



Failure to follow these instructions
will void the warranty.

SOLAR-OPERATED SUBMERSIBLE PUMP SYSTEMS

PS4000 HR/C

MANUAL FOR INSTALLATION, OPERATION, SERVICE



1 WARNINGS

General Warnings

- The manual contains basic instructions which must be observed during mounting, operation and maintenance. Therefore the manual should be carefully read before installation and start-up by the person in charge of the installation as well as by all other technical personnel/operators and should be available at the installation site at all times.
- **Personnel Qualification and Training** – All personnel for the operation, maintenance, inspection and installation must be fully qualified to perform that type of job. Responsibility, competence and the supervision of such personnel must be strictly regulated by the user. Should the available personnel be lacking the necessary qualification, they must be trained and instructed accordingly. If necessary, the operator may require the manufacturer/supplier to provide such training. Furthermore the operator/user must make sure that the personnel fully understands the contents of the manual.
- **Dangers of Ignoring the Safety Symbols** – Ignoring the safety directions and symbols may pose a danger to humans as well as to the environment and the machine itself. Non-observance may void any warranties. Non-observance of safety directions and symbols may for example entail the following: Failure of important functions of the machine/plant; failure of prescribed methods for maintenance and repair; endangerment of persons through electrical, mechanical and chemical effects; danger to the environment because of leakage of hazardous material; danger of damage to equipment and buildings.
- **Safety-oriented Operation** – The safety directions contained in the manual, existing national regulations for the prevention of accidents as well as internal working-, operational- and safety-regulations of the operator/user must be observed at all times.
- **General Safety Directions for the Operator/User** – If hot or cold machine parts pose a danger, such parts must be protected by the operator/user against contact with personnel. Protective covers for moving parts (e.g. coupling) must not be removed when the machine is running. Leakages (e.g. at the shaft seal) of hazardous pumping media (e.g. explosive, toxic, hot liquids) must be disposed of in such a way that any danger for personnel and the environment is removed. All government regulations must be observed at all times. Any danger to persons etc. by electrical energy must be excluded. (For details see e.g. regulations of VDE and the local utilities).
- **Safety Directions for Maintenance, Inspection and Assembly Work** – It is the user's responsibility to make sure that all maintenance, inspection and assembly work is performed exclusively by authorized and

qualified experts sufficiently informed through careful perusal of the Operating Instructions. The accident prevention regulations must be observed. Basically, all work on the machine is to be performed while the machine is not in operation. The sequence for shutting the machine down described in the manual must be strictly observed. Pumps or pump units handling hazardous liquids must be decontaminated. Immediately upon completion of the work, all safety and protective equipment must be restored and activated.

- **Unauthorized Changes and Manufacturing of Spare Parts** – Any conversion or changes of the machine may only be undertaken after consulting the manufacturer. Original spare parts and accessories authorized by the manufacturer guarantee operational safety. Using non-authorized parts may void any liability on the part of the manufacturer in case of consequential damage.
- **Unauthorized Operation** – The operational safety of the machine delivered is only guaranteed if the machine is used in accordance with the directions contained in manual. Limits stated in the data sheets may not be exceeded under any circumstances.
- **Cited Standards and other Documentations** – DIN 4844 Part 1 Safety marking; Safety symbols W 8, Supplement 13; DIN 4844 Part 1 Safety marking; Safety symbols W 9, Supplement 14
- **Transportation and Intermediate Storage** – Prolonged intermediate storage in an environment of high humidity and fluctuating temperatures must be avoided. Moisture condensation may damage windings and metal parts. Non-compliance will void any warranty.

Specific Warnings for PS4000

- Open circuit (no-load) voltage above 375V will destroy the PS4000 controller. This may occur if the solar array is wired incorrectly. (See section Wiring, section 7.)
- Do not attempt to run the motor without the PS controller.
- Do not attempt to use the controller for any purpose other than LORENTZ PS pump systems.
- Solar pumps run at low flow rates, and have closer tolerances than conventional pumps. Extreme sand or silt concentration (greater than 2 % by volume) may cause the pump to stop, or the pipe to fill with sand. Do not use the pumps to clean out a dirty well.
- Helical rotor pumps are sensitive to heat. Protect the pump from sunshine or other source of heat, or it may lock temporarily. If the water source is, or will be warmer than 72° F (22° C), a special model may be required.

- Undersized wire will cause failure to start.
- Do not touch the controller input or pump wires together to test for a spark.
- Do not run the pump dry.
Exception: to test direction of rotation, for not longer than 15 seconds.
- Test the direction of motor rotation before installing the pump (counter-clockwise looking down). If direction is reversed, exchange the connection of any two of the three power wires to the pump.
- When pump is stopped by a shadow or by action of a float switch, it will restart after a 120 seconds.
- The low water probe must be submersed, or the pump will stop for 20 minutes. If no probe is used, connect the probe terminals in the controller box.
- Helical rotor models (without "C" in the model number) are not self-draining. If drainage is required for freeze-protection, install a weep hole or draining device below freeze level.
- Install this system in accordance with local regulations and accepted codes of professional practice.



Failure to follow these instructions will void the warranty.



Before beginning installation procedures, these installation and operating instructions should be studied carefully.



The installation and operation should also be in accordance with local regulations and accepted codes of good practice.

2 ELECTRICAL INSTALLATION



Motor cable strain relief: Submersible motors must use a safety rope or cable to act as a strain relief for the motor cable and to avoid losing the pump in the well if the pipe breaks.



Do not run the motor without the controller.



To be installed, connected and serviced by qualified personnel only. Ensure all power sources are disconnected when making connections to this unit. Follow all appropriate electrical codes. There are no user serviceable parts inside the motor or the controller.



Install proper grounding for safety and lightning protection.



Do not touch the controller input or motor wires together to test for a spark.

Protection from solar heat Electronic devices are most reliable when they are protected from heat. Mount the controller in the shade of the midday sun. An ideal location is directly under the solar array, on the North side of the mounting pole. If no shade is available, cut a piece of sheet metal and bolt it behind the top of the controller. Bend it over the controller to provide shade. This is especially important in extremely hot locations. Extreme heat may trigger a thermal switch in the controller and cause it to turn off.

Location of controller Mount the controller vertically to keep out rainwater. It is preferable to mount it on the North side of a pole or other structure to help reduce solar heating. This may also allow easiest access without hitting your head on the lower (South) edge of the array.

Electrical conduit is recommended We urge you to use electrical conduit (pipe) to protect outdoor wiring from the weather, from human activities, and from chewing animals. If you do not use conduit, use strong, high-quality outdoor cable. Where cables enter the junction box, install sealed strain-relief cable clamps.

Keep the controller box sealed Unused holes must be sealed to keep out small animals, insects, water and dirt. Each hole is supplied with a rubber plug that can be kept in place for this purpose.



WARNING! TEST THE VOLTAGE before connecting power to the controller. Voltage (open circuit) must not exceed 375V for PS4000 systems.

(Even in cloudy weather, the open circuit voltage will be near maximum.)



WARNING! Do not apply a direct connection or an amp meter between + and – when the controller is connected. A short circuit here will cause a strong discharge.



WARNING! Solar-direct systems only — Do not connect any electrical load to the solar array if it is not part of the LORENTZ PS system. Connection of active solar tracker controller, electric fence charger, or other load simultaneously with LORENTZ PS systems may “confuse” the controller and prevent proper operation.

System Wiring Diagram for solar-direct systems, refer to the system diagram in this manual (section 7) and wire accordingly.

POWER IN Ensure that the solar array DISCONNECT SWITCH (or circuit breaker) is OFF. In case no disconnect switch is used, make shade or cover the solar array. Connect the power from the solar array to the input terminals in the controller box. Observe polarity. If your wires are not clearly marked +/–, test them using a DC voltmeter or multimeter.



WARNING! To be installed, connected and serviced by qualified personnel only. Ensure all power sources are disconnected when making connections to the controller. Follow all appropriate electrical codes. No user serviceable parts inside the motor or the controller!



CAUTION! Loose connections are the most common cause of system failures. Pull on each connection to confirm that it is secure.

3 WIRING ORDER FOR CORRECT ROTATION

The power wires of the pump have a marking to allow correct wiring. Connect the power wires using this sequence:

- L1
- L2
- L3
- Ground



CAUTION! When splicing the pump cable, carefully take a note of the markings of the cables you have connected.

Testing the pump for direction Helical rotor pumps will produce water flow only if they are rotating in the right direction. If you place it in a water tank or a bucket, you will observe flow if the rotation is correct. Submerge at least 75 % to observe full flow.

Alternative, dry test If you do not have a water vessel to test the pump in, you can test it dry by watching the pump shaft and running it for only a few seconds. The metal label on the pump has an arrow to indicate the proper direction of rotation. It can be run dry safely for about 5 seconds. This gives more than enough time to observe the direction of the shaft.

If you did not write down the colour match (or the wind blew your note away) connect the three power wires to the controller in any random order. Apply power. Observe the pump shaft rotation, then turn the power off. If the direction is wrong, exchange any two of the power wires at the controller. In any case, when you are finished connecting the pump to the controller, test it to assure the proper direction.

**Did you install the pump in the well without checking the wiring order or the direction?
OR – Is it running but not pumping?**

HELICAL ROTOR pump (no “C” in the model number) Turn the pump on. Observe if air is rising from the pipe. If it is not, reverse any two motor wires and observe again. If you cannot observe air rise, chose whichever direction is quieter (less vibration). There is risk of dry-run damage if it runs too long in reverse. If the pump is new from the factory, it is lubricated so it can run dry for about 90 seconds without risk. If the pump has been used, it must not be run for more than about 15 seconds. In many cases, a pump that is reversed will turn off due to overload.

CENTRIFUGAL pump (with “C” in the model number) In reverse, it will produce no flow (or very little). This will not damage the pump. If the flow is not normal, reverse any two motor wires.

Question The motor shaft is hard to turn by hand and moves in a bumpy manner. Is this normal?

4 OPERATING THE PUMP

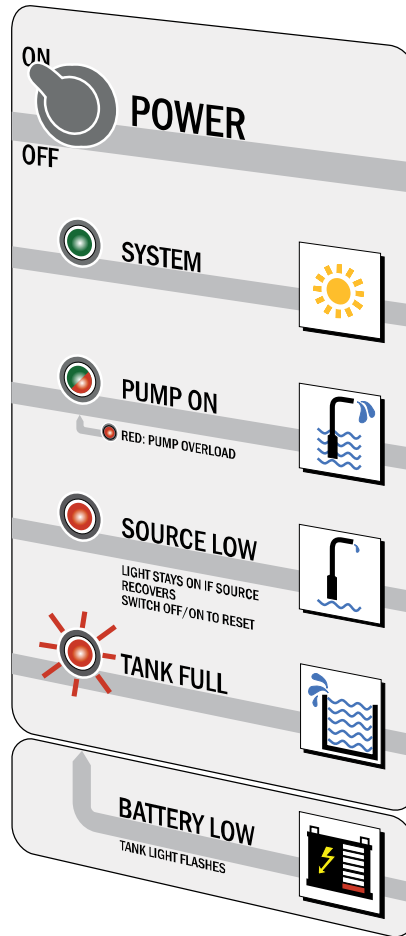
Answer YES. This is caused by permanent magnets in the motor. It is especially hard to turn when it is connected to the controller, or if the pump wires are connected together.



WARNING! If the pump wires are in the wrong order, the motor will run in reverse and the pump will not function. Damage may result. Check the direction **BEFORE** installing the pump. The proper direction is **COUNTER-CLOCKWISE** when viewed from above.



WARNING! When testing for direction, do not run the pump dry for more than 15 seconds.



- **SOURCE LOW (red)** The water source has dropped below the level of the low-water probe. After the water level recovers, the pump will restart, but this light will slowly flash until the sun goes down, power is interrupted, or the POWER switch is reset. This indicates that the water source ran low at least once since the previous off/on cycle.
- **TANK FULL (red)** Pump is turned off by action of the remote float switch (or pressure switch or manual switch, whichever is wired to the "remote float switch" terminals.)

Starting the pump Be sure there is not a closed valve or other obstruction in the water line. Switch on the array disconnect switch in the junction box and toggle the power switch on the controller. It is normal to leave the switches on at all times, unless you desire to have the system off.

A solar-direct pump should start under the following conditions:

1. clear sunshine at an angle of about 20° or more from the surface of the solar array;
2. under cloudy conditions if the sunshine is bright enough to cast some shadow;
3. low-water probe submersed in the water source (or bypassed in the controller) – water-low light OFF;
4. full-tank float switch is not responding to a full tank – tank-full light OFF; and

This chapter explains the function of the switch and the indicator lights on the pump controller.

POWER ON/OFF SWITCH

When switched off/on during operation, it resets the system.

INDICATOR LIGHTS

- **SYSTEM (green)** The controller is switched on and the power source is present. In low-power conditions, the light may show even if there is not enough power to run the pump.
- **PUMP ON (green)** Motor is turning. Sequence of flashing indicates pump speed. Pump speed (RPM) can be read off by the flashing sequence of the Pump ON LED:

LED ON	>	900
1 flash	>	1,200
2 flashes	>	1,600
3 flashes	>	2,000
4 flashes	>	2,400
5 flashes	>	2,800

If the **PUMP OVERLOAD**, green changes to red.

When sunshine is insufficient When sunshine on the array is present, but too weak for the pump to run, it will attempt to start about every 90 seconds. During each attempt, you will see the PUMP ON light come on.

When pump runs slowly (PUMP ON) under weak sun conditions:

1. **for centrifugal pumps** (with "C" in the model number) – in weak sun, the pump may spin without lifting water all the way to the outlet. This is normal;
2. **for helical rotor pumps** (without "C" in the model number) – if the pump is turning, even slowly, water will be delivered at a slow rate.

When pump stops from a sudden shadow on the solar array If a shadow suddenly passes over the array, e.g. if you walk in front of it, the controller will lose track of the input voltage. It may make rapid on/off noises and a high-pitched noise, then stop. This does not indicate a problem. The pump will attempt to restart after the normal delay.

5 TROUBLE SHOOTING

Time delays

1. After pump stops due to insufficient sunshine – 120 seconds;
2. After full-tank float switch resets – 2 to 3 seconds;
3. After low-water probe regains contact with water in the source – 20 minutes, but the indicator light will slowly flash for the rest of the solar day, or until power is disrupted or the controller is turned off/on;

To force a quick start To test or observe the system, you can bypass the normal time delays. Switch the POWER switch off then on again. The pump should start immediately if sufficient power is present.

Pump vibration Most PS pump models use a helical rotor pump end (without “C” in the model number.) A slight vibration is normal with these pumps. If noise is disturbing, try changing the position of the pump. PS pump models that have a “C” in the model number use a CENTRIFUGAL pump end, similar to conventional pumps. They should produce no significant vibration.

PUMP OVERLOAD (PUMP ON light shows red instead of green) The system has shut off due to an overload. This can happen if the motor or pump is blocked or very difficult to turn and is drawing excessive current (hard to turn). Overload detection requires at least 250 W output of the solar array. This can be caused by a high concentration of solids in the pump, high water temperature, excessive pressure due to high lift or a restriction in the pipe, or a combination of these factors. The controller will make 3 start attempts before shutting down the system. The System ON LED will be OFF and the red OVERLOAD LED ON. The system will not reset until the ON/OFF switch is turned OFF and ON again.

Please read this section before calling for help. If you call for help, please refer to the model and serial numbers.

If the pump does not run Most problems are caused by wrong connections (in a new installation) or failed connections, especially where a wire is not secure and falls out of a terminal. The System ON light will indicate that the system is switched on and connected to the controller. It indicates that VOLTAGE is present but (in a solar-direct system) there may not be sufficient power to start the pump. It should attempt to start at intervals of 120 seconds.

Pump attempts to start every 120 seconds but does not run The controller makes a slight noise as it tries to start the pump. The pump will start to turn or just vibrate a little.

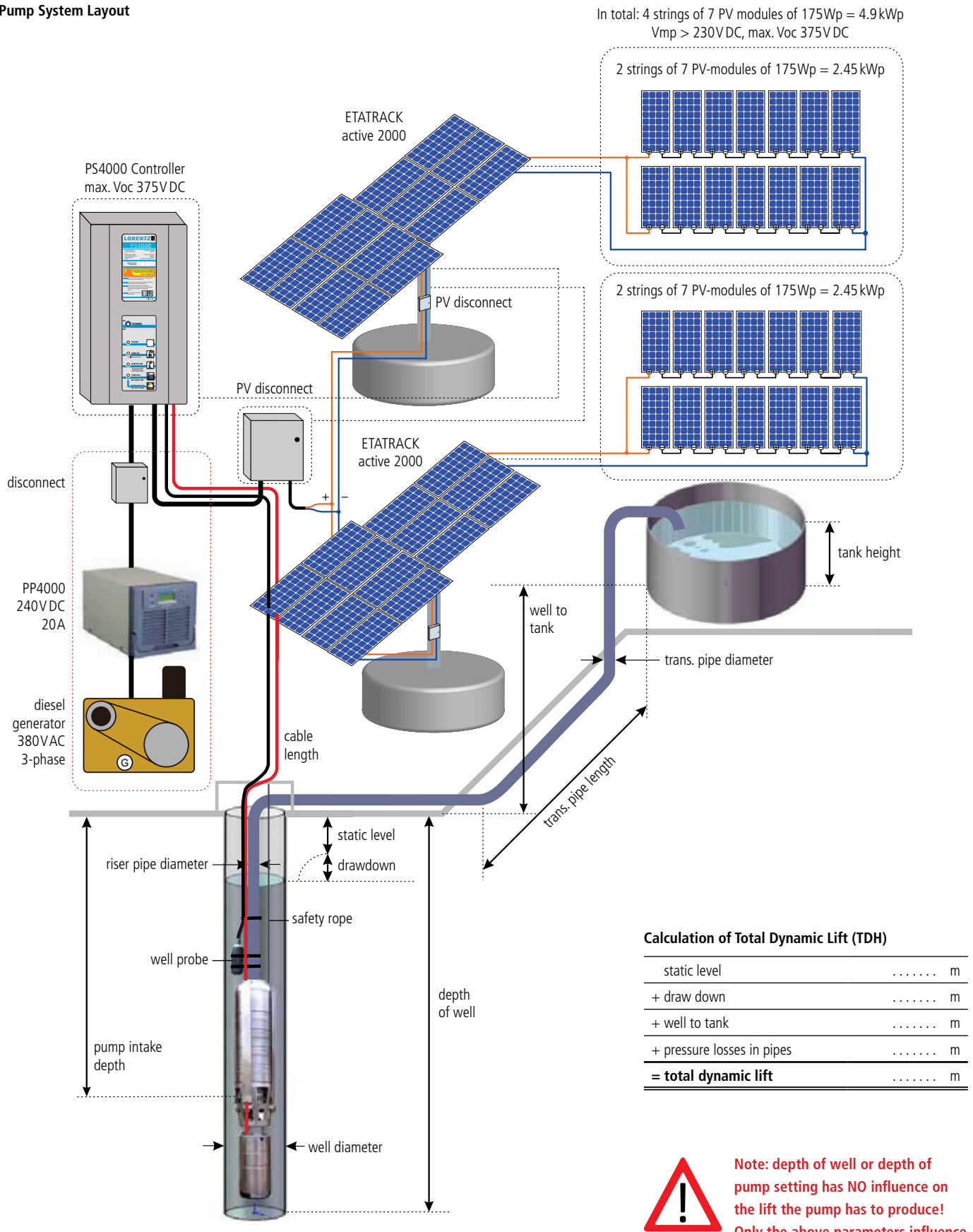
1. There may be insufficient power reaching the controller. A solar-direct (non-battery) system should start if there is enough sun to cast a slight shadow.
2. If the pump was recently connected (or reconnected) to the controller, it may be running in reverse direction due to wiring error.
3. If the motor shaft vibrates, but does not turn, it may be getting power on only two of the three motor wires. This might happen if there is a broken connection or if you accidentally exchanged one of the power wires with the ground wire.
4. The pump or pipe may be packed with mud, clay, sand or debris.
5. **Helical rotor models only:** The pump may have run dry. Remove the pump stator (outer body) from the motor, to reveal the rotor. If there is some rubber stuck to the rotor, the pump end must be replaced.
6. **Helical rotor models only:** The check valve on the pump may be faulty or stuck, allowing downward leakage when the pump is off. This can prevent the pump from starting.



CAUTION! DO NOT REMOVE THE CHECK VALVE from the pump. If you want to look for dirt stuck inside the pump, it is preferable to unbolt the pump body and pull it from the pump. IF YOU MUST REMOVE THE CHECK VALVE, use a hardening adhesive sealant on the screw threads when you replace it. Epoxy glue is good. The threads are not tapered. They will leak if a hardening sealant is not used. Teflon tape will make a good seal, but it may not prevent the joint from unscrewing.

6 WIRING DIAGRAMS

6.2 Pump System Layout



Calculation of Total Dynamic Lift (TDH)

static level m
+ draw down m
+ well to tank m
+ pressure losses in pipes m
= total dynamic lift m

! Note: depth of well or depth of pump setting has NO influence on the lift the pump has to produce! Only the above parameters influence the pump lift.

7 SYSTEM AND COMPONENTS

System voltage

Date of purchase

Purchased from

Battery system yes no

if not: Quantity of solar modules

Solar module brand

Module model #

Controller model PS4000

Controller serial #

Pump end model #

Pump end serial #

Temperature Range

Helical rotor pumps (without "C" in the model number) work optimally only in a specific temperature range. Last digit of pump end model # indicates temperature class. If a special temperature range was not specified, the last digit of model number will be 1.

Class 0 32 °F to 54 °F 0 °C to 12 °C

Class 1 46 °F to 72 °F 8 °C to 22 °C (Class 1 is the standard class)

Class 2 64 °F to 90 °F 18 °C to 32 °C

Class 3 82 °F to 108 °F 28 °C to 42 °C

Class 4 100 °F to 126 °F 38 °C to 52 °C

8 INSTALLATION REPORT

Installation date

by

Well depth

Pump depth

Additional vertical lift (to top of tank)

Static water level

Drawdown level

Drop pipe (vertical from the pump)

Size

Type

Length

Additional pipe length (to tank)

Size

Type

Length

Submersible pump cable

Wire size

Length (controller to pump)

Max. RPM control

Factory setting is maximum. yes no

If this setting was reduced, enter setting here:

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