity with displacer arrangements E and G

Displacer Type	Liquid Temp. °F	0.58				0.60				0.70				0.80			
		H	J	K	L	H	J	K	L	H	J	K	L	H	J	K	L
Porcelain	100	—	—	—	—	—	—	—	—	2.50 (63)	2.20 (55)	5.80 (147)	1.90 (48)	2.30 (58)	2.00 (50)	5.50 (139)	2.10 (53)
Stainless Steel or Karbate	100	4.50 (114)	3.70 (93)	7.70 (195)	2.80 (71)	3.80 (96)	3.20 (81)	7.50 (190)	2.70 (68)	4.20 (106)	3.80 (96)	6.60 (167)	2.50 (63)	1.80 (45)	2.20 (55)	5.80 (147)	2.20 (55)
	200	—	—	—	—	—	—	—	—	—	—	—	—	3.20 (81)	2.90 (73)	7.00 (177)	3.40 (86)

Displacer Type	Liquid Temp. °F	0.90				1.00				1.10				1.20			
		H	J	K	L	H	J	K	L	H	J	K	L	H	J	K	L
Porcelain	100	3.00 (76)	2.40 (60)	6.30 (160)	3.20 (81)	1.40 (35)	1.40 (35)	5.70 (144)	1.90 (48)	3.00 (76)	2.60 (66)	6.10 (154)	3.60 (91)	1.70 (43)	1.70 (43)	5.70 (144)	3.40 (86)
	200	—	—	—	—	3.20 (81)	2.70 (68)	6.40 (162)	3.60 (91)	1.70 (43)	1.70 (43)	5.90 (149)	3.40 (86)	—	—	—	—
Stainless Steel or Karbate	100	3.10 (78)	3.20 (81)	7.00 (177)	3.80 (96)	1.30 (33)	1.90 (48)	6.30 (160)	3.40 (86)	3.10 (78)	3.20 (81)	7.00 (177)	4.40 (111)	1.60 (40)	2.20 (55)	6.40 (162)	4.00 (101)
	200	3.60 (91)	3.60 (91)	6.20 (157)	3.00 (76)	1.70 (43)	2.30 (58)	5.60 (142)	2.70 (68)	—	—	—	—	—	—	—	—
	300	3.40 (86)	3.00 (76)	6.90 (175)	3.70 (93)	1.60 (40)	1.80 (45)	6.20 (157)	3.30 (83)	—	—	—	—	—	—	—	—

Note: All levels ±0.25" (6).

4.3.11 Model C15 Dimensional Data

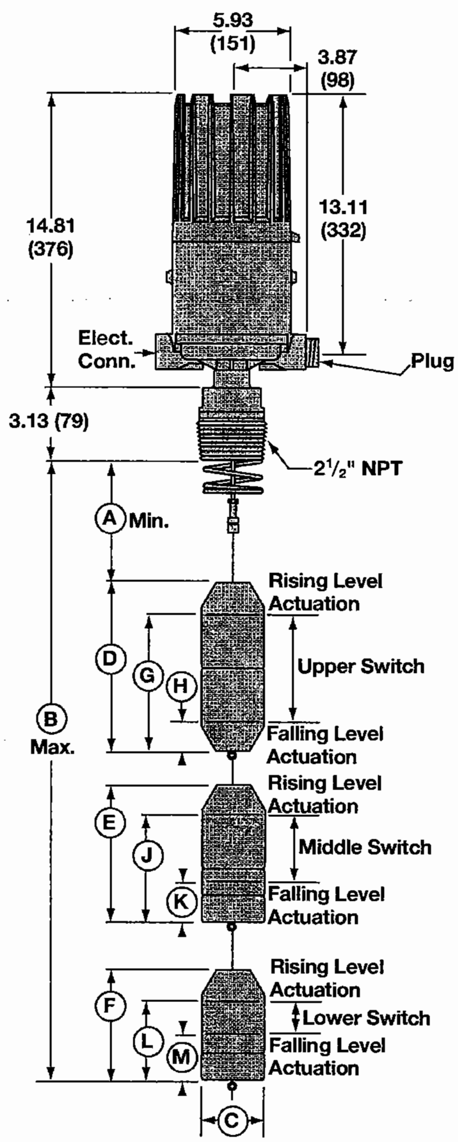
Inches (mm)

Model C15

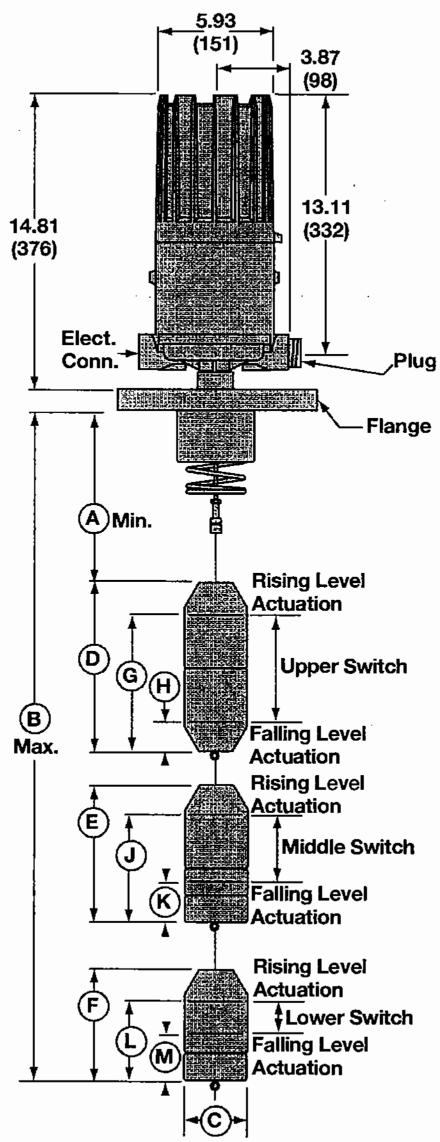
Displacer Type	OUTLINE DIMENSIONS: Threaded Mounting A	Threaded Mounting B	Flanged Mounting A	Flanged Mounting B
Porcelain	7.75 (196)	125.00 (3175)	9.75 (247)	127.00 (3225)
Stainless Steel or Karbate	7.25 (184)	124.00 (3149)	9.25 (234)	126.00 (3200)

Displacer Type	C	D	E	F
Porcelain	2.56 (65)	7.25 (184)	6.42 (163)	5.02 (127)
Stainless Steel or Karbate	2.50 (63)	9.00 (228)	7.50 (190)	6.00 (152)

Electrical Connections
NEMA 4X/7/9 Group B: 1" NPT



Model C15 with Threaded Mounting



Model C15 with Flanged Mounting

4.3.12 Model C15 Actuating Levels

Inches (mm)

C15 Standard actuating levels and liquid specific gravity

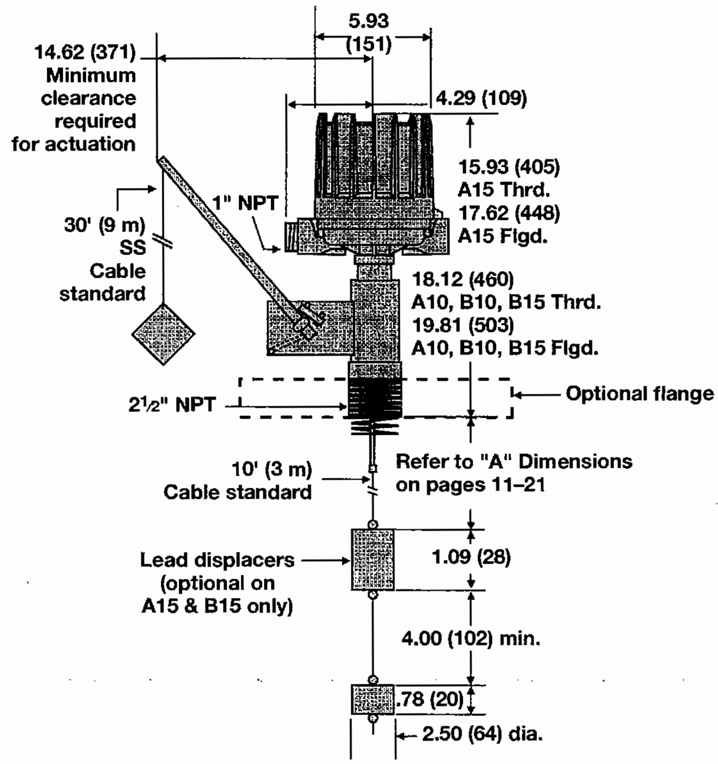
Displacer Type	Liquid Temp. °F	0.65						0.70						0.80					
		G	H	J	K	L	M	G	H	J	K	L	M	G	H	J	K	L	M
Porcelain	0 to +130	—	—	—	—	—	—	—	—	—	—	—	—	6.20 (157)	1.40 (35)	5.30 (134)	1.00 (25)	3.80 (96)	0.90 (22)
Stainless Steel or Karbate	0 to +130	7.70 (195)	2.20 (55)	6.10 (154)	2.00 (50)	4.90 (124)	1.40 (35)	6.70 (170)	1.60 (40)	5.50 (139)	1.60 (40)	4.60 (116)	1.30 (33)	6.50 (165)	2.00 (50)	5.20 (132)	1.60 (40)	4.30 (109)	1.10 (27)

Displacer Type	Liquid Temp. °F	0.90						1.00						1.10					
		G	H	J	K	L	M	G	H	J	K	L	M	G	H	J	K	L	M
Porcelain	0 to +130	6.20 (157)	1.90 (48)	5.00 (127)	1.40 (35)	3.60 (91)	1.00 (25)	4.60 (116)	0.70 (17)	4.00 (101)	0.80 (20)	3.30 (83)	0.90 (22)	4.20 (106)	1.10 (27)	3.80 (96)	1.00 (25)	3.10 (78)	0.90 (22)
Stainless Steel or Karbate	0 to +130	6.60 (167)	2.60 (66)	5.20 (132)	1.80 (45)	4.00 (101)	1.20 (30)	4.60 (116)	1.00 (25)	4.00 (101)	1.00 (25)	3.60 (91)	1.10 (27)	—	—	—	—	—	—

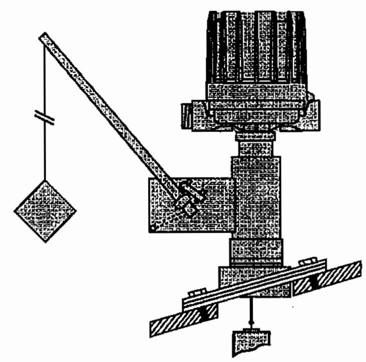
Displacer Type	Liquid Temp. °F	1.20						1.25					
		G	H	J	K	L	M	G	H	J	K	L	M
Porcelain	0 to +130	4.50 (114)	1.60 (40)	3.70 (93)	1.10 (27)	2.90 (73)	0.90 (22)	3.90 (99)	1.10 (27)	3.30 (83)	0.90 (22)	2.80 (71)	0.80 (20)

4.3.13 Proof-er Dimensional Data

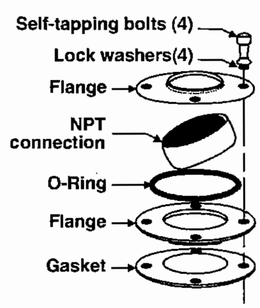
Inches (mm)



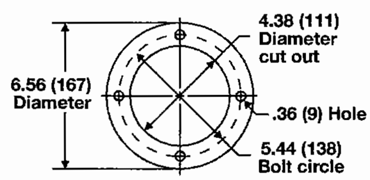
TYPICAL PROOF-ER INSTALLATION WITH VERSA FLANGE



VERSA FLANGE ASSEMBLY
PART NUMBER 089-5207-001

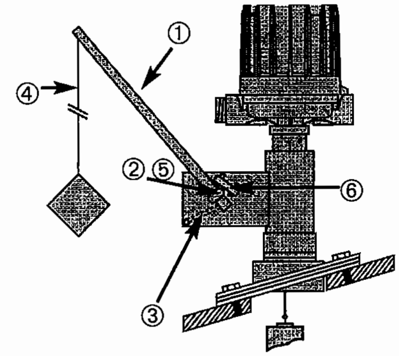


VERSA FLANGE BOLT CIRCLE



4.3.14 Proof-er Replacement Parts

		Proof-er Replacement Part Number	
Item	**Description**	**Low Pressure**	**Medium Pressure**
1	Handle	004-4011-001	004-0490-001
2	O-Ring	Not Required	012-2205-001
3	Spring	013-2502-001	
4	Cable Assembly	089-5807-001	
5	O-Ring Cover	Not Required	004-0489-001
6	Nut	010-2107-004	Not Required



[illegible]

Item No.	Description		A10	A15	B10/B15	C10/C15
1	Enclosing Tube	Standard	Z32-6325-007	Z32-6325-001	Z32-6325-007	Z32-6301-029
		316 SS	Z32-6325-008	Z32-6325-002	Z32-6325-008	Z32-6302-029
2	E-Tube Gasket		012-1301-002			
3	Spring and Stem Kit ①	Standard	089-5327-001	089-5325-001	Consult Factory	
		316 SS	089-5328-001	089-5326-001	Consult Factory	
4	Body Bushing		089-5707-001			
5	Flange and Spring Protector		Specify size and rating. Furnish serial number of control.			

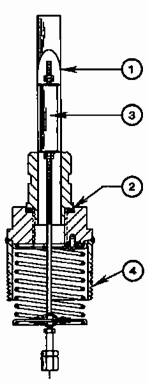
① 316 SS Spring and Stem Kit includes 316 SS sheathed magnetic sleeve.

4.4.1 Displacer Replacement Parts

Displacer Material		A10	A15	B10	B15	C10	C15
Porcelain②		089-6141-001	089-6142-001	089-6143-001	089-6144-001	089-6153-001	089-6156-001
Karbate②		089-6145-001	089-6146-001	089-6147-001	089-6148-001	089-6154-001	089-6157-001
Stainless Steel②		089-6149-001	089-6150-001	089-6151-001	089-6152-001	089-6155-001	089-6158-001
10 feet (3m) Cable	316 SS	089-5802-003③					
with Displacer	Hastelloy	089-5803-003③					
Clamps only	Monel	089-5804-003③					

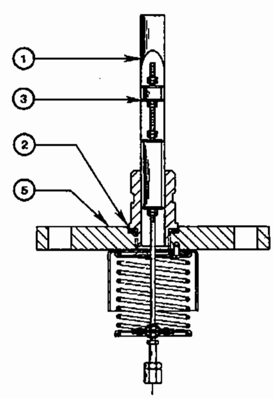
② Kits contain 10 feet (3m) 316 SS cable.
③ For Model C10 with operating sequences A, B, or C order kits:
89-5802-004 (316 SS), 89-5803-004 (Hastelloy), or 89-5804-004 (Monel).

NOTE: Refer to pages 11, 12, 13, 21, 23 & 27 for dimensional specifications of displacers.



Threaded Connection Model
(Typical Single Switch Model)

Flanged Connection Model
(Typical Dual Switch Model)



CAUTION: *Location of magnetic sleeve must be maintained for proper switch actuation. DO NOT attempt to alter differential or [illegible] by repositioning jam nuts.*

4.5.1 A10 & A15 Single Switch Models

PART NUMBER CODE AND SPECIFIC GRAVITY LIMITS*

Part Number Code	Description	Liquid Temp. °F	Liquid Temp. °C	Series A thru E, J and K Switches: Porcelain	Stainless Steel	Karbate
A10①	Wide Differential, 1 switch	100	38	0.60 to 1.20	0.60 to 1.20	0.60 to 1.20
		200	93	0.70 to 1.20	0.70 to 1.20	0.70 to 1.20
		300	149	0.80 to 1.20	0.80 to 1.20	0.80 to 1.20
		400	204	1.00 to 1.20	0.90 to 1.20	—
		500	260	1.10 to 1.20	1.00 to 1.20	—
A15	Narrow Differential, 1 switch	100	38	0.60 to 2.40	0.40 to 1.65	0.40 to 1.65
		200	93	0.62 to 2.40	0.40 to 1.65	0.45 to 1.65
		300	149	0.65 to 2.40	0.50 to 1.65	0.50 to 1.65
		400	204	0.70 to 2.40	0.55 to 1.65	—
		500	260	0.75 to 2.40	0.60 to 1.65	—

MATERIALS OF CONSTRUCTION

Code	Support Spring	Trim	E-Tube Mtg. Nut	Displacer Clamps/ Susp. Cable	Magnetic Sleeve	Process Connection
1	Inconel 600	300 Series SS	Carbon Steel	316 SS	400 Series SS	Carbon Steel ⑩
2 ①	Inconel 600	316 SS	316 SS	316 SS	316 SS	Carbon Steel⑩
4 ①						316 SS
5 ①	Inconel 600	300 Series SS	Carbon Steel	Monel	400 Series SS	Carbon Steel⑩
6 ①				Hastelloy		
M ①② NACE Const.	Inconel X750	316 SS	316 SS	316 SS	316 SS	316 SS
N ①② NACE Const.	Inconel X750	300 Series SS	316 SS	316 SS	316 SS	Carbon Steel

TANK CONNECTION

Tank Connection	Code
2½" NPT Threaded ③	E2
3" 125 lb. Cast Iron Flange ④⑤⑥	G2
3" 150 lb. Steel Flange ⑤⑦	G3
4" 125 lb. Cast Iron Flange ④⑥	H2
4" 150 lb. Steel Flange ⑦	H3
4" 300 lb. Steel Flange ⑦	H4
6" 125 lb. Cast Iron Flange ④⑥	K2
6" 150 lb. Steel Flange ⑦	K3
6" 300 lb. Steel Flange ⑦	K4

DISPLACER MATERIAL AND PROOF-ER OPTION

Proof-er** Type	Displacer Material: Porcelain	316 SS	Karbate	Floating Roof Weight Mat'l: Lead
Without Proof-er	A	B	C	K ④
Low Pressure ③	D ④	E ④	F ④	L ④
Medium Pressure ③	G ④	H ④	J ④	—

A	1		—					—			

* Specific gravity limits do not apply to floating roof top units not to be used in liquid.

**Proof-er option constructed of carbon steel material.

4.5.1 A10 & A15 Single Switch Models (continued)

ELECTRIC SWITCH MECHANISM AND ENCLOSURE[8] FOR MODELS A10 AND A15

Switch Description	Max.[9] Process Temp. ° F (°C)	One Set Point	A10 Codes			A15 Codes		
			Aluminum Polymer Coated NEMA 4X/7/9[10]					
			Class I, Div. 1, Groups C & D	Class I, Div. 1, Group B	ATEX	Class I, Div. 1, Groups C & D	Class I, Div. 1, Group B	ATEX
Series A Mercury Switch	500 (260)	SPDT	AKB	AKK	AC9	AKQ	AKS	AA9
		DPDT	ANB	ANK	AF9	ANQ	ANS	AB9
Series B Snap Switch	250 (121)	SPDT	BKB	BKK	BC9	BKQ	BKS	BA9
		DPDT	BNB	BNK	BF9	BNQ	BNS	BB9
Series C Snap Switch	450 (232)	SPDT	CKB	CKK	CC9	CKQ	CKS	CA9
		DPDT	CNB	CNK	CF9	CNQ	CNS	CB9
Series D Snap Switch For DC Current Applications	250 (121)	SPDT	DKB	DKK	DC9	DKQ	DKS	DA9
		DPDT	DNB	DNK	DF9	DNQ	DNS	DB9
Series E Vibration Resistant Mercury Switch	500 (260)	SPDT	EKB	EKK	EC9	EKQ	EKS	EA9
		DPDT	ENB	ENK	EF9	ENQ	ENS	EB9
Series HS Hermetically Sealed Snap Switch w/Wiring Leads	500[11] (260)	SPDT	HMJ	HMK	—	HMC	HEK[12]	—
		DPDT	HMS	HMT	—	HMF	HET[12]	—
Series HS Hermetically Sealed Snap Switch w/Terminal Block	500[11] (260)	SPDT	HM3	HM4	HA9	HM3[13]	HM4[13]	HA9
		DPDT	HM7	HM8	HB9	HM7[13]	HM8[13]	HB9

PNEUMATIC SWITCH MECHANISM AND ENCLOSURE FOR MODELS A10 AND A15

Switch Description	Maximum Supply Pressure		Maximum[9] Process Temperature		Bleed Orifice Diameter		A10 Codes	A15 Codes
	psig	bar	° F	° C	Inches	mm	NEMA 1	NEMA 1
Series J Bleed Type Pneumatic Switch	100	7	400	204	.063	1.6	JGF	JDE
	60	4	400	204	.094	2.3	JHF	JEE
Series K Non-Bleed Pneumatic Switch	100	7	400	204	—	—	KOF	KOE

① Not available with displacer material and proof-er option codes K, L.

② Not available with displacer material and proof-er option codes D, E, F, G, H, J, K and L.

③ Pressure/temperature ratings on page 10. Flanges are ANSI type.

④ Not available with material of construction codes M and N.

⑤ Not available with displacer material and Proof-er option codes K, L.

⑥ Not available with material of construction code 4.

⑦ 316 SS flange is provided with material of construction code 4 and M.

⑧ Consult factory for NEMA 4X/7/9 cast iron housings.

⑨ Process temperature based on +100° F (+38° C) ambient.

⑩ Uncontrolled housing heater or drain available in NEMA 4X/7/9 enclosures. Consult factory for standard part numbers.

⑪ On steam applications, temperature down rated to +400° F (+204° C) process at +100° F (+38° C) ambient. Available with a 6" tall cover only.

⑫ CSA approval does not apply to these switch designations.

⑬ Available with a 6" tall cover only.

⑭ 125# flanges will be cast iron.

A	1		—					—			

4.5.2 B10 & B15 Dual Switch Models

PART NUMBER CODE AND SPECIFIC GRAVITY LIMITS*

Part Number Code	Description	Liquid Temp.		Series A thru E, J and K Switches		
		° F	° C	Porcelain	Stainless Steel	Karbate
B10	Wide Differential, 2 switches	100	38	0.60 to 1.50	0.50 to 1.00	0.50 to 1.00
		200	93	0.64 to 1.50	0.50 to 1.00	0.50 to 1.00
		300	149	0.80 to 1.50	0.60 to 1.00	0.60 to 1.00
		400	204	1.00 to 1.50	0.72 to 1.00	—
		500	260	1.10 to 1.50	0.84 to 1.00	—
B15	Narrow Differential, 2 switches	100	38	0.95 to 1.20	0.70 to 1.20	0.70 to 1.20
		200	93	1.10 to 1.20	0.80 to 1.20	0.80 to 1.20
		300	149	—	0.90 to 1.20	0.90 to 1.20
		400	204	—	1.00 to 1.20	—
		500	260	—	1.04 to 1.20	—

MATERIALS OF CONSTRUCTION

Code	Support Spring	Trim	E-Tube Mtg. Nut	Displacer Clamps/ Susp. Cable	Magnetic Sleeve	Process Connection
1	Inconel 600	300 Series SS	Carbon Steel	316 SS	400 Series SS	Carbon Steel ⑬
2 ①	Inconel 600	316 SS	316 SS	316 SS	316 SS	Carbon Steel ⑬
4 ①						316 SS
5 ①	Inconel 600	300 Series SS	Carbon Steel	Monel	400 Series SS	Carbon Steel ⑬
6 ①				Hastelloy		
M ①② NACE Const.	Inconel X750	316 SS	316 SS	316 SS	316 SS	316 SS
N ①② NACE Const.	Inconel X750	300 Series SS	316 SS	316 SS	316 SS	Carbon Steel

TANK CONNECTION

Tank Connection	Code
2½" NPT Threaded ③	E2
3" 125 lb. Cast Iron Flange ④⑤⑥	G2
3" 150 lb. Steel Flange ⑤⑦	G3
4" 125 lb. Cast Iron Flange ④⑥	H2
4" 150 lb. Steel Flange ⑦	H3
4" 300 lb. Steel Flange ⑦	H4
6" 125 lb. Cast Iron Flange ④⑥	K2
6" 150 lb. Steel Flange ⑦	K3
6" 300 lb. Steel Flange ⑦	K4

DISPLACER MATERIAL AND PROOF-ER OPTION

Proof-er** Type	Displacer Material			Floating Roof Weight Mat'l Model B15 Only
	Porcelain	316 SS	Karbate	Lead
Without Proof-er	A	B	C	K ④
Low Pressure ③	D ④	E ④	F ④	L ④

B	1		–					–			

* Specific gravity limits do not apply to floating roof top units not to be used in liquid.
**Proof-er option constructed of carbon steel material.

4.5.2 B10 & B15 Dual Switch Models (continued)

ELECTRIC SWITCH MECHANISM AND ENCLOSURE ⑧ FOR MODELS B10 AND B15

Switch Description ⑨	Max. ⑩ Process Temp. ° F (°C)	Two Set Points	Switch Enclosure NEMA 4X/7/9 ⑪ Class I, Div. 1, Groups C & D	Switch Enclosure NEMA 4X/7/9 ⑪ Class I, Div. 1, Group B	Switch Enclosure ATEX
Series A Mercury Switch	500 (260)	SPDT	ALB	ALK	AD9
		DPDT	AOB	AOK	AG9
Series B Snap Switch	250 (121)	SPDT	BLB	BLK	BD9
		DPDT	BOB	BOK	BG9
Series C Snap Switch	450 (232)	SPDT	CLB	CLK	CD9
		DPDT	COB	COK	CG9
Series D Snap Switch For DC Current Applications	250 (121)	SPDT	DLB	DLK	DD9
		DPDT	DOB	DOK	DG9
Series E Vibration Resistant Mercury Switch	500 (260)	SPDT	ELB	ELK	ED9
		DPDT	EOB	EOK	EG9
Series HS Hermetically Sealed Snap Switch w/Wiring Leads	500 ⑫ (260)	SPDT	HMN	HMP	—
		DPDT	HMY	HMZ	—

① Not available with displacer material and proof-er option codes K, L.
② Not available with displacer material and proof-er option codes D, E, F, K and L.
③ Pressure/temperature ratings on page 10. Flanges are ANSI type.
④ Not available with material of construction codes M and N.
⑤ Not available with displacer material and Proof-er option codes K, L.
⑥ Not available with material of construction code 4.
⑦ 316 SS flange is provided with material of construction code 4 and M.
⑥ Not available with displacer material and Proof-er option codes K, L.
⑧ Consult factory for NEMA 4X/7/9 cast iron housings.
⑨ Pneumatic switch mechanisms and enclosures are unavailable for Models B10 and B15 switches.
⑩ Process temperature based on +100° F (+38° C) ambient.
⑪ Uncontrolled housing heater or drain available in NEMA 4X/7/9 enclosures. Consult factory for standard part numbers.
⑫ On steam applications, temperature down rated to +400° F (+204° C) process at +100° F (+38° C) ambient.
⑬ 125# flanges will be cast iron.

B	1		—					—			

4.5.3 C10 & C15 Triple Switch Models

PART NUMBER CODE AND SPECIFIC GRAVITY LIMITS**

Part Number Code	Description	Liquid Temp.		Series A thru E, J and K Switches		
		° F	° C	Porcelain	Stainless Steel	Karbate
C10	Wide Differential, 3 switches	100	38	0.65 to 1.20	0.58 to 1.20	0.58 to 1.20
		200	93	0.95 to 1.10	0.76 to 1.00	0.76 to 1.00
		300	149	—	0.82 to 1.00	0.82 to 1.00
C15*	Narrow Differential, 3 switches	130	54	0.80 to 1.25	0.65 to 1.00	0.65 to 1.00

* Consult factory for high temperatures

** Each C10/C15 instrument is factory calibrated to operate for a given specific gravity within the minimum and maximum values listed

MATERIALS OF CONSTRUCTION

Code	Support Spring	Trim	E-Tube Mtg. Nut	Displacer Clamps/ Susp. Cable	Magnetic Sleeve	Process Connection
1	Inconel 600	300 Series SS	Carbon Steel	316 SS	400 Series SS	Carbon Steel ⑦
2 ①	Inconel 600	316 SS	316 SS	316 SS	316 SS	Carbon Steel ⑦
4 ①						316 SS
5 ①	Inconel 600	300 Series SS	Carbon Steel	Monel	400 Series SS	Carbon Steel ⑦
6 ①				Hastelloy		
M ①② NACE Const.	Inconel X750	316 SS	316 SS	316 SS	316 SS	316 SS
N ①② NACE Const.	Inconel X750	300 Series SS	316 SS	316 SS	316 SS	Carbon Steel

TANK CONNECTION

Tank Connection	Code
2½" NPT Threaded ①	E2
3" 125 lb. Cast Iron Flange ②	G2
3" 150 lb. Steel Flange ③	G3
4" 125 lb. Cast Iron Flange ②	H2
4" 150 lb. Steel Flange ③	H3
4" 300 lb. Steel Flange ③	H4
6" 125 lb. Cast Iron Flange ②	K2
6" 150 lb. Steel Flange ③	K3
6" 300 lb. Steel Flange ③	K4

DISPLACER MATERIAL

Displacer Material		
Porcelain	316 SS	Karbate
A	B	C

C 1 0 – 2 E 2 A – Q K B

4.5.3 C10 & C15 Triple Switch Models (continued)

ELECTRIC SWITCH MECHANISM AND ENCLOSURE ⑥ FOR MODELS C10 AND C15

Switch Description ④	Maximum ⑤ Process Temp. ° F (° C)	Three Set Points	Aluminum Polymer Coated Switch Enclosure NEMA 4X/7/9			
			Class I, Div. 1, Groups C & D	Aluminum With Heater	Aluminum With Drain	Aluminum Class I, Div. 1, Group B
Series N Mercury Switch	300 (149)	SPDT	NMB	NRB	NWB	NMN
		DPDT	NKB	NLB	NNB	NKN
Series O Snap Switch	300 (149)	SPDT	OMB	Not Available	OWB	OMN
		DPDT	OKB		ONB	OKN
Series Q Snap Switch	250 (121)	SPDT	QMB	QRB	QWB	QMN
		DPDT	QKB	QLB	QNB	QKN
Series T Vibration Resistant Mercury Switch	300 (149)	SPDT	TMB	TRB	TWB	TMN
		DPDT	TKB	TLB	TNB	TKN

① Pressure/temperature ratings on page 10. Flanges are ANSI type.
② Not available with material of construction codes 4, M and N.
③ 316 SS flange is provided with material of construction code 4 and M.
④ Pneumatic switch mechanisms and enclosures are unavailable for Models C10 and C15 switches.
⑤ Process temperature based on +100° F (+38° C) ambient.
⑥ Consult factory for NEMA 4X/7/9 cast iron housings.
⑦ 125# flanges will be cast iron.

C 1 ☐ – ☐ ☐ ☐ ☐ – ☐ ☐ ☐

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of Magnetrol controls may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. Magnetrol will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory, prior to the material's return. This is available through Magnetrol's local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

Magnetrol

5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4000 • Fax 630-969-9489 • www.magnetrol.com
145 Jardin Drive, Units 1 & 2 • Concord, Ontario Canada L4K 1X7 • 905-738-9600 • Fax 905-738-1306
Heikensstraat 6 • B 9240 Zele, Belgium • 052 45.11.11 • Fax 052 45.09.93
Regent Business Ctr., Jubilee Rd. • Burgess Hill, Sussex RH15 9TL U.K. • 01444-871313 • Fax 01444-871317

STI

5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4028 • Fax 630-969-9489 • www.sticontrols.com

BULLETIN: 45-610.19
EFFECTIVE: May 2006
SUPERSEDES: December 2005

Appendix I

Westbay® Monitoring Well Operations and Repair Manual

OPERATIONS MANUAL

Westbay MOSDAX Sampler Probe - Model 2531

Schlumberger
WATER SERVICES

NOTICE

Operation of Westbay System equipment should only be undertaken by qualified instrument technicians who have been trained by Westbay authorized personnel.

This document contains proprietary information. No part of this document may be photocopied, reproduced or translated to another language without the prior written consent of Westbay Instruments Inc. The information contained in this document is subject to change without notice.

DO NOT OPEN THE SAMPLER

All warranties expressed or implied will be void if, after examination by Westbay Instruments Inc. personnel, it is established that any of the instrument housings have been opened without prior authorization from Westbay Instruments Inc.

DO NOT LET THE SAMPLER FREEZE

Extreme care should be taken to avoid freezing the MOSDAX Sampler probe. Permanent transducer damage may result from freezing.

Manual Revision: 1.13 20 October 2006

Issued for Serial No.: ________________

Date: ________________

Signature: ________________

Contents

1. DESCRIPTION

1.1 MOSDAX Sampler Probe, Model 2531

The MOSDAX Sampler is a downhole probe designed to collect fluid pressure information and fluid samples from Westbay System monitoring wells. Each MOSDAX pressure sensor is calibrated over its full pressure range for nonlinearity and temperature variation. MOSDAX Sampler probes are available in a variety of pressure ranges to permit operation to various depths. The shoe and valve motors can be operated from the surface. The power for the shoe and valve motors is supplied from the surface.

1.2 MOSDAX Automated Groundwater Interface (MAGI), Model 2536

The MOSDAX Sampler can be operated directly by the keypad on the MOSDAX Automated Groundwater Interface (MAGI), or by a Hand Held Controller (HHC) connected to the MAGI, or with a computer running Microsoft Windows (2000 or higher) and Westbay software connected to the MAGI. The MAGI translates the signals between the computer or HHC and the MOSDAX Sampler. The MAGI requires 12 volt DC power to operate.

Older versions of MOSDAX sampling equipment may incorporate a Model 2522 MOSDAX PC Interface (MPCI) and HHC rather than a MAGI. For such systems, reference to the MAGI in this document can be considered as reference to the MPCI and HHC.

1.3 Cable Reels

The manual cable reel can operate all Westbay probes and tools to a depth of 300m (1,000 ft) on a single-conductor cable. The manual reel is hand operated with an internal brake to control the speed of descent of the probe in the well. The two-pin cable connects the MAGI to the reel and the signals pass through a slipring located in the hub of the reel into the control cable. For maintenance information, see the appropriate cable reel manual.

Motorized cable reels are available for deeper applications.

1.4 Sample Containers

Sample containers can be used with the MOSDAX Sampler. The nonvented stainless steel sample containers maintain samples under formation pressure while the sampler and container are brought to the surface.

2. PRESSURE PROFILING

2.1 Items Required

- MOSDAX Sampler Probe, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sheave with counter and tripod
- 12 VDC, 2 Amp power source (Battery pack, car/truck battery, or transformer)
- Water level measuring tape
- MProfile User's Guide for computer or the Handheld Controller Operations Manual
- Westbay Casing Log showing depths to ports and couplings in hole to be tested.

2.2 Surface Checks

1. Remove the MOSDAX Sampler from its storage case. Inspect the probe housing and body for any damage. Please contact Westbay for advice on any cover tube damage.
2. Assemble the tripod and counter over the well. Run the cable over the counter.
3. Connect the probe to the cable. Before attaching, inspect the O-ring at the top of the probe and lubricate with silicon. The O-ring should be clean and intact. Tighten the nut hand tight only.
4. Connect the two-pin cable from the MPCI to the cable reel. With the MPCI OFF connect the three-pin cable from the MPCI to the 12 v power supply.
5. Connect the 9 pin cable from computer or HHC to the MPCI and turn the MPCI ON.
6. Perform the following surface checks to ensure that the location arm and the shoe mechanisms are operating normally: Release the location arm. The location arm should extend smoothly. The number of revolutions used to release the location arm is displayed and should be 15 to 16 revolutions. If a smaller number of revolutions is reported, retract the arm and repeat. Place the probe in a piece of Westbay casing or coupling. Activate the shoe. The shoe should extend and hold the probe firmly in the coupling or casing. The display should indicate 16 to 19 revolutions. A reading of 23 revolutions indicates the probe is activated in open air. Retract the backing shoe.

7. Check that the face plate for sampling and the plastic plunger are installed on the sampler.

8. The probe is now ready to be lowered down the well.

2.3 Pressure Measurement Procedures

1. Obtain the completed Westbay Casing Log.

2. With the location arm retracted, lower the probe into the Westbay casing to immediately below the lowest measurement port coupling to be monitored. If magnetic collars have been installed on the well, the Collar Detect Command can be used to detect the collars. The Collar Detect Command is cancelled by pressing any key.

3. Release the location arm. The display should update and beep after the arm is released.

4. Raise the probe about 0.5 m (1.5 ft) above this measurement port. If the probe is accidentally lifted above the next higher coupling, it will be necessary to retract the location arm and lower the probe to below the measurement port and release the arm.

5. Lower the probe gently until the location arm rests in the measurement port.

6. Record the pressure and temperature inside the Westbay casing.

7. Optional: If a water level tape is available, measure and record the depth to water in the Westbay casing.

8. Activate the shoe. The pressure on the display should change to the formation pressure.

9. When the reading has stabilized, record the formation pressure.

10. Once the pressure has been recorded, retract the shoe.

11. Record the pressure of the fluid in the Westbay casing. This reading should be similar to that recorded in Step 6. If a large difference is noted between the readings, record the water level inside the Westbay casing again using the water level tape.

12. The three pressure readings plus the time and water level constitute a complete set of readings at a measurement port coupling.

13. Continue up the Westbay casing to obtain the pressure data from other measurement ports.

14. Take one last set of pressure and temperature readings at the surface. These readings should be similar to those recorded in Step 2.

CAUTION: If a water level tape was used, remove the water level tape from the Westbay casing before removing the sampler probe from the well to prevent them from becoming jammed.

3. FLUID SAMPLING

3.1 Items Required

- MOSDAX Sampler, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sample containers and connecting tubes
- Westbay Casing Log
- Groundwater Sampling Field Data Sheet
- 12 VDC, 2 amp power source (battery pack, car/truck, or transformer)
- Counter and tripod
- Westbay Sampling Kit including vacuum pump

3.2 Surface Checks and Preparation

1. Set up the MOSDAX Sampler probe following Steps 1 through 8 of Section 2.2.
2. Attach the sample containers.
3. Release the location arm. Locate the probe in the vacuum coupling.
4. Activate the shoe in the vacuum coupling.
5. Close the sampler valve. The motor should run about 5 seconds. The display should indicate one revolution.
6. Use the vacuum pump to apply a vacuum through the vacuum coupling. The vacuum should remain constant. If the vacuum is not maintained, inspect for leaks at the face seal of the probe, the connection to the pump and at the probe sampling valve.
7. Once a vacuum has been maintained, open the sampler valve. Apply a vacuum again to check that all connections are sealed.
8. Close the sampler valve. A vacuum has now been applied to the sample bottles.
9. Retract the shoe.

3.3 Drillhole Sampling

1. Check recent pressure logs of the hole and ensure that the head inside the Westbay casing is lower than the head outside the measurement port to be sampled.
2. After completing the surface checks, follow Steps 1 to 5 of Section 2.3 to locate the sampler at the measurement port in the monitoring zone to be sampled.
3. Record the pressure reading.
4. Activate the probe and record the formation pressure.
5. Open the sampler valve. The pressure should drop and then slowly increase as the bottles fill. When the pressure in the bottle equals the zone pressure from Step 4, the bottle is full. Wait a maximum of two minutes per sample bottle even if the pressures are not equal.
6. Close the sampler valve and retract the shoe.
7. Record the pressure reading. A reading the same as in Step 3 indicates that the sample is OK.
8. Reel the sampler to the surface and remove it from the Westbay casing.
9. **Do not open the sampler valve as damage to the probe or injury to the operator could occur.**
10. Remove the cap from the bottom sample bottle and open the valve on the bottle to release the pressure and to transfer the sample.
11. Open the sampler valve to allow the sample to flow from the bottles. Once the pressure in the sampler and bottles has decreased to atmospheric, the bottles may be disconnected to speed the process.
12. Take particular care in handling pressurized samples.

3.4 Rinsing Instructions

Rinse the sampler around the face seal and the bottom connector. With the sampler valve open, flush the interior of the sampler from the bottom connector. Rinse the sample bottles and connectors.

Note: Project specific procedures for decontaminating the sampler and sample bottles are the responsibility of the project manager and are not covered in this manual.

4. Care and Maintenance

The MOSDAX Sampler System must be routinely maintained for optimum performance. The procedures outlined here are required to keep the instrument operating properly. For any additional information or advice, please contact Westbay Instruments Inc.

4.1 MAGI

The MAGI should be cleaned to remove dirt and dust and inspected for damage or wear. If any part requires replacement, contact Westbay for information.

4.2 Cable Reels and Control Cable

The cable reels should be kept clean and protected from damage. The cable and cable head should be inspected for kinks and corrosion. Rehead the cable if necessary. For more information concerning cable reels and the control cable, refer to the appropriate reel manual.

4.3 MOSDAX Sampler Probe

1. Never allow the probe to freeze or the pressure transducer may be damaged.
2. Clean and inspect the probe for dents and scratches on the cover tube. Clean the threads with a nylon brush, such as a toothbrush. DO NOT use a wire brush. Protect the O-rings from damage and dirt.

4.3.1 Face Seal

Inspect the face seal and replace if damaged or worn.

1. Remove the two screws holding the face plate to the probe body and lift the face plate off.
2. Remove the face seal and plunger. Set the location arm assembly aside. Clean the plunger and probe body.
3. When reinstalling the face plate hold the face seal, plunger and location arm assembly in place. Replace the two screws the hold the face plate on the probe.

4.3.2 Location Arm

Release the location arm. Check that the arm moves smoothly and freely and check for damage and sharp edges due to wear. Replace the location arm if necessary.

1. Release the location arm. Remove the two screws and face plate (Section 4.3.1).
2. Remove the location arm with its spring and pivot pin. Clean and inspect all parts and replace if needed.
3. Insert the spring and pivot in the location arm and place the assembly in the probe body. Place the face plate over the face seal and location arm and tighten the two screws.

SECTION 4.3.2 SUPPLEMENT

WESTBAY Probe Location Arm replacement

a) It is easier when the arm is first extended to the "out" position (Fig. A). Do this before powering down and disconnecting the probe.

b) Remove the face seal slowly and stabilize the arm as it is under tension from the spring (Section 4.3.2.2) and may suddenly pop out. Observe the position and orientation of the parts as they are removed (Fig. B).

c) Insert the hook of bent leg of the spring into the tiny hole on the neck of the new arm and align the spring coil opening alongside the larger hole in the arm with the spring leg positioned directly against the arm and over the pivot facing out (Fig. C-1). The metal pivot pin goes through the hole in the arm and through the spring coil (Fig. C-2). The straight leg of the spring leads under the pivot into the smaller side slot on the side of the main arm aperture, parallel with the probe. Place the assembly into its space in the probe body (Fig. C-3). The arm assembly has to be held in place while replacing the face seal to counter the force of the slightly compacted spring (Fig.C-4).

d) Replace the face seal by sliding it toward the top of the probe and sliding the top edge into the slot while at the same time allowing the arm to protrude through the face seal. The arm should remain in the extended position while screwing down the face seal.

e) Check to see that the arm can be freely, manually pushed in and that it pops back out when released. Attach the probe to the cable and mechanically retract the arm using the MAGI commands.

Figure **A** - Arm is extended out at start of replacement operation.

Figure **B** - Disassembled face seal and location arm.

Figure **C-1 -** Orientation of spring relative to arm.

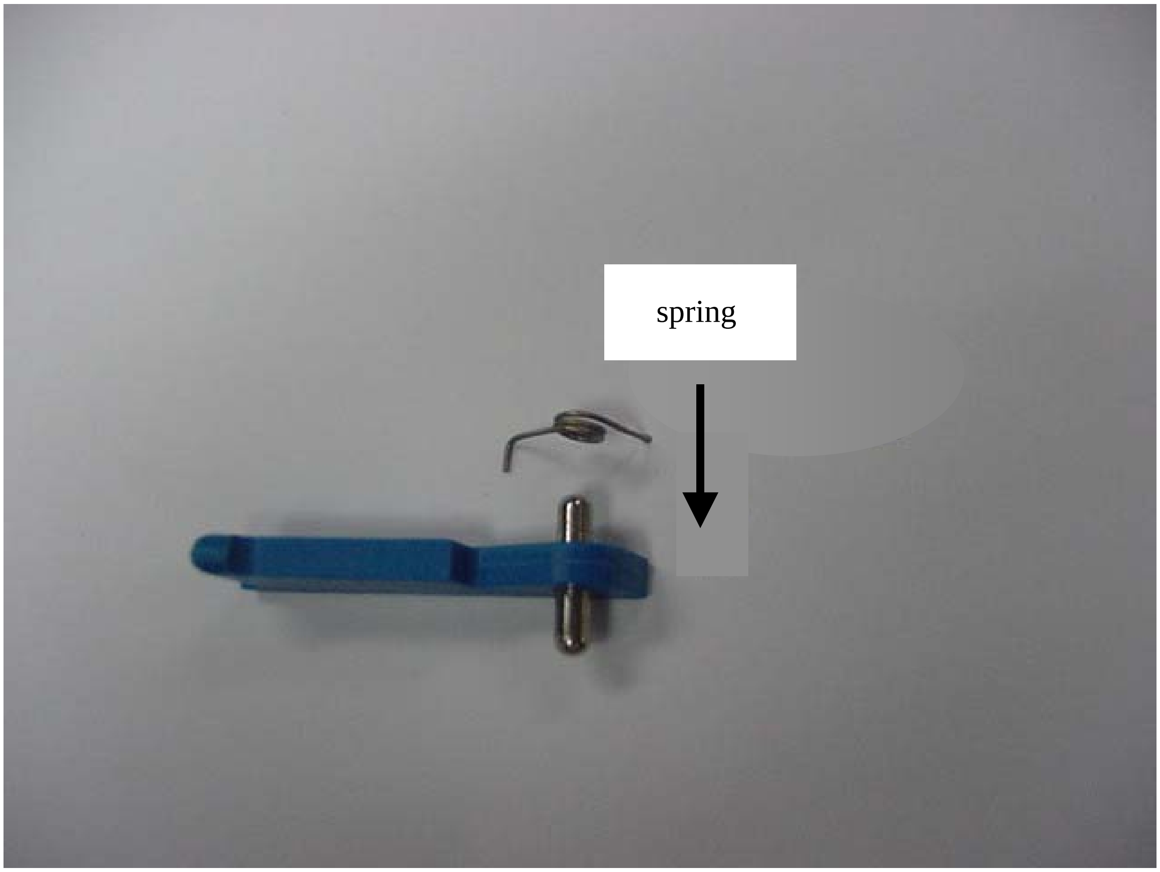


Figure **C-2 -** Position of spring and pivot in the arm.

Figure **C-3** - Placement of arm assembly.

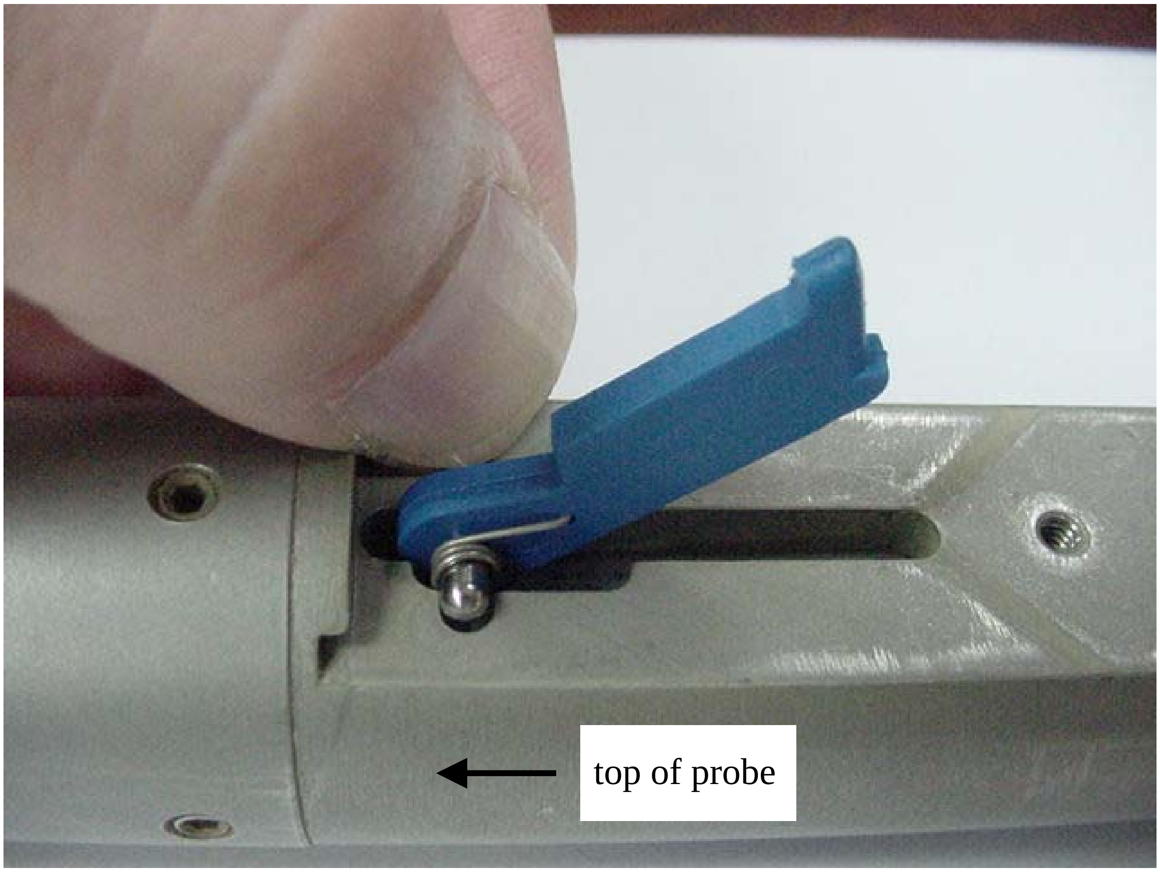
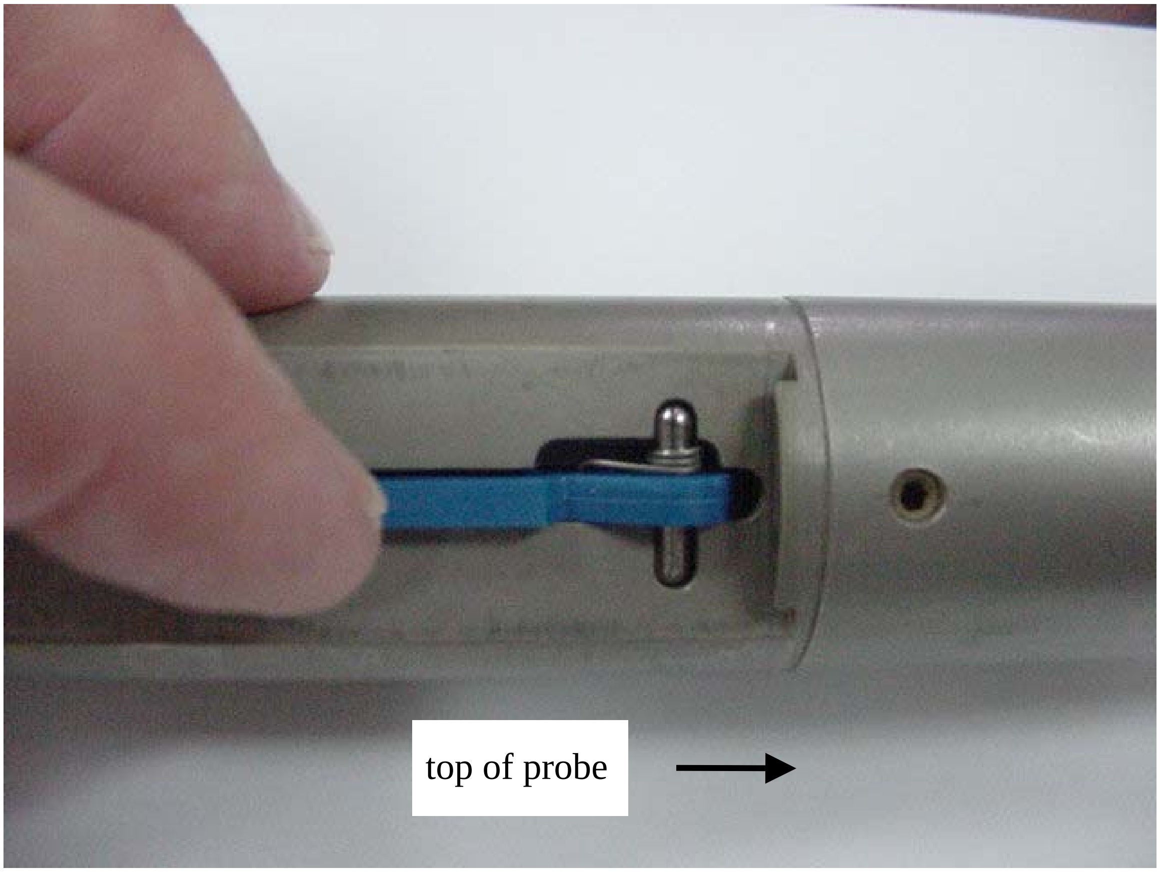


Figure **C-4 -** Top view of arm and spring placement.



Check that the arm is moving freely and the face seal insert and plunger are held securely in place.

4.3.3 Shoe Replacement

Activate the shoe and inspect for damage or wear. The shoe should rotate freely about the pivot pin. When the shoe is retracted it should retract quickly and smoothly back into the probe. The shoe may be replaced in the following manner:

1. Release the location arm and extend the shoe to expose the pivot pin.
2. Unscrew the shoe pivot pin from the lever arm and remove the shoe.
3. Place a new shoe in the lever arm and install the shoe pivot pin.

4.3.4 Actuator Nut

The actuator nut needs to be routinely cleaned to remove particles of grit which can interfere with its movement. Remove the actuator nut in the following manner:

1. Remove the two set screws that hold in the lever arm pivot pin. Using the Allen key, push the lever pivot pin out of the probe body.
2. Remove the set screws on the side of the probe body that holds the plastic support block.
3. Remove the screw closest to the top of the probe.
4. Lift out the lever arm, guide plate, shoe, spring and plastic support block as one unit.
5. Use the Clean Nut Command to remove the actuator nut from the actuator screw. Turn off the MPCI and remove the nut from the probe.
6. Clean the actuator nut with the cleaning tap. Use the Clean Nut Command and clean the actuator screw with a nylon brush. DO NOT use a wire brush.
7. Apply a thin coating of silicone lubricant to the actuator screw. Place the actuator nut in the probe body against the actuator screw and retract the arm to thread the nut onto the actuator screw. Allow the nut to travel along the full length of the screw. YOU MAY HAVE TO REPEAT THIS OPERATION.
8. Install the single unit from Step 4 in the probe body. Install the lever arm pin through the probe body, lever arm, and spring. Lock the pin in position with two set screws.
9. Install the top screw into the guide plate and install the set screws to secure the support block.

5. CALIBRATION

The Westbay System permits frequent or periodic calibration of the transducers used for pressure measurement. Contact Westbay for details.

6. SPARE PARTS LIST

Item	Part No. or Size	Qty
Face Seal Insert	200302	5
Plunger	(see Note 1)	5
Location Arm	252112	5
Shoe	252313	5
Pin 3 (Location Arm)	252320	2
Spring 2 (Location Arm)	252319	2
Pin 1 (Shoe)	252316	2
Spring 1 (Shoe Lever)	252318	2
Pan Head Screw	# 4-40 x 1/4 - inch	2
Pan Head Screw	# 6-32 x 3/16 - inch	2
Pan Head Screw	# 6-32 x 1/2 - inch	2
Hex Socket Head Screw	# 8-32 x 1/8 - inch	4
Hex Socket Head Screw	# 10-32 x 3/16 - inch	4
Hex Socket Set Screw	# 8-32 x 5/16 - inch	2
Allen Key	5/64 - inch	1
Allen Key	3/32 - inch	1
Actuator Nut Tap	208001	1
Cablehead Parts:		
O-ring	# 111 B	2
Termination Sleeve	251805	1
Termination Insert	251806	1
Feedthru Connector	251814	1
Bushing 1	251812	1
Bushing 2	251813	1
O-Ring	# 108 V	1
O-Ring	# 010 V	1
O-Ring	# 004 V	1
Boot	JF0602CF	1
Contact	JF0603CF	1
Cable Heading Tool	208100	1

1. Plunger appropriate to type of measurement port to be accessed.

Schlumberger
WATER SERVICES

Groundwater Sampling
Field Data Sheet

Project: ______________________

Monitoring Well No.: ______________________

Sampling Zone No(s).: ______________________

Date: ______________________

Start Time: ____________ Atm. Rdg: ____________

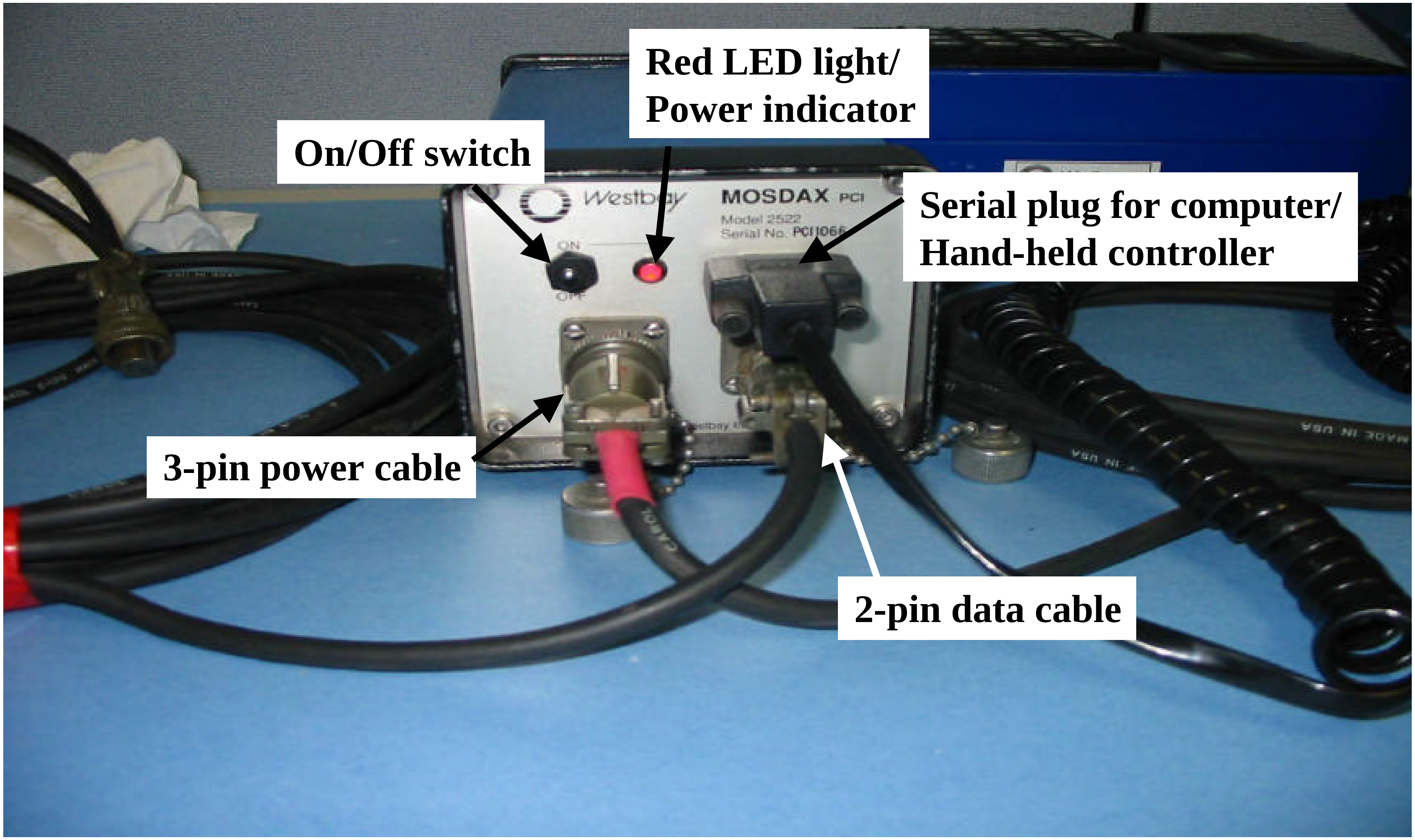
End Time: ____________ Atm. Rdg: ____________

Operators: ______________________

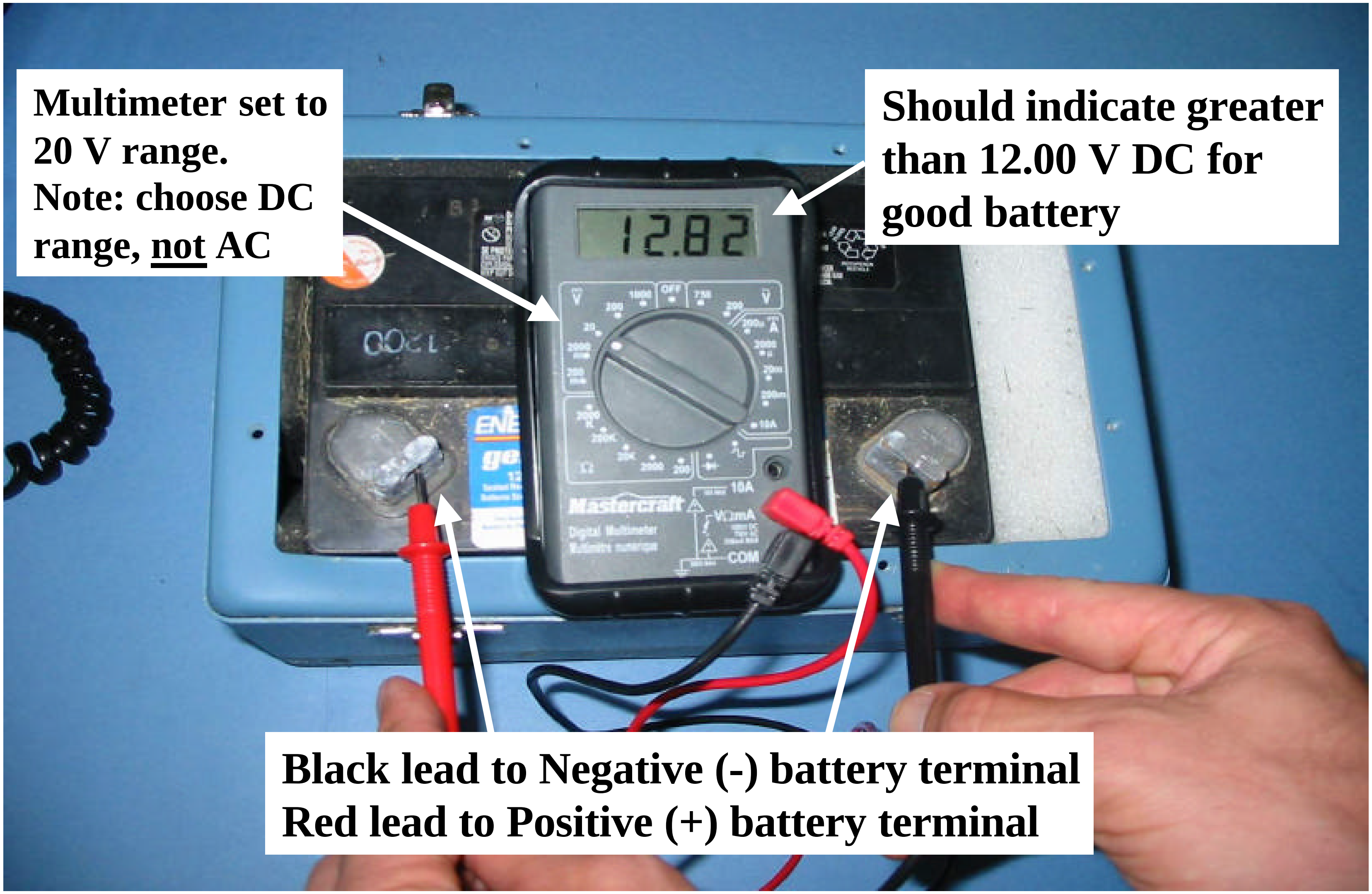
Port No.	Run No.	Surface Function Tests (probe in flushing collar)						Position Sampler			Sample Collection Checks (probe located at sampling zone in Westbay casing)								Comments (volume recovered)
		Shoe Out	Close Valve	Check Vacuum	Open Valve	Apply Vacuum	Close Valve	Locate Port	Arm Out	Land Probe	Pressure in Westbay ( )	Shoe Out	Zone Pressure ( )	Open Valve	Zone Pressure ( )	Close Valve	Shoe In	Pressure in Westbay ( )	

Additional Comments: (pH, turbidity, S.C., etc.)

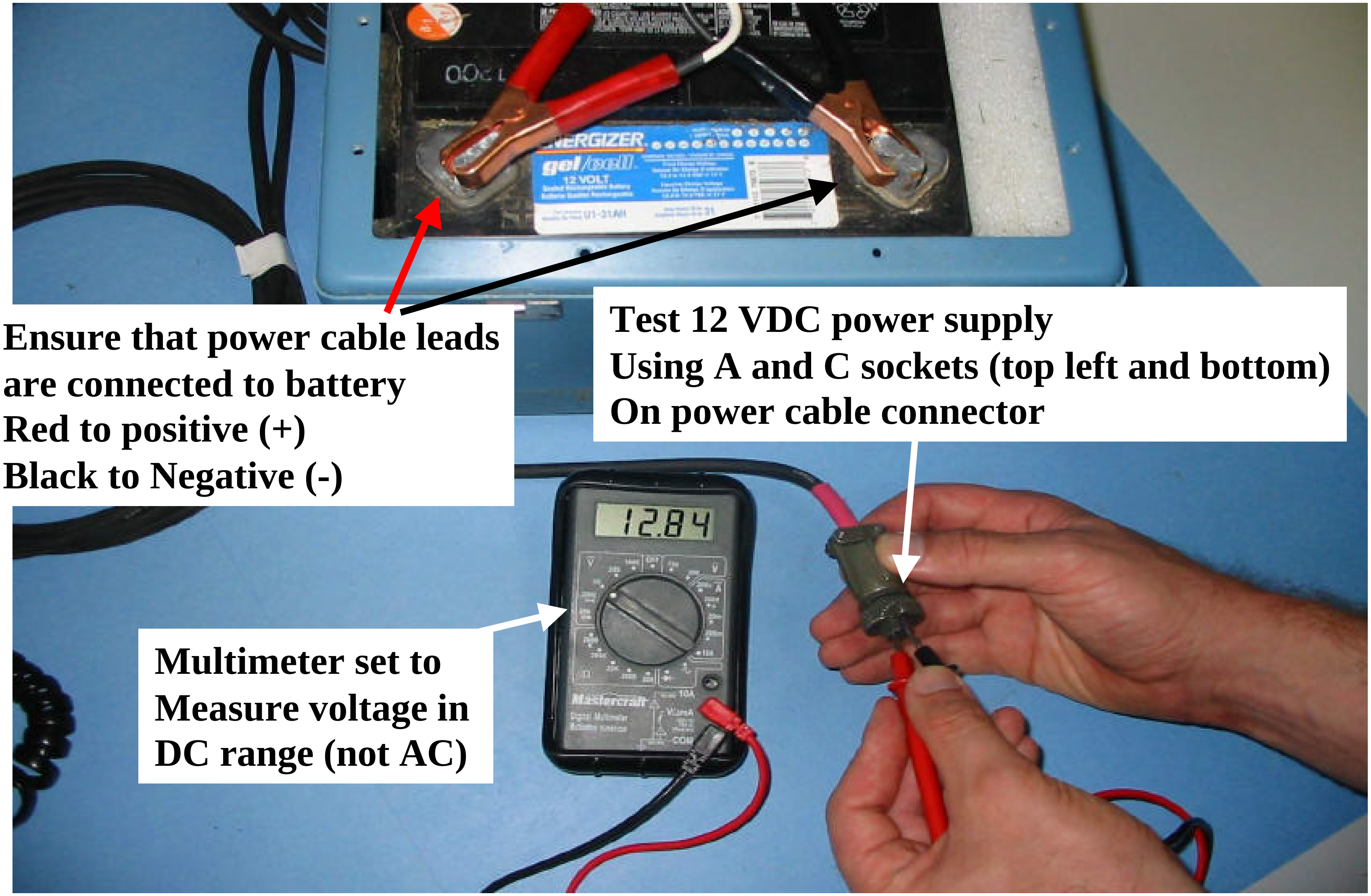
Pic.1 Computer Interface Units, old and new:
MPCI model 2522 (left) and MAGI model 2536 (right)



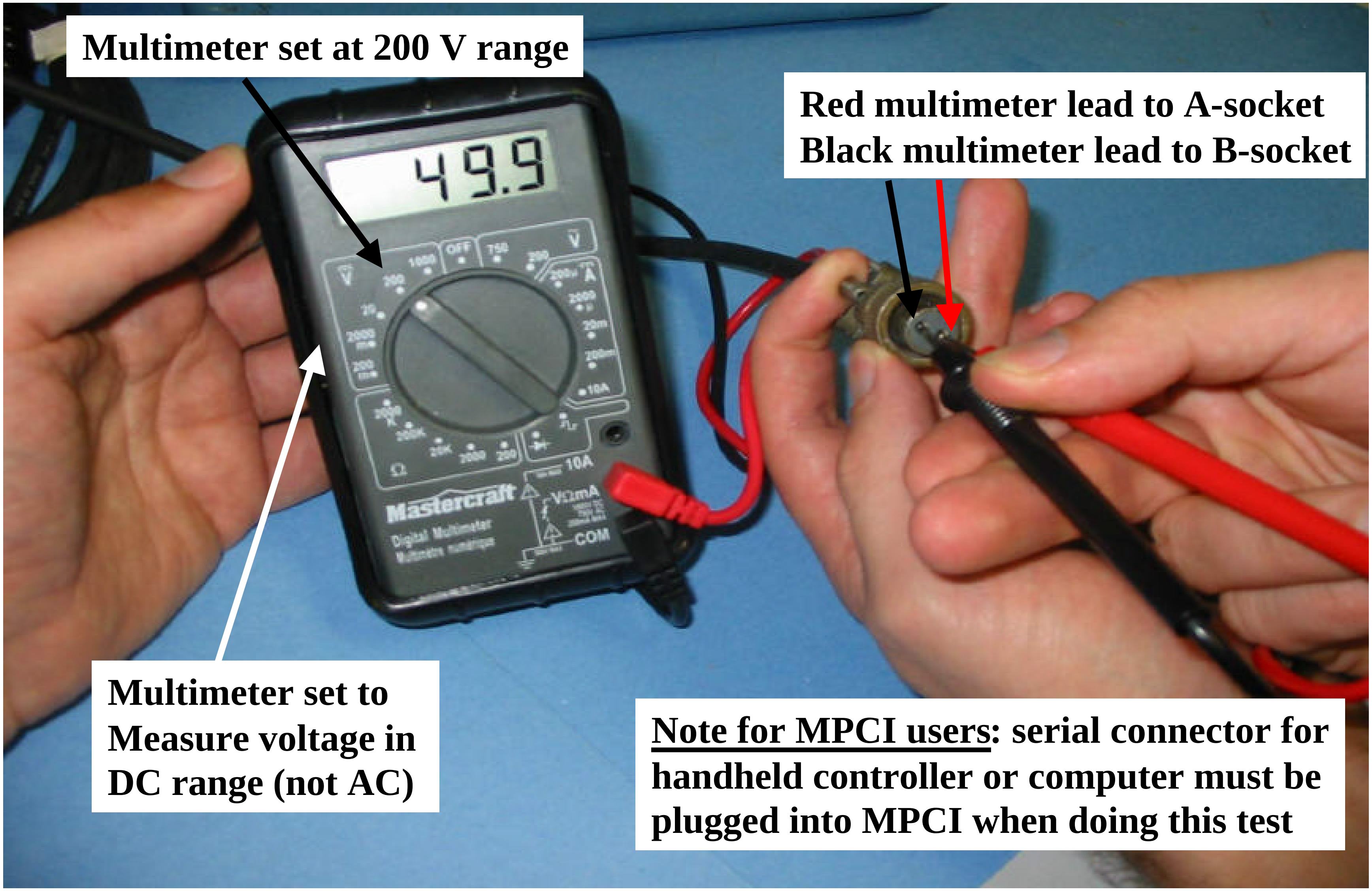
Pic.2 MPCI unit showing typical set-up configuration



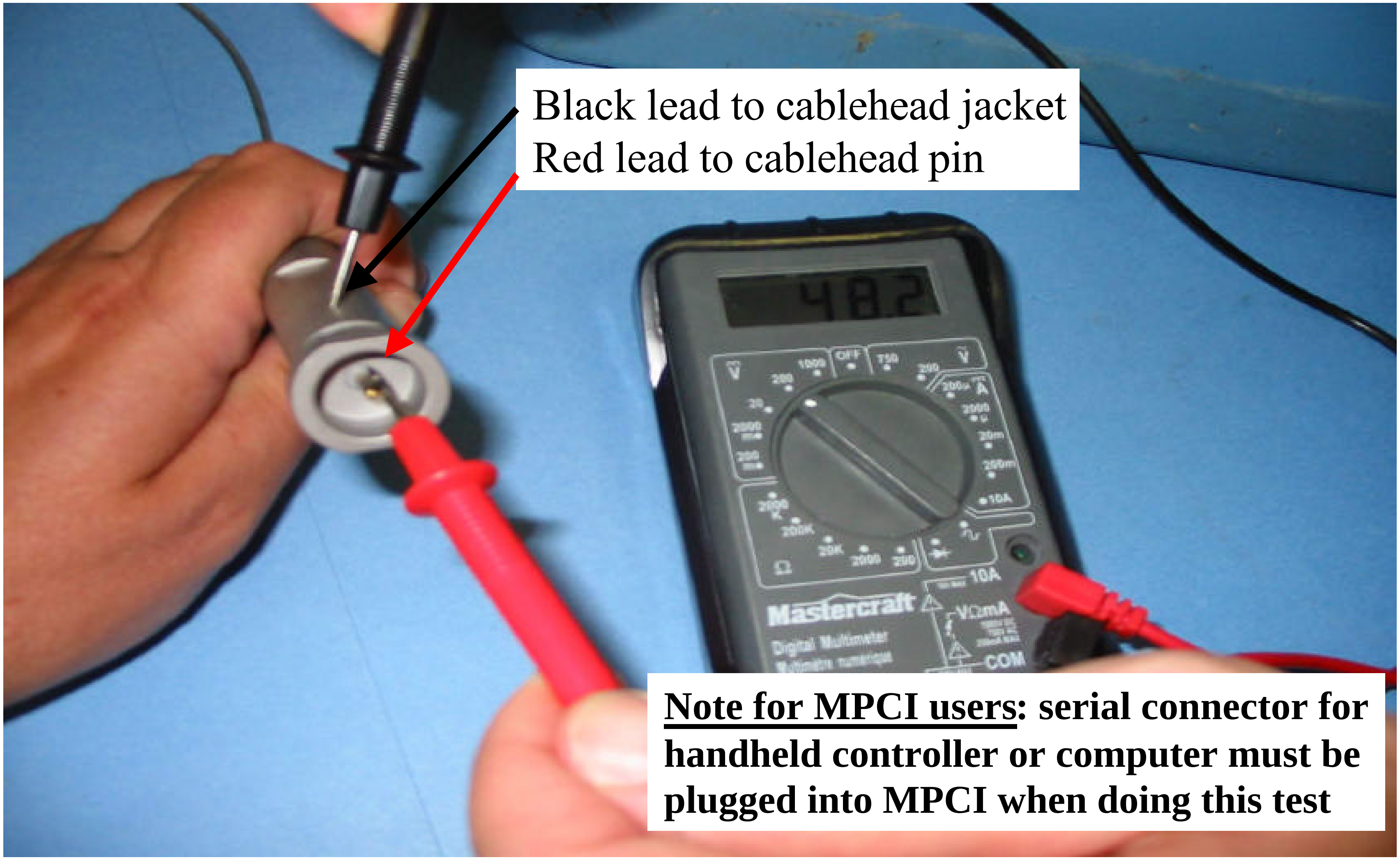
Pic.3 Testing 12 VDC Power Supply using Multimeter



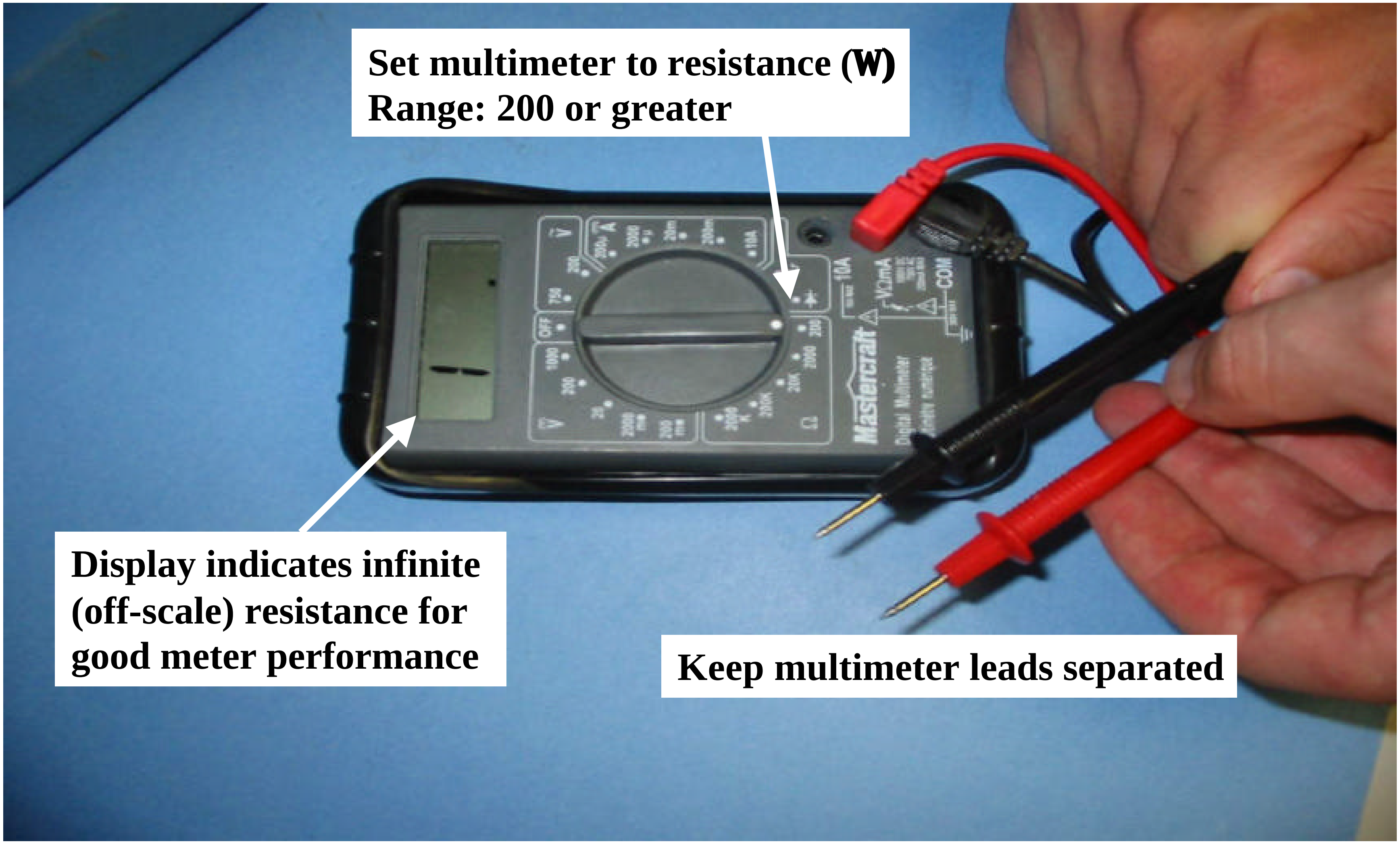
Pic.4 Testing Power Cable Voltage
(should indicate greater than 12.00 V DC for good battery and cable)



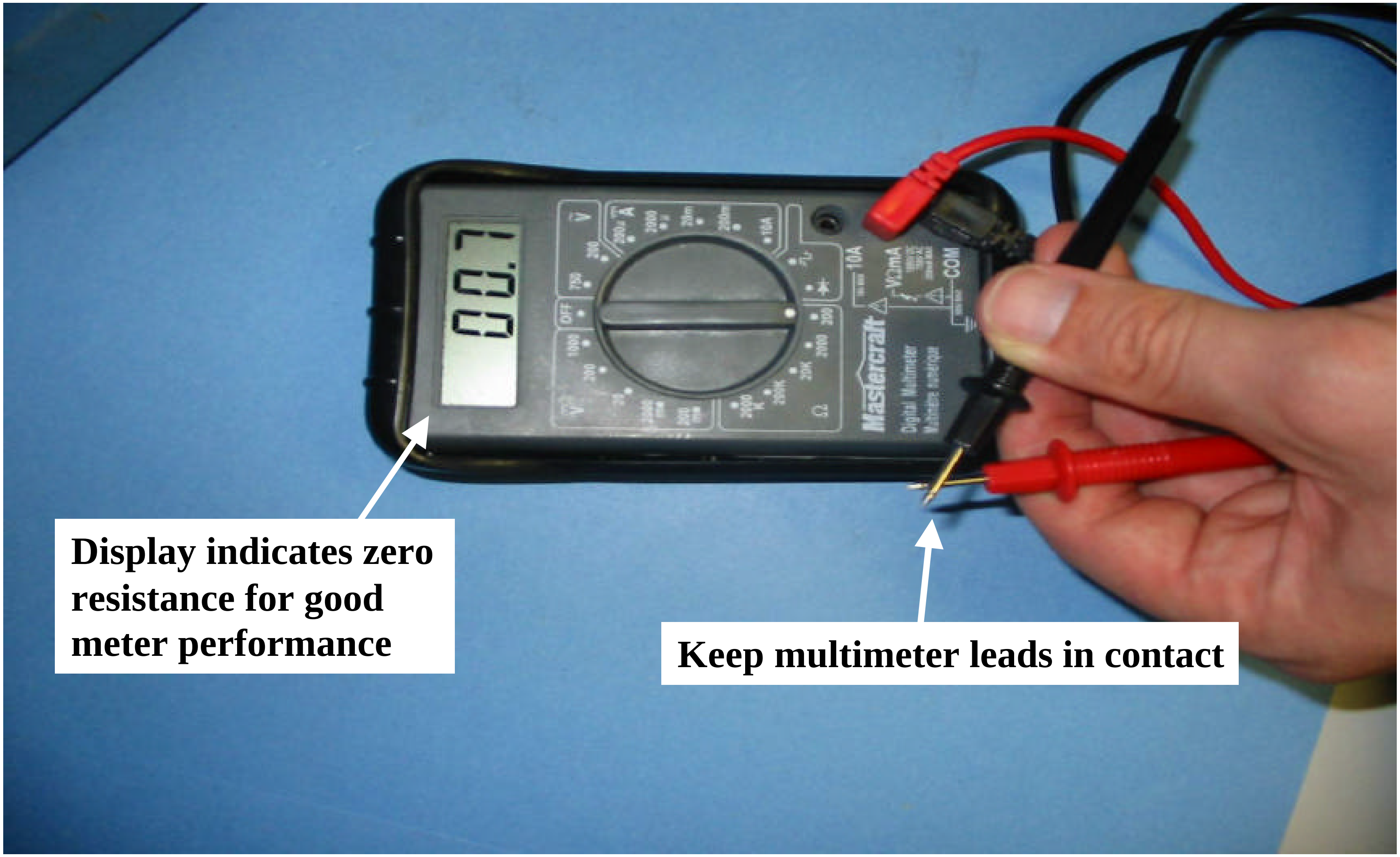
Pic.5 Testing Power output from MPCI or MAGI using data cable (should be greater than 48 V) ***Note: MPCI/MAGI must have power 'on' and be connected to power supply.***



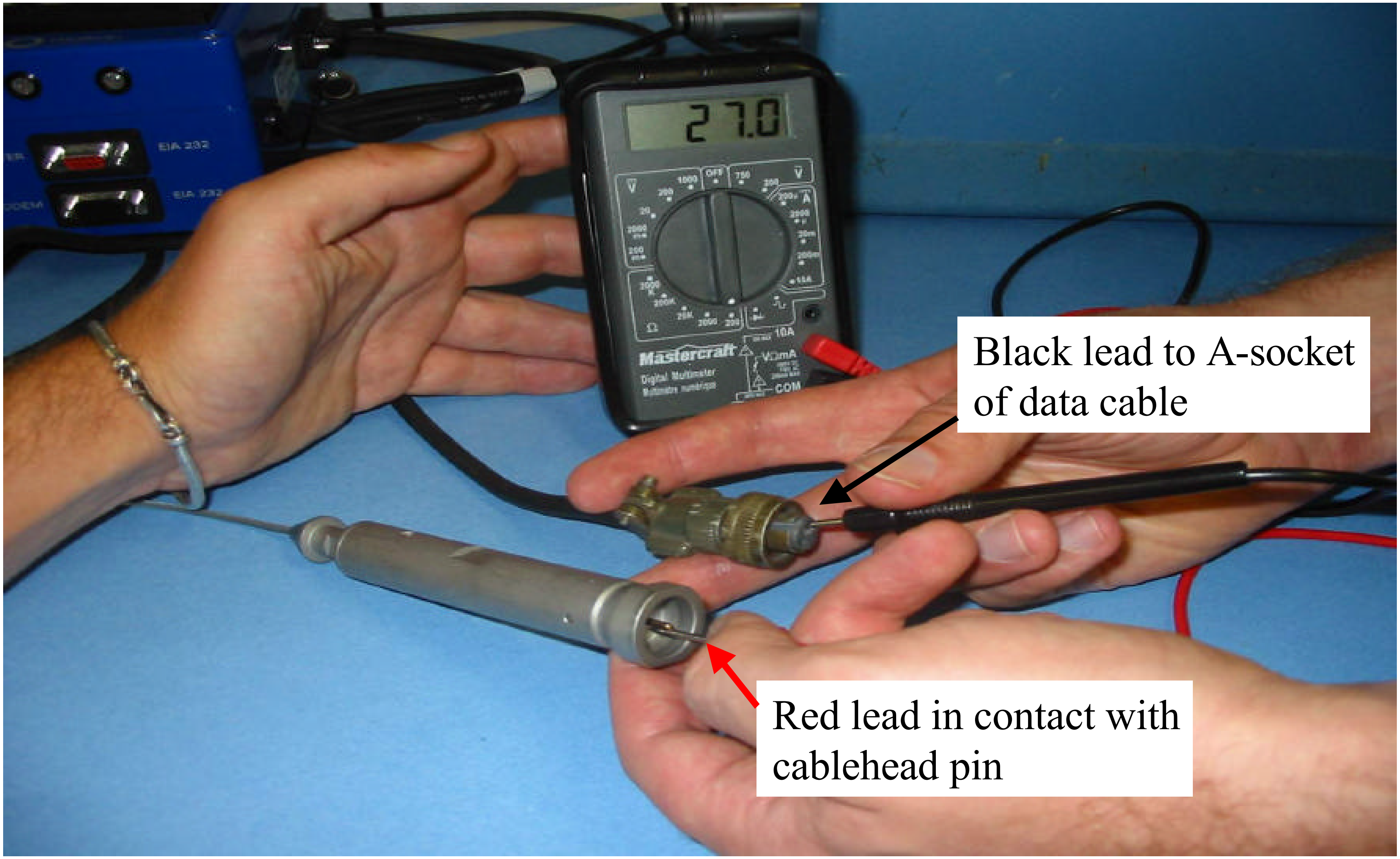
Pic.6 Checking power output at cablehead (should be greater than 48 V)
Note: MPCI/MAGI must have power 'on' and be connected to power supply.



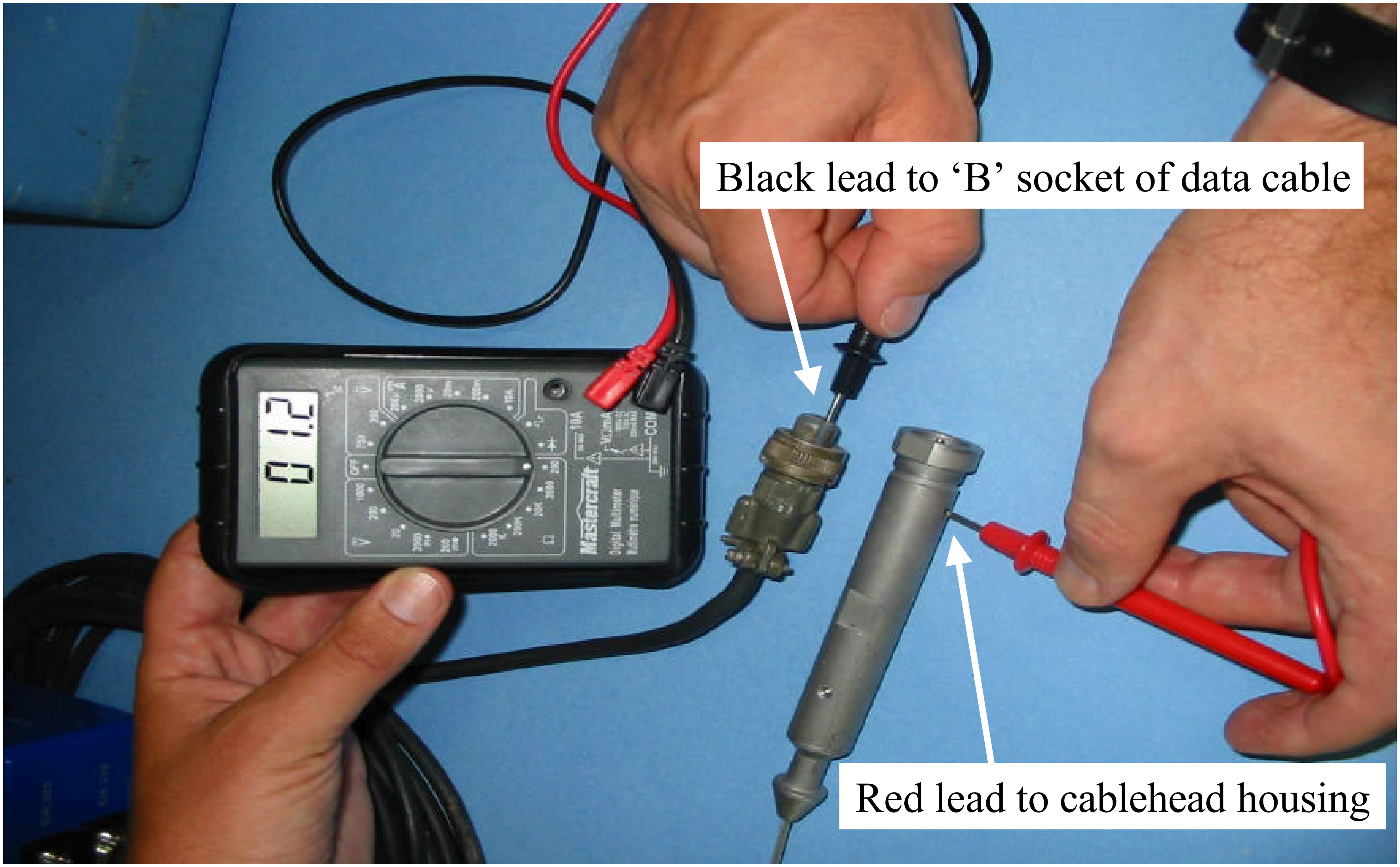
Pic.7 Test multimeter "open" resistence



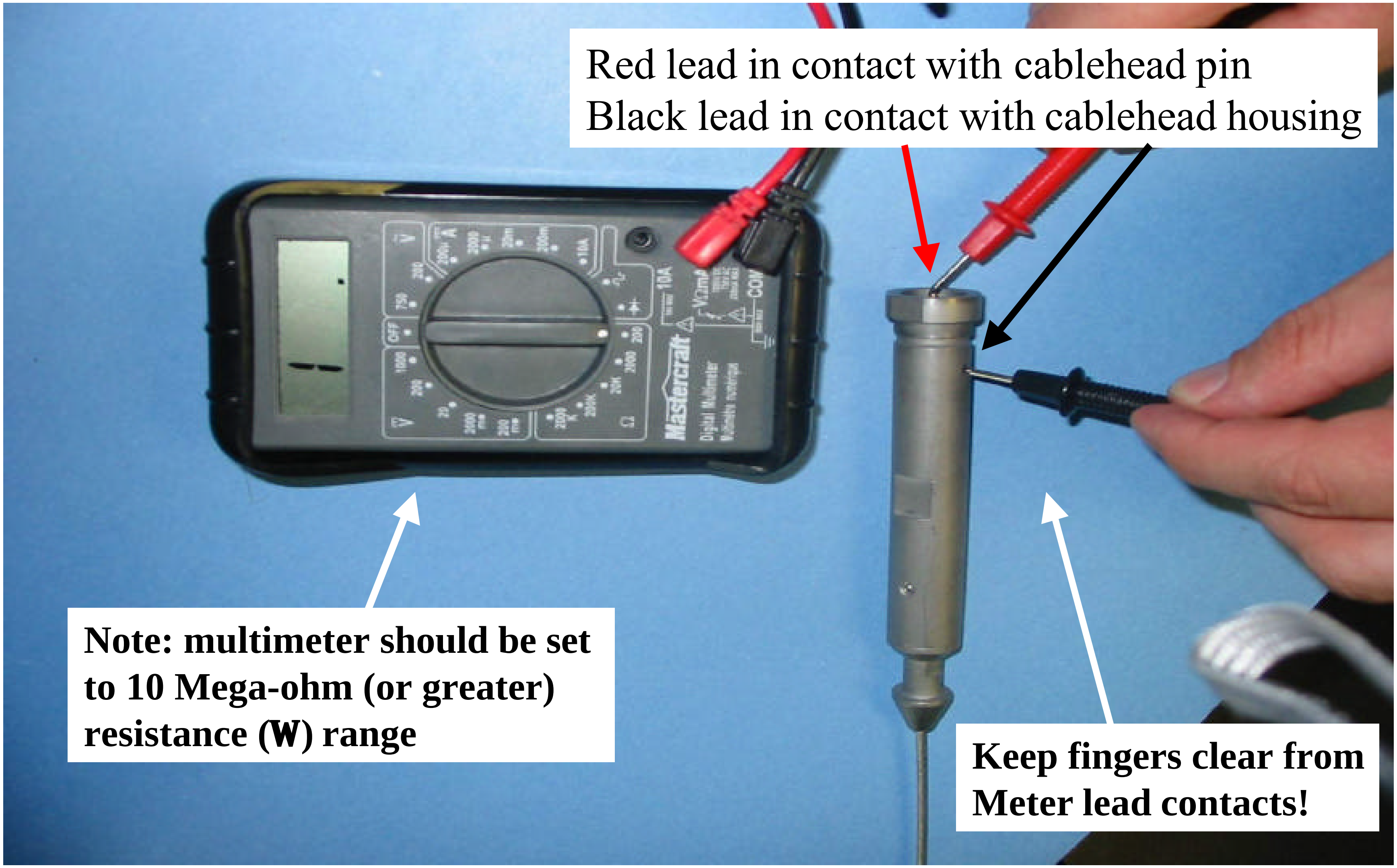
Pic.8 Test multimeter “closed” resistence



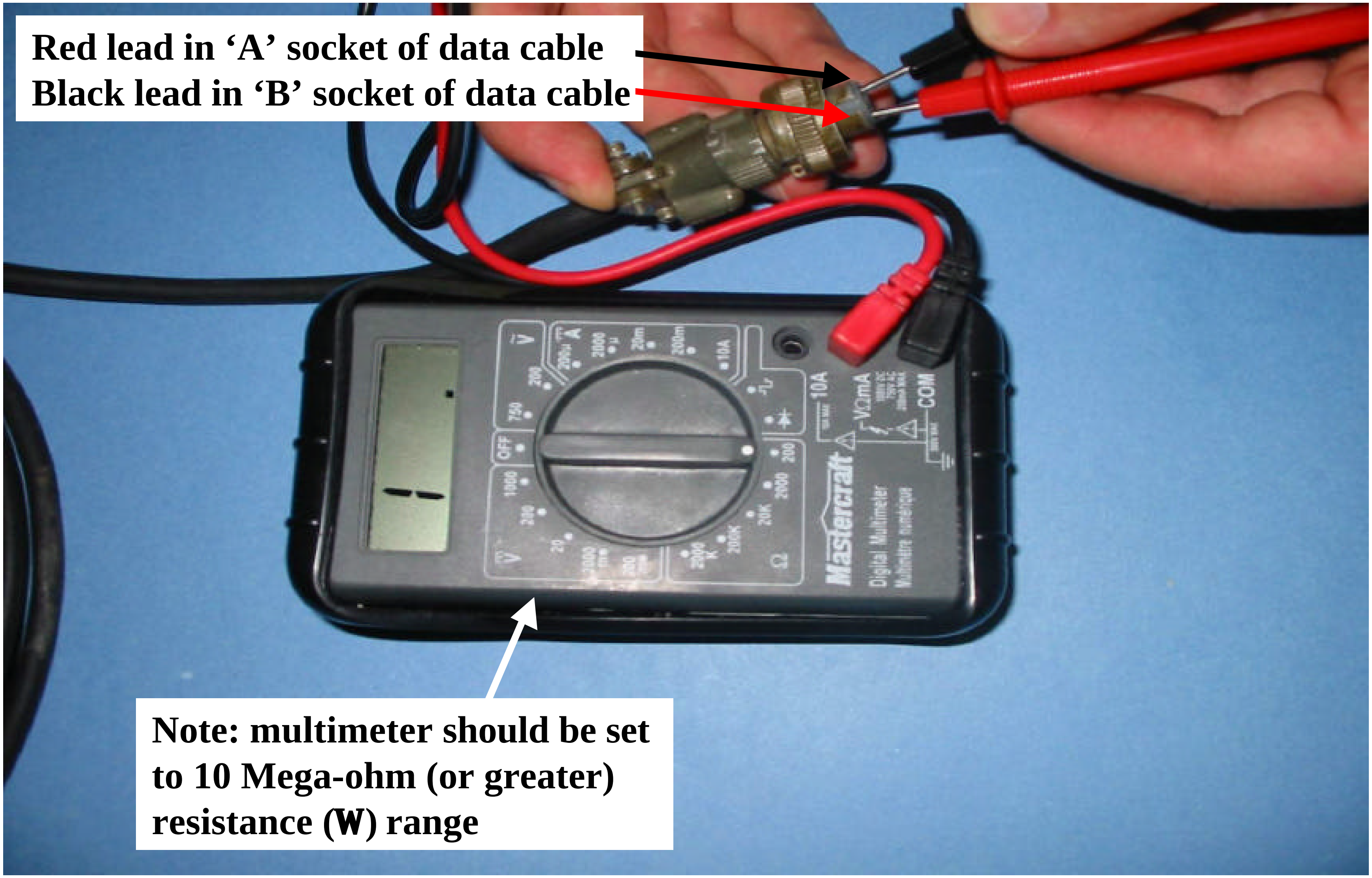
Pic.9 Test wireline ‘A-A’ resistance (approx. 27 W/1000 ft)



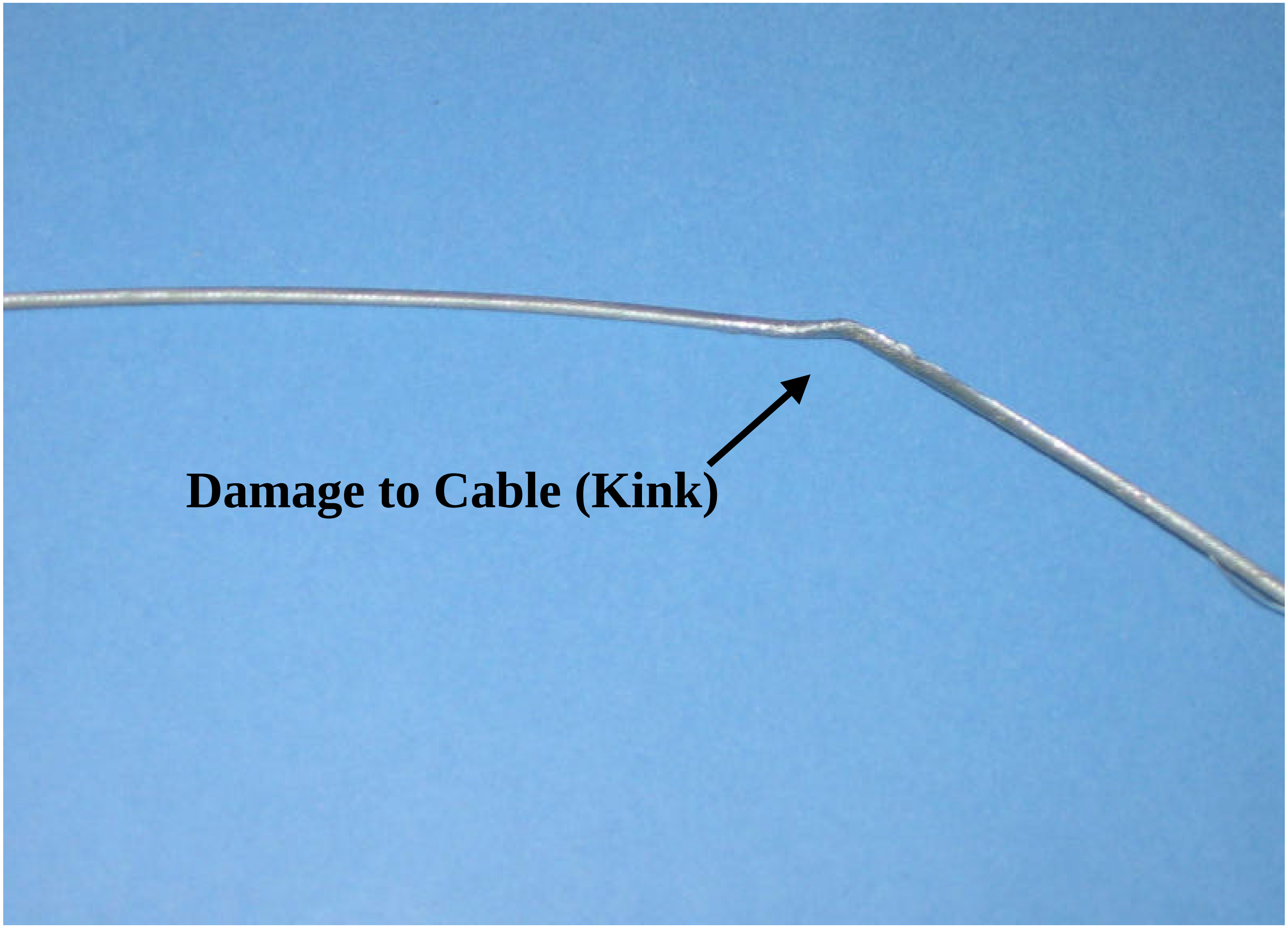
Pic.10 Test wireline 'B-B' resistance (should be less than 'A-A')



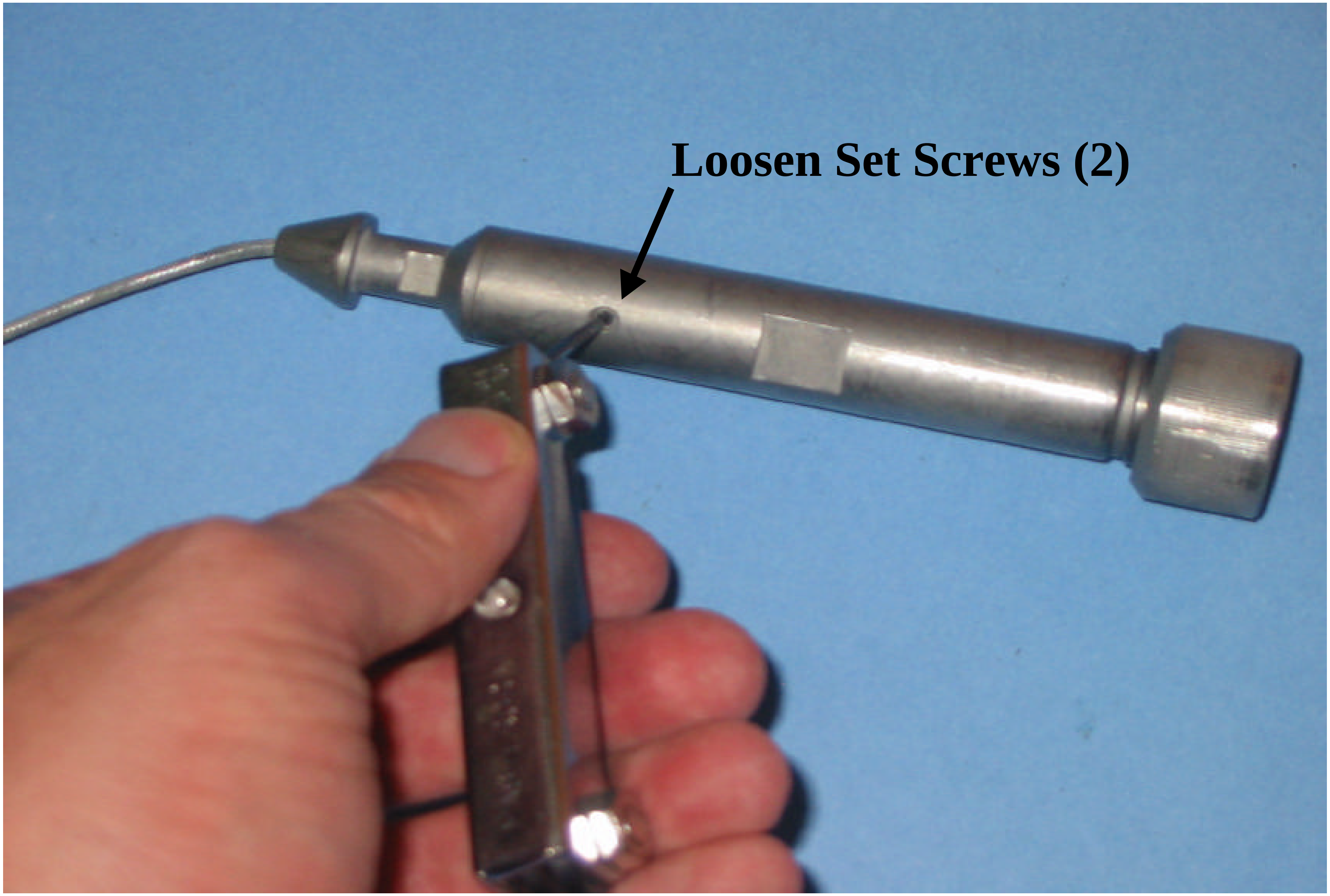
Pic.11 Test wireline ‘A-B’ resistance at cablehead (should be off-scale)



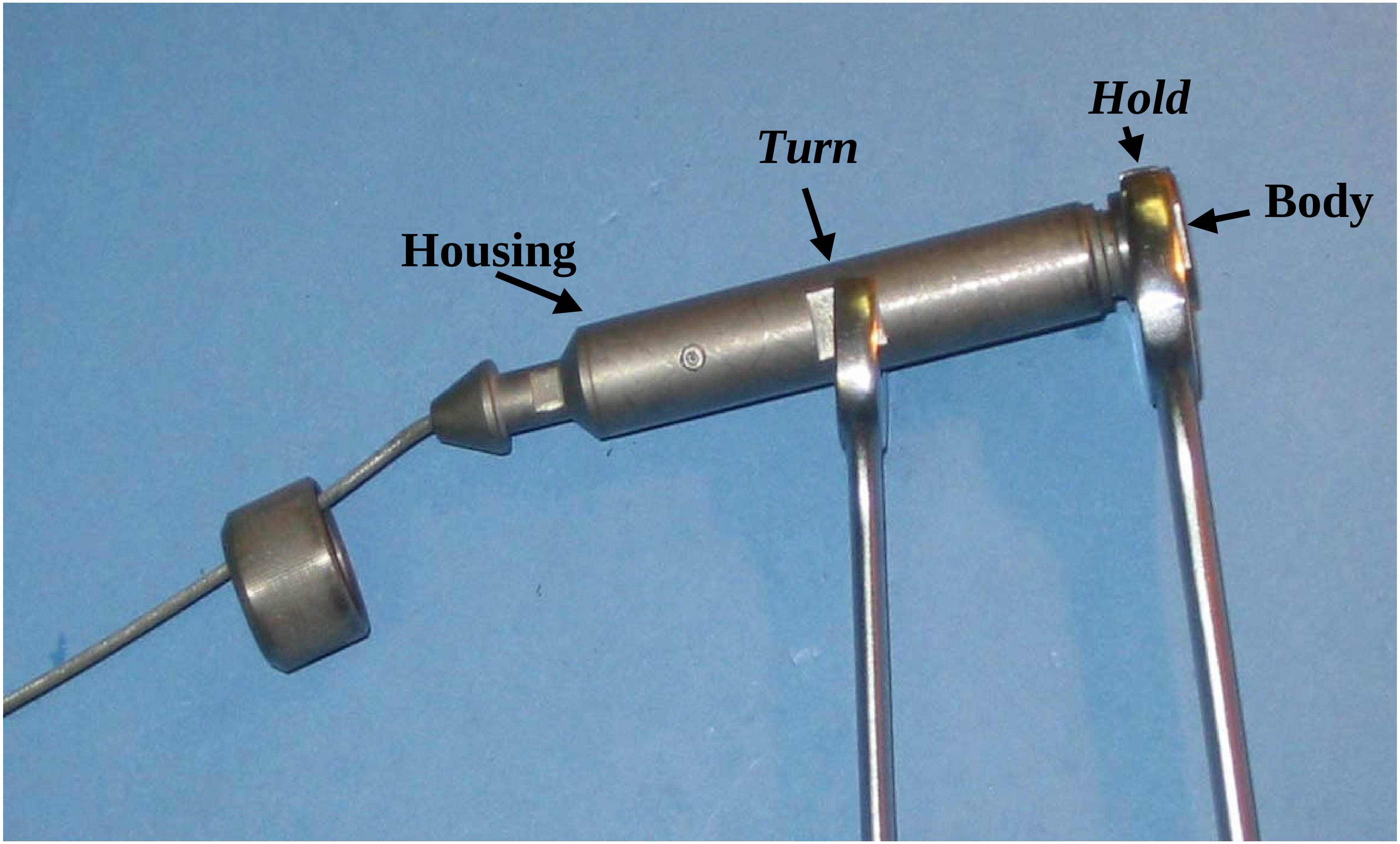
Pic.11 Test wireline ‘A-B’ resistance at data cable (should be off-scale)



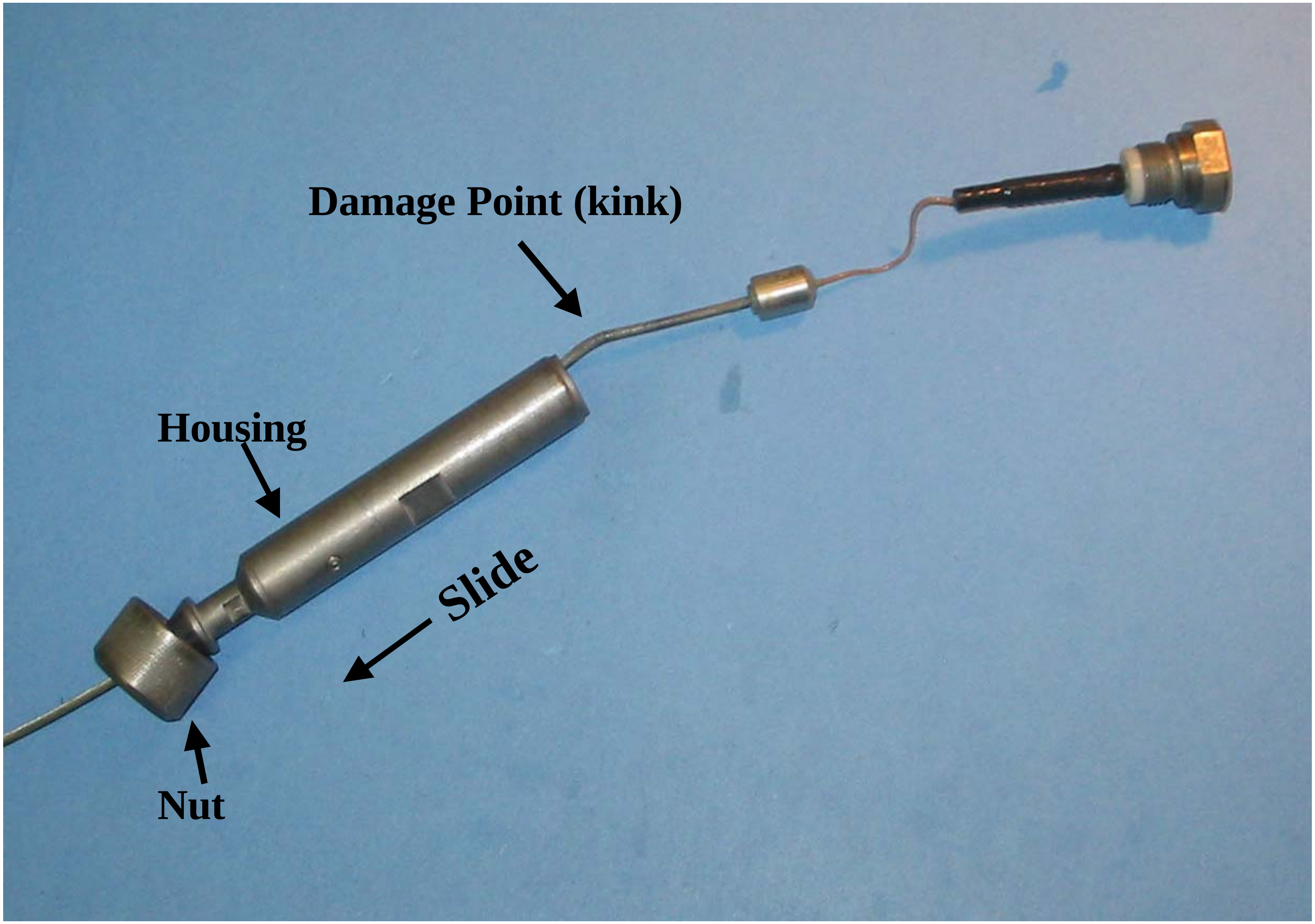
Pic.1 Identification of Cable Damage



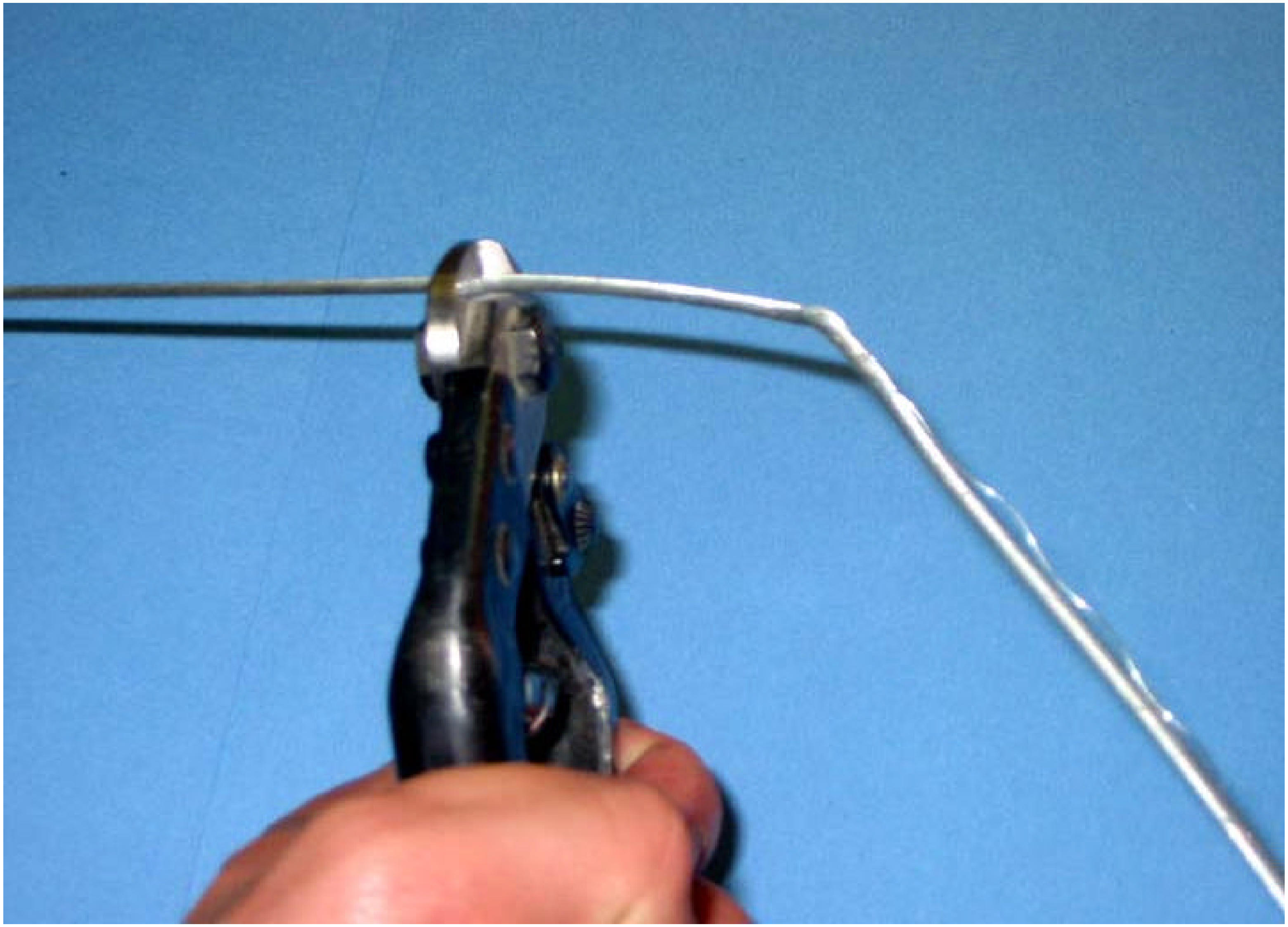
Pic.2 Cablehead Disassembly (1): Loosen set Screws



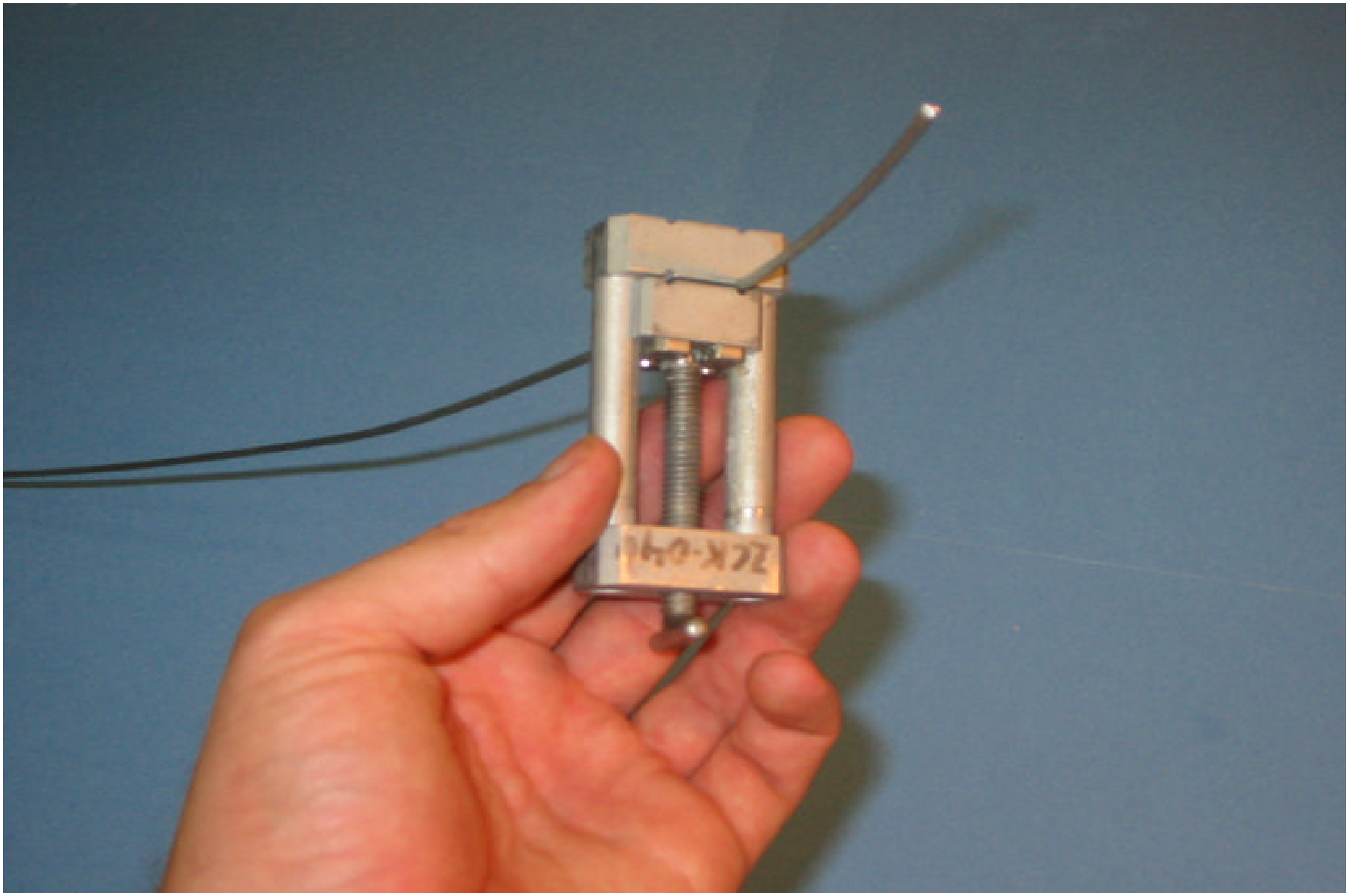
Pic.3 Cablehead Disassembly(2): Unscrew Housing From Body



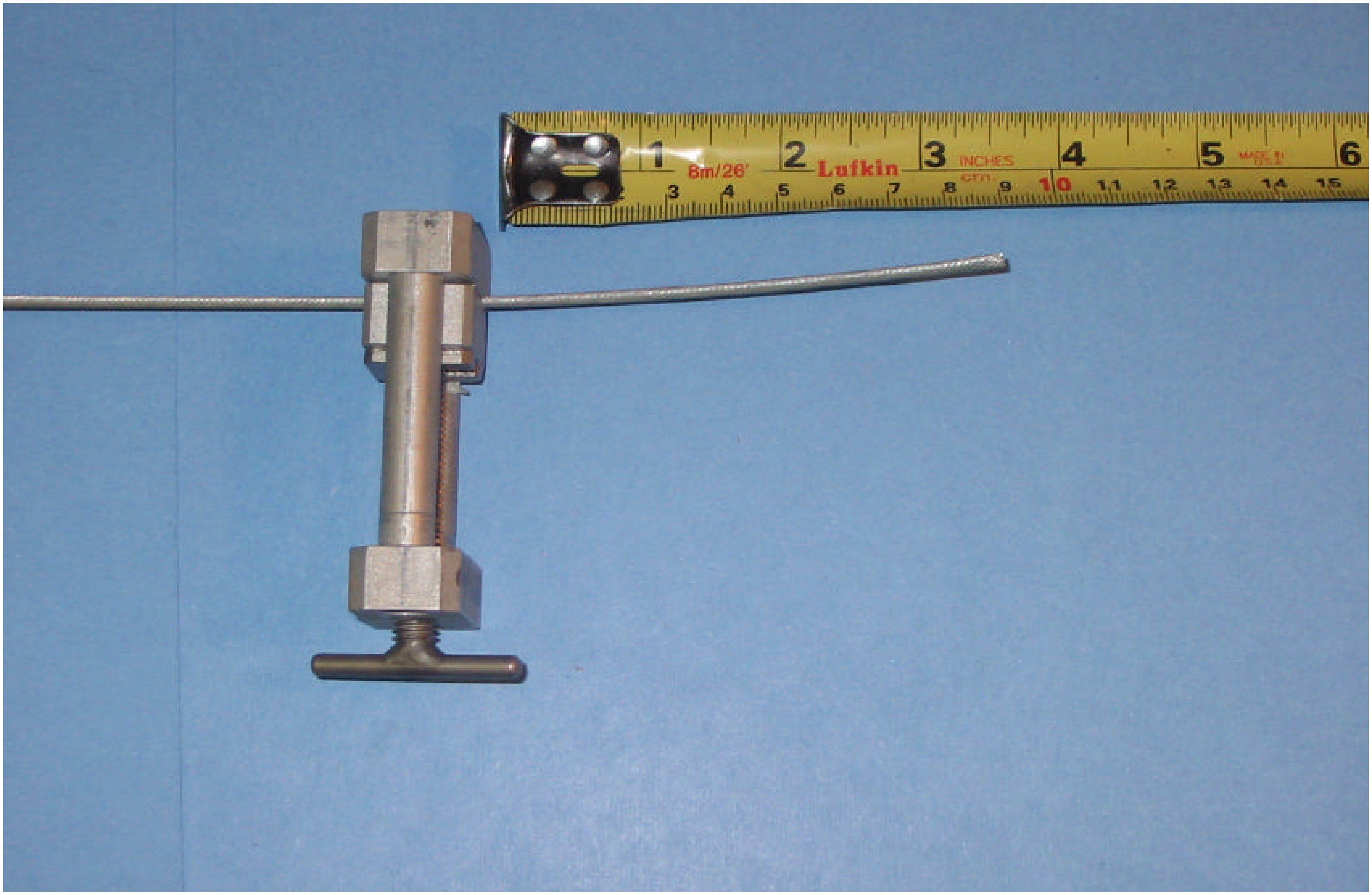
Pic.4 Cablehead Disassembly(3):
Slide Housing and Cablehead Nut Past Damage Point



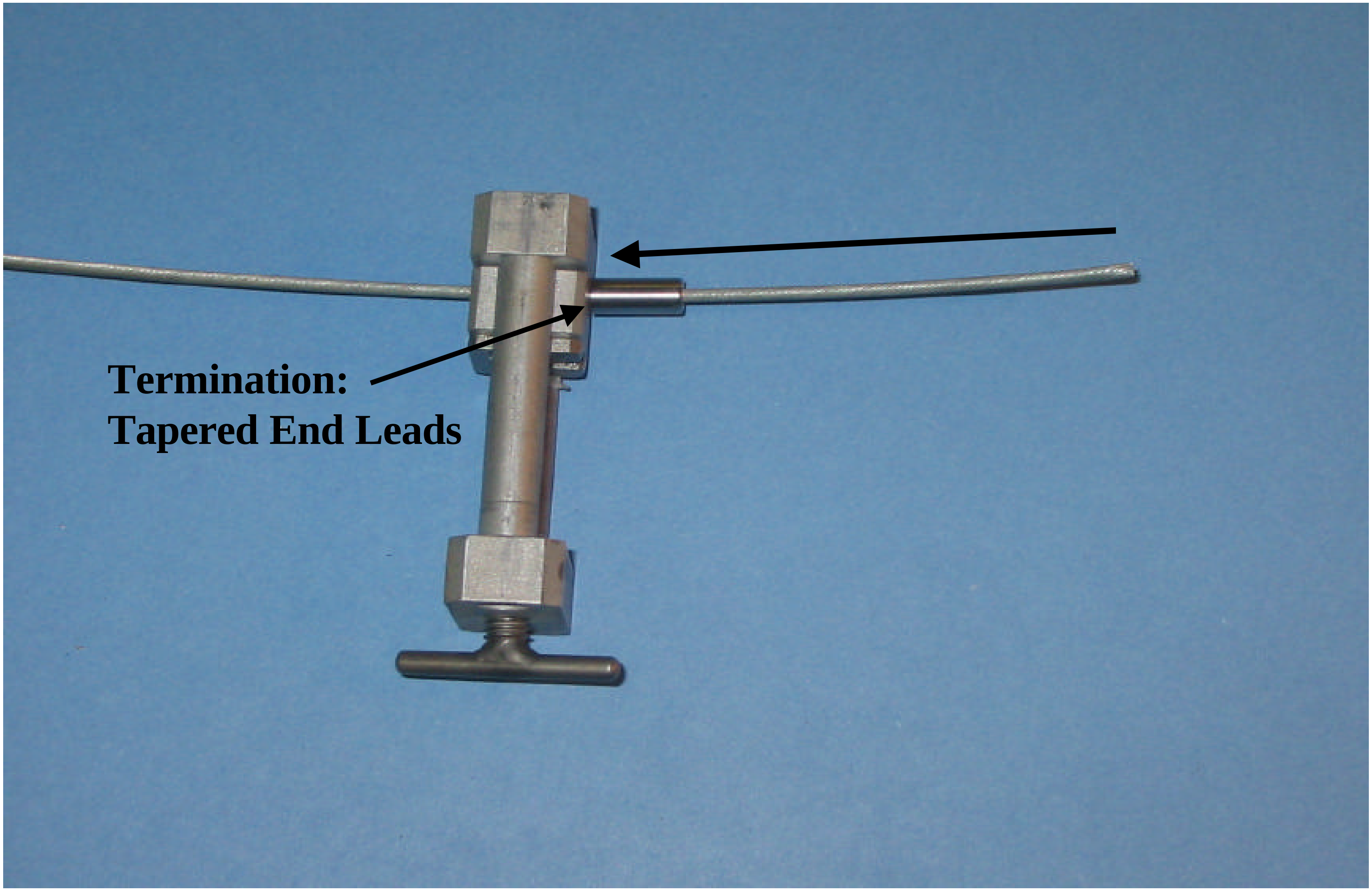
Pic.5 Cut Cable above Damage Point



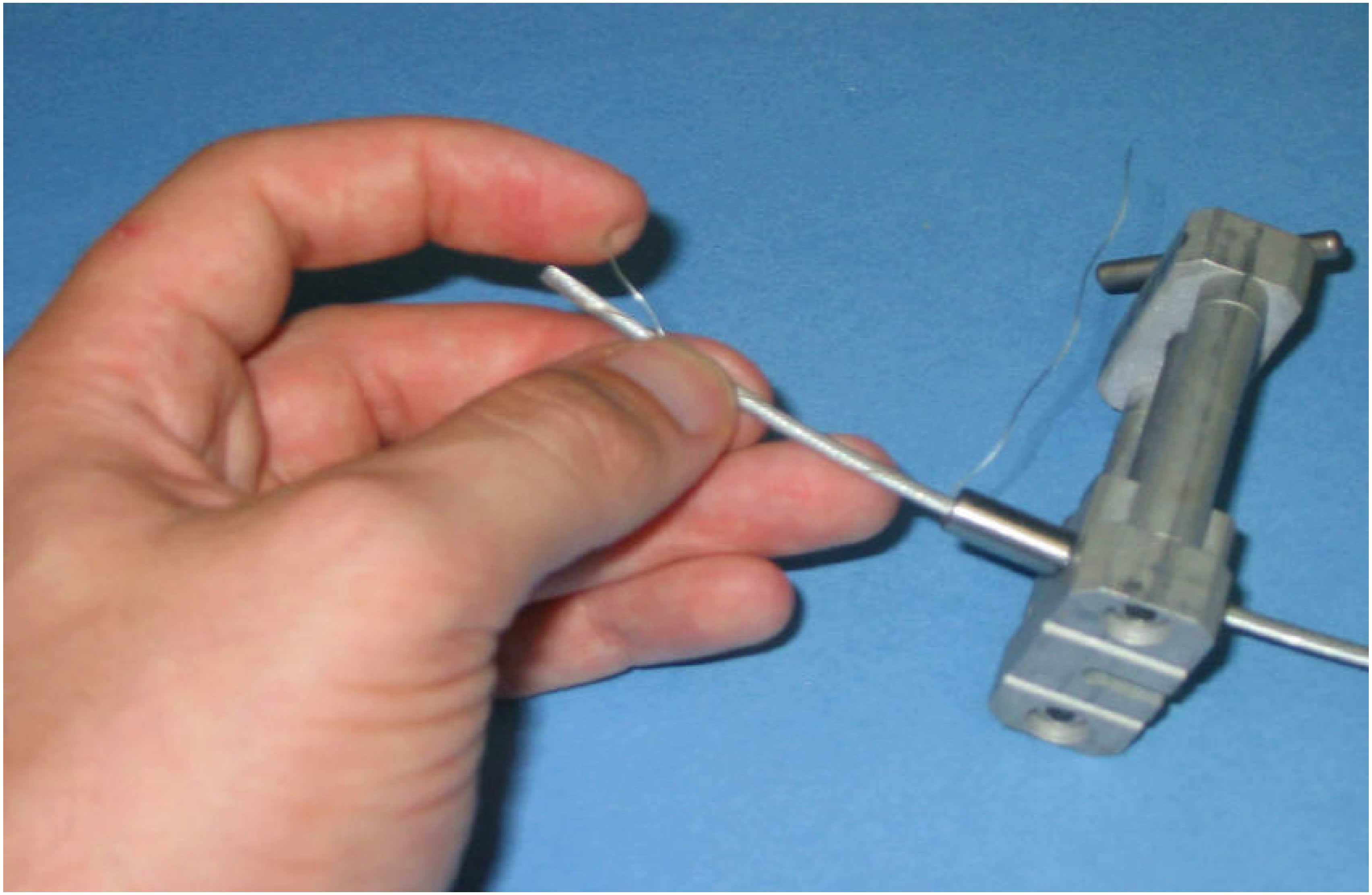
Pic.6a Clamp Cable in Termination Jig



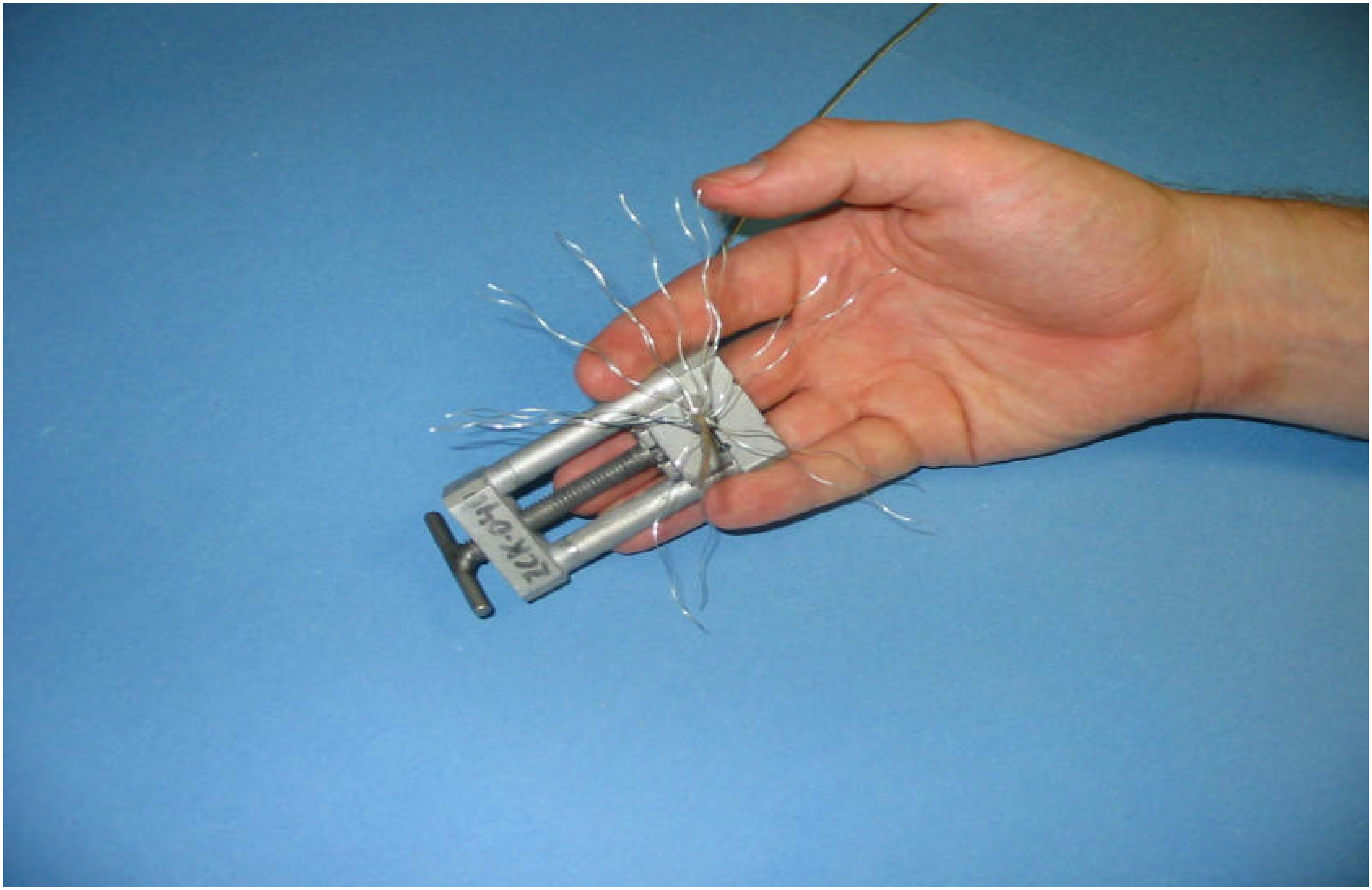
Pic.6b   Leave 3.5 inches Cable Exposed



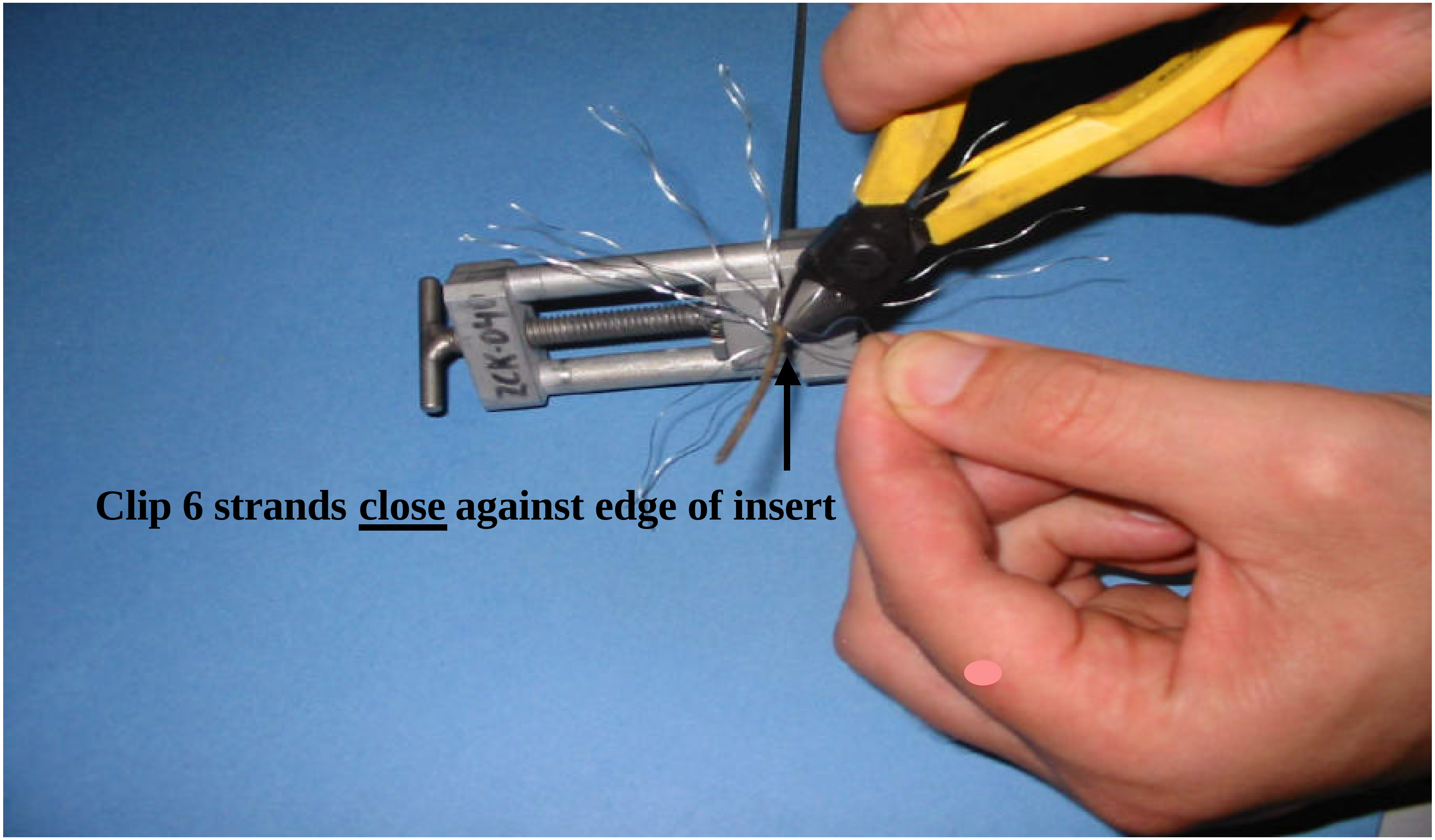
Pic.6c Slide Termination Insert Over Cable



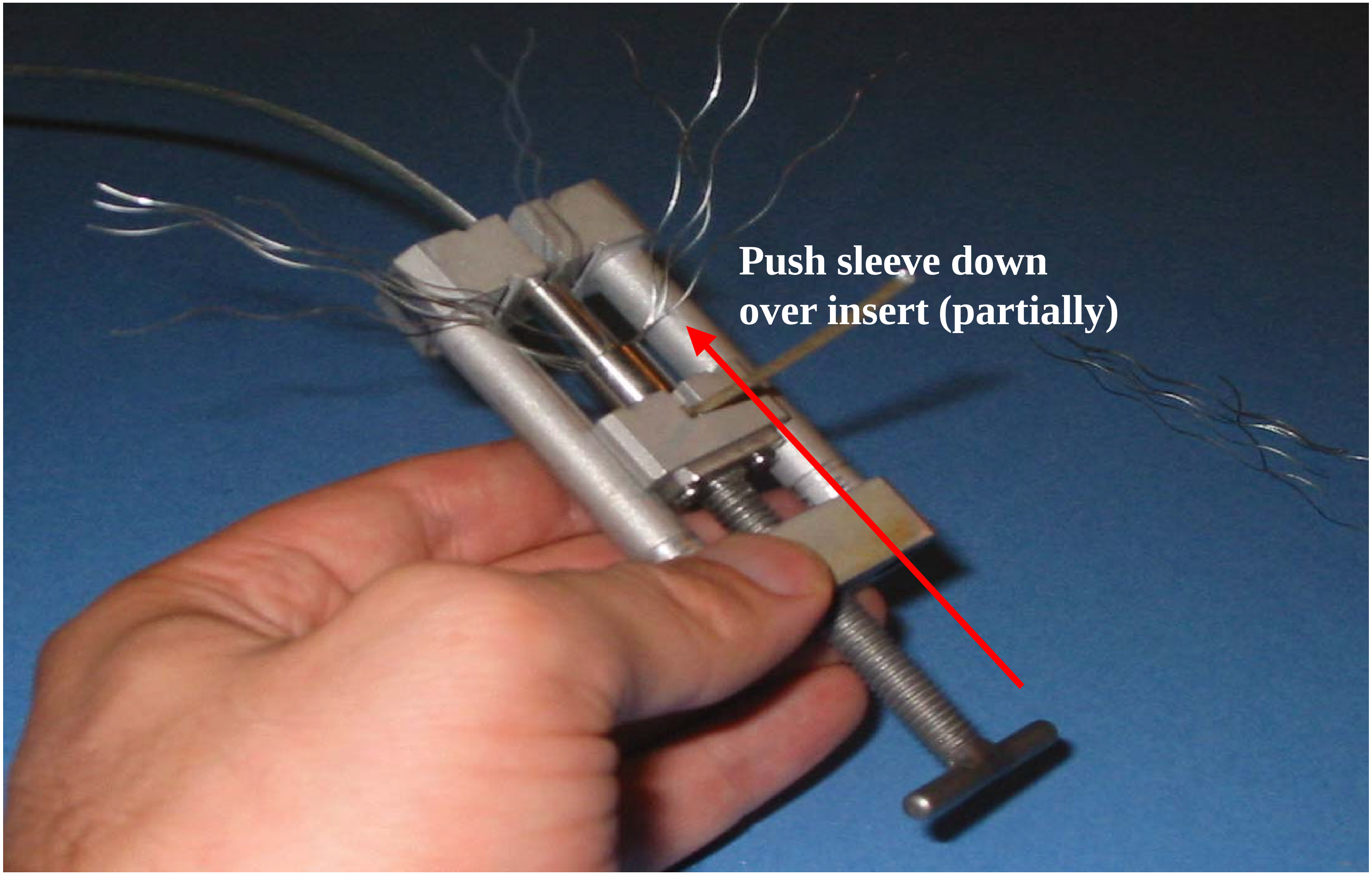
Pic.7a Unwind Outer-layer Strands (start)



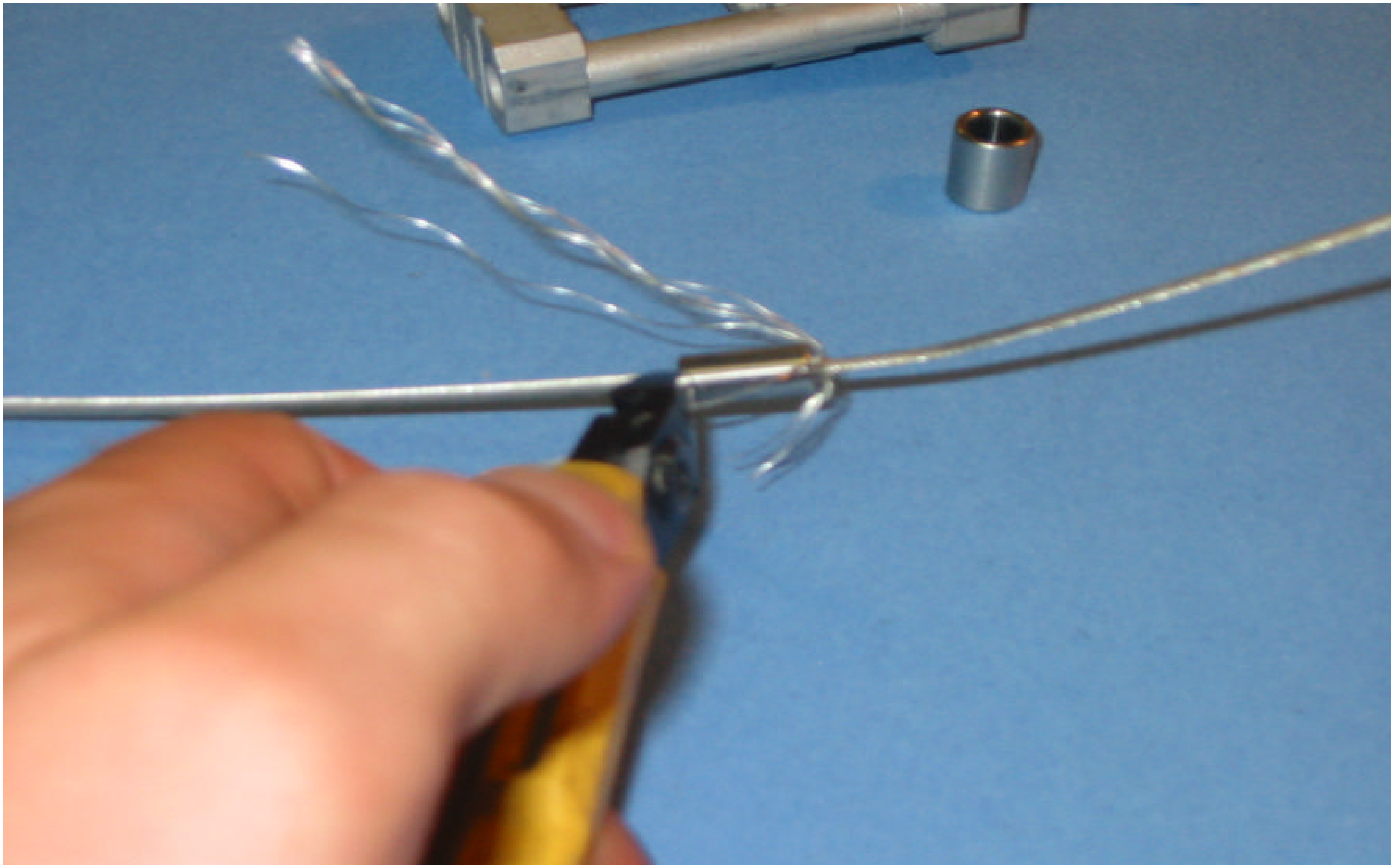
Pic.7b   Unwind Outer Layer Strands (finish)



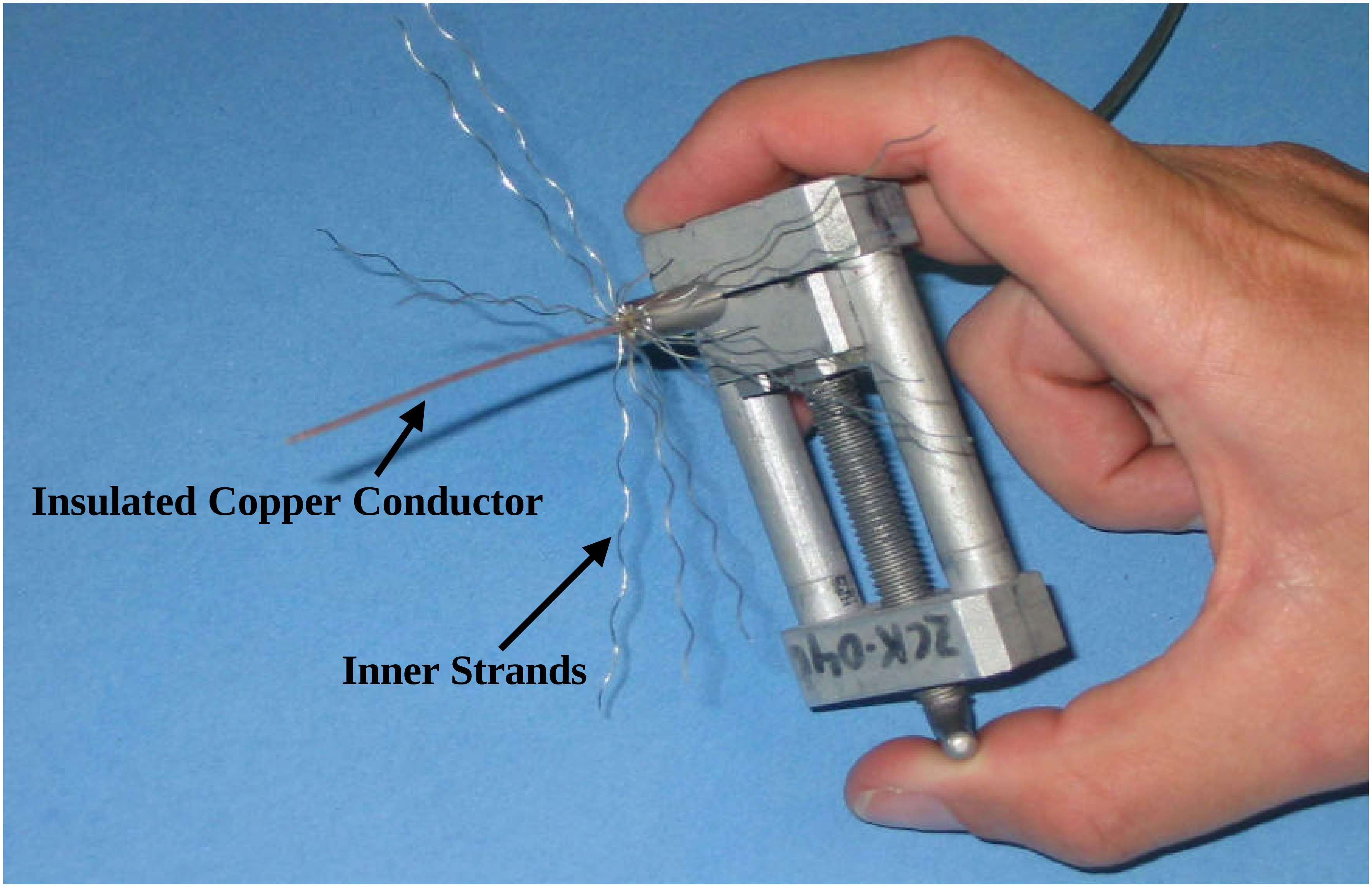
Pic.8 Clipping Outer Wire Strands (6 strands out of 18)



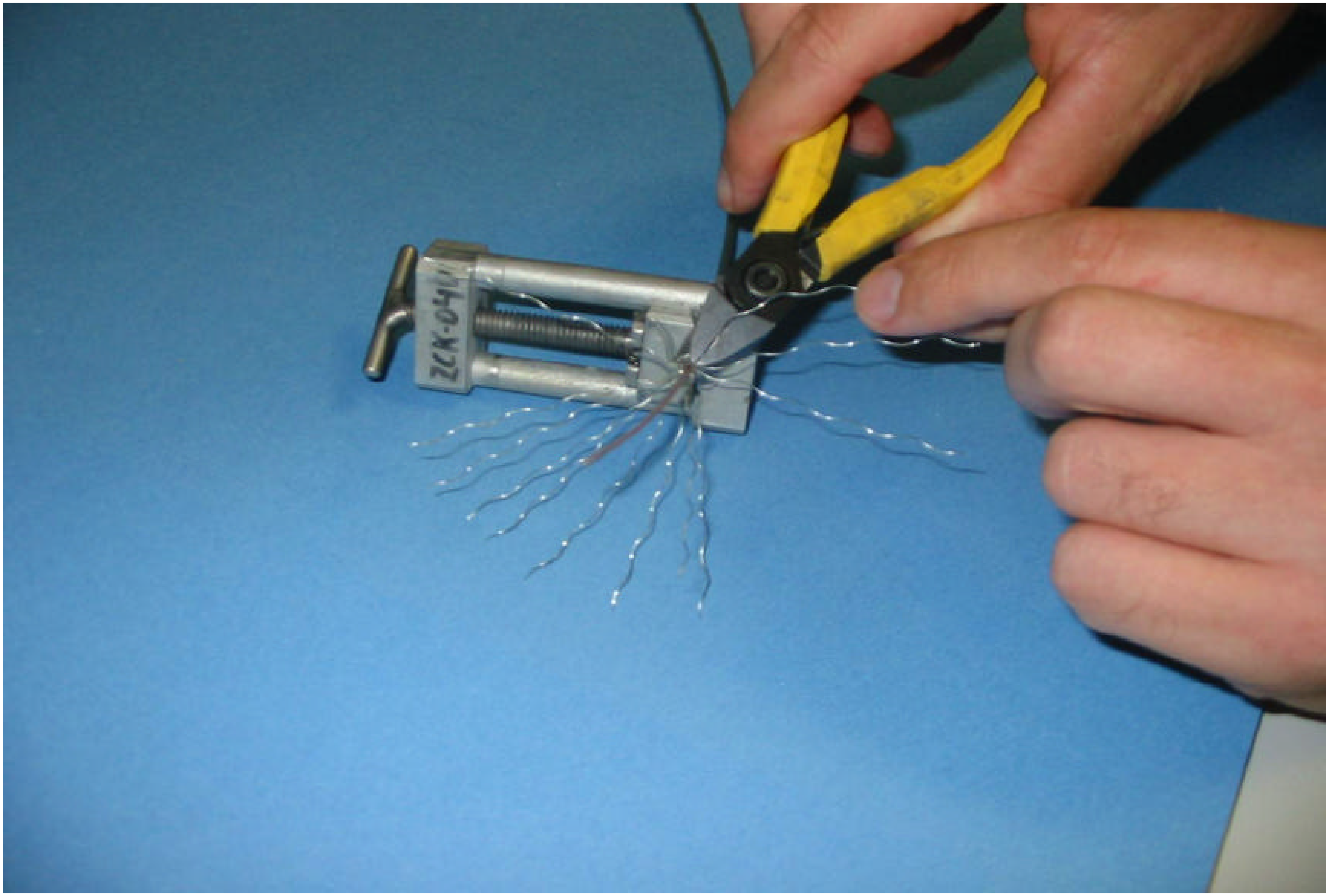
Pic.9 Partially Push Sleeve Down on Insert Using Jig
(enough to bend strands down along insert)



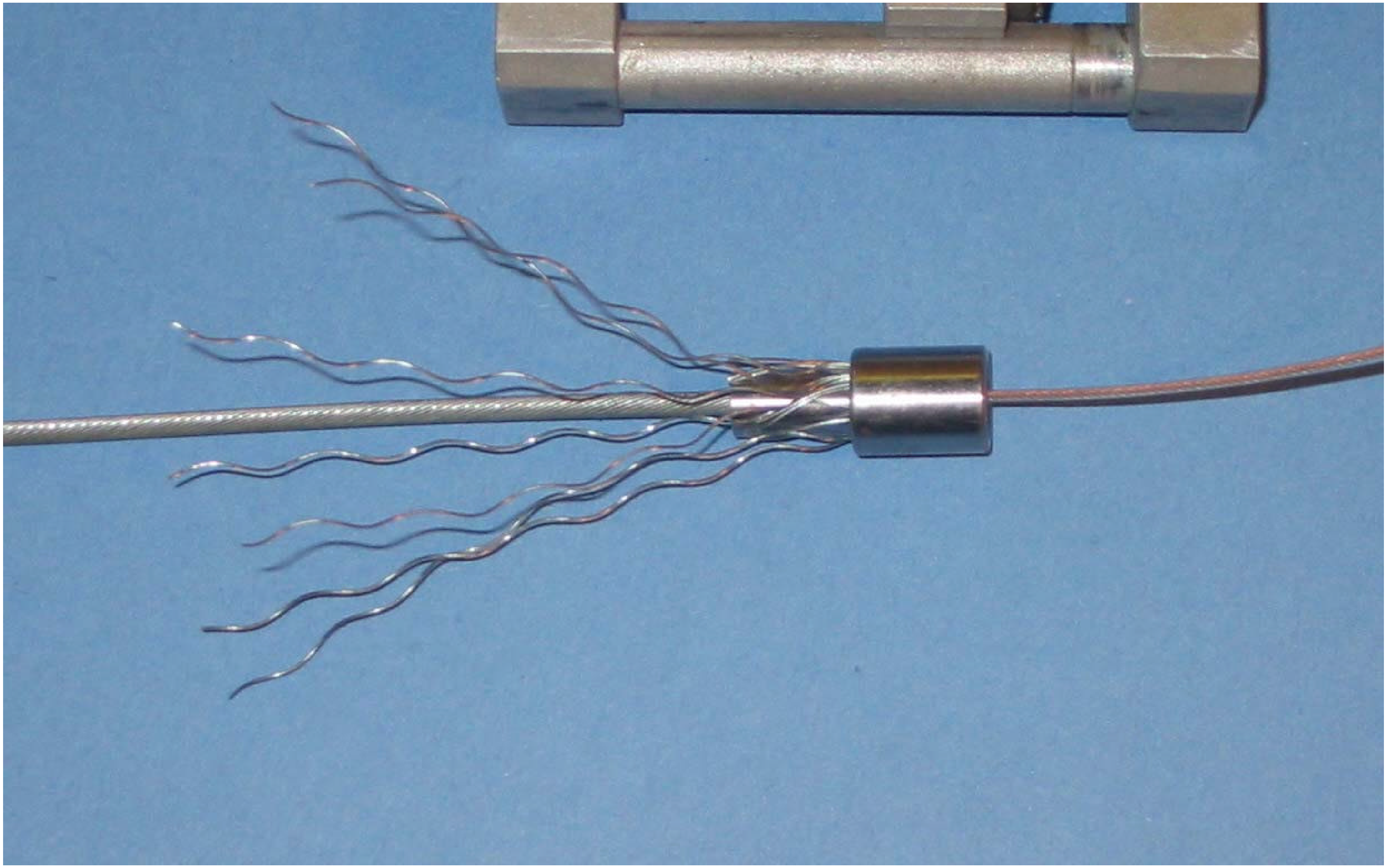
Pic.10 Trim Outer Wire Strands to Base of Insert.



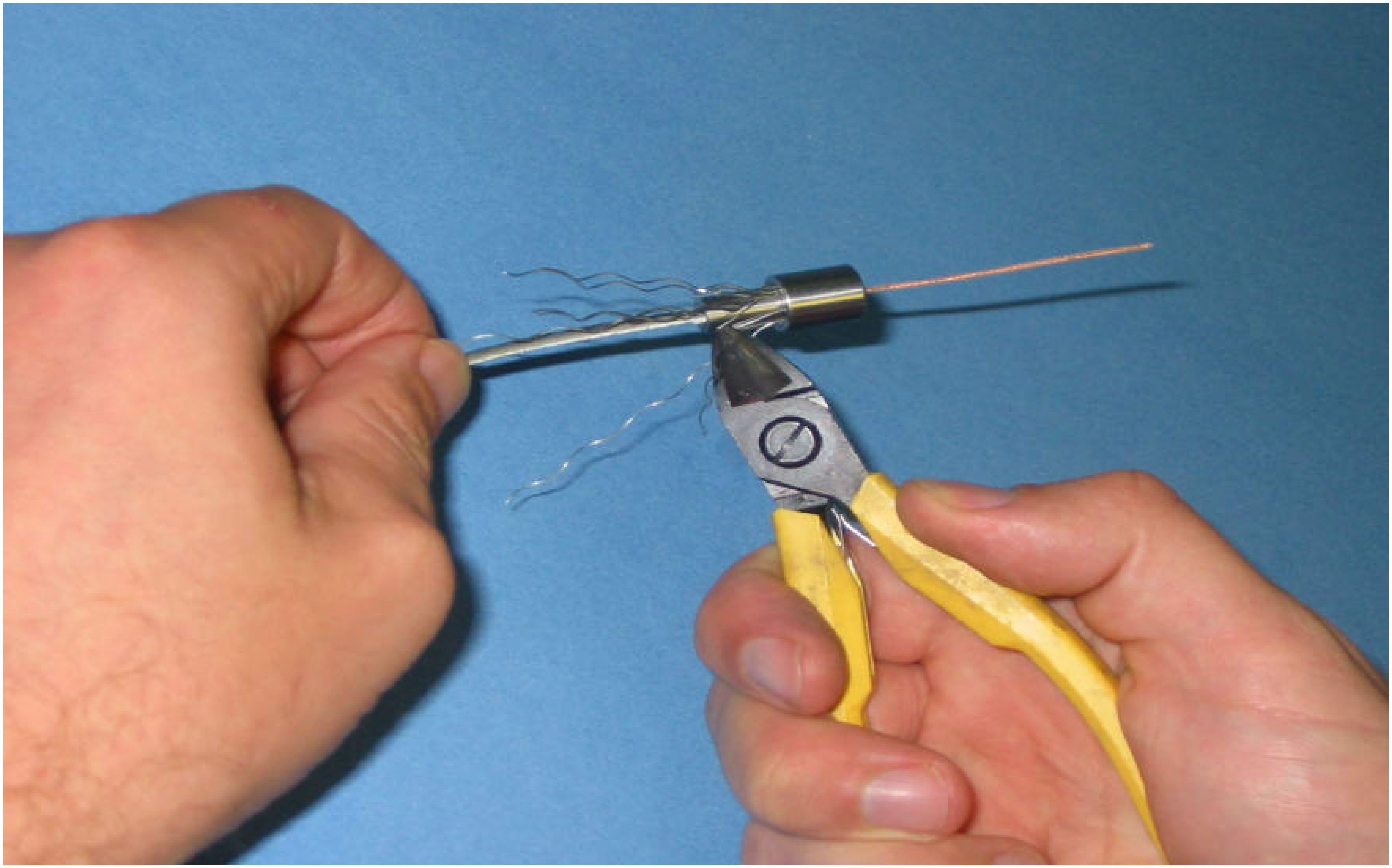
Pic.11 Unwind inner-layer strands of armor (exposing the insulated conductor wire)



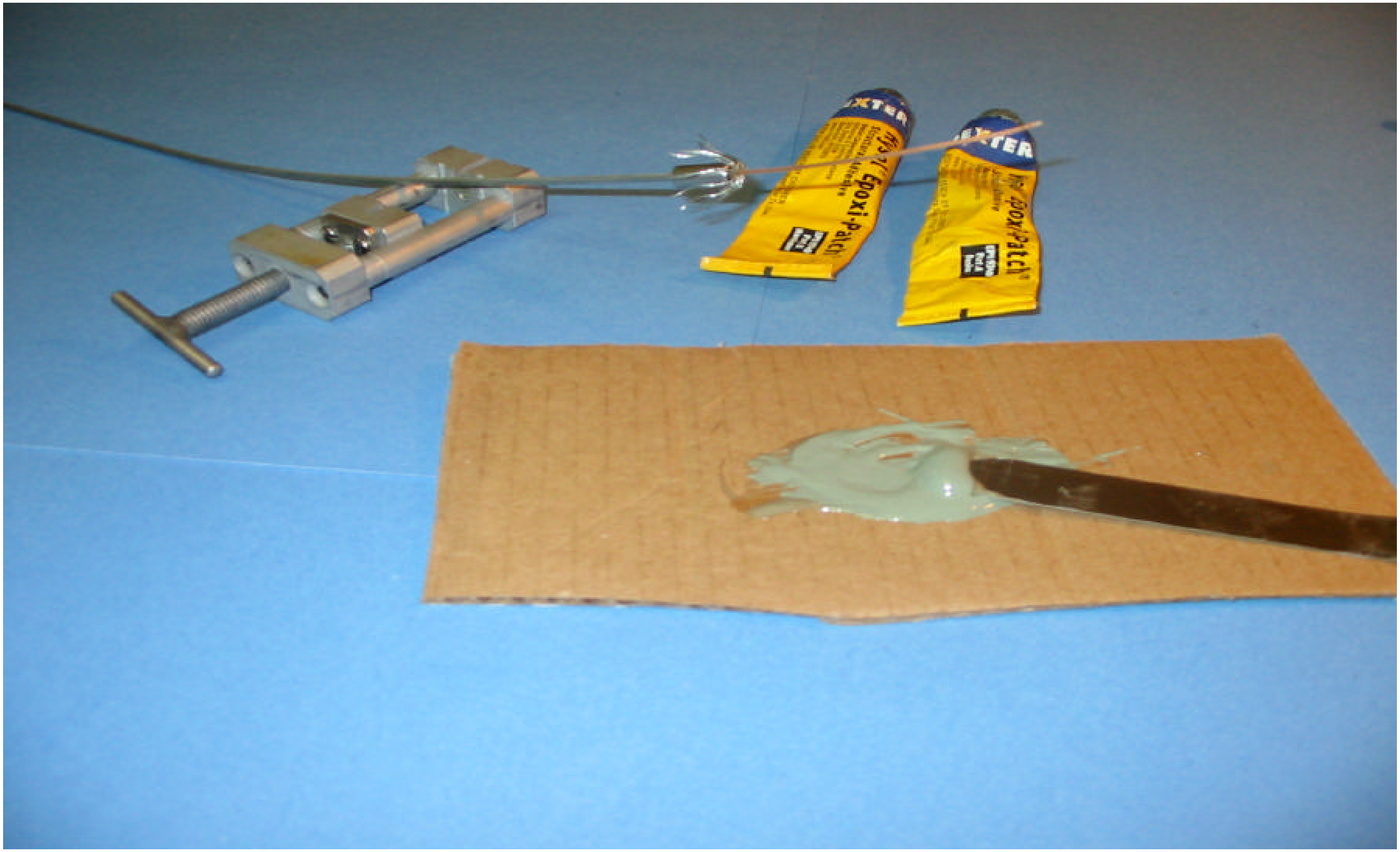
Pic.12 Clip 5 of the 12 inner armor strands close to the top of the insert



Pic.13 Bend down Remaining Inner Wire Strands
(Use jig and termination sleeve)

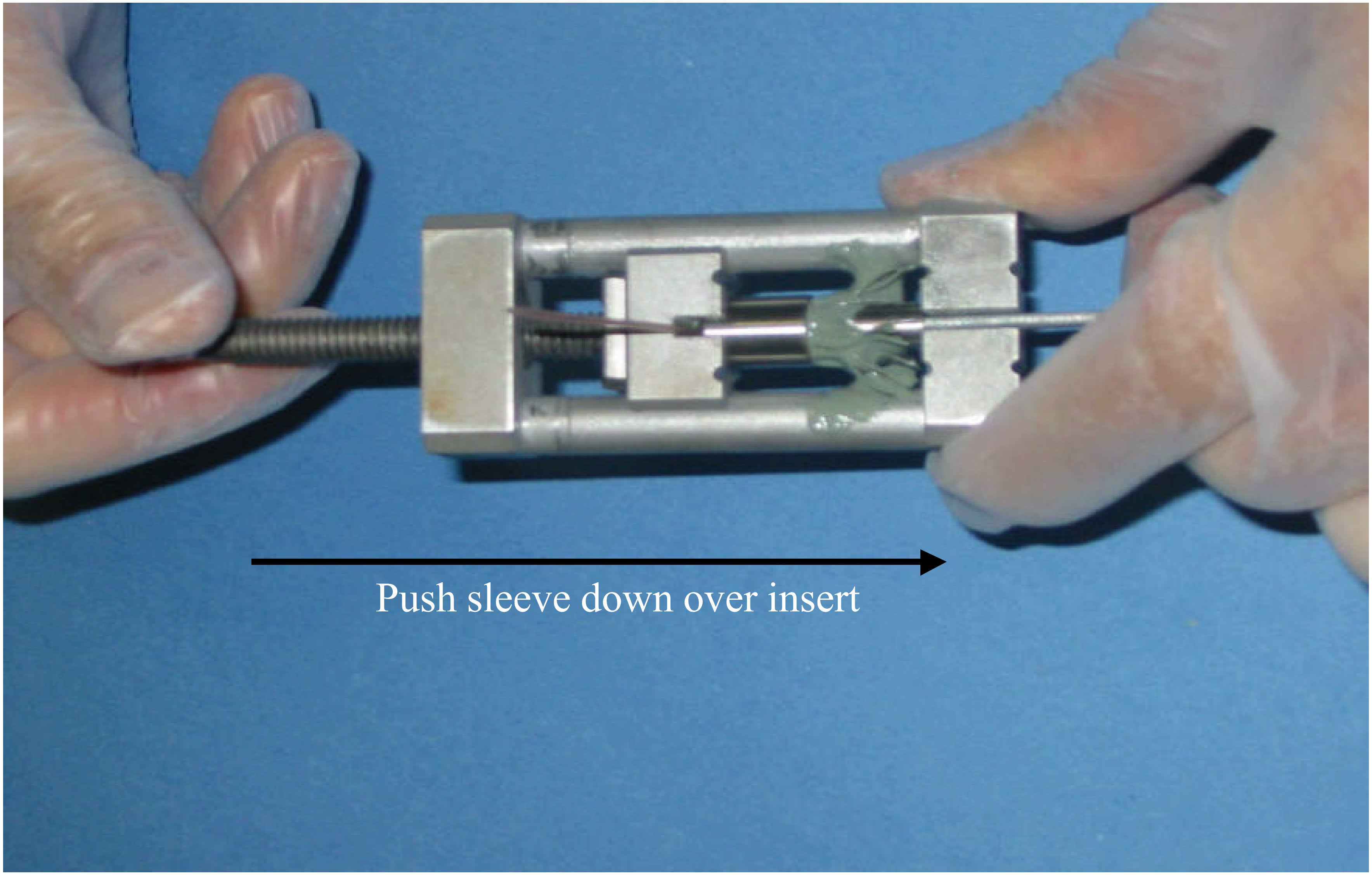


Pic.13 Trim Inner Wire Strands to Base of Insert

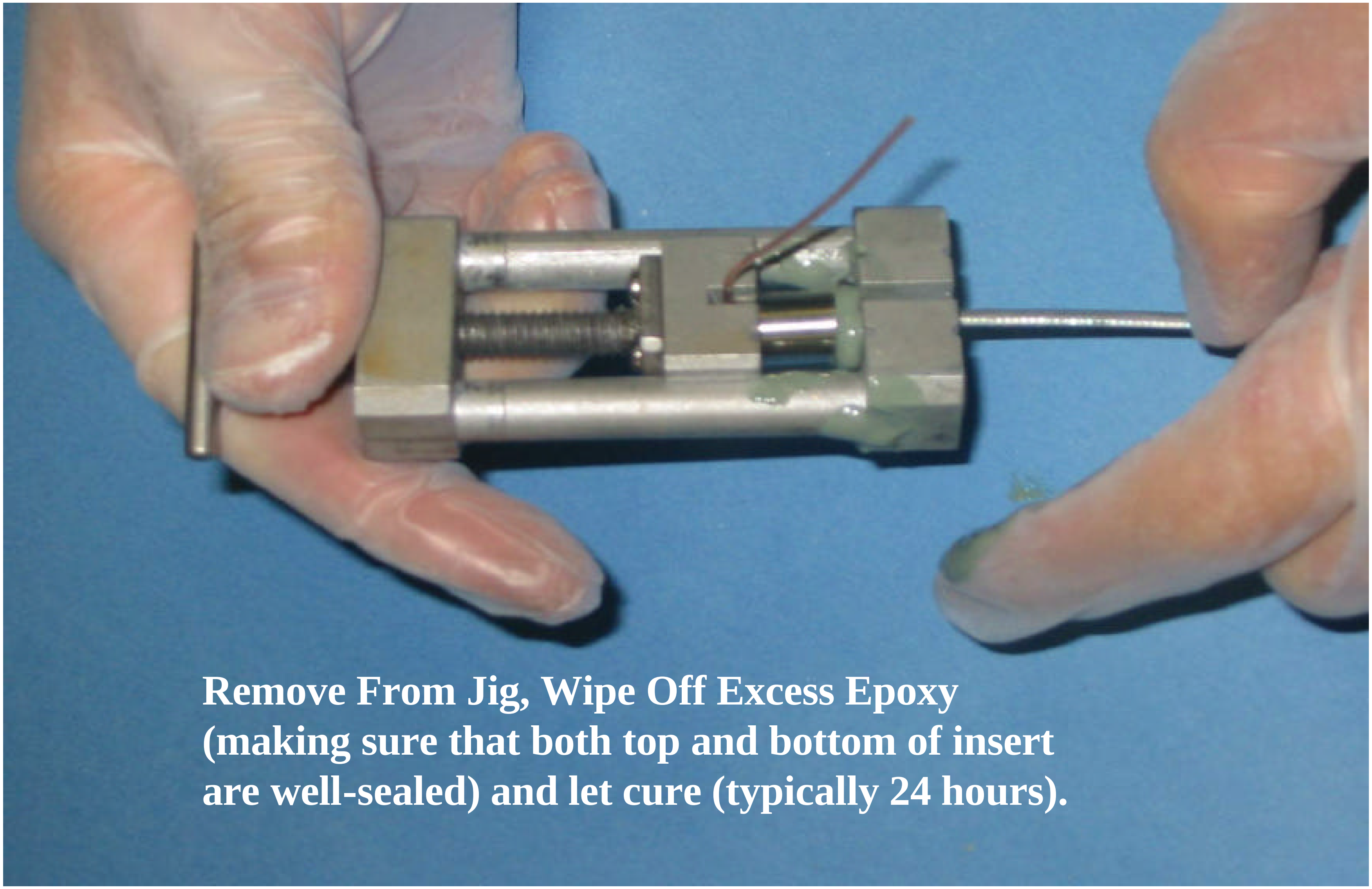


Pic.14 Mix epoxy

Pic.15 Apply epoxy. Cover the trimmed armor strands with epoxy

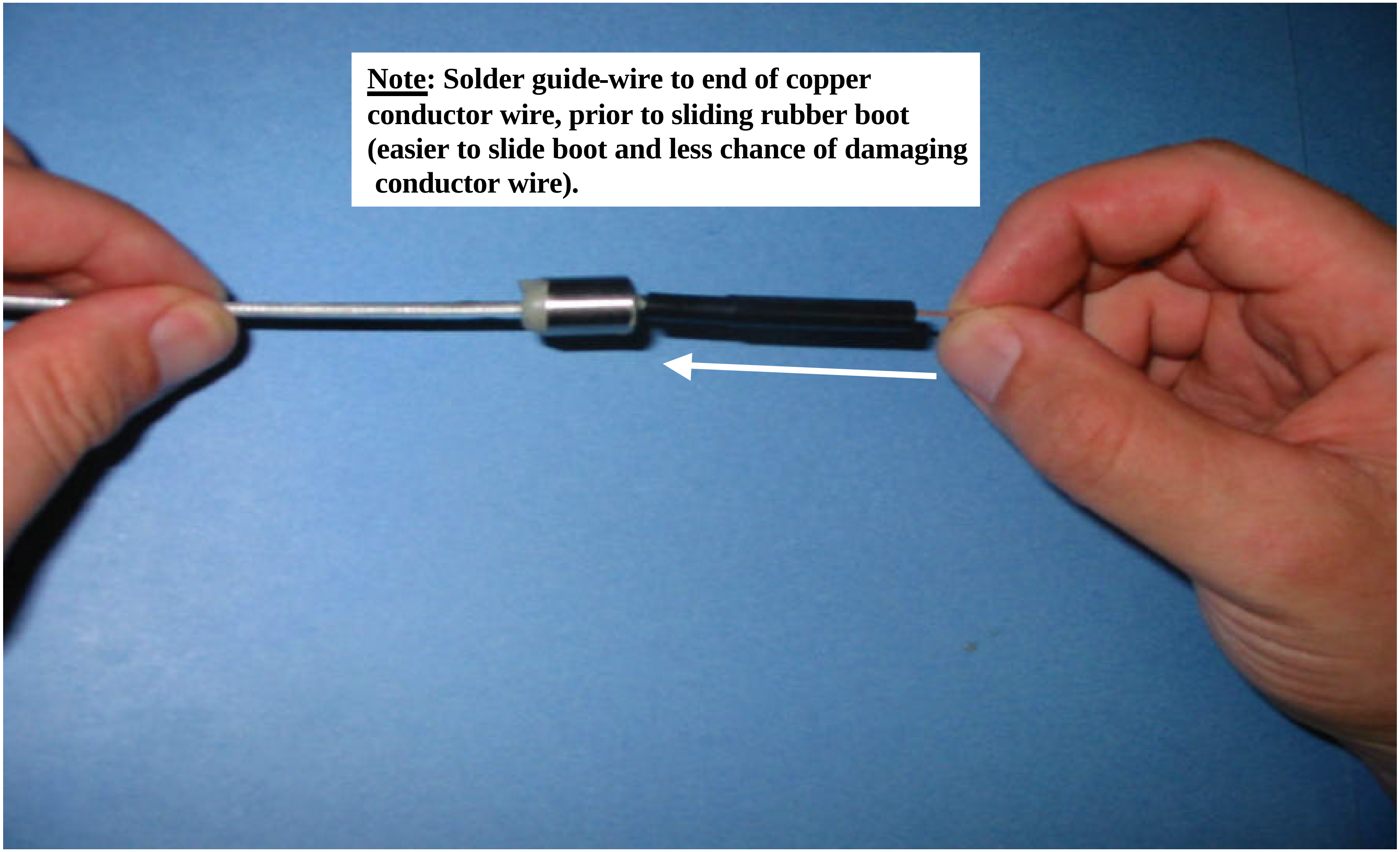


Pic.16 Using the termination jig, push the termination sleeve completely down over the insert

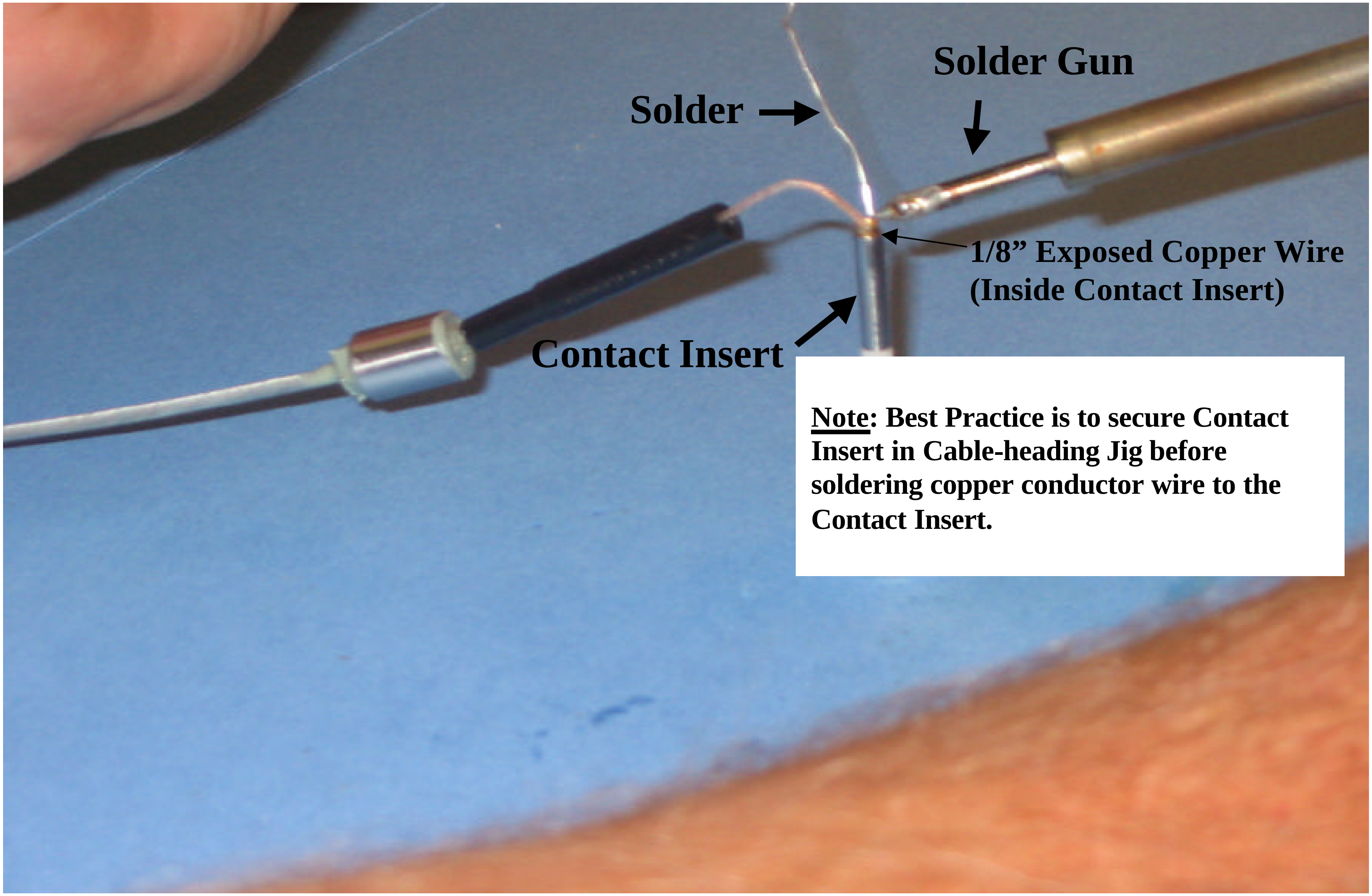


Pic.17 Termination Sleeve completely pushed down over insert

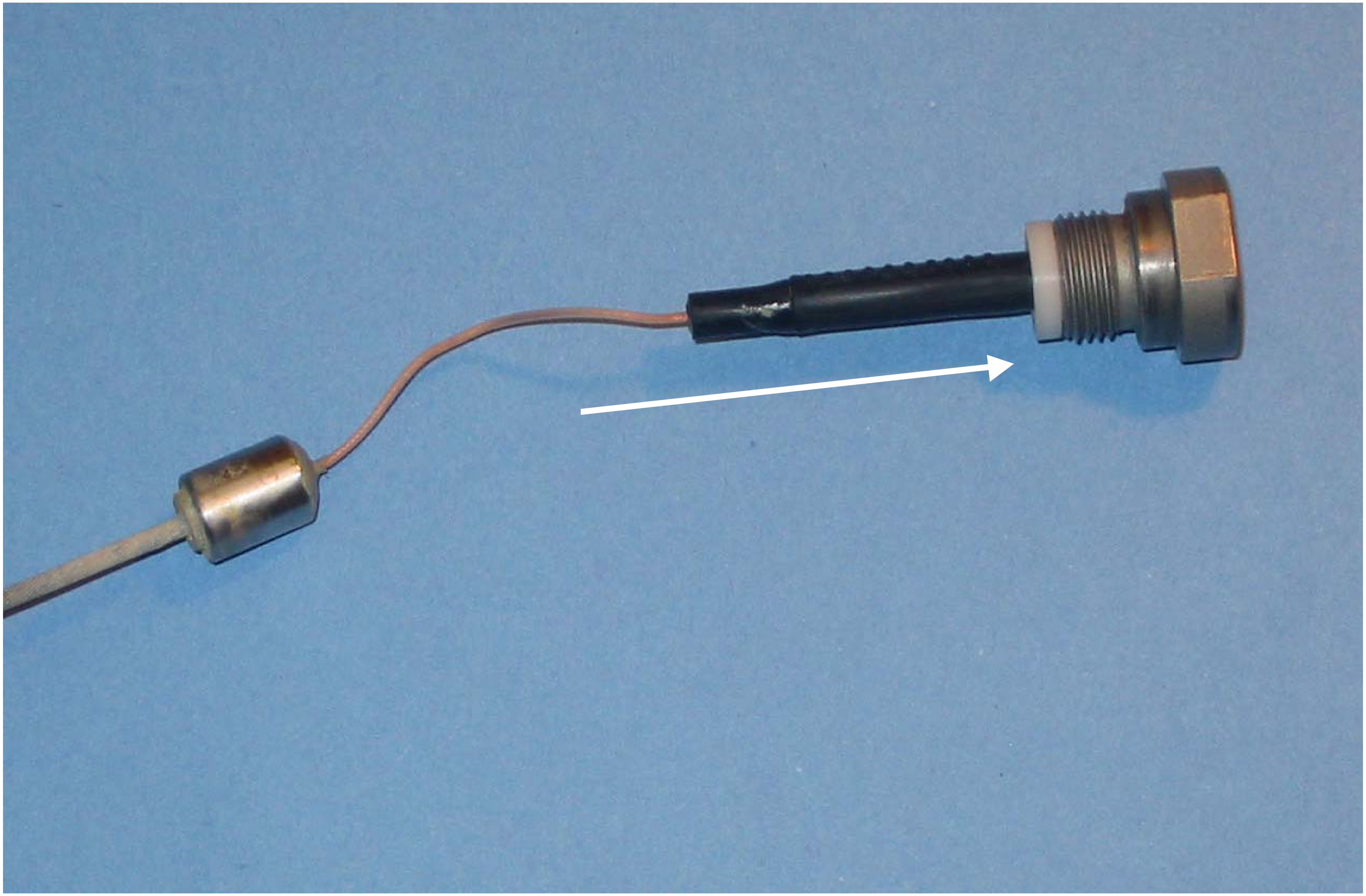
Pic.18 Apply silicon lubricant to the insulated conductor wire



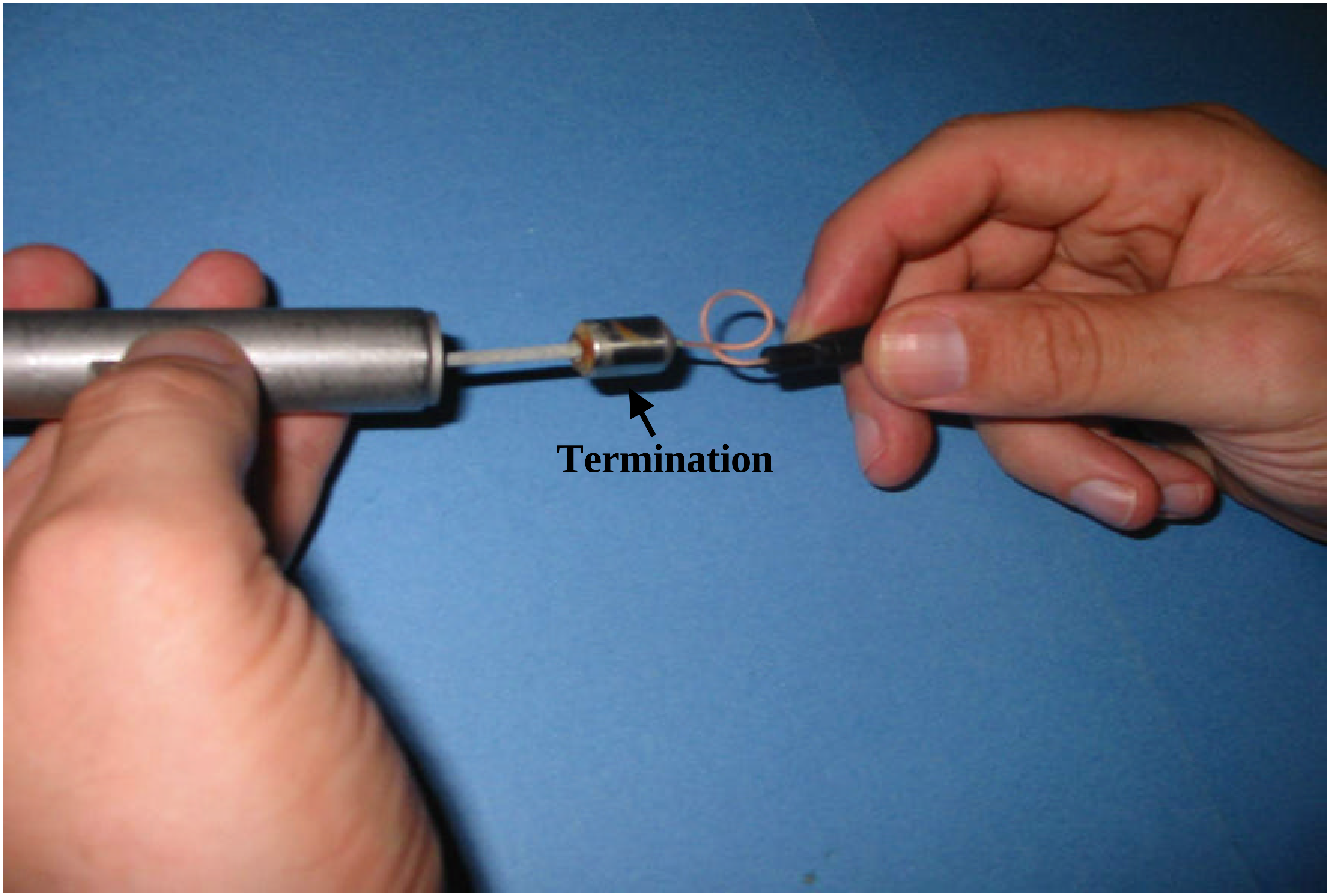
Pic.20 Slide the rubber boot towards the cablehead termination (final position)



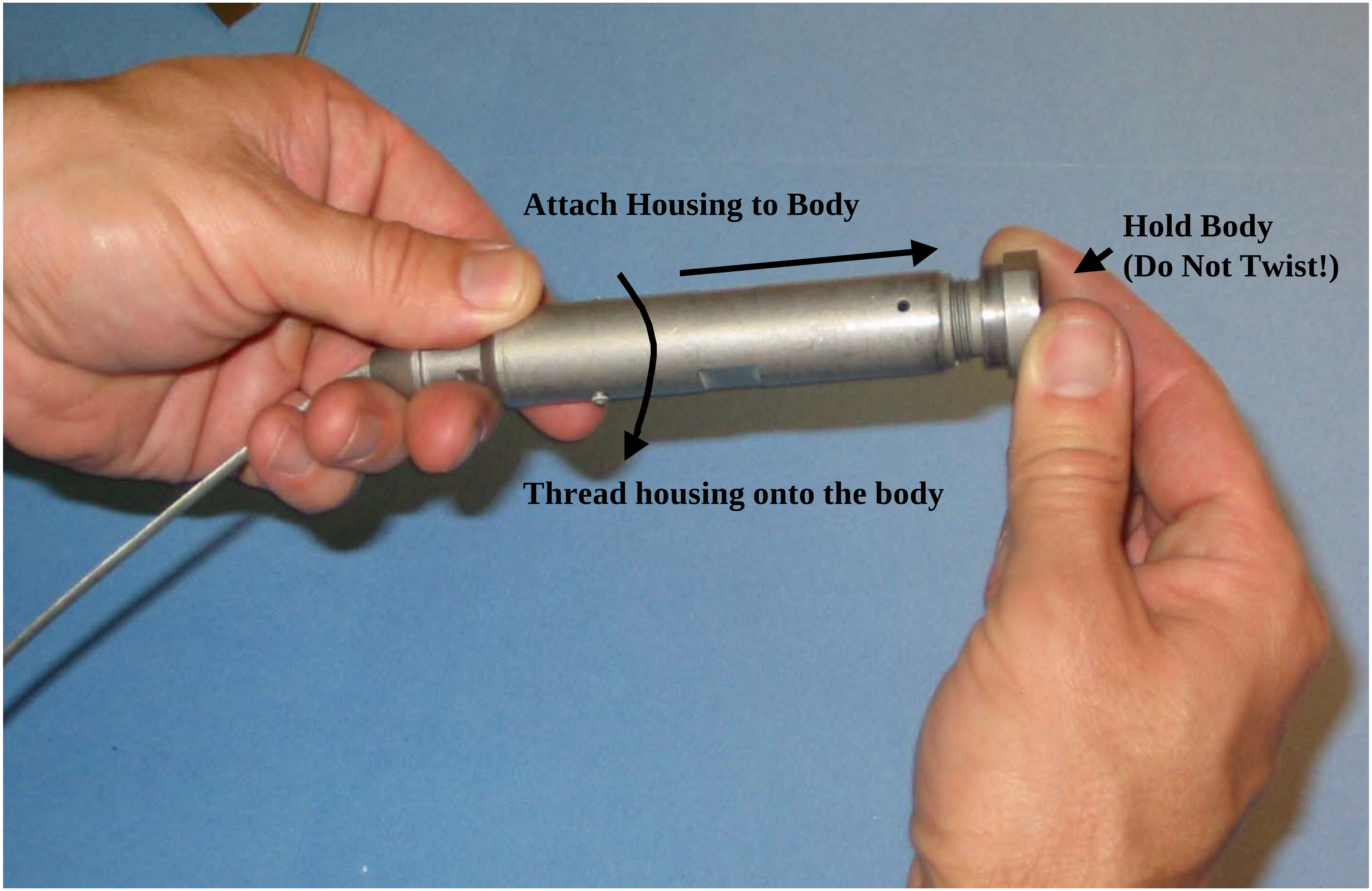
Pic.21 Solder 1/8 inch exposed copper wire (use wire strippers) into contact insert



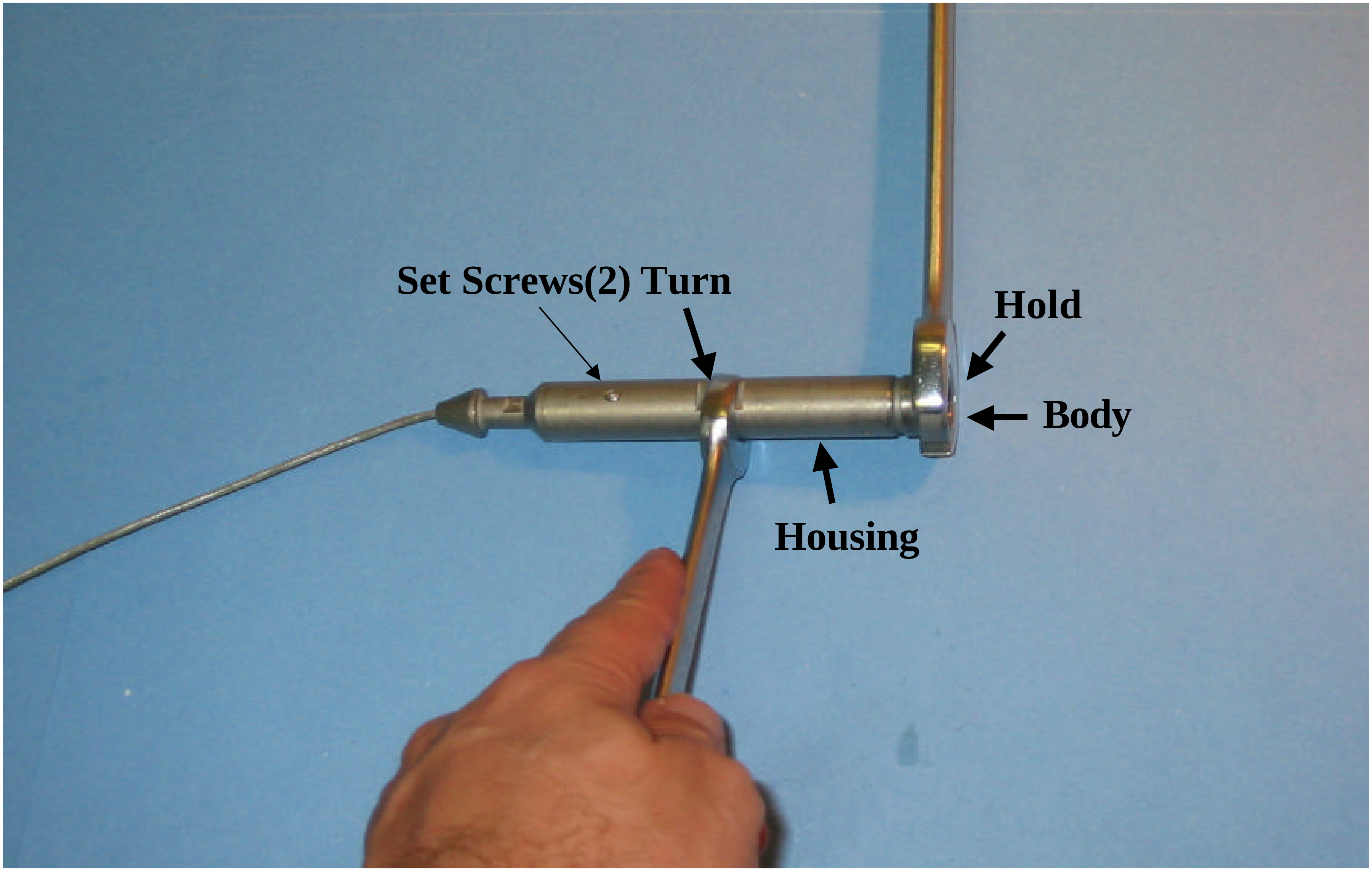
Pic.22 Slide the rubber boot down over the contact insert (when the solder has cooled)



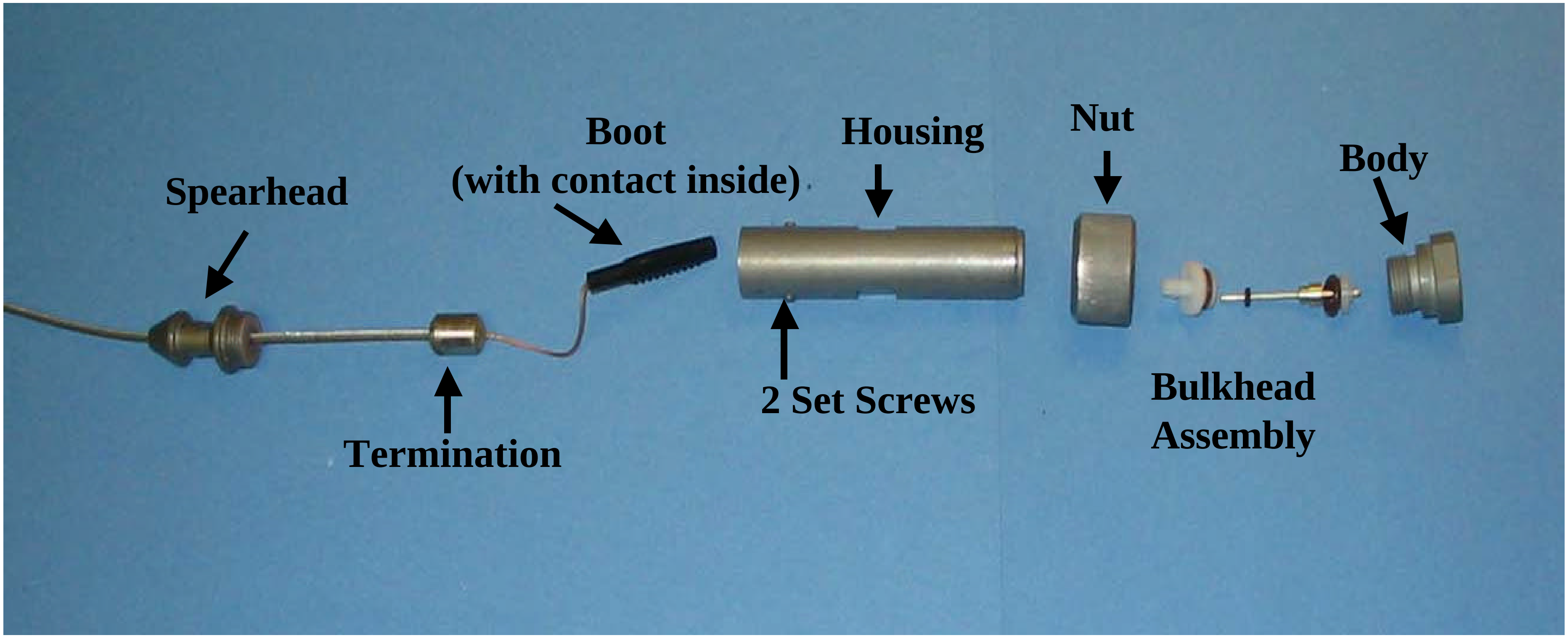
Pic.23 Create a loop in the conductor wire before sliding the cablehead housing down over the termination



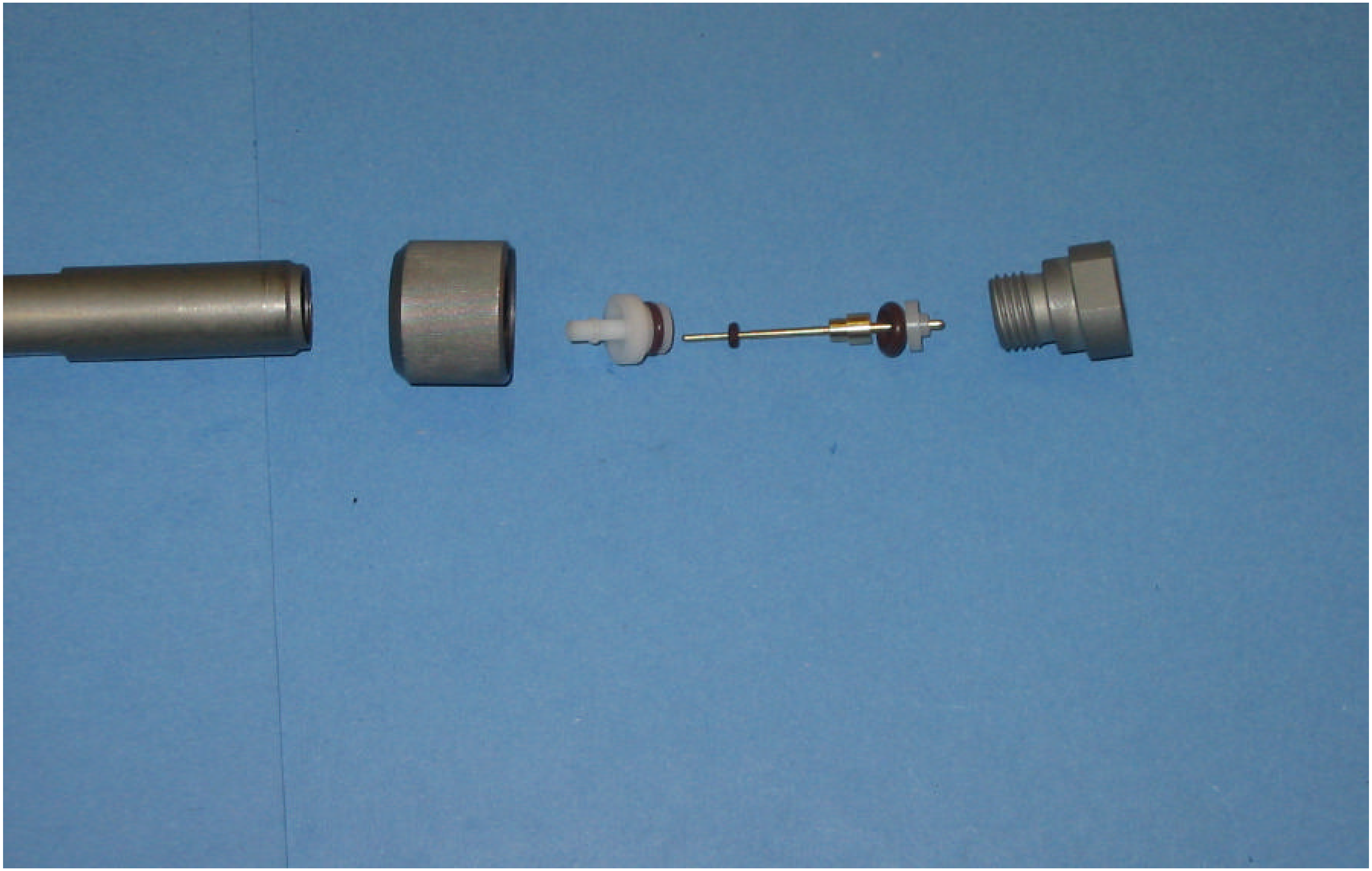
Pic.24 Thread the cablehead housing onto the body
(Do not twist the body! –this can damage the conductor wire)



Pic.25 Tighten the housing to the body
Tighten the set screws to complete re-assembly of the cablehead



Pic.26 Exploded view of cablehead assembly



Pic.27 Exploded view of bulkhead assembly

Appendix J
Field Monitoring Forms

Bioreactor Monitoring

Personnel:

Trench Sumps Water Levels ('BTOC)

Sump ID	Sump Depth (ft BTOC)	Sump Water Level (ft BTOC)	pH	Temp. (deg. C)	SpCond. (mS/cm)	ORP	DO (mg/L)	Trench Currently Being Used (√)	Notes
Date:		*Time:*							
B3-T1-1	**12.9**								
B3-T1-2	**12.4**								
B3-T1-3	**12.85**								
B3-T2-1	**9.67**								
B3-T2-2	**10.01**								
B3-T3-1	**9.96**								
B3-T3-2	**7.4**								
B3-T4-1	**6.32**								
B3-T5-1	**9.33**								
B3-T5-2	**7.98**								
B3-T6-1	**11.45**								
B3-T6-2	**12.34**								
B3-UIC									

B-3 Transfer System Monitoring

Flow Meters Readings

Meter	**Monday**		**Tuesday**		**Wednesday**		**Thursday**		**Friday**	
Date/Time:										
Rate (gpm) / Cumulative Total (gal)										
T-1										
T-2										
T-3										
T-4										
T-5										
T-6										
B-3 (Total)										
CS-MW16-LGR										
CS-MW16-CC										

Bag Filter Pressure Reading (Pressure Drop (PB-1) - (PB-2)= *Note: If bag filter pressure drop is > or = 20 psi change fliter.

PB-1 - PB-2 =	*PB-1 - PB-2 =*	*PB-1 - PB-2 =*	*PB-1 - PB-2 =*	*PB-1 - PB-2 =*

Notes:

Personnel	

Weekly Water Level Monitoring

Well Interval	Sampling Port Depth (ft BTOC)	Sample Date	Sample Time	Pressure at TOC (psi)	Pressure in MP (psi)	Zone Pressure (psi)
CS-WB05-LGR-01	99					
CS-WB05-LGR-02	182					
CS-WB05-LGR-03A	216					
CS-WB05-LGR-03B	262					
CS-WB05-LGR-04A	277					
CS-WB05-LGR-04B	329					
CS-WB05-BS-01	362					
CS-WB05-CC-01	432					
CS-WB05-CC-02	460					
CS-WB06-UGR-01	20					
CS-WB06-LGR-01	93					
CS-WB06-LGR-02	174					
CS-WB06-LGR-03A	207					
CS-WB06-LGR-03B	260					
CS-WB06-LGR-04	320					
CS-WB07-UGR-01	14					
CS-WB07-LGR-01	90					
CS-WB07-LGR-02	175					
CS-WB07-LGR-03A	208					
CS-WB07-LGR-03B	257					
CS-WB07-LGR-04	318					
CS-WB08-UGR-01	38					
CS-WB08-LGR-01	115					
CS-WB08-LGR-02	193					
CS-WB08-LGR-03A	228					
CS-WB08-LGR-03B	273					
CS-WB08-LGR-04	341					

Personnel	

Monthly Monitoring

MPMWs	Sample Date	Sample Time	pH	Temp	SpCond	ORP	DO	Regulatory (√)	Performance (√)
CS-WB05-LGR-01									
CS-WB05-LGR-02									
CS-WB05-LGR03A									
CS-WB05-LGR03B									
CS-WB05-LGR04A									
CS-WB05-LGR04B									
CS-WB05-BS-01									
CS-WB05-CC-01									
CS-WB05-CC-02									
CS-WB06-UGR-01									
CS-WB06-LGR-01									
CS-WB06-LGR-02									
CS-WB06-LGR03A									
CS-WB06-LGR03B									
CS-WB06-LGR-04									
CS-WB07-UGR-01									
CS-WB07-LGR-01									
CS-WB07-LGR-02									
CS-WB07-LGR03A									
CS-WB07-LGR03B									
CS-WB07-LGR-04									
CS-WB08-UGR-01									
CS-WB08-LGR-01									
CS-WB08-LGR-02									
CS-WB08-LGR03A									
CS-WB08-LGR03B									
CS-WB08-LGR-04									

Notes *As part of monthly monitoring, Sumps 1-1, 1-2, 1-3, and uppermost saturated intervals of WB05 and WB-07 will be sampled for Performance list of analyses. Sumps in any trench that has beeen used during the previous 30 days will be sampled for Regulatory list of analyses. TDS has to be added to the list of analyses for Sumps 1-1, 1-2, and 1-3 if Trench 1 has been used in the previous 30 days.*

Performance list of analyses Volume Required: 1.5 L	Regulatory list of analyses Volume Required: 0.5 L
VOCs (Volatile Organic Compounds)	VOCs (Volatile Organic Compounds)
DOC (Dissolved Organic Carbon)	TDS (Total Dissolved Solids)
TOC (Total Organic Carbon)	Notes
Methane, Ethane, Ethene	
Carbon Dioxide	
Hydrogen Sulfide	
Alkalinity	
Nitrogen, Nitrate + Nitrite	
Sulfate, Chloride, Ferrous Iron, Manganese	
Hydrogen (after bioreactor operational for 1 year)	

Personnel

Quarterly Monitoring

MPMWs	Sample Date	Sample Time	pH	Temp	SpCond	ORP	DO	Regulatory (√)	Performance (√)
CS-WB05-LGR-01									
CS-WB05-LGR-02									
CS-WB05-LGR03A									
CS-WB05-LGR03B									
CS-WB05-LGR04A									
CS-WB05-LGR04B									
CS-WB05-BS-01									
CS-WB05-CC-01									
CS-WB05-CC-02									
CS-WB06-UGR-01									
CS-WB06-LGR-01									
CS-WB06-LGR-02									
CS-WB06-LGR03A									
CS-WB06-LGR03B									
CS-WB06-LGR-04									
CS-WB07-UGR-01									
CS-WB07-LGR-01									
CS-WB07-LGR-02									
CS-WB07-LGR03A									
CS-WB07-LGR03B									
CS-WB07-LGR-04									
CS-WB08-UGR-01									
CS-WB08-LGR-01									
CS-WB08-LGR-02									
CS-WB08-LGR03A									
CS-WB08-LGR03B									
CS-WB08-LGR-04									
CS-MW1-LGR									
B3-MW01									
CS-D									
CS-MW16-LGR									
CS-MW16-CC									

Quarter ___

Lockout/Tagout Log

Name	Activity Requiring Lockout/Tagout	Date	Time	
			Start	Finish