HANDBOOK OF WATER SYSTEMS

Part 9

SUBMERSIBLE PUMP SERVICE

Six charts covering ninety-five percent of all submersible service work . . . most of which can be done without touching the pump.

THE SUBMERSIBLE pump has, in the past few years, gained in acceptance. The simplicity of operation, ease of installation and improved electrical and mechanical design have contributed much to its popularity. In order to gain this acceptance, the manufacturers have had to do much educational work. It was necessary to teach the installer how to handle and service the electrical parts of this system.

The installer was also required to purchase and learn to use such electrical instruments as an ohmmeter, an ammeter and a voltmeter. The proper use of these instruments and an adequate knowledge of the functions of the electrical components has overcome much of the fear of installing and servicing this equipment. The instruments are necessary to help locate the source of trouble and prevent pulling a satisfactory unit.

Once the instruments and the procedure for checking a unit have been mastered, you have only to follow the procedure outlined in the following six charts.

These charts cover most of the submersible service work. Most of the checking can be done without touching the pump itself. Always make all the above ground checks before the pump is pulled from the well.

As submersible designs have improved, there has been a corresponding simplification in service procedures. Today, trouble-shooting submersibles is easy and uncomplicated. And, contrary to a widely held impression, most service checks can be made without pulling the pump.

As much of the check out work on submersibles involves electrical tests, it's essential that the servicing contractor be thoroughly familiar with the electrical components of the water system. But the tests are not complicated and manufacturers' service literature generally includes explicit instructions for making electrical tests.

For the most part, only two instruments are needed: a combination voltmeter/ammeter and an ohmmeter, inexpensive and readily available from most water systems suppliers. Once these instruments are mastered — and they can be mastered in an hour or less — you have only to follow a systematic trouble-shooting procedure to be able to diagnose almost all service troubles that might be encountered with submersibles.

Such a procedure is outlined on the following pages. Each of the six accompanying charts outlines the procedure for tracing down the source of a major operating trouble. Together, the six charts cover ninety-five percent or more of all submersible service work.

As indicated, most of this checking can be done without touching the pump.

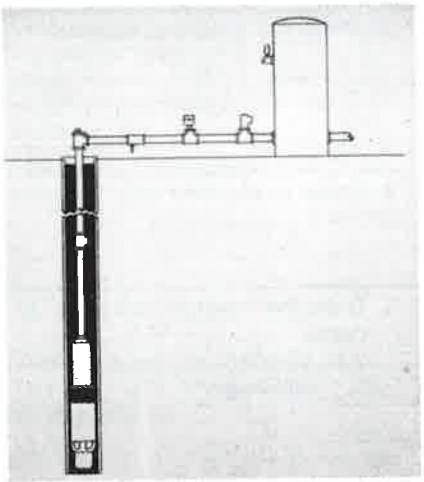

Figure 9-1 shows a typical submersible pump installation.

A — FUSES BLOW OR CIRCUIT BREAKER TRIPS WHEN MOTOR IS STARTED

CAUSE OF TROUBLE	HOW TO CHECK	HOW TO CORRECT
1. Incorrect line voltage.	Check the line voltage terminals in the control box (or connection box in the case of the 2-wire models) with a voltmeter. Make sure that the voltage is within the minimum-maximum range prescribed by the manufacturer.	If the voltage is incorrect, contact the power company to have it corrected.
2. Defective control box: **a. Defective wiring.**	Check out all motor and power-line wiring in the control box, following the wiring diagram found inside the box. See that all connections are tight and that no short circuits exist because of worn insulation, crossed wires, etc.	Rewire any incorrect circuits. Tighten loose connections. Replace worn wires.
b. Incorrect components.	Check all control box components to see that they are the type and size specified for the pump in the manufacturers' literature. In previous service work, the wrong components may have been installed.	Replace any incorrect component with the size and type recommended by the manufacturer.
c. Defective starting capacitor (skip for 2-wire models).	Using an ohmmeter, determine the resistance across the starting capacitor. When contact is made, the ohmmeter needle should jump forward, and then drift back slowly. No movement indicates an open capacitor (or defective relay points); no resistance means that the capacitor is shorted.	Replace defective starting capacitor.
d. Defective relay (skip for 2-wire models).	Using an ohmmeter, check the relay coil. Its resistance should be as shown in the manufacturer's literature. Recheck ohmmeter reading across starting capacitor. With a good capacitor, no movement of the needle indicates defective relay points.	If coil resistance is incorrect or points defective, replace relay.

3. Defective pressure switch.	Check the voltage across the pressure switch points. If less than the line voltage determined in "1" above, the switch points are causing low voltage by making imperfect contact.	Clean points with a mild abrasive cloth or replace pressure switch.
4. Pump in crooked well.	If wedged into a crooked well, the motor and pump may become misaligned, resulting in a locked rotor.	If the pump does not rotate freely, it must be pulled and the well straightened.
5. Defective motor winding or cable: **a. Shorted or open motor winding.**	Check the resistance of the motor winding by using an ohmmeter on the proper terminals in the control box (see manufacturer's wiring diagram). The resistance should match the ohms specified in the manufacturer's data sheet. If too low, the motor winding may be shorted; if the ohmmeter needle doesn't move, indicating high or infinite resistance, there is an open circuit in the motor winding.	If the motor winding is defective—shorted or open—the pump must be pulled and the motor repaired.
b. Grounded cable or winding.	Ground one lead of the ohmmeter onto the drop pipe or well casing, then touch the other lead to each motor wire terminal. If the ohmmeter needle moves appreciably when this is done, there is a ground in either the cable or the motor winding.	Pull the pump and inspect the cable for damage. Replace damaged cable. If cable checks OK, the motor winding is grounded.
6. Pump sand locked.	Make pump run backwards by interchanging main and start winding (black and red) motor leads at control box. Before doing, check with motor manufacturer to see if motor can be reversed.	Pull pump, disassemble and clean. Before replacing, make sure that sand has settled in well. If well is chronically sandy, a submersible should not be used.

B—PUMP OPERATES BUT DELIVERS LITTLE OR NO WATER

CAUSE OF TROUBLE	HOW TO CHECK	HOW TO CORRECT
1. Pump may be air locked.	Stop and start pump several times, waiting about one minute between cycles. If pump then resumes normal delivery, air lock was the trouble.	If this test fails to correct the trouble, proceed as below.
2. Water level in well too low.	Well production may be too low for pump capacity. Restrict flow of pump output, wait for well to recover, and start pump.	If partial restriction corrects trouble, leave valve or cock at restricted setting. Otherwise, lower pump in well if depth is sufficient. Do not lower if sand clogging might occur.
3. Discharge line check valve installed backward.	Examine check valve on discharge line to make sure that arrow indicating direction of flow points in right direction.	Reverse valve if necessary.
4. Leak in drop pipe.	Raise pipe and examine for leaks.	Replace damaged section of drop pipe.
5. Pump check valve jammed by drop pipe.	When pump is pulled after completing "4" above, examine connection of drop pipe to pump outlet. If threaded section of drop pipe has been screwed in too far, it may be jamming the pump's check valve in the closed position.	Unscrew drop pipe and cut off portion of threads.

6. Pump intake screen blocked.	The intake screen on the pump may be blocked by sand or mud. Examine.	Clean screen, and when reinstalling pump, make sure that it is located several feet above the well bottom—preferably 10 feet or more.
7. Pump parts worn.	The presence of abrasives in the water may result in excessive wear on the impeller, casing, and other close-clearance parts. Before pulling pump, reduce setting on pressure switch to see if pump shuts off. If it does, worn parts are probably at fault.	Pull pump and replace worn components.
8. Motor shaft loose.	Coupling between motor and pump shaft may have worked loose. Inspect for this after pulling pump and looking for worn components, as in "7" above.	Tighten all connections, setscrews, etc.

C—PUMP STARTS TOO FREQUENTLY

CAUSE OF TROUBLE	HOW TO CHECK	HOW TO CORRECT
1. Pressure switch defective or out of adjustment.	Check setting on pressure switch and examine for defects.	Reduce pressure setting or replace switch.
2. Leak in pressure tank above water level.	Apply soap solution to entire surface of tank and look for bubbles indicating air escaping.	Repair or replace tank.
3. Leak in plumbing system.	Examine service line to house and distribution branches for leaks.	Repair leaks.
4. Discharge line check valve leaking.	Remove and examine.	Replace if defective.
5. Air volume control plugged.	Remove and inspect air volume control.	Clean or replace.
6. Snifter valve plugged.	Remove and inspect snifter valve.	Clean or replace.

D—FUSES BLOW WHEN MOTOR IS RUNNING

CAUSE OF TROUBLE	HOW TO CHECK	HOW TO CORRECT
1. Incorrect voltage.	Check line voltage terminals in the control box (or connection box in the case of 2-wire models) with a voltmeter. Make sure that the voltage is within the minimum-maximum range prescribed by the manufacturer.	If voltage is incorrect, contact power company for service.
2. Overheated overload protection box.	If sunlight or other source of heat has made box too hot, circuit breakers may trip or fuses blow. If box is hot to the touch, this may be the problem.	Ventilate or shade box, or remove from source of heat.
3. Defective control box components (skip this for 2-wire models).	Using an ohmmeter, determine the resistance across the running capacitor. When contact is made, the ohmmeter needle should jump forward, and then drift back slowly. No movement indicates an open capacitor (or defective relay points); no resistance means that the capacitor is shorted. Using an ohmmeter, check the relay coil. Its resistance should be	Replace defective components.

	as shown in the manufacturer's literature. Recheck ohmmeter reading across running capacitor. With a good capacitor, no movement of the needle indicates relay points.	
4. Defective motor winding or cable.	Check the resistance of the motor winding by using an ohmmeter on the proper terminals in the control box (see manufacturer's wiring diagram). The resistance should match the ohms specified in the manufacturer's data sheet. if too low, the motor winding may be shorted; if the ohmmeter needle doesn't move, indicating high or infinite resistance, there is an open circuit in the motor winding. Ground one lead of the ohmmeter onto the drop line or well casing, then touch the other lead to each motor wire terminal. If the ohmmeter needle moves appreciably when this is done, there is a ground in either the cable or the motor winding.	If neither cable or winding is defective—shorted, grounded, or open—pump must be pulled and serviced.
5. Pump becomes sand-locked.	If the fuses blow while the pump is operating, sand or grit may have become wedged in the impeller, causing the rotor to lock. To check this, pull the pump.	Pull pump, disassemble, and clean. Before replacing, make sure that sand has settled in well. If well is chronically sandy, a submersible should not be used.

E—PUMP WON'T SHUT OFF

CAUSE OF TROUBLE	HOW TO CHECK	HOW TO CORRECT
1. Defective pressure switch.	Arcing may have caused pressure switch points to "weld" in closed position. Examine points and other parts of switch for defects.	Clean points or replace switch.
2. Water level in well too low.	Well production may be too low for pump capacity. Restrict flow of pump output, wait for well to recover, and start pump.	If partial restriction corrects trouble, leave valve or cock at restricted setting. Otherwise, lower pump in well if depth is sufficient. Do not lower if sand clogging might occur.
3. Leak in drop line.	Raise pipe and examine for leaks.	Replace damaged section of drop pipe.
4. Pump parts worn.	The presence of abrasives in the water may result in excessive wear on the impeller, casing, and other close-clearance parts. Before pulling pump, reduce setting on pressure switch to see if pump shuts off. If it does, worn parts are probably at fault.	Pull pump and replace worn components.

F—MOTOR DOES NOT START, BUT FUSES DON'T BLOW

CAUSE OF TROUBLE	HOW TO CHECK	HOW TO CORRECT
1. Overload protection out.	Check fuses or circuit breaker to see that they are operable.	If fuses are blown, replace. If breaker is tripped, reset.

2. No power.	Check power supply to control box (or overload protection box) by placing a voltmeter across incoming power lines. Voltage should approximate nominal line voltage.	If no power is reaching box, contact power company for service.
3. Defective control box.	Examine wiring in control box to make sure all contacts are tight. With a voltmeter, check voltage at motor wire terminals. If no voltage is shown at terminals, wiring is defective in control box.	Correct faulty wiring or tighten loose contacts.
4. Defective pressure switch.	With a voltmeter, check voltage across pressure switch while the switch is closed. If the voltage drop is equal to the line voltage, the switch is not making contact.	Clean points or replace switch.