

# INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS AND PARTS LIST FOR

# SUBMERSIBLE TURBINE PUMPS

CUSTOMER:

PUMP SERIAL NUMBER: \_\_\_\_\_

DATE SHIPPED: \_\_\_\_\_

# DELIVERING VERTICAL TURBINE PUMP RELIABILITY, QUALITY AND SERVICE SINCE 1969.

PERFORMANCE | QUALITY | SERVICE | TRUST

# NATIONAL PUMP COMPANY

Subject to the terms and conditions set forth below, NATIONAL PUMP COMPANY ("National") warrants that its manufactured equipment is free from defects in workmanship and materials USING ITS SPECIFICATIONS AS A STANDARD. This warranty does not extend to anyone except the first purchaser to whom the goods are shipped from National.

National's obligation under this warranty is expressly limited to replacing or repairing, free of charge, F.O.B. point of manufacture, any defective part or parts of its manufactured equipment; however, NATIONAL SHALL HAVE NO SUCH LIABILITY EXCEPT WHERE IT IS SHOWN TO THE SATISFACTION OF NATIONAL THAT THE DAMAGE OR CLAIM RESULTED FROM BREACH OF THIS WARRANTY. All parts claimed defective must be delivered to National at its factory or any factory branch, freight or express thereon PREPAID.

Every claim under this warranty SHALL BE DEEMED WAIVED UNLESS MADE IN WRITING AND RECEIVED BY NATIONAL WITHIN THIRTY (30) DAYS OF THE DATE THE DEFECT WAS DISCOVERED OR SHALL HAVE BEEN DISCOVERED, and within one year of the date of installation. The installation date must be within six months of the date the pump was purchased from National.

This Warranty does not cover those parts of the manufactured equipment which are not manufactured by National except to extend to the purchaser the same warranty, if any, which is given to National by the manufacturers of said parts.

National makes no other representation of warranty of any kind, express or implied, in fact or in law, including without limitation, the warranty of merchantability or the warranty of fitness for a particular purchase, other than the limited warranty set forth herein. In no event shall National be liable for any consequential or incidental damages resulting directly or indirectly from the use or loss of use of the manufactured equipment. National shall not be liable for any alleged negligence, breach of warranty, strict liability, or any other theory other than the limited liability set forth herein.

THIS WARRANTY CONTAINS THE ENTIRE WARRANTY RELATING TO THE MANU-FACTURED GOODS OF NATIONAL, AND NO CONDUCT, ORAL STATEMENTS OR REPRESENTATIONS NOT CONTAINED IN THIS WARRANTY SHALL HAVE ANY FORCE OR EFFECT OR BE DEEMED A WAIVER THEREOF, THIS WARRANTY SHALL NOT BE MODIFIED IN ANY WAY EXCEPT IF IN WRITING AND SIGNED BY AN AUTHORIZED REPRESENTATIVE OF NATIONAL.

This Warranty, and any liability of National hereunder, shall be governed by, construed, and enforced in accordance with the laws of the State of Ohio.

## **TERMS AND CONDITIONS OF SALE**

The following general Terms and Conditions of Sale (the "Terms") are applicable to the provision of all goods supplied and/or services rendered ("Goods") by National Pump Company ("Seller") to any purchaser thereof ("Buyer").

 <u>GENERAL</u>. These Terms, together with any quotation, proposal, acknowledgement or invoice from Seller, constitute the complete and exclusive statement of the terms of the agreement governing the sale of Goods by Seller to Buyer, unless otherwise agreed by Seller in writing. These Terms supersede all other communications, negotiations, and all prior oral or written statements, regarding the subject matter hereof.

If an order for Goods ("Order") is deemed to be an offer by Buyer, then Seller's acceptance of such offer is expressly conditioned on Buyer's assent to the Terms. Any additional, different or conflicting terms proposed by Buyer in any Order, acceptance, confirmation, specifications or otherwise are hereby rejected and objected to by Seller and will not be binding in any way on Seller. Seller reserves the right in its sole discretion to refuse Orders.

2. WARRANTY: LIMITATION OF REMEDY. Seller warrants that its manufactured Goods are free from defects in workmanship and meet Seller's specifications at the time of shipment (under the conditions of proper storage, installation by a licensed well-driller or contractor, normal use, and regular service and maintenance) for a period of 12 months from the date of shipment of the goods by Seller or 18 months from the date of manufacture of the goods by Seller, whichever occurs sooner. All claims under this warranty with respect to any Goods must be made in writing and delivered to Seller within 30 days after the defect is discovered (or should have been discovered).

Seller's obligation under this warranty is expressly limited to replacing or repairing, free of charge, F.O.B. point of manufacture, any defective part of its manufactured Goods; however, Seller shall have no liability except where it is shown to the satisfaction of Seller that the defect resulted from breach of this warranty. All parts claimed defective must be delivered to Seller, freight or express prepaid, unless otherwise agreed by Seller in writing.

Seller's warranty does not cover those parts of its manufactured Goods that are not manufactured by Seller except to the extent that the seller of such parts extended its warranty to Seller as the purchaser of such parts.

SELLER MAKES NO OTHER REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, IN FACT OR IN LAW, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WHETHER OR NOT THE PURPOSE OR USE HAS BEEN DISCLOSED TO SELLER IN SPECIFICATIONS, DRAWINGS OR OTHERWISE, AND WHETHER OR NOT SELLER'S PRODUCTS ARE SPECIFICALLY DESIGNED AND/OR MANUFACTURED BY SELLER FOR BUYER'S PURPOSE OR USE.

IT IS EXPRESSLY AGREED THAT THE ABOVE STATES BUYER'S EXCLUSIVE REMEDY for any breach of warranty and for any claim for personal injury, property damage or commercial loss, whether sounding in contract, tort, strict liability or negligence based on any defect in such Goods.

3. <u>LIMITATION OF LIABILITY.</u> IN NO EVENT SHALL SELLER BE LIABLE, WHETHER BY WAY OF INDEMNITY OR BREACH OF CONTRACT OR STATUTORY DUTY OR REASON OF TORT, FOR ANY LIQUIDATED, DIRECT, INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR EXEMPLARY DAMAGES OR LOSS OF PROFIT, SAVINGS, REVENUE, INCOME, BUSINESS, PRODUCTION, OPPORTUNITY OR REPUTATION ARISING OUT OF OR RELATED TO THE ORDER OR THE GOODS WHETHER FORESEEABLE OR UNFORESEEABLE OR KNOWN OR UNKNOWN. The foregoing limitation of liability shall be effective without regard to Seller's acts or omissions or negligence or strict liability in performance or non-performance hereunder.

Except as otherwise provided by law, in no event shall Seller's liability under any Order or these Terms exceed the amount paid by Buyer under such related Order.

4. DELIVERY; LIMITATION OF LIABILITY AND REMEDY. Unless otherwise specified on any Order or as agreed by Seller in writing, all shipments are F.O.B. Seller's plant and all risk of loss with respect to any Godds shipped shall pass to Buyer when such Goods are delivered to the carrier at Seller's plant. Shipping dates are approximate and are based upon the prompt receipt of all necessary information. Seller shall not be liable for damages or delays in delivery or failure to manufacture or deliver due, directly or indirectly, to (a) causes beyond its reasonable control; (b) acts of God, acts of Buyer, acts of any civil or military authority, fires, labor disputes, earthquakes, floods or other weather conditions, accidents, epidemics, wars, riots or other civil disturbances, or delays in transportation; or (c) delays or defaults by Seller's suppliers or subcontractors or other inability to obtain necessary labor, fuel, materials, components or manufacturing facilities. In the event of any such delay, the date of delivery shall be extended for a period equal to the time lost by reason of the delay.

Delivery dates cannot be altered by Buyer without Seller's written consent. Any extension of the delivery date by Buyer will be subject to storage charges as determined by Seller, interest charges as set forth below, and any applicable price increases.

Goods produced by Seller in compliance with the Order requirements which cannot be shipped solely due to missing information from Buyer, including but not limited to carrier arrangements, will be charged an additional 10% of the Order value within 5 business days after Seller notifies Buyer of same.

5. PRICE AND PAYMENT. The price of Goods sold shall be Seller's price in effect for such Goods on the date of shipment of such Goods. Unless otherwise agreed by Seller in writing, prices quoted do not include freight, insurance, installation costs, special packaging or any sales, use, excise, VAT or similar taxes. Taxes imposed by any federal, state, county, city or municipal law on the Goods will be added to the invoice unless a fully completed and executed tax exemption certificate is received by Seller with the Order. Unless otherwise agreed by Seller in writing, payment terms are net thirty (30) days from the date of Seller's invoice in U.S. dollars. BUYER SHALL PAY A LATE CHARGE OF ONE AND ONE-HALF PERCENT (1.5%) PER MONTH ON ALL AMOUNTS NOT PAID WHEN DUE. Buyer waives its right to set-off against claims it may have against Seller and acknowledges that it may not suspend its payment obligations to Seller.

Seller reserves the right to withhold shipment or to require other adequate assurances of performance of Buyer's payment obligations as Seller in its discretion may require, notwithstanding any Order confirmation issued by Seller. Buyer shall be liable for all expenses, including attorneys' fees, relating to the collection of past due amounts.

- 6. <u>SECURITY INTEREST</u>. Buyer hereby grants Seller a security interest in and a lien upon all Goods sold to Buyer by Seller and the proceeds therefor (including any insurance proceeds), which security interest shall continue until all such Goods are fully paid for in immediately available funds. Buyer, upon Seller's demand, will execute and deliver to Seller such instruments as Seller requests to protect and perfect such security interest. Buyer shall have no right to sell, encumber or dispose of the Goods until Seller receives full payment for such Goods.
- 7. <u>CANCELLATION; RETURN OF GOODS.</u> Buyer may not cancel any Order except upon reasonable advance written notice and upon payment to Seller of Seller's cancellation fee, which shall include all costs and expenses incurred by Seller prior to the receipt of the cancellation notice including, but not limited to, all commitments to its suppliers and subcontractors, all fully burdened labor and overhead expended by Seller, and a reasonable profit charge. Such cancellation fee could equal the quoted total price of the Order. Seller's determination of such cancellation fee shall be conclusive.

Return of Goods shall be in accordance with Seller's most current return authorization process and shall be subject to a minimum fifteen percent (15%) restocking fee.

- <u>SUBSTITUTION</u>. Seller reserves the right to substitute materials and/or modify specifications of an Order to the extent required to comply with any governmental law or regulation.
- <u>AMENDMENTS; CHANGES.</u> The Terms may be amended, modified or waived only as agreed by Seller and Buyer in writing. No changes to an Order may be made by Buyer unless approved by Seller in writing.
- FAIR LABOR STANDARDS. Seller represents that any Goods to be delivered hereunder will be produced in compliance with the requirements of the Fair Labor Standards Act of 1938, as amended.
- 11. EXPORT REGULATIONS. The marketing, sale, use, export and release of the Goods are subject to applicable export laws and regulations of the United States and other countries. Buyer agrees to comply with all such applicable laws and regulations, including without limitation, U.S. Export Administration Regulations, regulations of the U.S. Office of Foreign Asset Control, the U.S. Foreign Corrupt Practices Act and comparable laws and regulations of other countries. Buyer shall be responsible for any breach of this Section.
- 12. <u>GOVERNING LAW.</u> These Terms and any Order hereunder shall be construed in accordance with the laws of the State of Ohio, without regard to conflicts of law principles. Any dispute arising hereunder shall be resolved in the federal or state courts of the State of Ohio, as applicable. The rights and obligations of Seller and Buyer shall not be governed by the U.N. Convention on Contracts for the International Sale of Goods.
- 13. WAIVER OF JURY TRIAL. EACH OF SELLER AND BUYER IRREVOCABLY WAIVES ANY AND ALL RIGHT TO TRIAL BY JURY IN ANY LEGAL PROCEEDING ARISING OUT OF OR RELATED TO THESE TERMS OR ANY ORDER HEREUNDER.
- 14. <u>MISCELLANEOUS</u>. The section titles in these Terms are for reference only and shall not limit or restrict the interpretation or construction of the Terms. Seller's failure to insist, in any one or more instances, upon Buyer's performance of any of the Terms, or to exercise any rights conferred by the Terms, shall not constitute a waiver of any such right to insist upon such performance or exercise such rights in the future. The partial or complete invalidity of any one or more provisions of these Terms shall not affect the validity or continuing force and effect of any other provision



# SUBMERSIBLE PUMPS

PUMP SERIAL NO.:	PURCHASE DATE:		
PERFORMANCE: GPM:	TDH:	RPM:	
WELL DIAMETER:			
CONSTRUCTION			
DISCHARGE ELBOW:		١١١	ICHES
COLUMN PIPE:	INCHES	x	FT.
BOWL ASSEMBLY: MODEL:	STA	GES:	
SUBMERSIBLE MOTOR: HP:	PHASE:	VOLTAGE:	
SUB POWER CABLE: FT:	SIZE:		
CONTROL BOX: SIZE:	HEATERS:	FUSES:	

The submersible pump consists of a submersible motor and turbine bowl assembly as designed for deep well application. The submersible motors may be emulsion oil, dielectric oil, or water filled and are designed for sustained operations submerged in water. The motor is ordinarily suspended below the turbine bowl assembly through a pump motor adapter. Rotating components of the bowl assembly are usually driven from the bottom where the pump shaft is connected to the motor shaft with a submersible motor coupling. Power is supplied to the submersible motor through a high quality submersible cable which is supported on the discharge pipe extending to the terminal box or to the motor control panel at the surface. The impeller adjustment has been made during the assembly at the factory so no further adjustment is necessary or recommended. The discharge pipe is threaded and coupled, usually in random lengths, and is supported from above by the surface plate or discharge elbow. See Figure 1 for typical deep well submersible turbine application.

CAUTION: DO NOT WORK ON PUMP, MOTOR, WIRING, OR OTHER COMPONENTS OF SYSTEM WITHOUT FIRST OPENING MAIN BREAKER OR PUMP DISCONNECT SWITCH.



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# **GENERAL ASSEMBLY**





# SUBMERSIBLE PUMP AND MOTOR

H.PPHASEHERTZVOLTSAI      R.P.MMFG	MP
R.P.MMFG	OUPLED
CABLE      SIZE    LENGTH    TYPE      DROP PIPE      SIZE    LENGTH SECTIONS      TYPE:    FLANGED    THREADED & C      PUMP      TYPE    US GPM @    F      AIR LINE    YES    NO LENGTH    DIAMETER      DEPTH GAUGE    TYPE    NO	OUPLED
SIZE    LENGTH    TYPE      DROP PIPE    SIZE    LENGTH SECTIONS      TYPE:    FLANGED    THREADED & C      PUMP    TYPE    STAGES      AIR LINE    YES    NO LENGTH    DIAMETER      DEPTH GAUGE    TYPE    NO	OUPLED
DROP PIPE      SIZE    LENGTH SECTIONS      TYPE:    FLANGED      TYPE:    FLANGED      TYPE    STAGES     US GPM @F      AIR LINE    YES      DEPTH GAUGE    INO	OUPLED
DROP PIPE      SIZE      TYPE:      FLANGED      TYPE:      PUMP      TYPE      US GPM @      AIR LINE      DEPTH GAUGE      DEPTH GAUGE	OUPLED
SIZELENGTH SECTIONS TYPE: □ FLANGED □ THREADED & C PUMP TYPESTAGES US GPM @F AIR LINE □ YES □ NO LENGTHDIAMETER _ DEPTH GAUGE □ YES □ NO	OUPLED
TYPE:    FLANGED    THREADED & C      PUMP      TYPE    STAGES     US GPM @F      AIR LINE    YES      DEPTH GAUGE    NO	OUPLED
PUMP    TYPE    US GPM @    F    AIR LINE    DEPTH GAUGE    DEPTH GAUGE	
TYPE	
I YPESTAGESF US GPM @F AIR LINE	
	FT. T.D.H
□ FUSES: RATINGTYPE	
STARTER MANUFACTURER:	
TYPE OF STARTER	
	SEC.
NUMBER ADJUSTABLE SET AT	AMPS
SUBTROL-PLUS:□ NO □ YES: REGISTRATION #: IF YES OVERLOAD SET2 □ NO □ YES SET AT	
	AMPS
MATERIALS	
DROP PIPE INTAKE SCREEN	
IMPELLERS DISC. ADAPT	
BOWL SHAFT CABLE GUARD	
REMARKS: CUSTOMER	
NOT FOR CONSTRUCTION	
UNLESS CERTIFIED FURNISHED BY	
COMPANY. GLENDALE AZ	
PUMP SERIAL NO.	

DRAWING NO.



# "HDS" SUBMERSIBLE PUMP SURFACE PLATE

AIR VENT TAP	4DIS. HOLES ONDIA. B.C.	SURFACE PLATE
WELL SOUNDING TAP	2 LIFTING EYES	# R.F. DISCHARGE FLANGE
REMARKS		FURNISHED BY
MFG. BY NATIONAL PUMP	CO., GLENDALE, AZ	

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# "HDS" SUBMERSIBLE PUMP SURFACE PLATE



ITEM NO.	DESCRIPTION	
1	DROP PIPE	
2	PIPE COUPLING	
3	HEX NUT, COMPANION FLANGE	
4	LIFTING LUGS	
5	HEX BOLT, COMPANION FLANGE	
6	COMPANION FLANGE	
7	GASKET, COMPANION FLANGE	
8	CONDUIT BOX (OPTION)	

ITEM NO.	DESCRIPTION
9	STOVE BOLT, RND. HEAD (4)
10	CONDUIT BOX - GASKET
11	SQUARE NUT
12	PIPE PLUG
13	CASING BOLTS
14	SURFACE PLATE
15	CABLE CLAMP
16	POWER CABLE

Standard construction includes steel baseplate (not machined) with threaded one end pipe welded through the center and 90 degree elbow with 150# R.F. flanged discharge; four foundation bolt holes; threaded cable/conduit box connection; holes for airline and vent. All other item are optional features.



The satisfactory operation of the deep well submersible turbine pump is dependent upon proper application, installation, and maintenance of the equipment. Because of variations in application and installation requirements, the following instructions must, of necessity, be rather general in tone. The installer and maintenance person must use sound judgment to adapt the methods outlined to the conditions existent for each particular installation.

The general assembly of a National Pump submersible deep well turbine pump is shown in Fig.1 (page 2) with the component parts properly identified. This nomenclature will be used as a reference throughout these instructions. It must be understood that this is a typical illustration and may not conform in complete detail to the equipment as furnished. Please refer to any drawings that may have been prepared for this specific installation and become thoroughly familiar with the construction of the pump in question before attempting to assemble, install, dismantle, or do repair work on the unit.

Submersible booster pumps are usually completely assembled at the factory and proper instructions for the handling for this type of pump will accompany the shipment. For submersible deep well turbine pumps as described in this booklet, the bowl unit is assembled at the factory and shipped with the motor to the job site for assembly. The column pipe, discharge elbow and electrical cable are usually shipped as components for job site assembly as suggested in the following instructions.

If there is any doubt or question during the process of installation or operation, contact the factory.

#### PRELIMINARY PRECAUTION

Examine the well and well site carefully before starting installation. Make sure sand has not covered the perforated sections of the well. If not already known, determine that the well is of ample diameter and depth, and is sufficiently straight to receive the pump. The submersible unit must be operated in a straight portion of the well. Otherwise, pressure exerted may cause misalignment of bearings or couplings, and shorten the life of the unit. Rather than endanger the unit by lowering it into a well with bends severe enough to damage, it is best to lower a test blank with the same length as the combined pump/motor assembly with electrical leads into the well to the desired depth. If the test blank can be lowered to this point without binding, a submersible pump can be installed. If there is any doubt about straightness, caging and plotting are recommended. The pump should never be installed with the bottom of the motor closer than five feet from the bottom of the well.

#### **OBSTRUCTION IN THE WELL**

In a previously used well, any obstruction such as jagged casing from perforations or other damage should be corrected to facilitate installation and to prevent damage to the electrical cable. Visual inspection of the well may be performed through the use of an underwater television camera or possibly other means. Any oil or oil emulsion must be removed from the surface of the water to prevent premature damage to the unit. The oil may be removed from the well by bailing the bulk of the oil and then swabbing with burlap. It is possible to prevent fluid from entering the unit during installation by wrapping with an envelope of water soluble polyvinyl alcohol, but this will not protect the jacket material of the electrical conductor

#### SURVEY OF WELL

Always sound the well to make sure of its depth and to permit proper installation of the unit. If the exact diameter and depth of the well are not known, test the well as outlined previously. Many wells have more than one size of casing installed and frequently the lower sections are smaller in diameter than the upper casing. Do not install the unit with the motor in mud, sand, or resting on the bottom of the well. It is important to prevent the well from sanding up at any time to the point that the motor becomes packed or even partially buried.



#### AIR AND GAS IN WELL

The hydraulic performance requirements are contingent upon pumping clean, cold water free from air, gas, and with the pump properly submerged. If either is present in excessive quantities, there will be a reduction in capacity and head, or pumping may stop altogether. Further, the presence of air or gas in the well may cause deterioration of the pump sooner than normal conditions. If it is known that either is present, consult your dealer for advice.

#### FLOW INDUCER SLEEVE / SHROUD

Submersible motors are designed to operate with a cooling flow of water over the motor. If that pump installation does not ensure at least the minimum flow of 0.5ft/sec. then a flow inducer sleeve should be used. Some conditions requiring a flow sleeve are:

- Well diameter is too large to meet 0.5ft/sec flow requirements.
- Pump is in open body of water.
- The well is "top-feeding".
- Pump is set in or below any part of screens or perforations.
- Water temperature exceeding 86 degrees f.

#### SANDY WELLS

The unit cannot be guaranteed against the erosive action of sand, silt, or other abrasive material suspended in the water pumped.

#### **EFFECT OF CHEMICALS**

The standard unit cannot be guaranteed against corrosive action. Even though the chemical analysis of the water is known, it is not always possible to predict this corrosive action on metals. In addition to chemicals, water may contain entrained air or gases that have oxidizing or corrosive effects on metals. Such conditions do not always appear in the chemical analysis of the water.

#### INSTALLATION EQUIPMENT

Although portable derricks or tripods are sometimes used, a properly designed pump setting rig is recommended. It must be possible to erect the crown block to a height so as to allow the load hook to be raised at least two feet higher than the longest piece. The lifting device must be of sufficient strength and rigidity to raise the total weight of the unit safely. During all steps of installation, care must be used to prevent strains from being imposed upon the pump parts which may cause misalignment, deformation, or malfunction of the unit.

The hoisting equipment will, of course, depend upon the type of tripod or rig in use. In any case, the equipment should have sufficient strength and power to provide a minimum factor of safety of at least six. Obviously for heavier pumps and deeper settings, installation equipment must be stronger and heavier in the direct proportion.

The load hook itself should be of the safety type, with a good easy working swivel and should be truly centered over the axis of the well. When the well is slightly out of plumb, it may be necessary to shift the crown block as the pump assembly becomes progressively longer on installation and displaces laterally with respect to the well head.

Regardless of the type of lifting equipment, or the type of pumping equipment, the primary rule during installation must be SAFETY FIRST.



The following miscellaneous tools are suggested and may be varied to suit the individual installation:

Wooden friction blocks or steel clamps Steel column lifting elevators of approved type and of proper size for the pipe Cable sling approximately 10 feet long of adequate size for the load involved Two chain tongs One megger, or similar instrument indicating electrical resistance Clamp-on ammeter Voltmeter Pipe wrenches and Mechanic's hand tools

A good grade of pipe joint compound must be available to facilitate assembly and possibly future disassembly. As the installation progresses, all threads must be cleaned thoroughly with a wire brush and compound applied with a paint brush.

#### PUMP FOUNDATION

A suitable pump foundation should always be provided, preferably of solid concrete construction. If this is not practical, adequate steel beams may be used.

The pump foundation should be built to carry the weight of the entire pump full of water and should be rigid enough to withstand and prevent any vibration. If the pump is mounted on beams, the beams should be heavy enough to prevent spring action between the spans, also with lateral bracing and to prevent side motion, if any.

A preferred pump foundation should be constructed of concrete mixes as follows:

One part cement Two parts sand Four parts gravel With sufficient water to make a stiff mix

The area of the base of the foundation should be at least six inches larger on all sides than the pump discharge elbow base, and should be governed by allowable soil loadings. On heavy, deep setting pumps, the foundation should be engineered for safety and should be large and deep enough so that the load per square foot of concrete does not exceed ordinary foundation standards.

#### UNLOADING AND PREPARATION FOR INSTALLATION

Refer to the assembly drawing which is included with these instructions and become familiar with the construction of the pump before attempting to assemble, install, dismantle or do any repair work on the unit. During all steps of unloading and installation care must be used to prevent strains from being imposed upon the pump parts which might cause bending or misalignment of any of the critical parts.

Uncrate the parts and inspect carefully to be sure nothing was damaged in shipment. Check in detail the condition of any exposed shafting or any electrical conductors. If any part has been damaged or broken in shipment, please report it immediately to the factory and to the transportation company involved with full particulars, with pictures of the damage if possible. Confirm all verbal understandings by letter. DO NOT ACCEPT SHIPMENTS SHOWING DAMAGE TO EQUIPMENT/OR CRATING. DO NOT SIGN FOR INCOMPLETE SHIPMENTS.

Extreme care must be taken in handling and installing all parts, particularly the electrical conductors. Parts which are too heavy to be lifted from the transporting car or truck should be skidded carefully to the ground so as to **prevent injury**. Never drop such parts directly from the carrier to the ground. Never use crates in which parts are shipped for skids.



Lay out the column pipe and bowl/motor assembly on suitable timbers or staging keeping all material out of the dirt. Pipe coupling ends should be located towards the well. Clean all threads thoroughly and coat with joint compound as installed. All other parts should be cleaned and laid out on a clean surface in the order in which they will be used. Check against the packing list to be sure that no parts are missing.

#### **DROP PIPE**

Drop pipe should have 3/4" NPT taper threads with matching heavy duty couplings. 3", 4" and 5" are normally 21 foot random lengths: larger sizes are usually 20 foot. If butt thread drop pipe is used, it must be pinned at each joint to prevent unscrewing, as the motor torque tends to loosen butt threads. **Please be advised that National Pump recommends that you never use butt thread column pipe with a submersible pump**.

#### MOTOR RESISTANCE CHECK

It is important to know that the motor has not been damaged during shipment. Before removing motor from shipping skids attach one pole of the megger to ground and the other pole of the megger to any one of the motor leads. The minimum reading for each lead to ground should be 50 megohms. To check phases for continuity, connect the megger poles to two of the three leads, alternating until all three pairs of leads have been checked. Megger readings should all be zero which indicates a continuous circuit.

Such a resistance check should be performed during and immediately following the completion of installation.

#### MOTOR TO PUMP END ASSEMBLY INSTRUCTIONS

#### Step 1

Remove the motor and pump end from containers. At this time, check to make sure pump model horsepower matches motor horsepower rating. Also, check motor phase and voltage to make sure it matches power source.

Raise motor to vertical position, making sure motor is adequately supported. Pump and motor should never be assembled in horizontal position as damage to pump shaft could occur.

#### NOTE: Oil or water filled motor - check levels.

#### Step 2

Raise pump to vertical position over motor, inspect flanges of pump and motor making sure all dust, paint, grease, and rust are removed from flange faces. Make sure no obstruction is in motor coupling. Verify that the pump shaft and motor shaft turn freely.

#### Step 3

Lower pump slowly onto motor. Guide pump into proper alignment (never rest pump on motor shaft). Align cable recess on pump making sure you do not pinch motor leads. Coupling should slip freely into place to join pump and motor. Pump should be lowered to meet motor flange flush. Bolt pump end and motor together with stainless fasteners provided. **Verify impeller lift at this time**. **NOTE: Should pump end not meet motor flange flush, see Step 4.** 

#### Step 4

The thrust assembly is pre-set at factory but could need final adjustment when pump and motor are coupled. The thrust assembly consists of either thrust bolt and jam nut or thrust plug. First, the thrust bolt should be screwed all the way down against the pump shaft. When the bolt bottoms, the bolt may be backed off two (2) turns. With a wrench as a backup, now screw the jam nut against the pump casting and jam lock nut and bolt.



With the thrust plug, screw all the way down against the pump shaft, then back off one and a half (1-1/2) turns. This will allow for ample momentary upthrust.

The thrust assembly, if set too closely, could prevent you from bolting pump and motor or even locking shaft rotation. Make sure you have ample clearance for pump to fit flush with motor.

#### CONSULT FACTORY OR LOCAL SALES OFFICE SHOULD QUESTIONS ARISE

Assemble the pump cable guard over the motor leads. Do not cut or pinch lead wire during assembly or handling of the pump during installation.

#### ELECTRICAL CABLE

Use cable suitable for use in water, sized to carry the motor current without overheating in water and in air, and complying with local regulations. To maintain adequate voltage at the motor, use lengths no longer than specified in the motor manufacturer's cable charts.

Include a ground wire to the pump as required by codes or surge protection connected to the power supply ground. Always ground any pump operated outside a drilled well.



# SUBMERSIBLE CABLE SELECTION CHART

CABLE LENGTH VERSUS MOTOR AMPERES



Based on 5% voltage drop - 60°C copper temperature and 30°C ambient temperature. Maximum ampere value for each cable size must be reduced if ambient temperature exceeds 30°C.



#### ELECTRICAL SPLICES AND CONNECTIONS

Splices must be waterproof. Make a strong mechanical bond between the motor leads and the cable to avoid high resistance at the connection. A poor mechanical connection, or a poorly wrapped splice, can cause motor malfunction and failure.

Before connecting the motor to the cable, perform a ground check to assure that the motor has not been damaged. Attach one end of an ohmmeter to any of the three motor leads and the other lead to the pump intake bracket. A new motor must have a resistance of 2 megohms or greater. If it does not, contact your dealer. Repeat for all three leads.

Prepare the cable and make the mechanical connections (Figure 3) and splices as follows:

- 1. Cut motor leads and corresponding cable ends at 3-inch spacings to stagger connections for a smooth splice.
- 2. Cut connecting cable to match the motor leads.

**NOTICE:** Match color coded wires, red to red, black to black, and white to white.

 If a "Sta-Kon" connector is used, bare wire should be exposed approximately 1/2". If stranded wire is to be soldered, exposed wire should be about 1 inch long

**NOTICE:** Sta-Kon connectors may be used with solid conductors through 8 AWG, and with stranded conductors through 10 AWG.

- 4. Clean exposed ends of the conductors thoroughly with emery cloth or sandpaper to assure good electrical connections.
- 5a. (Sta-Kon Connection). Insert conductors and

crimp connector to the conductor using a Sta-Kon pliers. Connectors should butt against insulation after crimping. Pull on the cable to assure the connection is solid and tight.

**NOTICE:** Do not use acid core solder or corrosive paste.

- 5b. (Soldered Connection). Straighten individual strands and spread apart slightly. Clean each strand and push strands of the cable into matching (color coded) open strands of the motor leads. Using fine copper wire, wrap entire length of the "joint" until the strands are compressed. Apply solder, being sure solder flows throughout the joint. Pull firmly on the cable to test the joint.
- 6. Repeat step 5 for each lead.
- 7. Clean joints and adjoining cable/wire insulation of all grease and dirt, and build up the joint area with tape until it matches the diameter of the cable.

#### SOLID CABLE



FIGURE 3

Because friction tape is not water resistant, never use friction tape on a watertight splice. Use Scotch Number 33, or equivalent.

- Starting 1-1/2" back from the joint, firmly apply one layer of tape, overlapping about half the previous lap and continuing approximately 1-1/2" beyond the joint. Cut tape evenly and press both ends firmly against cable.
- Apply two additional layers of tape, as described in Step 8, beginning and ending 1-1/2" beyond the previous starting point.



#### CABLE SPLICING INSTRUCTIONS

There are several good methods of attaching the drop cable to the motor leads. Any method used must have high insulation value, be corrosion resistant, and most of all, must be waterproof under pressure.

As every 2.31 feet of water represents one pound of pressure, the total pressure at the splice depends on the submergence. This is why testing a finished splice in a bucket of water, as is sometimes done, is not an accurate test.

As pressure testing is not a practical operation, in most cases it becomes evident that great care should be used in the splicing operation. Generally splicing is not a complicated job and if the necessary care and time is taken, there is no reason why the splice should not be successful.

#### TAPE SPLICING

A good waterproof electrical tape must be used. Never use ordinary friction tape. The tape recommended is the "Scotch" brand due to their personal experience with the product; however, any other brand of good waterproof electrical tape would serve the purpose.

The three types of "Scotch" tape used are as follows:

**No. 23** This is used for the first layer as it affords excellent insulation and, most importantly, it is of a thick pliable texture which is good for the filling of voids in the connection, thus preparing the way for the final layers of tape with its waterproofing qualities. It should be noted at this point that on some of the larger sizes of cable splices, it may be necessary to use several wraps of No. 23 to fill the gaps at the connection and smooth out the joint.

**No. 33** This is the tape generally used in tape splicing and is an excellent waterproofing electrical tape which is used for the final laps. If No.23 is not available, the No. 33 may also be used for the initial layer. A word of caution concerning the use of No. 33, this tape tends to lose its elastic and adhesive qualities when applied in a cool or cold atmosphere. It is, therefore, necessary to apply this tape at close to room temperature or in some way keep it warm when using.

**No. 88** This tape, although a little more expensive than No. 33, has superior adhesive qualities in cold weather and is highly recommended as a splicing tape under any installation conditions. As with all tapes that have an elastic quality, it should be wrapped firmly but not over-stretched as this tends to "thin the tape out".

#### TAPE SPLICING INSTRUCTIONS

Cut the cable so that connections will be staggered about 3' apart. Take care not to nick or cut the copper conductor, strip enough insulation from wire to fit well into connector. Shape the end of the insulation in the manner of sharpening a pencil. This makes it easy to fill the void between the insulation and connector. Carefully scrape or sand the copper wire clean. This step is very important if finished splice is to be a trouble free connection.

Follow the cable color code, crimp the wires in the connectors. It is important that the proper crimping tool is used rather than ordinary pliers. If a crimping tool is not available, it is recommended that a good solder connection is made between the wire and the connector. Never use an acid core solder on electrical connections.

As most outer cable insulation has a wax type finish which makes a poor surface for the tape, use sandpaper or steel wool and clean the surface 3" to 6" on each side of the connector, depending on the size splice to be made.

Fill in around the connector and 1-1/2" to 2-1/2" along the cable with the No. 23 or No. 33 tape. Then, using No. 33 or No. 88 tape, wrap firmly and smoothly (without wrinkles) using an overlap about half the width of the tape. Complete the splice with 4 of the finishing laps, taking each lap beyond the end of the layer underneath to make a tapered finish. When finished, cut: do not tear the tape. To help insure good sealing, finish off with a coat of "Scotchkote" which is a fairly fast drying sealant and bonding agent. Some pump men prefer to use this sealant between each layer of tape, which is, of course, an added safety feature, but not absolutely necessary if the rest of the splice has been made with care.

A very good splice can also be made using heat shrink tubing in combination with the aforementioned tapes. The shrink tubing contains a sealant which melts when treated, thus making a better seal between cable and tubing.



To use shrink tubing, prepare cables in the same way: slide tubing on cables and make connections. Fill in the gaps with No. 23 or No. 33 tape. Centralize tubing on connector: then, using a small heating torch, heat the tubing, working out from the center until the sealant flows from the ends of the tubing. CAUTION: Do not allow naked flame to contact the tubing or the cables.

Cover the tubing with 2 or 3 lap layers of No. 33 or No. 88 tape and coat with "Scotchkote."

#### CABLE SPLICE RESISTANCE CHECK

It is important that the cable be tested both before and during the installation to test the cable after splice, connect one megger lead to the bowl assembly and the other lead to one of the cable leads at the cable reel. Minimum reading should be 50 megohms. Wet the cable splice and as much of the cable as practical. The megger reading should be the same as before. If it reduces substantially, there is a leak somewhere and it should be found by wetting down the cable a portion at a time, taking megger readings all the while. When testing cable during installation, the cable should be megged every pipe section as soon as the motor reaches water level. To do this, connect one megger lead to the cable reel and the other lead to the discharge pipe. This will immediately indicate any cable damage during installation. Minimum reading should be 50 megohms.

#### **DIRECTION OF ROTATION**

While bowl/motor assembly is still at the surface, connect lead wires to proper terminals in control box. Secure the pump and motor with chain tongs to absorb the torque. Bump-start the pump by pressing the start button and **immediately** hitting the stop button one second maximum observe the direction the unit tries to react to the pump torque the instant the motor starts. This reaction should show as a clockwise kick when viewed from suction end of bowls, indicating that the shaft and impellers are rotating in the opposite or counterclockwise direction. If any other direction is indicated, interchange any two of the motor leads at the control panel. Correct rotation is of extreme importance. Excessive overloads may be developed under operating conditions with reverse rotation.

Since shaft and bearing in the bowl assembly are dry at this point, care must be taken to apply power for rotation check for only a minimum time increment. Start and stop should be operated almost simultaneously. Too long a period of operation may lead to generation of journal heat and consequent bearing seizure.

When rotation is correct, mark the leads. It is of extreme importance to establish proper direction of rotation. At this time, copy the full load amperes from the motor nameplate. This data will be required before starting the unit for the first time after it is in the well. Secure the cable above the lifting hook to avoid tension on the motor leads and splice.

#### **INSTALLING PUMP**

Depending upon the clearance in the well casing, depth and straightness of the well, there may be some danger of pinching the cable between the column pipe coupling and well casing when lowering the unit. If protector-type cable supports are not used, a rubber padding may be used to cover the cable at these points if there is any danger of abrasion or pinching of the cable. When lowering the unit, the discharge pipe should be held against the casing on the side opposite to the cable to allow as much clearance for the cable as possible.

The top of the well casing may have sharp or rough edges and so it is important to protect the cable against cutting or scraping at this point also. A protective covering may be clamped over the rough well casing or the cable may be run over a pulley mounted high enough to allow the conductor to follow the discharge pipe down during the installation. Padding made of gasket material or something similar could also be used — a simple device that affords adequate cable shielding.

Set the pipe clamps over the well and open up wide enough for the motor and bowl assembly. Care should be taken so that threads will not be damaged while each section is being raised. Clean all threads and paint with thread lubricant. Thread the pipe into the discharge case connection and make up tight, using one set of chain tongs for back-up. The discharge pipe threads **MUST** be made up tight so that the motor torque will not loosen the joint during start-ups. A **MINIMUM** torque force of ten foot pounds per rated motor horsepower **MUST** be applied to each threaded joint in order to resist the reaction of the torque applied by the motor during starts and stops.



Lower the unit into the operating location with the various pipe sections. Make up each joint tight as described above, keeping in mind the **MINIMUM** figure of 10 foot pounds per horsepower. Be very careful to keep the electrical cable from rubbing over the sharp edges and position the elevators so as to avoid damage to the cable. Avoid twisting the unit, wrapping the cable around the pipe. Mount a cable guard directly above the couplings in convenient spacing. The cable guard spacing should not exceed 20 feet in any case. The first cable guard should be applied just above the splice and as near the bowl assembly as practical. Be sure that the cable remains reasonably taut and on the same side of the discharge pipe during the complete installation. Place the final cable guard approximately 3 feet below the surface plate, leaving a small amount of slack in the cable. Lower the surface plate and discharge elbow into position on the discharge pipe and make up tight. Insert the cable through surface plate or through channel if provided in the foundation and on into the terminal box or to the motor control panel.

The unit may now be lowered onto the foundation, with extreme care to avoid damage to the electrical cable. Lowering **MUST** be done gently and evenly with **NO** jerks or impacts. Insert the flange bolts if used and tighten evenly. Any future disassembly may be accomplished by reversing the procedure.

#### ELECTRICAL CONTROL EQUIPMENT

The characteristics of submersible motors are different from standard motors and special overload protection is required. WARRANTY ON THREE PHASE SUBMERSIBLE MOTORS IS VOID UNLESS PROPER QUICK TRIP AMBIENT COMPENSATED PROTECTION IS USED IN ALL THREE MOTOR LINES. All recommended overload protection selections are of the ambient compensated type to maintain protection at high or low air temperatures. Other controlling devices must depend on system design. This would include pressure switches and other such equipment. Additional protection should be provided to insure that the unit will not start or run unless adequate submergence is provided. In areas where electrical storms are prevalent, the use of lighting arresters is recommended as a motor protection.

#### **CURRENT CHECK**

With a suitable ammeter, read the current of the three phased, immediately upon starting, then while pump is running at its rated capacity and head. The average of the three current readings in the three phases should be approximately equal to full load current on the nameplate, assuming a full torque load on the motor. If the average current exceeds the nameplate value by over 15% at any time, stop the unit immediately. Such high current is an indication that something is wrong, the cause of which must be determined before the motor is operated. Please note that this is a quick initial check. Actual power input must be established with a watt hour meter.

#### **VOLTAGE CHECK**

In addition to showing proper average current, the individual values of line current should be approximately equal. If the current in any leg differs from the average value of all three by more than 5%, the supply voltage is probably unbalanced. A voltmeter reading should be taken on each of the three phases with the pump running. The average of the readings should be within plus or minus 10% of the motor nameplate rating of the motor. In addition, the maximum variation if any phase from the average value should not exceed 1%. The effect of unbalanced supply voltage is to create a current unbalance and increased loses in the motor far out of proportion to the magnitude of the voltage imbalance.

#### AIRLINE INSTALLATION AND OPERATION

An airline submerged in the well water provides the simplest method of determining the depth to the water level.

To use an airline, it is necessary to know the exact length of the line from a reference point, generally the discharge elbow base. The airline should extend past the bowl to about the middle of the motor. As the length of discharge pipe is known, the distance to the top of the bowl assembly from the foundation is usually some multiple of 10 feet. Mark a point on the motor if the airline is to extend to the depth. Measure the distance of the point below the lowest section of discharge pipe length. This is the total length of airline.



While the bowl assembly is in an upright position, before lowering into well, secure the first section of airline in the predetermined location. It is a good idea to slot the airline with a sawcut, some two to three inches above the bottom. This will reduce closure or clogging of the bottom end. Fasten the line in place so that it will not slip downward as additional sections are installed. It is recommended that the position of the upper end be marked on the discharge pipe as soon as each section of airline is installed so that it can be noted if any displacement occurs.

Add sections of airline at random lengths after the sections of discharge pipe have been installed and the pump is hanging from the hoist. It can be routed along with the power cable. Keep the airline outside of the elevators and fasten to the discharge pipe after removing the elevators at the level. Each joint must be made up airtight to be effective; so uses a thread sealing compound rather than a simple thread lubricant.

The last section of airline will have to be cut and fitted for length to match with the fitting furnished with the gauge and discharge elbow. Avoid hanging the weight of the airline on a fitting having its thread in a horizontal direction. For example, if the airline is to hang from an elbow, support the elbow rather than the horizontal nipple just behind the elbow.

Mount the gauge and air valve on the discharge elbow and connect the airline to it. It is generally good practice to remove the glass on the gauge and mark the depth of airline on the dial for record purposes. It will also be helpful to add the date of installation. If at any subsequent time an extension is added to the pump and the airline is extended also, the record on the gauge should then be brought up to date with the new length and new date.

Gauges are two types: direct reading and altitude. Each uses the same values of pressure to determine the depth. By pumping the airline full of air through the Schrader valve, the air pressure recorded at the surface of the ground is equal (within small limits) to the depth of water over the end of the airline.

With a direct reading gauge it is necessary to set the hand to point on the dial equal to the length airline. This must be done while there is no pressure on the gauge. Remove the Schrader valve core before making this adjustment. This gauge will read the distance to the water when the airline is pumped up. The hand will move away from the position equal to the pressure in the airline.

With an altitude gauge, this pressure is recorded directly on the gauge so that the depth of water is equal to the length of the airline, minus reading on the altitude gauge

A periodic determination of water level recorded together with hours of pump operation from a vital record of the well performance and changes. Well performance will vary or may even deteriorate over a period of time and any required revisions in the pump can best be planned from a good well record.

#### **GENERAL INFORMATION**

Column check valves are sometimes used to control reverse flow back to the pump, and to protect the well. Prevention of reverse flow and consequent reverse rotation will protect the pump and motor to reduce or eliminate over-speeding in reverse rotation, a condition which will not harm the pump, but might damage the motor.

Caution should be used in using check valves due to the possibility of sand locking and air accumulation under the valve. An airlock condition may cause prevention of the flow of water which could cause damage to the unit.

If check valves are used, install the first check valve after the first 20 foot section of pipe above the pump. To avoid water hammer and pipe breakage for 6" and larger submersible turbine pumps installed deeper than 600 feet, a second check valve should be installed at the nearest pipe joint about halfway between the pump and ground level. The distance from the first check valve to the second check valve and from the second check valve to ground level should not be equal.

The motor maximum diameter and the minimum inside diameter of the well shall be in such relationship that the minimum velocity past the motor shall be 0.5 feet per second.

If there is inadequate or restricted circulation of water past the motor, the motor may overheat and burn out. Each motor manufacturer has different recommendations; but in general, if water is continually flowing into the pump chamber and flow past the motor is unrestricted, the motor will operate satisfactorily. Consult the factory in doubtful cases. Use of liquid level control or flow switch to prevent pump breaking suction is recommended.



If the temperature of the water exceeds 86°F (30°C), motor failure may result. Consult factory if water temperature exceeds this limitation.

Developing the well, surging and freeing it from sand, are part of the well driller's contract and should be performed using a test pump. A new submersible MUST not be used to develop the well.

Never pull the discharge pipe to the discharge head with the cap screws or bolts. Install the pipeline so that the fasteners are used to prevent leakage only. Hanging the weight of the discharge line and fitting on the elbow is not recommended. Support the line by blocking or concrete saddles. Use a dresser-type coupling wherever possible, although adequate tie bars across the coupling must be provided in this case. Elbow must be securely anchored to foundation.

Be sure the pump is always submerged, even at extreme pumping rates. It is recommended that the pump be installed about 10 to 20 feet below the lowest "draw down" water level. Set the pump at least 5 feet above the bottom of the well.

Never allow a pump to start while it is possible that it may still be rotating in reverse direction after having shut down. It is advisable to install a time delay relay to prevent this. Replacing heaters with components of heavier rating than recommended if the pump load begins to trip those furnished originally is never advisable since these are protective devices.

It is considered good practice to avoid excessive cycling in any pumping operation. This is especially true with submersible pumps. If possible, the system should be arranged to require not more than two starts in each twenty four hours. Frequent cycling, such as once every couple of hours, could be injurious to the motor.

In all cases, it is recommended that regular maintenance schedules be established and followed. Making accurate recordings periodically of the various measurements recommended herein will permit preventative measures to be taken before trouble occurs. It will also provide information for the diagnosis of any difficulties.

#### **OPERATION AT SHUT-OFF HEADS**

In the usual application of vertical turbine pumps, no harm will result from operation under conditions of shut-off heads for a short period of time; however, not all installations are "usual" and, for this reason, consideration should be given to any unit which may be subjected to this usage. The following points should therefore be checked and resolved before putting the equipment into operation at or near shut-off heads.

- 1. Thrust bearing capacity must be adequate.
- 2. If prolonged operation at no flow is contemplated, the problem of heat dissipation may become acute, since the entire shut-off horsepower is converted to heat in the available fluid.
- 3. For high pressure units, stresses at shut-off heads should be investigated. This information may be obtained from the factory upon request
- 4. Certain impeller designs may have critical horsepower characteristics at low flows. Shut-off power requirements should be examined for driver overloads.
- It must be kept in mind that impeller shaft bearings depend on pumped fluid for lubrication. Fluid temperatures, if raised excessively due to lack of flow, may impair lubrication efficiency and may also damage the motor through excessive heat.

To summarize, designs will easily accommodate most of the considerations listed above. However, to obtain the best possible application, the factory should be notified at the time of order if operation at static flow heads will be a possibility and this precaution must be observed to validate any warranties.

### SUBMERSIBLE PUMP ASSEMBLY THREADED S6 - SE6 MODELS





### SUBMERSIBLE PUMP ASSEMBLY THREADED SJ8 MODEL

# SUBMERSIBLE PUMP ASSEMBLY

SK8 - S8 - S9 - S10 - SH10 - SJ10, SM10 - SJ11 MODELS

FOR 6", 8" AND 10" MOTORS



### SUBMERSIBLE PUMP ASSEMBLY LARGE MODELS





# NOTES





### **CORPORATE OFFICE**

### ARIZONA

7706 N. 71st Avenue Glendale, AZ 85303-1703 623-979-3560 Toll Free: 800-966-5240 Fax: 623-979-2177

## FACTORY BRANCH LOCATIONS

### CALIFORNIA

2830 San Antonio Drive Fowler, CA 93625 559-497-5071 Toll Free: 800-868-9755 Fax: 559-497-8816

### FLORIDA

195 E. Third Street Zolfo Springs, FL 33890 863-735-8222 Toll Free: 800-994-3045 Fax: 863-735-8202

### **MISSISSIPPI**

11176 Green Valley Drive Olive Branch, MS 38654 662-895-1110 Toll Free: 866-668-4914 Fax: 662-895-5083

### PASADENA, TEXAS

109 Richey Street Pasadena, TX 77506 713-641-6818 Toll Free: 800-231-0590 Fax: 713-641-4569

### LUBBOCK, TEXAS

4229 Adrian Street Lubbock, TX 79415 806-745-5396 Toll Free: 800-745-5393 Fax: 806-745-6668

**Email:** info@natlpump.com **Website:** www.nationalpumpcompany.com