

Installation and Maintenance
SERIES 1150
Submersible Direct Coupled
Vertical Turbine Pumps



AURORA PUMP

A UNIT OF GENERAL SIGNAL

P.O. BOX 1500 • CITY OF INDUSTRY, CA • 91739

RECOMMENDATIONS FOR STORAGE AURORA VERTI-LINE SUBMERSIBLE PUMPS

Aurora Verti-Line submersible pumps are carefully prepared for shipment from the factory. Skids and boxes are intended to resist mechanical damage from normal handling and preservatives are used to protect critical surfaces from routine conditions of weather and corrosion in transit. Effective life of factory-applied protection, however, can vary widely under different circumstances and should be considered adequate only to secure the equipment during shipment and installation. If installation and operation cannot be effected within a reasonably short time after delivery to jobsite, the product is determined to be in storage and subject to precautionary procedures as outlined below.

With common sense as the best guide, store the equipment off the ground in an indoor location where it will not be exposed to excess moisture or humidity, extreme weather conditions, blowing dust, corrosive fumes, or other harmful factors. If storage must be outdoors, provide at least a roof shelter and cover all pieces securely with six mil polyethylene sheet or equivalent.

Inspect pump periodically to assure that factory applied protection remains intact. With the first sign of deterioration, renew the protective measure in question. If rust spots appear on machined surfaces, clean with fine emery cloth and apply approved rust preventive.

Any components shipped to the jobsite on skids should remain on the skids just as delivered. Any exposed threads or shaft ends must be covered with wrapping and tape or with suitable caps. The electrical cable should be left on the reel or otherwise protected from weather and mechanical damage. See individual manufacturer's storage instructions for motors and other appurtenances.

For long term storage, but not to exceed 36 months, the following precautions should be observed:

- Air dry hydraulic portion of pump to remove any residual liquid.
- Cover with wrapping and seal with pressure sensitive waterproof tape all openings into flowstream areas.
- Wrap any exposed shafting with pressure sensitive waterproof tape.
- Coat any exposed machined surfaces with heavy grease and protect from mechanical damage.
- If possible, roll electrical cable back up on a reel; in any case, arrange for protection from mechanical damage and keep ends off the ground in a dry location.
- Wrap exposed conductor ends with electrical tape and seal with pressure sensitive waterproof tape.
- Store all parts in a clean dry area with ambient temperature reasonably constant between 40 and 100 degrees F.

Upon removing a pump from any type of storage, proceed as follows:

- Consider contracting with the pump manufacturer for the services of a factory trained field service engineer or technician.
- Remove all covers and tape from openings, threads, and other parts.
- Remove grease and rust preventive from mating fits and running surfaces.
- Clean all threads, mating fits, and electrical connections thoroughly.
- Follow individual manufacturer's instructions regarding driver, conductor, and other appurtenances.
- Inspect all visible parts.
- Install pump and start up in accordance with applicable instruction manual.

Occasionally a pump is stored in its installed position for protracted periods while related equipment is made ready or perhaps simply in seasonal shutdown or intermittent use. In this event, the unit should be energized and run momentarily twice a month, using proper startup procedures at each start.

These procedures are offered as a guide to assist users and may not be construed to amend, to extend, or to modify in any way the Aurora Pump warranty.

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SECTION 1

A WORD TO THE OWNER

Efficient performance. Satisfactory operation. Dependable service.

We know these are the things you want from your Aurora Verti-Line deep well submersible turbine pump and we've designed it accordingly. We've prepared this booklet to help you assure continuance of these features by effecting a careful and proper installation and maintenance program. If you want further assistance, you might consider contracting for the services of an experienced Aurora service engineer to supervise your installation and/or startup.

Because of variations in jobsite environments and installation requirements, we've had to be somewhat general but we've tried to list all the truly important guidelines. Your installer must still use sound judgment to adapt the methods we've outlined to the specific site circumstances and pump design features

in each particular installation. We hope he will, since failure to comply with recommended procedures may abrogate your warranty.

If any question should arise during the course of the work, we urge you to see your local Aurora representative immediately. Please be able to identify the unit by its serial number. We stamp the number on the nameplate that we put on the discharge head.

Figure 3 will show you the relationship of all the parts after installation is complete. The nomenclature we've used here will identify the items throughout the instructions. Before starting installation, please read through the entire process we've described in this book, omitting any material not applicable to your particular pump. Study in detail the precautionary directions emphasized in Section 15.

Then, when you do start the work, refer to the instructions for each individual step. After the equipment is in operation, we suggest you keep a manual available at the site for future use in maintenance programs.

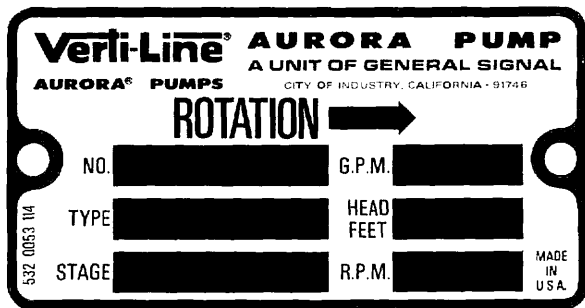


Figure 1. Discharge Head Nameplate

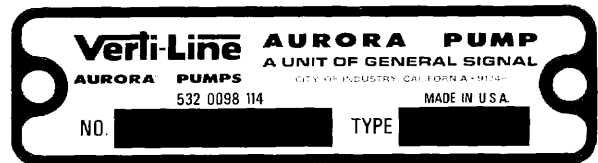


Figure 2. Bowl Assembly Nameplate

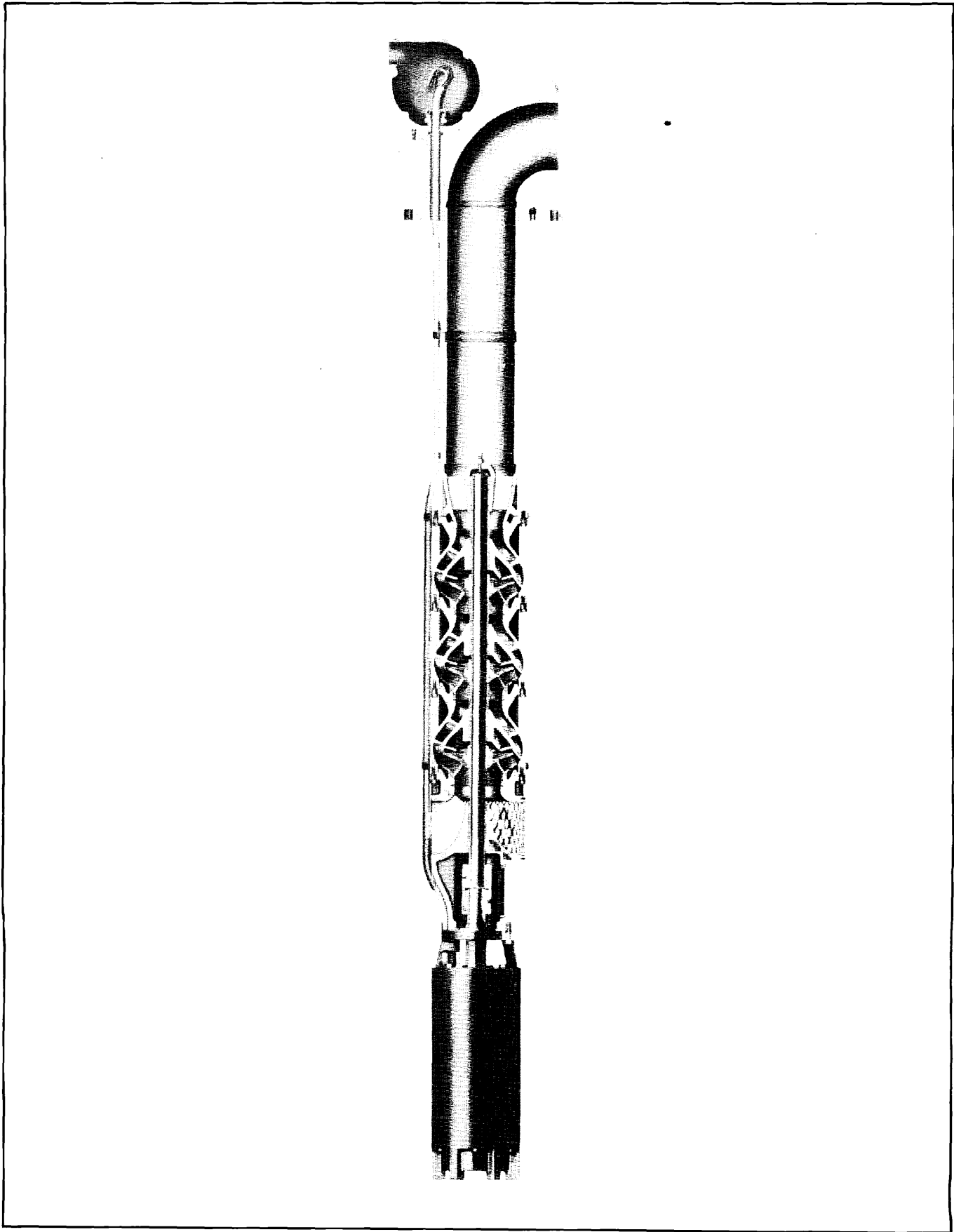


Figure 3. Submersible Turbine Pump

SECTION 2

THE WELL

Examine your well carefully before you start installation procedures. Be sure sand hasn't covered any of the perforated sections. If you don't already know, now is the time to determine that your well is of ample diameter and depth, and also is straight enough, to receive your pump and allow at least five feet from the lower end of the motor to the bottom of the hole.

If you have any doubts at all about the straightness, we recommend caging and plotting. As an alternate procedure, you can check the well by inserting a test section down to the eventual setting of the pump/motor assembly. The test blank is usually a pipe as big around as the largest diameter of your pump/motor assembly including the electrical cable and guards; its length should be at least twice that of the assembly it represents.

By the time you receive your pump at the jobsite, your well should already have been developed and tested. We cannot recommend the use of your new Aurora submersible pump for this purpose since such operation can be classified as unusual abuse.

The well test must indicate that the aquifer will supply the proper quantity of clean water, free from gas and/or abrasives, at a temperature never to exceed 86° F. The pumping level must be such that the bowls remain submerged at all times under any condition of operation.

It is particularly important with a submersible pump that your well be in first class condition. Any ob-

struction such as jagged casing projections or other defects must be repaired to prevent harm to the electrical cable and otherwise to facilitate installation.

You must also arrange to clean up any residual oil from the surface before installation to prevent premature damage to the unit. You can remove the bulk of the oil first by bailing and then by swabbing out the remainder with burlap sacking or something similar.

If you desire, you can prevent liquid from entering the pump during installation by wrapping the openings with water soluble polyvinyl alcohol. This would protect the rubber bearings in the bowl assembly from attack by the oil but it isn't a complete solution since it offers no protection for the cable insulation.

Never start installation until all of these conditions are satisfied. Then later, during operation over a period of time, we advise that you sound your well occasionally to be aware of any change in the bottom. A buildup of sand or silt is not uncommon and, if allowed to creep up to the motor level, will shortly lead to motor failure. If such an unacceptable condition appears to be developing, you must remove your pump and clean out your well.

Your submersible pump will continue to give you excellent service as long as you maintain its environment properly. Watch for defects, damage, or deterioration of the well in particular so that you can make correction immediately upon discovery.

SECTION 3

THE FOUNDATION

Your pump requires a foundation suitable for the weight of the entire unit when full of water. While the preferred material is solid concrete, you can use adequate beams or timbers within reason. Regardless of material, the foundation must be properly engineered, structurally sound and stable, able to withstand and prevent objectionable vibration. It must not exceed allowable soil loading for your specific site.

Most Aurora Verti-Line pump heads are designed so that there is no projection below the base to interfere with the foundation or well casing. However, once in a great while, you may find a model with unusual size combinations that will interfere if precautions are not taken. You can observe the bottom of the head for this at the same time you check for location of mounting bolt holes. If interference appears possible, merely construct the foundation so that the well casing terminates in a recess sufficient to clear the pump projection.

Keep in mind that your foundation must also permit the installation of the electrical power cable and sometimes an airline, Section 10, if you are using one in your well. The top rim of the well casing must be filed or ground smooth so it will not damage the power cable as it is fed into the hole with the pump. It's a good idea to shield the cable from the casing lip with sacking or gasket material if there is even the slightest chance of abrading or gouging the insulation.

We like to see anchor bolts on any installation but there are a few instances where we must insist on them. These would include pumps with settings less than 50 feet and/or with discharge pressures exceeding 10 PSIG, also those with a check valve in the column or at

the bowls. We prefer the sleeve bolt design shown in Figure 4, and we think you will too since it's much easier to use. Alternate bolt designs are illustrated, however, for your information.

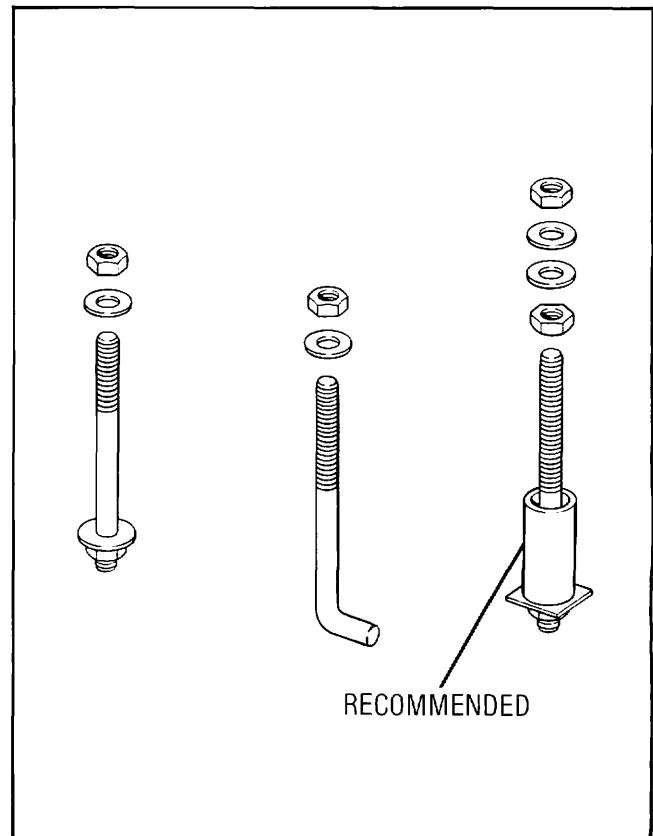


Figure 4. Foundation Anchor Bolts

SECTION 4

THE ELECTRICAL EQUIPMENT

The electrical equipment with your Aurora submersible pump includes the motor, the starter, the accessories, and the conductors to carry power to and from these components, such as the submersible cable. The system is, of necessity, slightly different from an arrangement made for a surface motor, particularly as regards the accessories.

The motor is designed for sustained operation under water and is suspended immediately below the bowl assembly. Detailed information and instructions for the motor are prepared by its manufacturer and should accompany your shipment. If not, please see your local Aurora representative. Study the motor data and become familiar with all details before attempting installation. Check thoroughly for compatibility with electrical power supply characteristics, especially the line voltage.

The submersible cable conducts electrical power from the starter down the well to the motor. In general, your major concern for the cable is to connect it properly and to guard it carefully against damage in handling and installation. Any breach in the jacket and/or insulation can cause electrical problems that will eventually force you to pull the pump, if indeed it doesn't abort the installation right at the outset.

We'll consider the splice a part of the power cable since that's just what it'll be if you do it right. We will, however, give you complete splicing instructions in Section 14.

In testing your electrical system, remember it's important to maintain continuity of circuit between starter and motor phases. It's equally crucial to avoid shorting or grounding in any part of the power system. Because these factors are critical, we'll cover them in detail as part of the installation instructions in Sections 8 and 9.

Your control equipment will be based on an ordinary pump motor starter which, however, must be modified to accommodate a submersible motor. For instance, you must add quick trip relays that are unaffected by sur-

face ambient temperatures, protecting each of three phases. You'll need a disconnect switch in the panel with circuit breakers or fuses. The basic control package may then be completed by including properly sized and adjusted heater protection in all three legs of the power system.

By way of emphasis at this point, we direct your attention to the difference between submersible and surface motors regarding full load current ratings and overload allowables. You must take this into account when sizing your protective devices.

Other controller accessories are available and will depend on the peculiarities of your individual system requirements and your power supply. However, there are certain components that you should at least consider for almost any service.

For example, a time delay relay can help you avoid restarting a pump during the period of reverse rotation immediately following shutdown. It will also dampen out some of the cycling sometimes generated if your submersible well pump also acts as a booster or discharges into a pressure tank.

Approved lightning arrestors are strongly recommended in areas where electrical storms are a possibility or where power lines may be subject to switching surges. For three phase systems, you'll need at least two arrestors.

We can also suggest consideration of a low level cutoff control. Such a component can insure that your motor will not start or run unless there is adequate submergence for your pump.

Other features of your plant or power supply might require investigation for other protective devices. We've sketched here only a general configuration for a basic controller package. Instructions for handling, checking, startup, and operation will be included in those later Sections where these actions become a sequential part of the installation process.

SECTION 5

THE INSTALLATION EQUIPMENT

The materials and equipment you'll need for installation may vary with the size of pump and type of job. We'll offer the following description and list as a guide but we want you to remember the primary tool to be used at all times is SAFETY FIRST.

You can use a portable derrick or tripod but we recommend either a boom crane of adequate capacity or a properly designed pump setting rig similar to that shown in Figure 5. Whatever you choose, your lifting device must allow the load hook to be raised at least two feet higher than the longest hook section you'll have to handle. Your hook should be of the safety latch type with a good easy working swivel, and you must have sufficient reach to center it over the well location. If your well is slightly out of plumb, you may have to compensate by shifting the crown block as the assembly becomes progressively longer during installation and displaces laterally with respect to the wellhead.

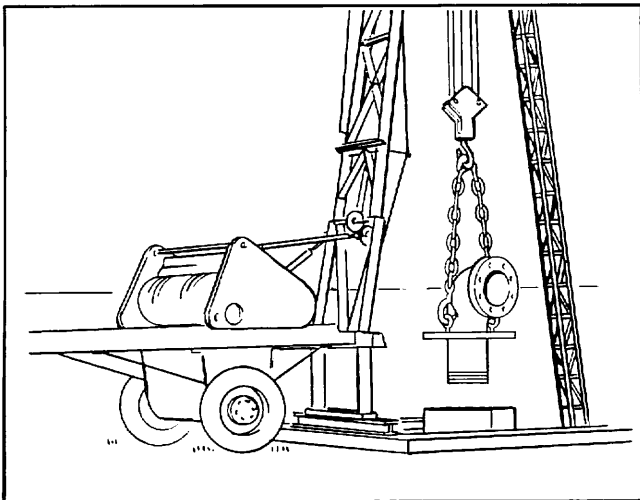


Figure 5. Pump Installation Rig

Your rig should include an extra winch or cathead to apply power for pipe joint tightening. In a later Section, we'll give you torque values for the threaded pipe assembly operation and you'll probably find that, because the column is usually furnished with taper threads, you'll need mechanical assistance to do a proper job. This is particularly true when handling the larger units.

We suggest the following tools and materials but you may want to vary them to suit the peculiarities of your individual installation:

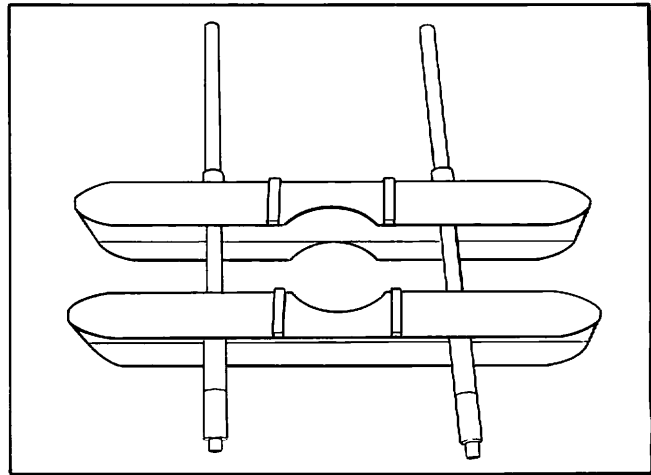


Figure 6. Steel Beam Clamps

Lifting equipment Figure 5

Steel beam clamps Figure 6

Steel lifting elevators of approved type and proper size Figure 7

Cable sling about 10 feet long of adequate size for job Figure 8

Two chain tongs

Medium size pipe wrenches

Adequate length 3/4 inch rope

Adequate length small rope

Set of ordinary mechanic's tools

Wire brush

Assortment of files

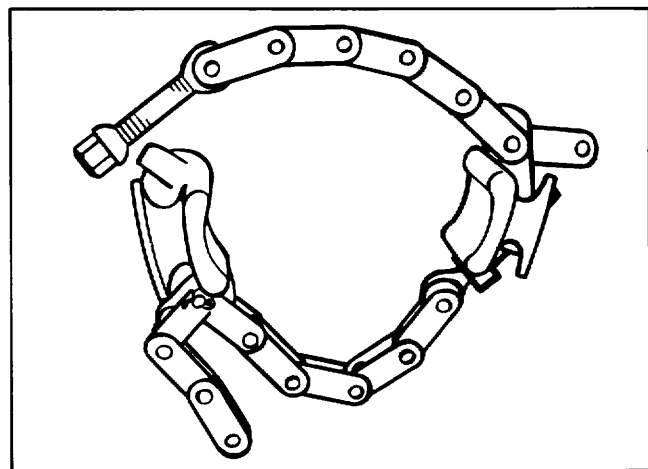


Figure 7. Elevators

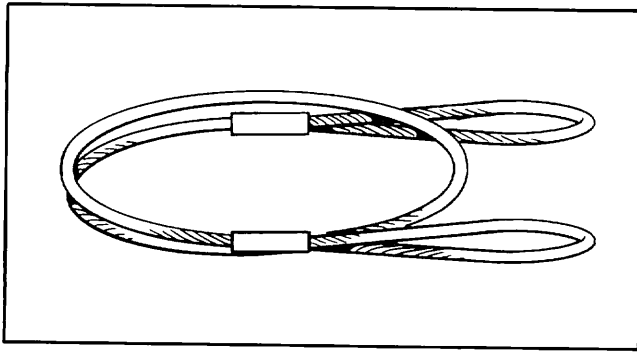


Figure 8. Cable Sling

Crimping tool of correct size for wire connectors

Banding tool

Megger or similar instrument to indicate electrical resistance

Clamp on ammeter

Voltmeter

Clean rags

Sacking or cover for bowl unit and column pipe

Covers, guards, and guides for submersible cable

Solvent

Shims and wedges

Non-shrink grouting material

Note

All combustible materials must be kept in approved safety containers and handled carefully away from any flame, sparks, exhaust, or any other possible source of ignition.

SECTION 6

RECEIVING THE PUMP

Your Aurora Verti-Line pump was inspected on the carrier just prior to leaving the factory. When you receive it at your jobsite, look carefully for any visible damage to parts, boxes, skids, or dunnage. Open the boxes to check any items thus packed but leave the pieces in the box for protection until ready for installation.

Take inventory on the truck or during the unloading process. We don't want you to sign for damaged or incomplete shipments unless you take the appropriate exceptions. Report such instances immediately to your Aurora representative and to the transportation company involved giving full particulars and confirming all verbal understandings in writing.

SECTION 7

UNLOADING THE PUMP

We cannot urge you too strongly to exercise extreme care in handling and installing all parts. Certain items are precision machined for proper alignment and, if dropped, banged, sprung, or mistreated in any way, misalignment and malfunction will surely result. Others, such as the electrical cable, may be vulnerable to gouging or scuffing. Parts which are too heavy to be lifted from the transporting car or truck should be skidded slowly and carefully to the ground so as to prevent damage. We ask you never to unload by dropping parts directly from the carrier to the ground and never to use shipping crates for skids.

If your jobsite conditions permit, you may be able to install directly from the truck that brought the pump to you. If not, move the components to the installation area and lay them out in a clean and protected space convenient to the work location. As illustrated in Figure 9, column pipe sections should be placed on suitable timbers to keep them out of the dirt, arranged so that the coupling ends point toward the wellhead. The bowl/motor assembly is to be left on the skids until lifted for installation. The power cable and motor leads must receive special protection from damage to jacket or insulation.

If installation cannot begin within a very few days after delivery, it's a good idea to segregate and identify all components comprising your Aurora shipment so they won't be lost in the midst of other equipment arriving at the jobsite. Under these conditions, you should obtain a copy of Aurora Pump Storage Instructions form your

Aurora representative. Read and follow the storage instructions carefully because care of the pump during this period before installation can be as important as maintenance after operation has begun.

Again, check against your packing list to make sure nothing is missing. It's much better to find out now than later when the installation is in actual progress.

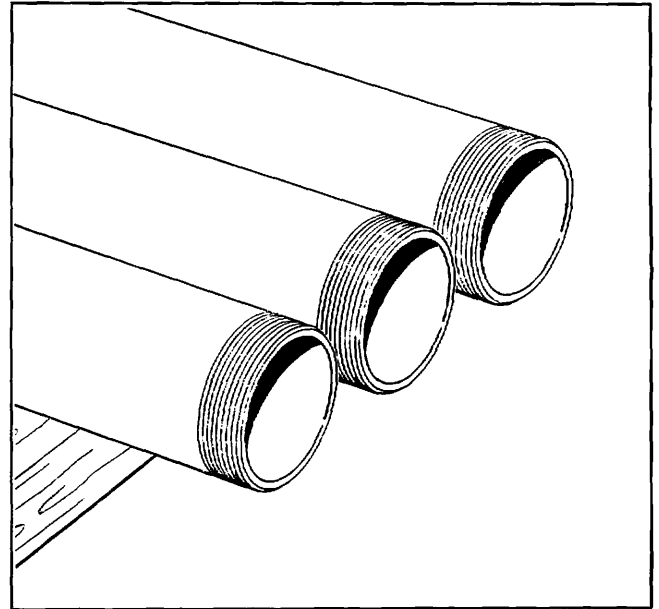


Figure 9. Readied for Installation

SECTION 8

PREPARING THE PUMP

Your bowl component will, in most cases, arrive at your jobsite with the motor completely assembled, ready for installation except for electrical connections and removal of shipping skids. Keep the assembly on the skids for the time being while you check for electrical continuity, resistance, and rotation.

To start this procedure, attach one lead of your megger to the motor frame, making sure you have a good connection. Clip the other megger lead to one of the three motor leads and operate the megger, repeating for each of the motor leads. With the equipment at ambient temperature, you should read in excess of 50 megohms. For any resistance indication less than 50 megohms, stop and check to be sure your motor leads are not accidentally grounded. If they are not, call your Aurora representative immediately.

To continue the procedure, you must next make the cable splice if this was not already done at the factory. See Section 14 for details according to the type of connection with which you've been furnished. When the splice is complete, immerse it in water if you can, or at least wet it thoroughly. With one lead of your megger grounded and the other lead connected alternately to each of the three conductors in your power cable, operate the megger to observe the resistance through the entire system. Your minimum again must exceed 50 megohms. If not, you must consider that you have an open circuit to ground somewhere and act accordingly.

Since the equipment is to go into the well and thus be relatively inaccessible, it's a good idea at this point to make a continuity check through your power system. You can do this with your megger by connecting the poles of the instrument to any two leads of the power cable, alternating leads until all three are covered. Readings of zero are required for proof of continuity.

Now secure the pump/motor assembly with chain tongs arranged back to back to resist torque, as shown in Figure 10. After opening the main disconnect switch, make a temporary connection between your cable leads and the starter panel, taking all the necessary safety precautions. With all personnel standing clear of the equipment, close the disconnect and energize the motor momentarily by switching the starter on and immediately off. The assembly should react by jerking in the direction opposite rotation, kicking in a clockwise direction when looking at the discharge end of the bowl assembly. If rotation is not correct the first time, open the disconnect and interchange any two of the three connections at the starter. When you've established correct rotation, mark the cable conductors and the

panel connections so that, when the installation is complete, you can make the permanent attachments properly and avoid reverse rotation in the well.

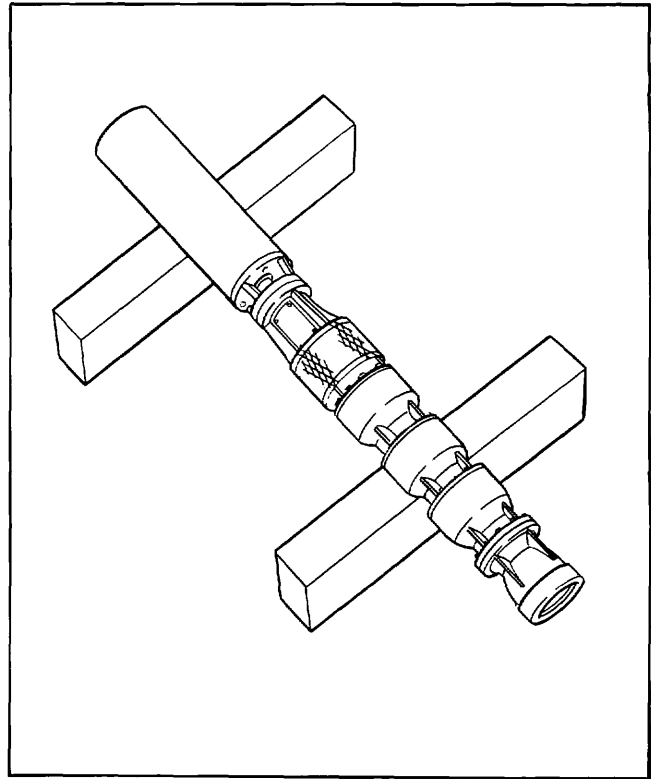


Figure 10. Secure Pump/Motor Assembly

Since shaft and bearings in the bowl assembly are dry at this point, care must be taken to apply power for rotation check for only a split second. Start and stop should be operated almost simultaneously. Too many revolutions could lead to generation of journal heat and consequent bearing seizure. You can reduce this danger if you can find a way to flush the inside of the bowls with water, particularly along the shaft.

Normally, you'll be furnished an extra motor data nameplate to attach to the pump at the surface. It should be a duplicate of the plate affixed to the motor itself. Even so, it's a good idea to copy the full load ampere rating and the voltage from the motor plate. You'll use this data at the time of startup. You can also use some of it right now by again checking for compatibility with line voltage at the power supply.

Raise the assembly with the shipping skids still in place. Suspend directly over the well, remove the skids, and lower the pump into the hole. Secure the component near the top with the beam clamps and cover the open end with sacking until ready to assemble the pipe joint. This will help you avoid dropping anything into the pump during the installation.

Attach the elevators to the bottom column pipe immediately below the coupling. Hoist the pipe with the coupling end up into place above the well over the top of the bowl assembly, using a soft board or pipe dolly for the end of the section to slide in on so that the threads will not be damaged. Clean the threads and paint with lubricant. Remove the sacking or cover, screw the pipe into the discharge case, and make up tight, using one set of chain tongs for backup.

The column pipe threads must be made up securely enough so that the motor torque will not loosen the joint during startups. A minimum torquing force of at

least ten foot pounds per rated horsepower must be applied to each threaded connection to resist the reaction of the torque generated by the motor during starts and stops. On larger units, you'll want an extra winch or cathead to use with your 3/4 inch rope to develop the power you'll need to secure the joint.

Lower the unit into the hole length by length, making each connection as described above and keeping in mind the minimum figure of ten foot pounds per horsepower. Continue to use care to keep the electrical cable from rubbing over sharp edges. Always position the elevators so as to avoid possibility of harm to the cable. Prevent the pipe from twisting or rotating in the well. Keep the cable on the same side of the pipe all the way in and maintain your maximum clearance on that side to avoid pinching the conductors between pipe and well casing. You can use your small rope to tie the cable to the hook, thus holding it up against the side of the pipe while you secure the supports.

SECTION 9

INSTALLING THE PUMP

You're now ready to start actual installation. Clear the work area at and around the wellhead so the installers can move freely and with safety. This will decrease the chances for anything to fall into the pump as it is lowered into the hole.

During the course of the work, you must never lose sight of the fact that you are handling precision parts no matter how awkward they may be to manipulate. All threads should be cleaned, engaged by hand, and checked before power is applied for tightening. The electrical power cable will require special attention at all times to keep it free from damage.

Place the cable in an accessible but shielded spot where it can be fed easily into the well and clamped to the column pipe as each section goes in. Conductors in larger sizes will probably be shipped to you on a reel; smaller wire very likely won't but, even then, it's a good idea for you to obtain a reel for handling. Place the drum on a stand adjacent to the wellhead so the cable will unreel off the top of the spool as in Figure 11.

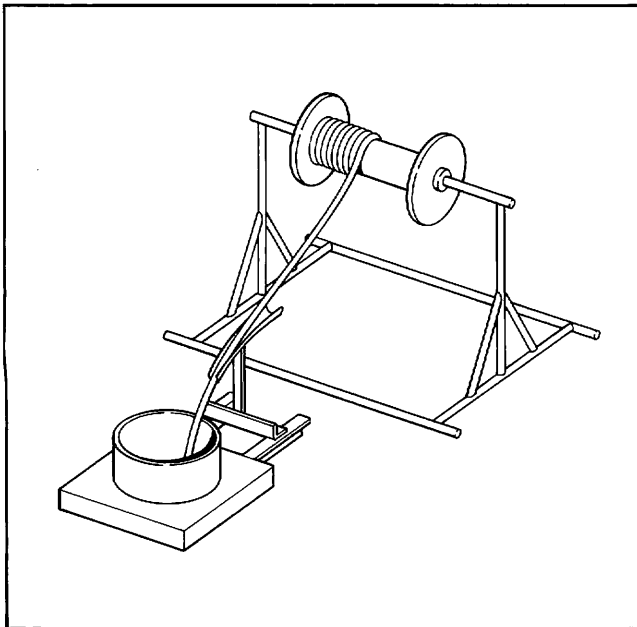


Figure 11. Cable Reel

Again, we emphasize that you protect the conductors from scraping and scuffing, particularly where they enter the well. Figure 12 shows one type of protective guide you might consider. If necessary, cover the casing lip with sacking or gasket material to obtain added protection.

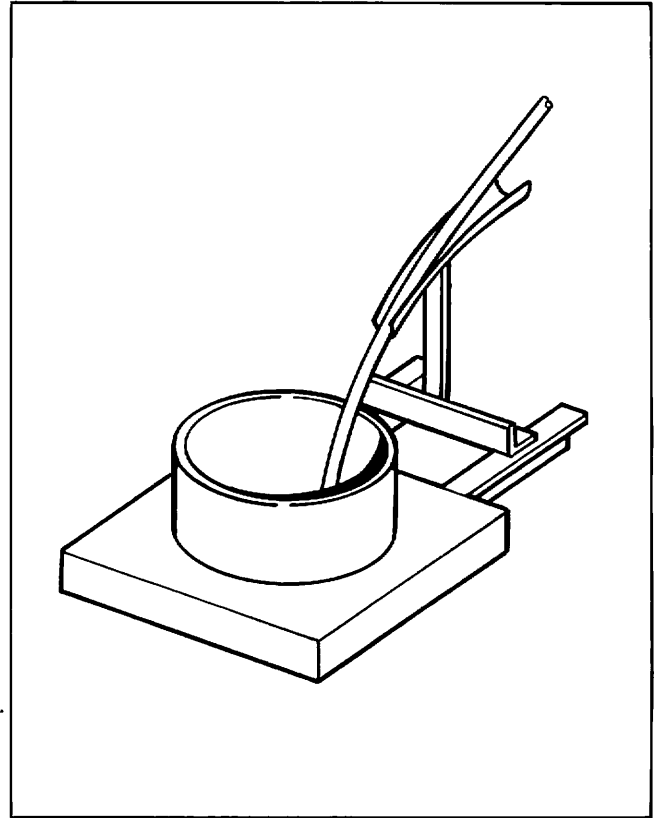


Figure 12. Protective Guide

Set the beam clamps, Figure 6, on the foundation over the well and open them wide enough for the bowl and motor assembly to pass through. Using elevators, seize the bowl assembly at a suitable point below the discharge case. Examine the assembly carefully. Make sure the discharge case coupling is tightly butted in place and that all stage connecting nuts or threads have been taken up securely. Examine the bypass ports in the discharge case to be sure they're properly plugged.

Locate the first cable guard and support just above the splice and as near the bowl assembly as practical. Be sure the cable remains reasonably taut without putting too great a strain on the splice. Support the cable on the pipe at about twenty foot intervals, with the final support approximately three feet below the surface plate, leaving a small amount of slack in the conductor. Refer to Figure 11 for installation of the cable guard and support assembly we usually furnish. If another type of attachment is used, apply the method proper for its assembly.

Remember to keep the open end of the column pipe covered except when actually threading in the next section. The extra effort is obviously worth your while when you recall that, if anything is dropped into the pump, you'll probably have to return the whole assembly to the surface before you can remove the object.

At the top, lower the discharge fitting into position on the top column pipe and make the joint up securely. Insert the power cable through the surface plate or through the channel provided in the foundation, as the case may be. Carry it on into the terminal box or to the motor control panel, depending on the design of your specific plant.

The total unit may now be lowered to the foundation, with extreme care to avoid damage to the electrical cable. The load must be transferred gently and evenly from hoist to foundation with no jerks or bumps.

If you intend to grout the base, now is the time to do it, using shims or wedges if you need to level the head. Refer to Figure 13. Allow proper time to set and cure. Assemble nuts on the tiedown bolts if used and tighten evenly and securely. Affix any of the loose nameplates that may have been provided.

During the installation, at the time the splice reaches the standing water level, make a resistance check with your megger as we had you do in Section 8. Repeat this operation at every pipe section from this point on in, in-

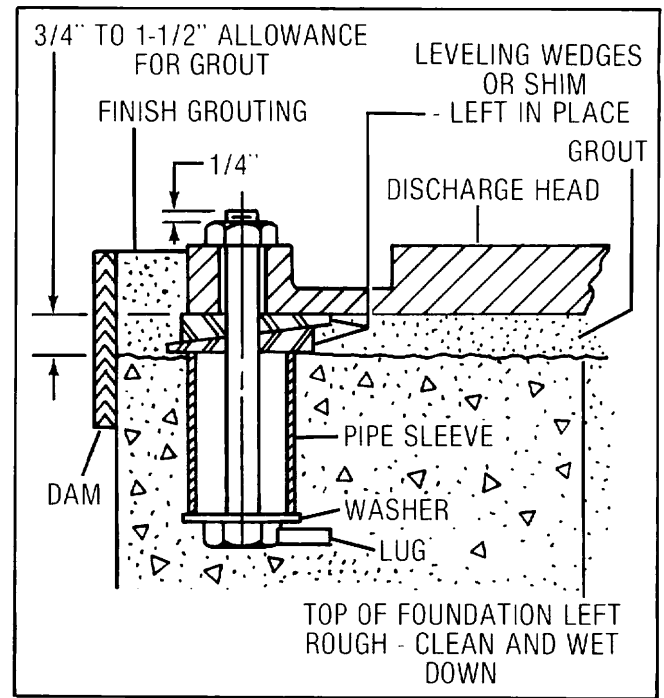


Figure 13. Typical Foundation Bolt Design

cluding the connection at the surface. Keep in mind that the absolute minimum value you can accept is 50 megohms.

SECTION 10

INSTALLING THE AIRLINE

If your pump is equipped with an airline to determine depth to water, it must be installed right along with the bowls and pump column. The total length of the installed airline must be known.

While the bowl assembly is hanging upright in the hoist, secure the first section of airline to it, placing the lower open end at the desired position. Fasten the line in place with banding or heavy copper or galvanized wire, making it secure so it won't slip downward as additional sections are added. Protect the line with hose at each banding point. We recommend you mark the column pipe for the location of each end of the airline as it is installed so you'll be able to tell if the line starts to slip.

Take extreme care when fastening the airline that you do no damage to the electrical power cable. Make sure the airline supports are not in a position to pinch or chafe the conductor. The line should run parallel to and on the same side of the cable all the up to the surface. Some support designs are arranged to receive both the electrical cable and the air piping. This is the type we've shown you in Figure 14.

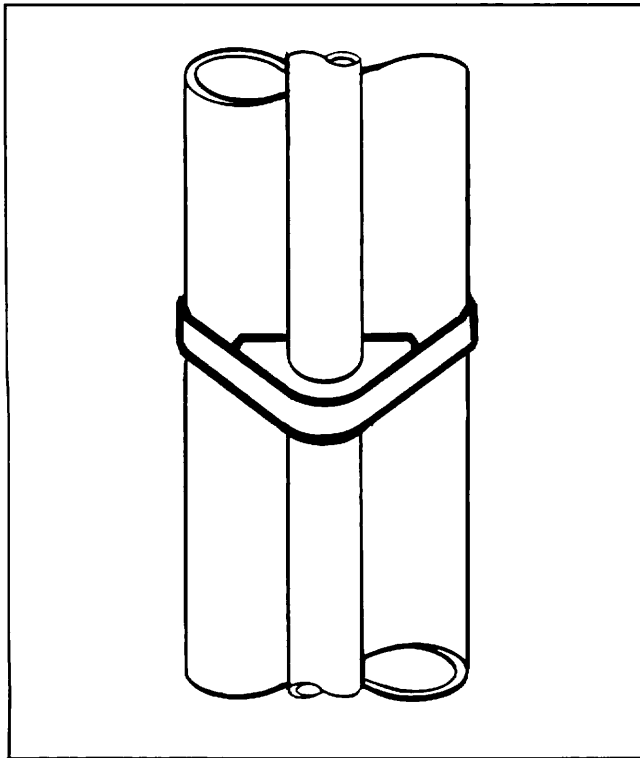


Figure 14. Cable Guard Assembly

Add sections of airline in random lengths during the installation of the column as each pipe joint is hanging in the hoist. Keep the airline outside of the elevators and fasten it to the column after removing the elevators at foundation level. Each joint must be made air tight to be effective, so you should use a thread sealing compound here rather than a lubricant.

The last section of airline will have to be cut and fitted for length to match with the fittings connecting to the gauge and discharge head. Avoid hanging the weight of the line on a fitting having its threads in a horizontal orientation. For example, if the line is to hang from an elbow, support the elbow instead of the horizontal nipple just behind the elbow. Insert the air pipe through the surface plate with the provisions offered there or bring it through the foundation, whichever way your surface arrangement is designed. Again, use all possible caution to avoid any interference with the power conductors.

Mount the gauge and air valve on the discharge head and connect the airline to it as shown in Figure 15. We consider it good practice to remove the gauge glass and mark the airline length on the face of the dial for record purposes, replacing the glass. You'll also find it helpful to add the date of installation. If, at any subsequent time, you add an extension to the pump and to the airline too, you should correct the record on the gauge with the new length and date.

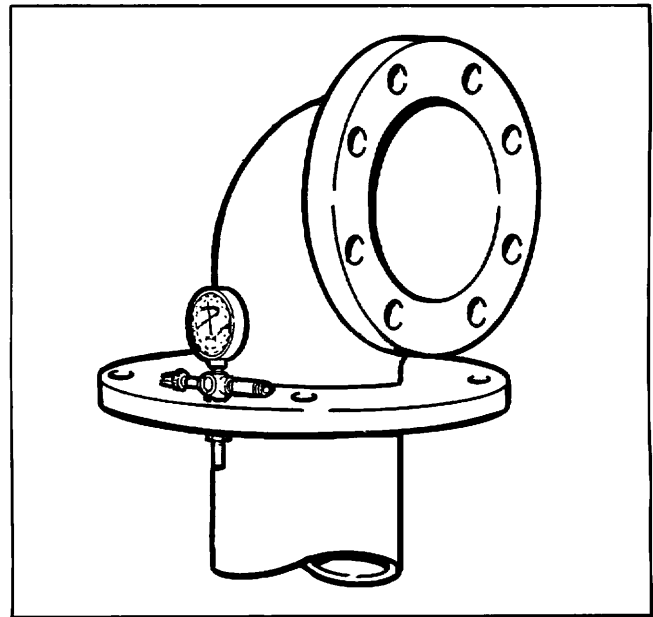


Figure 15. Airline Assembly

Your gauge may be one of two different types: altitude, and direct reading. Each use the same principles and values of pressure to indicate the depth. If you pump the airline full of air through the air valve, 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. From this, you can see the length of installed airline is important to the system.

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

If you have a direct reading gauge, you may set the reference hand to a point on the dial equal to the length of the line. You must do this while there is no pressure

on the gauge, so it's a good idea to remove the air valve core, make the adjustment, and replace the core. The indicator hand on the gauge will show the distance to water when the airline is pumped up. The hand will move away from the reference position a distance equal to the pressure in the airline.

If you record a periodic determination of water levels together with hours of pump operation, you'll have a vital record of well performance and deviations. Well performance will vary or even deteriorate over a period of time and your well log will be of invaluable aid in planning revisions to the pumping equipment made necessary by well change. This kind of close watch on the well is especially recommended when you're using a submersible pump.

SECTION 11

CONNECTING THE DISCHARGE

You will usually provide some form of discharge system into which the pump is to deliver flow. It may be a sophisticated grid or a simple piece of pipe to direct the water into a ditch but it will normally be connected to the pump at the discharge flange. Whatever your particular system is, it must be independently supported. It must not be allowed to impose stresses

on the discharge elbow due to weight, misalignment, thermal expansion, or any other condition.

When bolting the system flange to the pump discharge flange, determine first that the flanges fit face to face and hole to hole before inserting bolts. Never draw the flanges together with the flange bolts.

SECTION 12

CONNECTING THE POWER

Check the power supply to make sure that the available voltage is compatible with the motor rating. Power supply line potential must be within $\pm 10\%$ of the nameplate voltage, preferably from 100% to 105% of nameplate because of the loss in the submersible cable. Values should be balanced between phases with no more than a 2% maximum variation.

Examine the starter once more to verify that it, too, is rated for the service to which it is connected. All components in the system must, of course, be compatible and this is about the last opportunity you'll have for verification before startup. The entire electrical system should be cleared for the power supply voltage and the current requirements of your pumping plant as indi-

cated on the motor nameplate. We know you've considered these things before, but it's imperative to be absolutely sure.

Open the pump disconnect switch and connect the leads from the pump to the power source. Be sure you maintain the relationship you established during the rotation check you performed in Section 8. Using your megger, make a final verification of resistance before startup. Remember, you must see 50 megohms to infinity, and the value must certainly not have decreased since your last reading.

If all is well with these considerations, you should now be ready to start the pump. See Section 13 coming up next.

SECTION 13

STARTING THE PUMP

Before starting a new submersible pump for the first time, you must establish the proper status of the following items:

- Pumping water level in the well will submerge the motor/bowl assembly.
- Power wiring is correct in every respect.
- All accessible connections are tight.
- Discharge system is in condition to accept full flow.

When these conditions are satisfied, you may start the pump. Because so much of the equipment is in the well and your only vantage point is at the surface, you must rely primarily on indications from the electrical system for your initial assessment of operation.

Take an amperage reading on all three legs. The average of these numbers should be approximately equal to the full load current stamped on the motor nameplate, assuming a full load torque on the motor. If the average current exceeds the nameplate value by more than 15% at any time, stop the unit immediately. Such high power draw is an indication that something is wrong, the cause of which must be determined before the motor is operated again. Please note that this is only a quick initial observation. You'll eventually establish actual power input with a watt-hour meter during normal operation.

In addition to establishing proper average current, the motor must require approximately equal phase amperage. If the current in any leg differs from the average of all three by more than 5%, the supply voltage is probably unbalanced.

Repeat your earlier voltage determinations now with the pump running. The average of these readings should be within $\pm 10\%$ of the motor nameplate rating at the motor, allowing for losses in the electrical conductor from the point of indication to the motor. Equally important, the maximum variation of any phase from the average value should not exceed 1%. The effect of unbalanced supply potential is to create a current imbalance with increased losses in the motor windings far out of proportion to the magnitude of the

voltage imbalance. If you see such a condition, call the power company at once.

If your initial analysis indicates proper operation to this point, allow the pump to run until system conditions have stabilized and the well has reached its normal pumping water level. Again record the power values and make a quick review of the hydraulic performance to establish lift and rate of discharge flow. If production is normal, let the pump run. If capacity is obviously below standard or power is clearly off the mark in either direction, you may have reverse rotation. You shouldn't run the pump in this mode for more than ten minutes. Interchange any two leads at the starter and try again.

During the initial shakedown period, you must keep in mind that there are limits to the number of start cycles to which a submersible motor may be subjected without consequences. It's not advisable to permit more than a couple of starts an hour while you're putting the plant in operation. After that, motor manufacturers usually recommend a limit of two starts per twenty four hours in normal operating plan. Frequent cycling prevents adequate cooling of the motor and leads to early deterioration of internal insulation, thus shortening life.

When your electrical characteristics indicate acceptable operation and the pump appears to be running smoothly without vibration from all you can detect at the surface, your installation is complete and your pumping plant is in business. We suggest you set up a monitoring program to make periodic reviews of pump performance, power requirement, electrical system resistance, and well behavior. You should make these observations once a month if you can, and certainly not less than four times a year. Be especially alert to any seasonal changes in well performance. We urge you to sound the well at least once every three months so you can forestall any tendency for the hole to build up sand or silt around the motor. Such a condition will lead very quickly to motor failure so it's worth your attention.

SECTION 14

SPLICING THE CABLE

Splicing the power cable to the motor leads is usually a part of the jobsite installation procedure. You'll need to make the connection when you prepare the motor and pump for initial insertion into the well as described in Section 8. We can recommend either one of three methods for your consideration and will detail them for you herein. In any case, the work must be performed by competent personnel as this is a most important step in a successful installation.

a. Tape Splice

If you choose to employ a tape splice, snip the cable outer jacket in two or three places and peel it back approximately one foot. Remove any cotton or other tape from the individual conductors to expose the insulation of each wire. Strip the insulation of each conductor back far enough to allow the wire to extend halfway through a sleeve type connector. Crimp the connector to the wire.

Strip the motor lead insulation back far enough to fit into the connector and butt the lead against the cable wire in the connector. Crimp the fitting as you did above, but this time to the motor lead. Pull on the wires to make sure the joint is secure and permanent. Scrape the insulation to remove any loose bits of tape or thread. Then roughen up the surfaces and clean them thoroughly with a suitable solvent.

Using a self-bonding polyethylene based tape, start at the center of the connector and tape one inch past the end of the fitting, stretching the tape about 10% while wrapping. Overlap the tape about one half its width. Continue taping back past the connector one inch on the other side. This completes your first layer of wrap.

As you finish each layer, coat the tape with ScotchKote electrical coating 31K8B or a similar material. Tape the next layer back one inch farther than the first so that the joint is now taped two inches past each end of the fitting. When you apply the coating, you'll have completed the second layer.

In the same way, make your third wrap out to three inches past the connector on each end. After coating, tape back to the center and cut off the tape. Your connector has now been wrapped at the center with four layers of half lapped tape.

Using vinyl plastic electrical tape, start at the center of the splice and wrap one inch past the end of the insulating tape. Stretch this tape about 25% while wrapping and overlap again about one half tape width.

Wrap to the other end, past the center of the splice and one inch past the end of the polyethylene based tape, thus completing the fifth layer. Wrap the sixth and seventh layers in the same way, extending each level one inch past the previous one.

To finish the taped splice, wrap back to the center and cut the tape off. The overall length of the splice should be about 12 inches long and is made up of eight layers of tape, four of them insulating and four jacketing.

b. Cast Splice

If, on the other hand, you elect to apply a cast splice, you'll start in much the same way but will follow the remainder of the procedure described below, producing the arrangement depicted in Figure 16. Strip the cable jacket back 2-1/2 inches from the end, taking care not to cut the insulation. Strip the cambric wrapping if any from the conductors and strip back the rubber insulation five eighths inch from the end. Assemble the cable connectors and crimp them firmly in place. If the cables are too large for the fittings, cut off enough strands to reduce them to the right size.

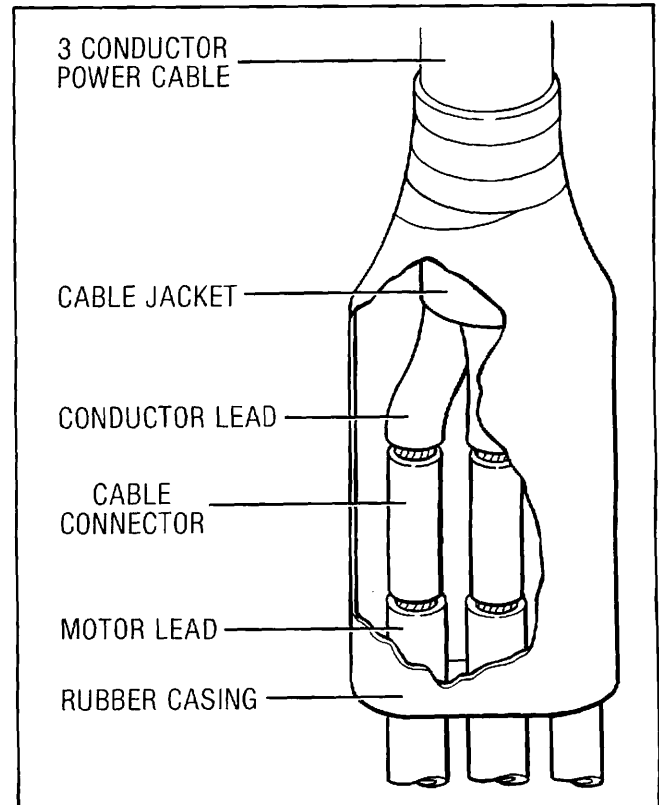


Figure 16. Cast Cable Splice

Cut off the motor leads to equal length. Clean off the ends of the leads for about a foot, using a rag soaked in a suitable solvent. Clean also the ends of the power cable. Insert the three motor leads into the corresponding holes in the bottom of the rubber casing and push them several inches out the top. Crimp the motor leads into the corresponding connectors, fastening the center one first. Bend the cables into line with the holes in the casing and slip the casing up until the connectors are inside the holes and about 1/4 inch from the top.

Mix the resin as directed. However, be careful to squeeze the bag only lightly when mixing as it might rupture if too much pressure is applied. Cut off a corner of the bag and force all of the resin into the casing. With the roll of tape at hand, fold the bag as shown in Figure 16 and tape the top snugly to the power cable until the resin runs out above. This will insure maximum coverage of the resin and will minimize the size of the finished splice. You won't have to tape over the top of the casing because the resin will seal it for you. When the resin is firm to the touch, the splice may be considered complete.

c. Heat Shrink Sleeve Splice

The third method is the heat sleeve splice. Refer to Figure 17. Train the cable in position and cut to the proper length so the cable ends will butt squarely. Remove the cable jacket 2-1/2" from the ends to be spliced. Do not cut into the cable insulation. Remove the cable insulation 1" from the ends to be spliced. Do not nick the conductors. Clean the entire area of the prepared splice by wiping with a solvent saturated cloth from the Scotch cable preparation kit (Scotch A-2).

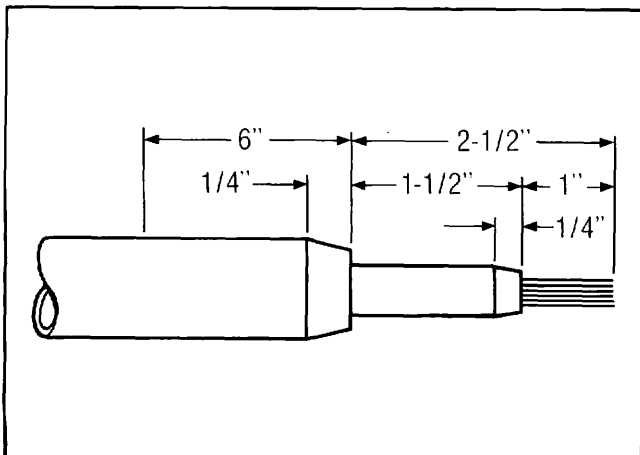


Figure 17. Prepare the Cable

We will now connect the conductors. Insert either cable through the Raychem heat shrink cable sleeve (WCS series with an "A" suffix). Spread the wires and interweave as shown in Figure 18.

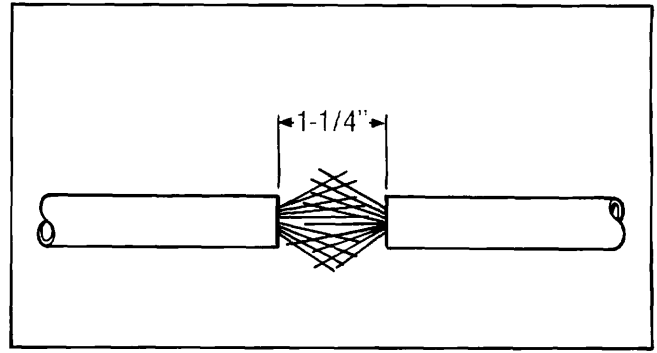


Figure 18. Interweave the Wires

Bind the weave with a single copper wire, as shown in Figure 19. Solder the conductors, taking care to protect the cable insulation with temporary wraps of cotton tape. Grind off any sharp points of solder and clean the flux from the conductor area with a solvent saturated cloth from the Scotch cable preparation kit (Scotch A-2). Wrap with two half lapped layers of Scotch 27 or mylar tape equivalent.

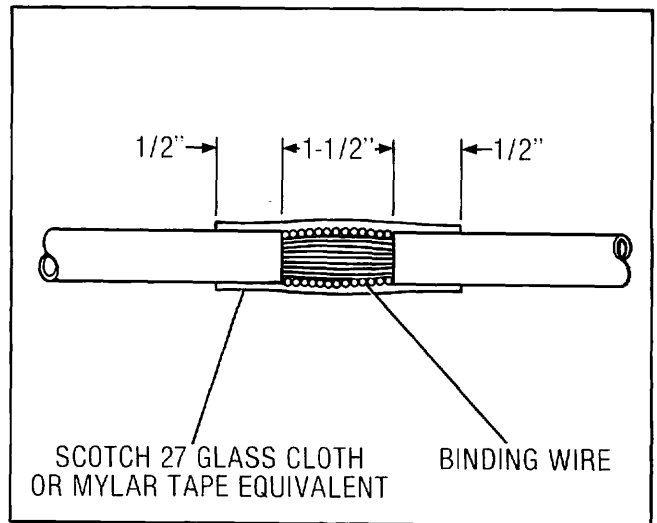


Figure 19. Bind and Tape the Splice

The next step covers taping the splice for insulation and water proofing. Clean both cables with a solvent saturated cloth 10" on each side of the splice area. Next, start in the center of the splice and 1/2 lap wrap 1-1/2" from the center to one side. Then 1/2 lap wrap back to 1-1/2" from the center on the other side of the connection until the following minimum thicknesses are obtained:

- a. Low voltage .08"
- b. High voltage .20"

Use Scotch 130C tape. Refer to Figure 20.

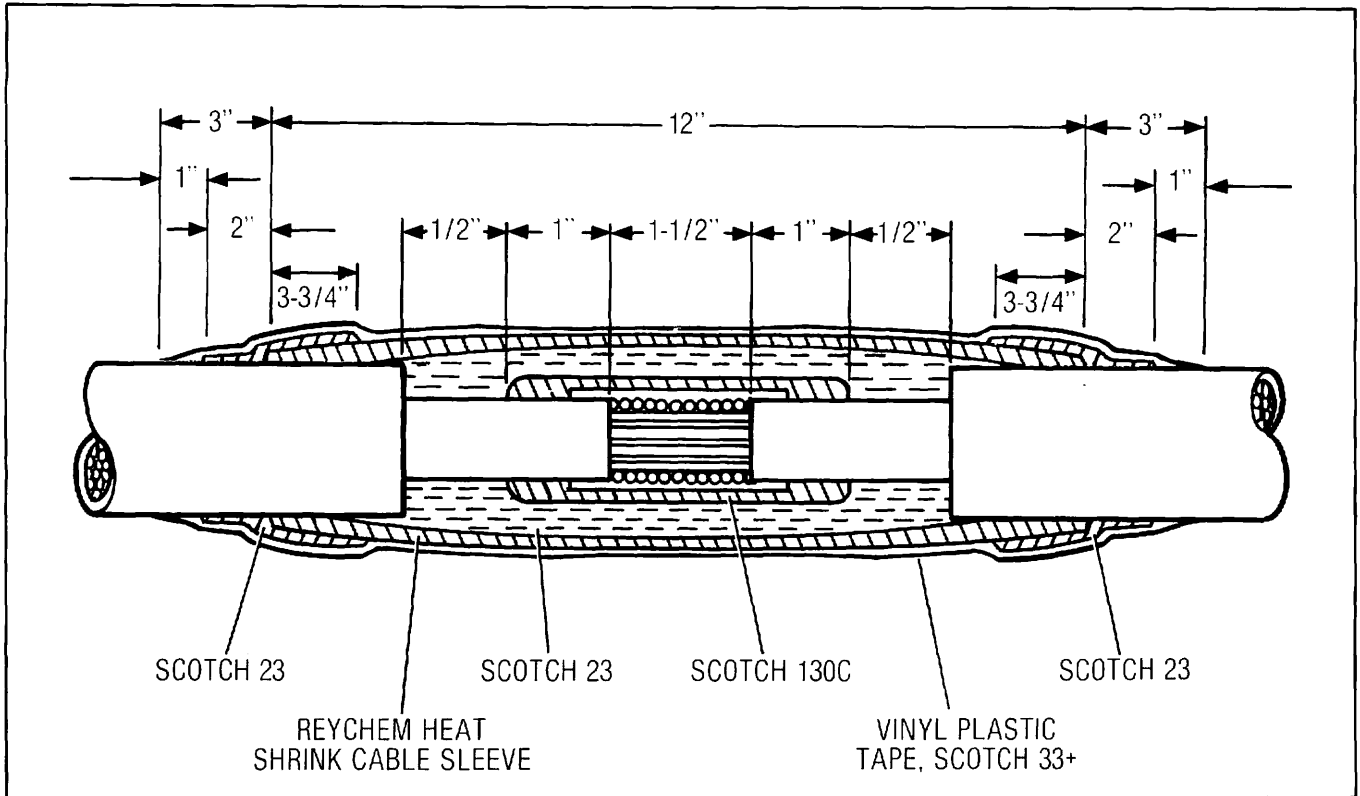


Figure 20. Taping for Insulation and Waterproofing

Now, start in the center and 1/2 lap wrap with Scotch 23 tape until the gap between the outer jackets is filled. Continue to wrap until the thickness at the center of the splice is slightly larger than the outer diameter of the cable. These last layers should overlap onto the jacket approximately 1/2".

Slide the Raychem heat shrink sleeve (or equivalent) over the splice. It should be centered exactly over the splice. Heat the sleeve until it is firmly and uniformly shrunk on the tape and cables.

Using Scotch 23 tape, wrap three layers of 1/2 lap. These layers should extend from 2" on the heat shrink sleeve outward to 2" beyond the end of the heat shrink sleeve. Refer to Figure 21.

Using vinyl plastic, Scotch 33 + tape wrap the entire splice with two layers of 1/2 lap. These layers should

extend 1" on both ends. The cable should be firmly clamped to the column pipe 12" on both sides of the splice.

Your choice of splice design may have been based on the kit furnished with your pump or on your personal preference. Whichever you elect to use, apply it with extreme care and attention. The joint will be immersed in water for all of its useful life and any leak or failure will force you to raise the entire pump to the surface for repair. The splice is thus a most important part of the installation procedure.

When the connection is made, make the tests we describe in Section 8 to establish integrity. During the installation, keep track of the resistance values so that, when the total installation has been accomplished, you'll be ready to start the pump without further complication.

SECTION 15

PRECAUTIONARY INFORMATION

a. Responsibilities

There are certain areas in which Aurora Pump has no control and can therefore accept no liability. For instance, unless supervised by an Aurora service engineer, responsibility for installation, startup, and maintenance belongs to the Owner and his authorized agents. Similarly, the following shall be the Owner's obligation and responsibility:

Suitability of well for intended purpose

Suitability of foundation or mounting structure

Suitability of power characteristics

Security and safety of jobsite and site conditions

Placement and maintenance of all appropriate guards and safety devices

Suitability and performance of system to which pump is applied

Aurora Pump cannot be responsible for damages, lost time, or injury resulting from failure to comply with these instructions. Aurora's obligations do not cover damage to the pump due to abrasives, gas, or corrosives in the water. They do not cover harm due to starting the pump in a sand locked condition or in reverse rotation mode; neither do they cover performance when parts not furnished by Aurora are used in the pump.

If you have any questions, please call your Aurora representative.

b. General Cautionary Notes

Your Aurora Verti-Line pump is an engineered assembly of precision parts and must be treated appropriately, even though sometimes the components are heavy and awkward to manipulate. Also, because they may be heavy, they must never be handled carelessly. Normal rules of safety and approved methods of practice as associated with the erection of heavy equipment must be observed in any activity related to your pump.

In addition to general acceptable industrial practice, we emphasize the following precautions:

Don't work on pumps, wiring, or any pump or system components without opening energizing circuits such as at main breaker or pump disconnect switch.

Don't work under a suspended load. Rest the load on positive supports when it is necessary to be underneath.

Don't forget this equipment contains rotating parts. Use CAUTION when testing motor and bowl assembly at the surface. Always replace all guards, covers, shields, and other safety devices before operation.

Don't permit smoking in the vicinity of petroleum base solvents.

Store solvents in approved containers.

Don't start pump while it is still rotating in reverse direction after having shut down. It is advisable to use a time delay relay to prevent this.

Don't put heavier than recommended heaters in the starter if the pump load begins to trip those furnished originally. These are protective devices. Call your Aurora representative for assistance.

Don't run the pump backward. Power requirements of some impellers increase when driven backward and can thus create undesirable overloads. In certain areas of the country prone to phase reversal problems, consider phase protection in your power circuit.

Don't allow oil, grease, or thread lubricant to contact rubber bearings or other rubber parts, such as cable guards.

Don't pump anything but water without first checking with your Aurora representative.

Don't attempt to restart a sand locked pump. Call for help.

Don't pull discharge piping to pump discharge flange with bolts or capscrews. Install pipeline so that fasteners are used to prevent leakage only.

Don't hang the weight of discharge lines and fittings on the pump. Support pipe runs by blocking or concrete saddles according to best piping practice. Use dresser type couplings with thrust ties if necessary wherever possible to eliminate piping strains imposed on the pump.

Don't throttle or obstruct the suction of the pump. Always be sure you have adequate submergence and flow into the pump.

Don't use a column or suction check valve if you can help it. Such devices are sometimes considered to control reverse flow from the system back into the well. However, with their use, you may encounter the dangers of extreme water hammer, sand locking, and airlocking, all with consequent damage to the unit. Try to locate your valve in the surface piping where you can get at it.

Don't change pump speed without checking effect on power, internal pressure, and other conditions. Remember your pump is guaranteed only for design conditions as purchased.

Don't neglect your maintenance checks.

And let us add one more DON'T for the benefit of your pump and your peace of mind:

Don't hesitate to call your Aurora representative when you need answers or assistance.

c. Operation at Shutoff Head

It is rarely advisable to operate a submersible pump at static flow heads for more than five minutes, if at all. The submerged electric motor depends on a flow of water past its location to cool the windings. In addition to this, if you allow prolonged exposure to static flow, the entire problem of heat dissipation may become acute since the total shutoff horsepower is converted to heat in the available liquid. In other words, the water in the well and aquifer may get hot, preventing heat transfer at the motor and bearing lubrication in the bowl assembly.

Other considerations must be cleared before you can contemplate running against shutoff. Some of these are:

Your thrust bearing must be adequate for downthrust at shutoff head.

In the case of high pressure or high lift units, you must investigate stresses at maximum head.

Certain impeller designs have critical horsepower characteristics at low flow rates. You should review shutoff horsepower requirements for possible motor overload.

If there's no way to avoid the possibility of operation at shutoff, you must notify the factory during purchase negotiations. An Aurora engineer can then perform the necessary analysis and design the pump to suit the special condition; or he may have to advise you that the requirement is impractical. This is for your protection and must be observed to validate any warranty.

d. Maintenance Hints

A good maintenance program will include the periodic checks we've already recommended. Any reduction in resistance values as determined with your megger must be watched carefully. If your readings drop below 50 megohms, it's time to pull the pump and find the trouble.

Be aware of changing conditions in your system. Any deviation from the original conditions or any variation in the environment could conceivably create an undesirable reaction in the pump assembly as the energizer of your system. If your pumping water level increases, for instance, check your performance curve and your thrust bearing capacity for the new situation.

It's best not to remove or to repair your pump without consulting your Aurora representative. If it becomes necessary to work on your equipment, be sure to review all instructions for operation and maintenance. In many cases, attempted field repair of submersible motors may invalidate the motor manufacturer's warranty. It's always advisable to take the motor to an authorized service center.

You may want to contract for the services of a trained Aurora field engineer to guide you in these various considerations. We want you to enjoy the best possible performance from your equipment.

NOTES

NOTES

TERMS AND CONDITIONS OF SALE

NOT INTENDED FOR SALE OR USE FOR PERSONAL, FAMILY, OR HOUSEHOLD PURPOSES.

1-79 Printed in U.S.A.

All orders shall be made out to Aurora Pump at North Aurora, Illinois, and shall be subject to acceptance by us at North Aurora.

1. CONSTRUCTION AND LEGAL EFFECT. Our sale to you will be solely upon the terms and conditions set forth herein. They supersede and reject any conflicting terms and conditions of yours, any statement in yours to the contrary notwithstanding. Exceptions to any of our terms and conditions must be contained in a written or typed (not printed) statement received from you; we shall not be deemed to have waived any of our terms and conditions or to have assented to any modification or alteration of such terms and conditions unless such waiver or assent is in writing and signed by an authorized officer. No representation of any kind has been made by us except as set forth herein; this agreement conclusively supersedes all prior writings and negotiations with respect thereto and we will furnish only the quantities and items specifically listed on the face hereof; we assume no responsibility for furnishing other equipment or material shown in any plans and/or specifications for a project to which the goods ordered herein pertain. Any action for breach of contract must be commenced within one year after the cause of action has accrued. Our published or quoted prices, discounts, terms and conditions are subject to change without notice.

2. PRICES. Unless otherwise noted on the face hereof, prices are net F.O.B. our producing factory, and include standard catalogue literature only. Service time of a factory-trained service man is not included and may be charged extra. The amount of any applicable present or future tax or other government charge upon the production, sale, shipment or use of goods ordered or sold will be added to billing unless you provide us with an appropriate exemption certificate. We may adjust prices to our prices in effect at time of shipment. Purchased equipment such as motors, controls, gasoline engines, etc., will be invoiced at prices in effect at time of shipment in accordance with pricing policy of manufacturer.

3. DEFECTIVE EQUIPMENT. Providing Purchaser notifies us promptly, if within one year from date of shipment equipment or parts manufactured by us fail to function properly under normal, proper and rated use and service because of defects in material or workmanship demonstrated to our satisfaction to have existed at the time of delivery, the Company reserving the right to either inspect them in your hands or request their return to us will at our option repair or replace at our expense F.O.B. our producing factory, or give you proper credit for such equipment or parts determined by us to be defective, if returned transportation prepaid by Purchaser. The foregoing shall not apply to equipment that shall have been altered or repaired after shipment to you by anyone except our authorized employees, and the Company will not be liable in any event for alterations or repair except those made with its written consent. Purchaser shall be solely responsible for determining suitability for use and the Company shall in no event be liable in this respect. The equipment or parts manufactured by others but furnished by us will be repaired or replaced only to the extent of the original manufacturer's guarantee. Our obligations and liabilities hereunder shall not be enforceable until such equipment has been fully paid for. Purchaser agrees that if the products sold hereunder are resold by purchaser, he will include in the contract for resale, provisions which limit recoveries against us in accordance with this section. In case of our failure to fulfill any performance representation, it is agreed that we may at our option remove and reclaim the equipment covered by this agreement at our own expense and discharge all liability by repayment to the purchaser of all sums received on account of the purchase price. (THE FOREGOING OBLIGATIONS ARE IN LIEU OF ALL OTHER OBLIGATIONS AND LIABILITIES INCLUDING NEGLIGENCE AND ALL WARRANTIES, OF MERCHANTABILITY OR OTHERWISE, EXPRESS OR IMPLIED BY FACT OR BY LAW, AND STATE OUR ENTIRE AND EXCLUSIVE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR ANY CLAIM OF DAMAGES IN CONNECTION WITH THE SALE OR FURNISHING OF GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATION.) WE WILL IN NO EVENT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES OR DELAY RESULTING FROM ANY DEFECT WHATSOEVER, AND OUR LIABILITY UNDER NO CIRCUMSTANCES WILL EXCEED THE CONTRACT PRICE FOR THE GOODS FOR WHICH LIABILITY IS CLAIMED.

4. DELIVERY. Delivery, shipment and installation dates are estimated dates only, and unless otherwise specified, are figured from date of receipt of complete technical data and approved drawings as such may be necessary. In estimating such dates, no allowance has been made, nor shall we be liable directly or indirectly for, delays of carriers or delays from labor difficulties, shortages, strikes or stoppages of any sort, fires, accidents, failure or delay in obtaining materials or manufacturing facilities, acts of government affecting us directly or indirectly, bad weather, or any causes beyond our control or causes designated Acts of God or force majeure by any court of law, and the estimated delivery date shall be extended accordingly. We will not be liable for any damages or penalties whatsoever, whether direct, indirect, special or consequential, resulting from our failure to perform or delay in performing unless otherwise agreed in writing by an authorized officer.

5. OPERATING CONDITIONS AND ACCEPTANCE. Recommendations and quotations are made upon the basis of operating conditions specified by the Purchaser. If actual conditions are different than those specified and performance of the equipment is adversely affected thereby, Purchaser will be responsible for the cost of all changes in the equipment required to accommodate such conditions, and we reserve the right to cancel this order and Purchaser shall reimburse us for all costs and expenses incurred in, and reasonable profit for, performance hereunder. We reserve the right to refuse any order based upon a quotation containing an error. The provisions in any specification or chart are descriptive only and are not warranties or representations; we will certify to a rated capacity in any particular product upon request. Capacity, head and efficiency certifications are based on shop tests and when handling clear, fresh water at a temperature of not over 85°F. Certifications are at this specified rating only and do not cover sustained performance over any period of time nor under conditions varying from these.

6. SHIPPING. Unless you specify otherwise in writing, (a) goods will be boxed or crated as we may deem proper for protection against normal handling, and extra charge will be made for preservation, waterproofing, export boxing and similar added protection of goods; (b) routing and manner of shipment will be at our discretion, and may be insured at your expense, value to be stated at order price. On all shipments F.O.B. our producing factory, delivery of goods to the initial carrier will constitute delivery to you and all goods will be shipped at your risk. A claim for loss or damage in transit must be entered with the carrier and prosecuted by you. Acceptance of material from a common carrier constitutes a waiver of any claims against us for delay or damage or loss.

7. PATENT INFRINGEMENT. We will not be liable for any claim of infringement unless due to infringement by goods manufactured by us in the form in which we supply such goods to you and without regard to their use by you. If you notify us promptly of any such claim of infringement and, if we so request, authorize us to defend or settle any suit or controversy involving such claim, we will indemnify you against the reasonable expenses of any such suit and will satisfy any judgment or settlement in which we acquiesce, but only to an amount not exceeding the price paid to us for the allegedly infringing goods. If an injunction is issued against the further use of allegedly infringing goods we shall have the option of procuring for you the right to use the goods, or replacing them with non-infringing goods, or modifying them so that they become non-infringing, or of removing them and refunding the purchase price. The foregoing expresses our entire and exclusive warranty and liability as to patents, and we will not be liable for any damages whatsoever, suffered by reason of any infringement claimed, except as provided herein. You will hold us harmless and indemnified against any and all claims, demands, liabilities, damages, costs and expenses resulting from or connected with any claim of patent infringement arising out of the manufacture by us of goods in accordance with a design or specifications which you furnish us.

8. CANCELLATION AND RETURNED EQUIPMENT. Orders may be cancelled only with our written consent and upon payment of reasonable and proper cancellation charges. Goods may be returned only when specifically authorized and you will be charged for placing returned goods in saleable condition, any sales expenses then incurred by us, plus a restocking charge and any outgoing and incoming transportation costs which we pay.

9. CREDIT AND PAYMENT. Payment for products shall be 30 days net. Pro-rata payments shall become due with partial shipments. A late charge of 1 1/2 percent per month or the maximum permitted by law, whichever is less, will be imposed on all pastdue invoices. We reserve the right at any time to alter, suspend, credit, or to change credit terms provided herein, when in its sole opinion your financial condition so warrants. In such a case, in addition to any other remedies herein or by law provided, cash payment or satisfactory security from you may be required by us before shipment; or, the due date of payment by you under this contract may be accelerated by us. Failure to pay invoices at maturity date at our election makes all subsequent invoices immediately due and payable irrespective of terms, and we may withhold all subsequent deliveries until the full account is settled, and we may terminate this agreement. Acceptance by us of less than full payment shall not be a waiver of any of our rights. You represent by sending each purchase order to us that you are not insolvent as that term is defined in applicable state or federal statutes. In the event you become insolvent before delivery of any products purchased hereunder, you will notify us in writing. A failure to notify us of insolvency at the time of delivery shall be construed as a reaffirmation of your solvency at that time. Irrespective of whether the products purchased hereunder are delivered directly to you, or to a customer of yours, and irrespective of the size of the shipment, we shall have the right to stop delivery of the goods by a bailee if you become insolvent, repudiate, or fail to make a payment due before delivery, or if for any other reason we have a right to withhold or reclaim goods under the applicable state and federal statutes. Where you are responsible for any delay in shipment the date of completion of goods may be treated by us as the date of shipment for purposes of payment. Completed goods shall be held at your cost and risk and we shall have the right to bill you for reasonable storage and insurance expenses.

10. SPECIAL JIGS, FIXTURES AND PATTERNS. Any jigs, fixtures, patterns and like items which may be included in an order will remain our property without credit to you. We will assume the maintenance and replacement expenses of such items, but shall have the right to discard and scrap them after they have been inactive for one year without credit to you.

11. INSPECTION. Inspection of goods in our plant by you or your representative will be permitted insofar as this does not unduly interfere with our production workflow, provided that complete details of the inspection you desire are submitted to us in writing in advance.

12. RECORDS, AUDITS AND PROPRIETARY DATA. Unless otherwise specifically agreed in writing signed by an authorized officer, neither you nor any representative of yours, nor any other person, shall have any right to examine or audit our cost accounts, books or records of any kind or on any matter, or be entitled to, or have control over, any engineering or production prints, drawings or technical data which we, in our sole discretion, may consider in whole or in part proprietary to ourselves.