



**INSTALLATION, OPERATION AND
MAINTENANCE INSTRUCTIONS
AND PARTS LIST FOR**

**SUBMERSIBLE TURBINE
PUMPS**

CUSTOMER: _____

PUMP SERIAL NUMBER: _____

DATE SHIPPED: _____

**DELIVERING VERTICAL TURBINE PUMP
RELIABILITY, DEPENDABILITY AND SERVICE
SINCE 1969.**

NATIONAL PUMP COMPANY LLC

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 MANUFACTURED 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 Arizona.

STANDARD TERMS AND CONDITIONS OF SALE

1. **ACCEPTANCE OF ORDERS:** All orders are subject to acceptance by an Officer of the Company and orders and deliveries are subject to the Company's regular credit policy. The Company reserves the right to refuse any order based on a quotation containing a gross error.
2. **PRICES:** List prices and discount schedules are to be maintained at all times. Prices are for merchandise F.O.B. shipping points, freight collect or prepaid, and added to the invoice. Prices, discounts, quotations, and specifications are subject to change without notice and will be applied as in effect at time of shipment.
3. **TERMS:** Except as otherwise indicated, payment is due 30 days after date of invoices. Interest at the maximum legal rate will be charged on all overdue amounts.
4. **TAXES:** Taxes imposed by any Federal, State, County, or Municipal law on the sale will be added to the invoice, unless a fully executed tax exemption certificate is received with the order.
5. **ORDER CHANGES:** No changes in orders will be accepted from the Customer except by special written arrangement with the executive office.
6. **RETURN OF GOODS:** Written permission from the factory must be obtained before returning any merchandise. All transportation charges must be borne by the Customer. New material of current design accepted by the Company for credit is subject to a restocking charge of at least 15 percent.
7. **CLAIMS:** All goods shall be deemed delivered to purchaser at the time they are placed in the hands of carrier and consigned to purchaser.
8. **ROUTING:** If routing of shipment is specified on Customer's order, it will be followed whenever practical.
9. **SUBSTITUTION:** The Company reserves the right to substitute materials and modify specification to the extent required in order to comply with any Government law or regulation.
10. **MINIMUM ORDER AMOUNT:** The minimum order amount to be charged on customer account is \$50.00. All orders for less than this amount will be billed at the minimum of \$50.00 not including tax or freight charges.

SUBMERSIBLE PUMPS

PUMP SERIAL NO.: _____ PURCHASE DATE: _____

PERFORMANCE:GPM:_____TDH:_____RPM:_____

CONSTRUCTION:

DISCHARGE ELBOW:_____ INCHES

COLUMN PIPE:_____ INCHES X _____ FT.

BOWL ASSEMBLY:MODEL:_____ STAGES:_____

SUBMERSIBLE MOTOR:H.P.: _____ 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.**

GENERAL ASSEMBLY

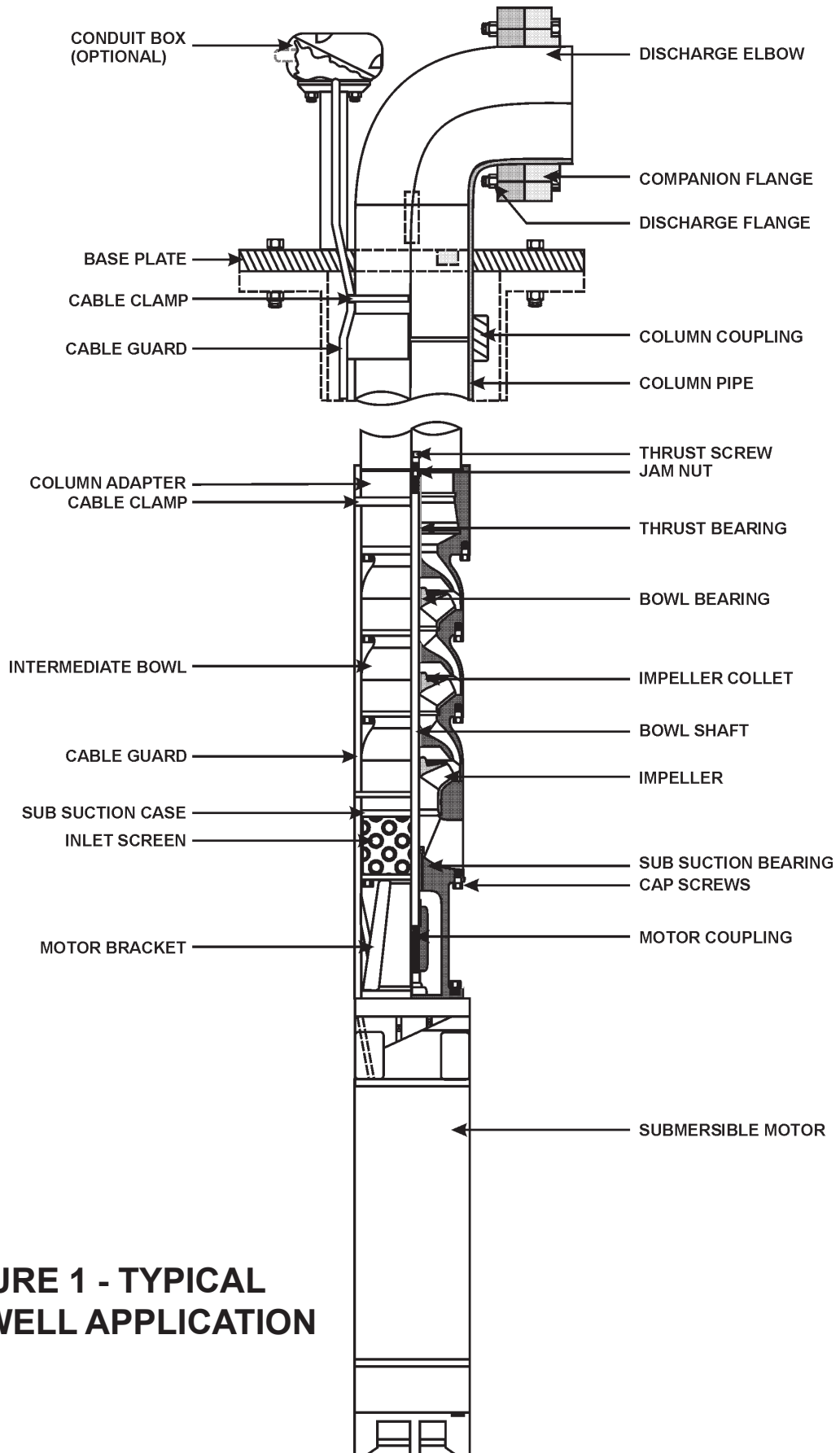
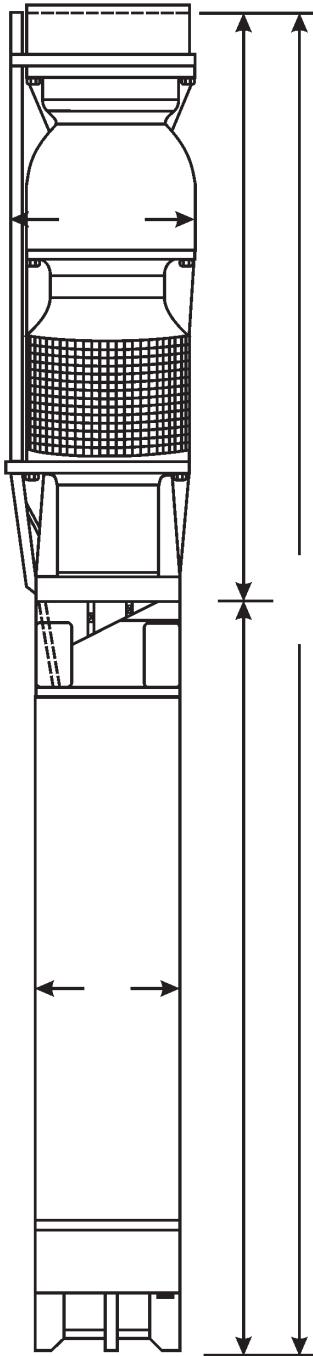


FIGURE 1 - TYPICAL DEEP WELL APPLICATION

SUBMERSIBLE PUMP AND MOTOR



MOTOR

H.P. _____ PHASE _____ HERTZ _____ VOLTS _____ AMP _____
 R.P.M. _____ MFG. _____

CABLE

SIZE _____ LENGTH _____ TYPE _____

DROP PIPE

SIZE _____ LENGTH SECTIONS _____
 TYPE: FLANGED THREADED & COUPLED

PUMP

TYPE _____ STAGES _____
 _____ US GPM @ _____ FT. T.D.H.
 AIR LINE YES NO LENGTH _____
 DEPTH GAUGE YES NO

CONTROL PANEL

PANEL MANUFACTURER _____
 SHORT CIRCUIT DEVICE:
 CIRCUIT BREAKER: RATING _____ SETTING _____
 FUSES: RATING _____ TYPE _____
 STANDARD DELAY
 STARTER MANUFACTURER: _____
 STARTER SIZE _____
 TYPE OF STARTER
 FULL VOLTAGE AUTOTRANSFORMER
 OTHER _____ FULL VOLTAGE IN _____ SEC.
 HEATERS MANUFACTURER: _____
 NUMBER _____ ADJUSTABLE SET AT _____ AMPS
 SUBTROL-PLUS: NO YES: REGISTRATION #: _____
 IF YES OVERLOAD SET? NO YES SET AT _____ AMPS
 UNDERLOAD SET? NO YES SET AT _____ AMPS

MATERIALS

DROP PIPE _____ INTAKE SCREEN _____
 AIR LINE _____ INTAKE BRKT. _____
 BOWLS _____ MOTOR CPLG. _____
 IMPELLERS _____ DISC. ADAPT. _____
 BOWL SHAFT _____ CABLE GUARD _____
 BOWL BRGS. _____ BOLTING _____

REMARKS:

NOT FOR CONSTRUCTION
 UNLESS CERTIFIED

MFG. BY NATIONAL PUMP
 COMPANY PEORIA, AZ

CUSTOMER

FURNISHED BY _____

P.O. NO. _____

PUMP SERIAL NO. _____

"HDS" SUBMERSIBLE PUMP SURFACE PLATE

SURFACE PLATE

_____ " _____ # R.F. DISCHARGE FLANGE

JUNCTION BOX YES NO

SIZE _____

TYPE _____

CABLE SIZE _____

MATERIALS

DISCHARGE FLANGE _____

DISCHARGE ELBOW _____

MOUNTING PLATE _____

LIFTING EYES _____

JUNCTION BOX* _____

DROP PIPE MOUNTING FLANGE* _____

_____ " NPT
 _____ FLANGED * IF REQUIRED

CUSTOMER _____

FURNISHED BY _____

P.O. NUMBER _____

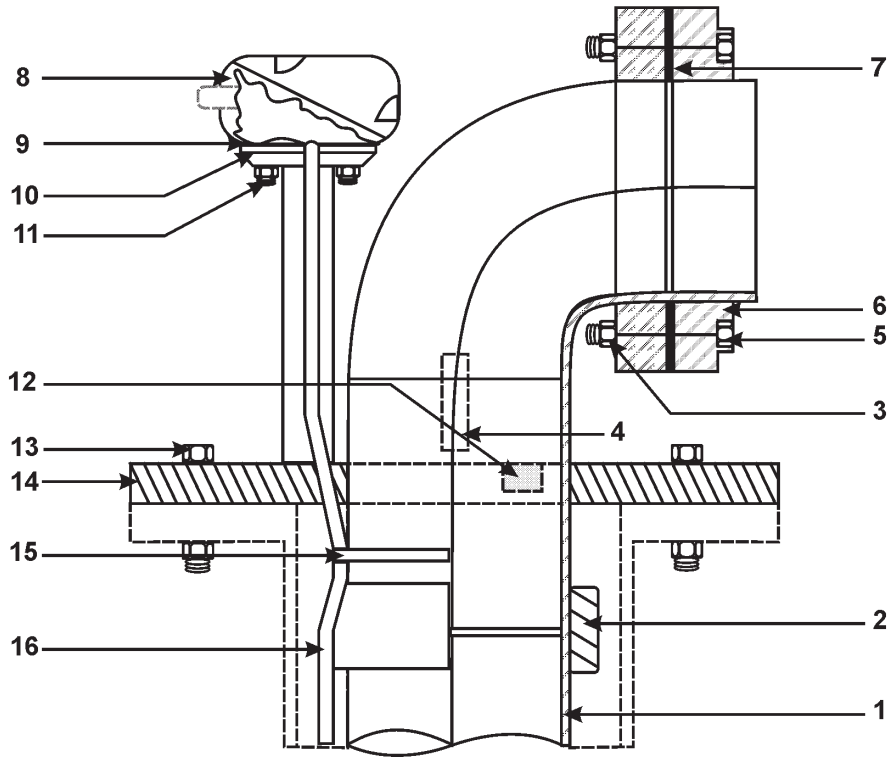
PUMP SERIAL NUMBER: _____

REMARKS _____

NOT FOR CONSTRUCTION UNLESS CERTIFIED

MFD. BY NATIONAL PUMP CO., PEORIA, ARIZONA

“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.

This satisfactory operation of the deep well submersible turbine pump is dependent upon proper application, proper installation, and proper 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 man must use sound judgment to adapt the methods outlined to the conditions existent for each particular installation.

The general assembly of a National Pump Company submersible deep well turbine pump is shown in Fig.1 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

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 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. Gasoline, naphtha, or kerosene should also be at hand for cleaning purposes.

PUMP FOUNDATION

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

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. 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

230 VOLT SINGLE PHASE SUBMERSIBLE MOTORS

VOLTS	HP	14	12	10	8	6	4	2	0	00
230 VOLT	1/2	404	641	1003	1575	2450	3750	5710		
	3/4	293	473	740	1161	1810	2760	4210	5680	
	1	248	392	617	968	1507	2300	3510	4730	5920
	1-1/2	205	328	510	801	1248	1920	2930	3950	4940
	2	180	286	449	703	1096	1675	2550	3440	4300
	3	0	229	359	563	877	1339	2041	2750	3440
	5	0	0	216	315	490	750	1142	1540	1925
	7-1/2	0	0	0	270	362	553	842	1136	1420
	10	0	0	0	0	250	425	650	875	1100

230 VOLT THREE PHASE SUBMERSIBLE MOTORS

VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000
230 VOLT	5	0	250	390	620	960	1470	2230				
	7-1/2	0	0	290	450	700	1070	1630	2200			
	10	0	0	0	340	520	800	1220	1640	2050		
	15	0	0	0	0	360	550	830	1130	1410	1680	
	20	0	0	0	0	0	420	640	860	1070	1280	1510
	25	0	0	0	0	0	340	520	700	870	1040	1230
	30	0	0	0	0	0	0	420	570	710	850	1000

460 VOLT THREE PHASE SUBMERSIBLE MOTORS

VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300	350	400	500	
460 VOLT	5	590	950	1500	2360	3700	5750											
	7-1/2	420	680	1070	1690	2640	4100	6260										
	10	310	500	790	1250	1980	3050	4680	7050									
	15	0	0	540	850	1340	2090	3200	4810	5900	7110							
	20	0	0	0	650	1030	1610	2470	3730	4580	5530							
	25	0	0	0	0	830	1300	1990	3010	3700	4470	5430						
	30	0	0	0	0	680	1070	1640	2490	3060	3700	4500	5130	5860				
	40	0	0	0	0	0	790	1210	1830	2250	2710	3290	3730	4250				
	50	0	0	0	0	0	0	980	1480	1810	2190	2650	3010	3420	3830	4180	4850	
	60	0	0	0	0	0	0	830	1250	1540	1850	2240	2540	2890	3240	3540	4100	
	75	0	0	0	0	0	0	0	1030	1280	1520	1850	2100	2400	2700	2950	3440	
	100	0	0	0	0	0	0	0	0	0	1130	1380	1560	1790	2010	2190	2550	
	125	0	0	0	0	0	0	0	0	0	0	0	1220	1390	1560	1700	1960	
	150	0	0	0	0	0	0	0	0	0	0	0	0	0	1340	1460	1690	
	175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1300	1510	
	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1310

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.

3. 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.

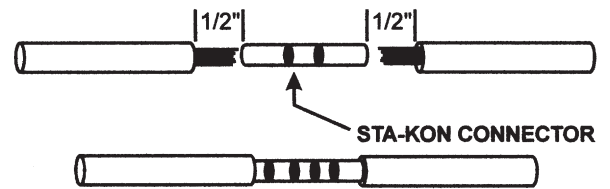
NOTICE: Do not use acid core solder or corrosive paste.

- 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.

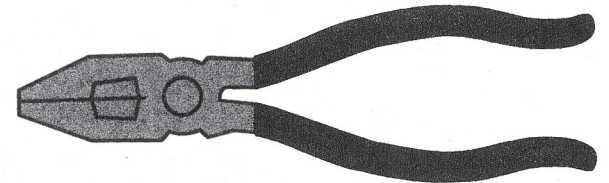
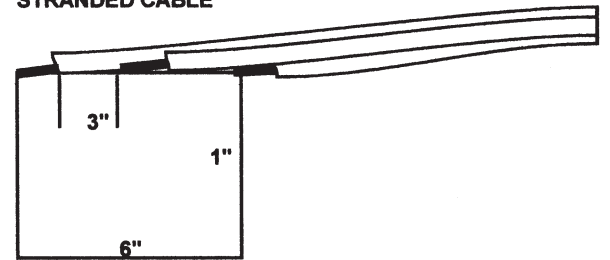
6. Repeat step 5 for each lead.

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



STRANDED CABLE



STA-KON PLIERS



FIGURE 3

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

8. 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.
9. 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 materially, 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. Buzz-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 discharge 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 the section is being raised. Clean all threads and paint with thread lubricant. Thread the pipe into the discharge pipe 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 lightning 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 losses 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 to it placing the lower end on the mark. It is a good idea to slot the airline with a sawcut or two, some three to 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

The use of column check valves is not recommended because of the danger of water hammer, sand locking, and air accumulations under the valve, that may airlock the pump and prevent the flow of water, any of which may damage the unit. Such valves are sometimes used, however, to control reverse flow back to the pump, protecting the well in this manner. Prevention of reverse flow and consequent reverse rotation also protects the pump and motor necessary to control back flow to eliminate over-speeding in reverse rotation, a condition which will not harm the pump, but might damage the motor.

If check valves are used, install the first check valve directly 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 on foot per second.

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 should 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 SHUTOFF HEADS

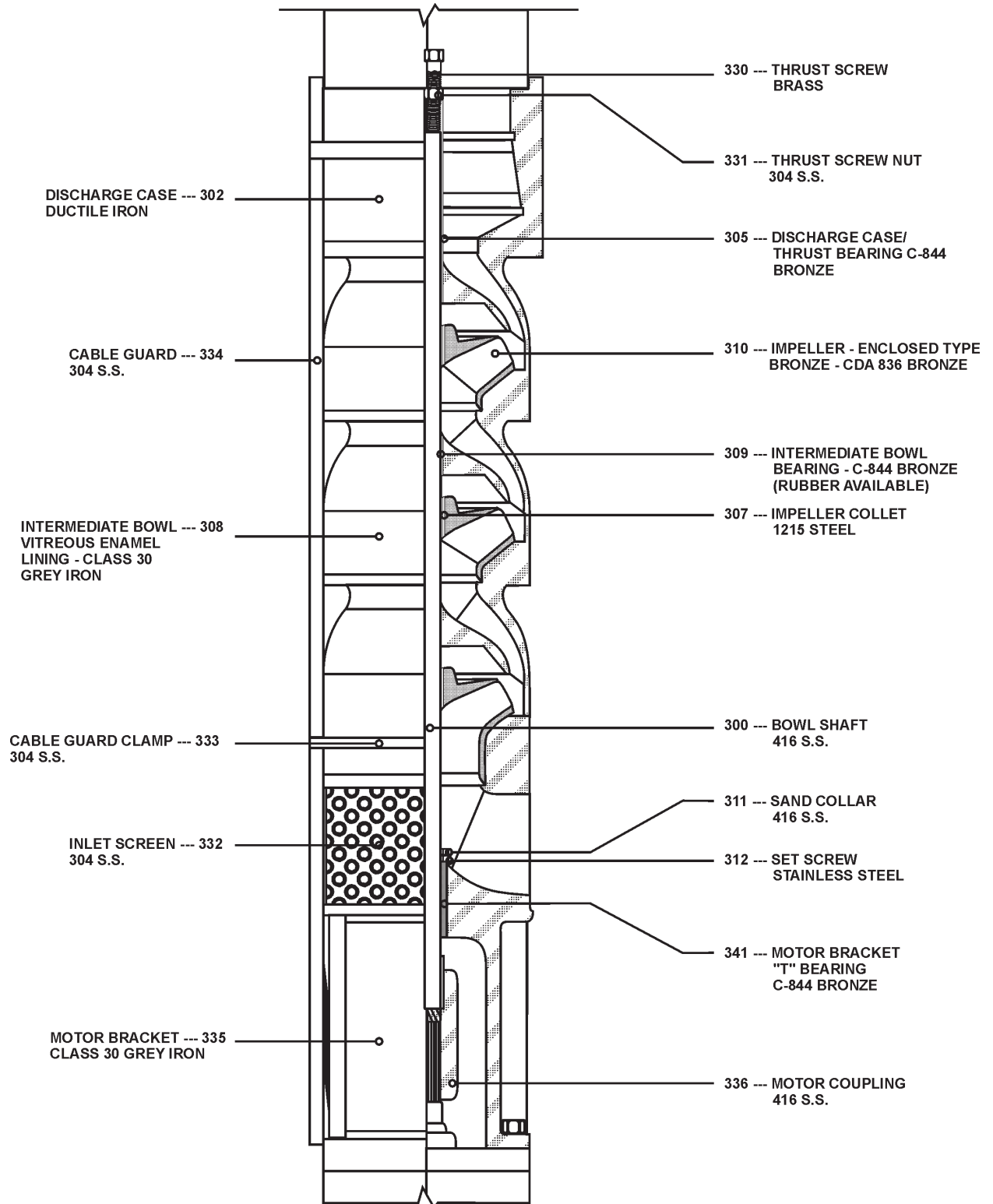
In the usual application of vertical turbine pumps, no harm will result from operation under conditions of static flowheads; however, not all installations are "usual" and, for this reason, consideration should be given to any unit which may be subjected to this usage. The following points should therefore be checked and resolved before putting the equipment into operation at or near shutoff 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 shutoff horsepower is converted to heat in the available fluid.
3. For high pressure units, stresses at shutoff 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.
5. 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 S6 - SE6 - SJ8 MODELS

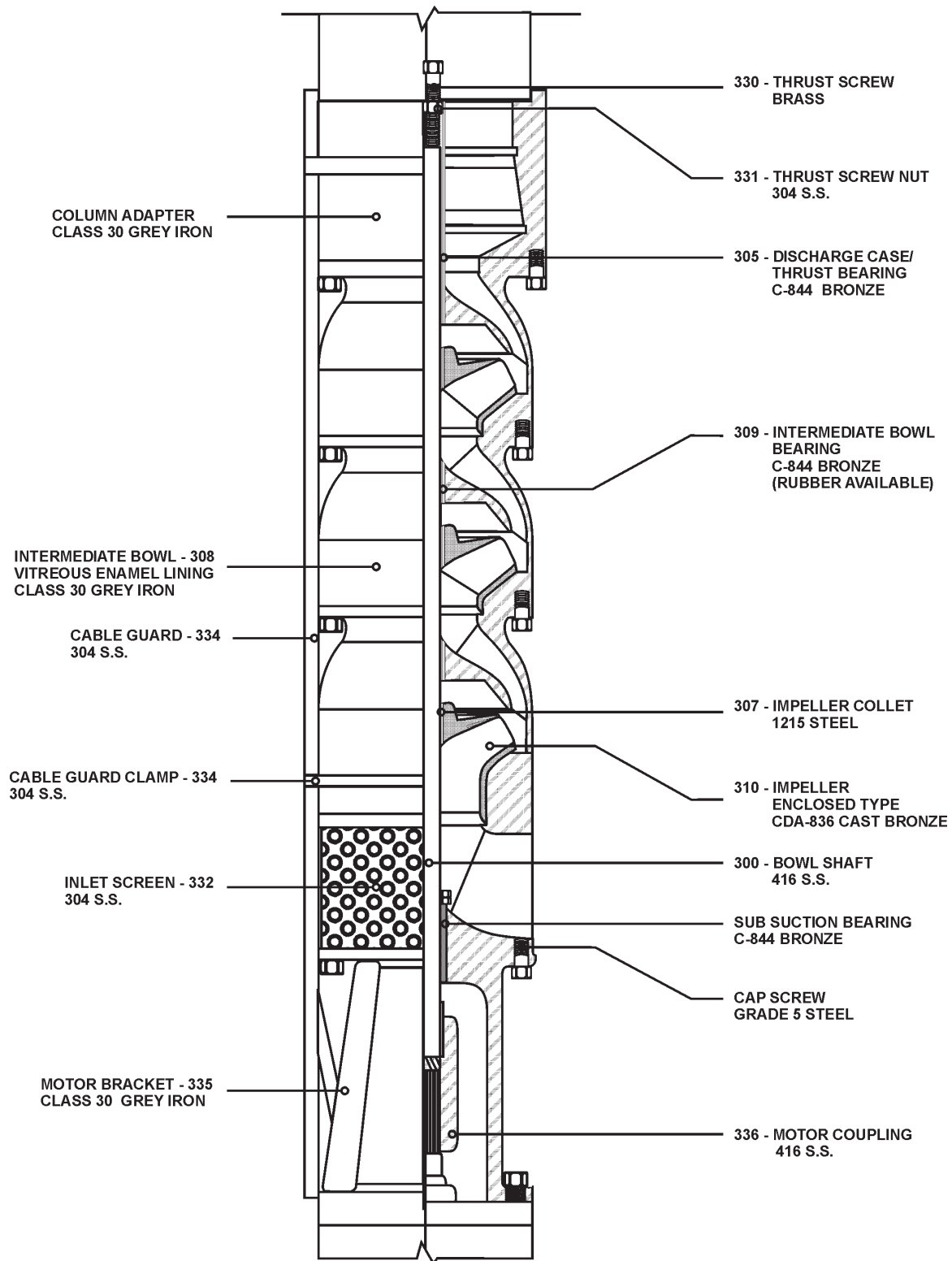
THREADED BOWLS



ALTERNATE MATERIALS AVAILABLE UPON REQUEST

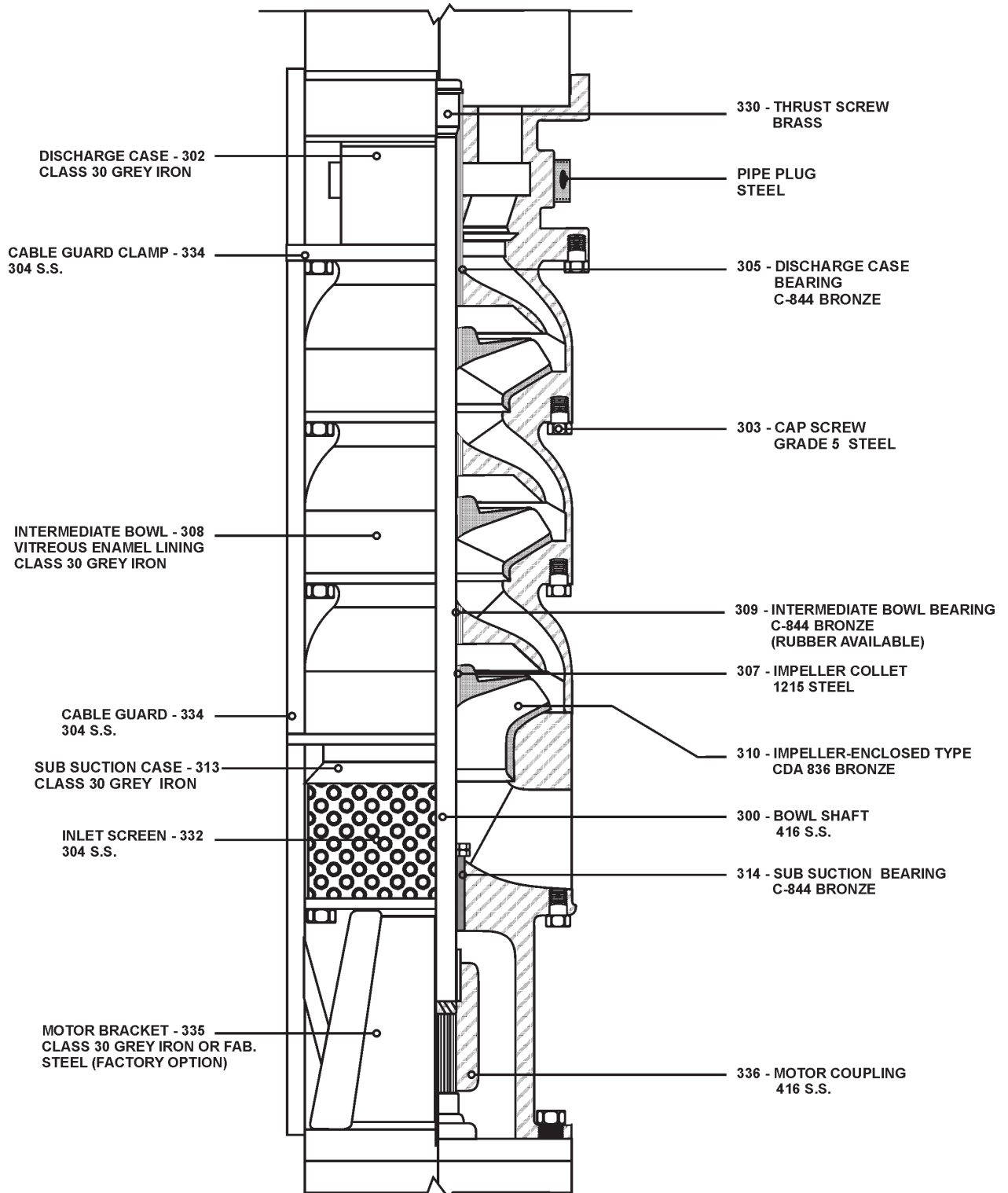
SUBMERSIBLE PUMP

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



ALTERNATE MATERIALS AVAILABLE UPON REQUEST

SUBMERSIBLE PUMP LARGER MODELS



ALTERNATE MATERIALS AVAILABLE UPON REQUEST



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