Installation Manual

SOLAR PUMP™

Thermo Dynamics Ltd.
101 Frazee Avenue
Dartmouth, Nova Scotia
Canada, B3B-1Z4
Tel: (902) 468-1001 Fax: (902) 468-1002
Email: solarinfo@thermo-dynamics.com
www.thermo-dynamics.com

P50140 Solar Pump™ (direct drive)

P24070M Solar Pump™ (magnetic drive)

Your Thermo Dynamics (TDL) Solar Pump™ is a precision-built pump. We take great effort to ensure your Solar Pump™ is of the highest quality.

Every Solar Pump™ is tested at our factory for pressure and flow. TDL Solar Pumps™ do not require lubrication and are virtually maintenance-free, except for cleaning the strainer. In the event of a problem, TDL provides a quick and low-cost rebuilding service.

General Instructions

To get the most from your Solar Pump™, follow these instructions.

• Unpack your Solar Pump™ carefully and examine it before installation. Do not drop or bang it. If you mishandle the pump, you can damage internal clearances and impair performance.

• A qualified technician must install the Solar Pump™.

• Make sure you have an adequate, well-lit workspace and use the correct tools.

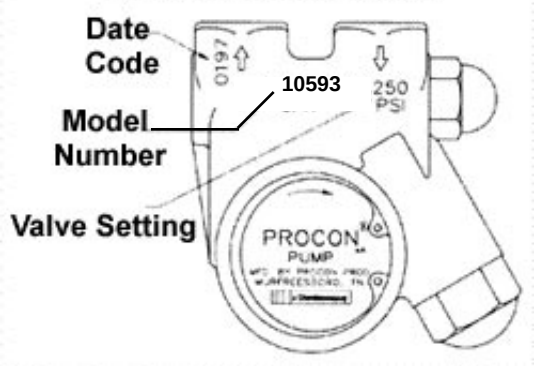
• The Solar Pump™ includes a DC motor and a brass pump head. Check the model number of the pump head (above the red nameplate) to ensure you have the correct pump. Refer to the illustration below for the location of the pump head model number.

• The Solar Pump™ has a pump head with one of the following model numbers:

Solar Pump™ model	Pump head model	Drive
P24070	10593	direct
P24070M	302A070F12BC	magnetic
P50140	10596	direct
P50140M	302A140F12BD	magnetic
P118330	10600	direct

• Do not exchange one Solar Pump™ model for another. Each model is engineered to meet specific flow and pressure requirements. Pumps within a series have the same housing. They may look alike, but they perform differently.

• A special order Solar Pump™ may have a pump head with a model number not shown in the table above.



• Do not remove plugs from the ports, if so shipped, until the fittings are ready to be installed. This will keep debris out of the pump.

• Do not allow the Solar Pump™ to ingest foreign materials.

• Do not use any components that are damaged or deformed. If you receive parts that are damaged or deformed, call TDL.

• Ensure power to the motor is disconnected before working on the Solar Pump™.

• If only a pump head has been shipped, and it has a shaft coupling (a brass or nylon drive pin), remove the drive pin and discard the foam shipping strip. Reinsert the drive pin. The nylon drive pins are slightly tapered. Ensure that the smaller end is inserted into the pump shaft. If the drive pin is brass, only one end will fit into the pump shaft.

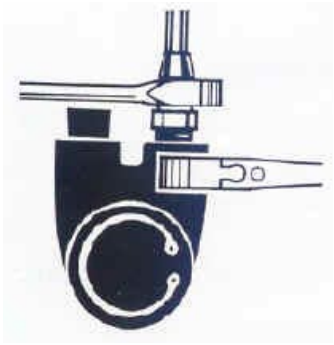
• Before installing a Solar Pump™, confirm that the motor shaft will turn freely, by turning the motor shaft extension, by hand only. Your Solar Pump™ has been tested at the TDL factory, however, if is advised to confirm that damage has not occurred during shipping of the Solar Pump™. Contact TDL if the shaft will not turn by hand.

• Disassembly of the Solar Pump™ voids the warranty. The Solar Pump™ must be returned to TDL for service or repair.

• If returning the Solar Pump™ to TDL, ensure that the packaging will prevent damage during shipping. We request that you not remove the fittings from the pump heads, before returning it to TDL for repair.

Replacing or installing new fittings on the Solar Pump™

• When you install fittings, do not vise or grip the round body portion of the pump housing. Grip the square inlet/outlet bosses with a wrench, even when the pump is mounted on the motor.



• Use an open-end or adjustable wrench on the square port boss to support the pump, as illustrated in the figure.

• Check the inlet line. It must be large enough to allow adequate flow to the pump. Use a minimum of 3/8 inch (10 mm) outer diameter tube for Solar Pump™ P24070 and P24070M; 1/2" minimum OD for Solar Pump™ P50140 and P50140M; and 5/8" minimum OD for Solar Pump™ P118330.

• Use brass fittings on the brass pump. Dissimilar metals may corrode.

• Coat the threads of the fittings with Teflon pipe thread sealant. We do not recommend the use of Teflon thread tape. If you use Teflon tape, do not allow any tape into the pump.

• Do not over-tighten the fittings. Do not strain the V-band clamp on Solar Pumps™ with direct drive, or the black plastic housing on Solar Pumps™ with magnetic drive.

Installing the Solar Pump™ in a Solar Heating System

• Before installing the Solar Pump™ in a solar heating system, flush the collector loop with hot water to remove foreign objects and debris from the solar collectors and the piping to and from the solar collectors.

• When flushing the solar loop, force the flow of water from collector top to collector bottom to assist in the removal of foreign materials from the solar collectors. This is opposite to the flow when running normally.

• After flushing the solar loop with water, clear the loop of water using compressed air. If compressed air is not available, then allow the solar loop to drain completely under the effects of gravity.

• If the piping run does not allow the solar loop to be completely drained, then drain valves should be installed in the piping as required to drain the solar loop completely.

• Mount the Solar Pump™ by securing the rectangular aluminum mounting plate with four bolts using the pre-punched holes in the aluminum base plate.

• The pump shaft must be horizontal. The mounting plate can be attached to a vertical surface, however, the shafts must be horizontal.

• The Solar Pump™ must be installed with the pump head upright, i.e., the inlet and outlet ports on the pump head in the 12 o'clock position. Rotate the pump head on the motor as required to keep the pump head in this position when mounting the Solar Pump™ on a vertical surface.

• Solar Pump™ P118330 is not equipped with a strainer. Install a 100-mesh (125 micron) strainer at the inlet to Solar Pump™ P118330.

• Solar Pump™ P24070M and P50140M, the mag-drive models, do not require strainers. However, the solar loop must be thoroughly flushed to remove debris before installing the mag-drive Solar Pump™.

• Connect the inlet and outlet pipes to the inlet and outlet fittings. When connecting copper tube to the pump fittings, ensure that the compression nuts are not overtightened. The nuts should be first hand-tightened, and then gently tightened with an open end wrench.

• Pressurise the system with air to 30 psi (2 bar) prior to charging the solar loop with liquid. A compression nut that leaks can be tightened, a little at a time, to stop leaking.

If you are not using a photovoltaic (PV) module to drive the Solar Pump™, skip the following section.

Selection of PV Module

• Use the performance curves provided with your Solar Pump™ to determine the wattage of the PV module(s) required for your situation. These curves are available at **www.thermo-dynamics.com**, or by contacting Thermo Dynamics Ltd.

• If you have problems determing the power required for your Solar Pump™, contact the engineering staff at TDL. We have the experience and expertise to design all aspects of your solar pumping system.

• In general, the correct PV wattage is determined by considering the length of the solar collector pipe run , the diamater of the pipe used in the solar loop and the number of solar collectors.

• The Solar Pumps™ can be operated with a 12 or 24 VDC PV system. Generally, the pumps should be operated at 12 VDC with a higher flow pump, rather than at 24 VDC with a low flow rate pump.

P24070 or P24070M Solar Pump™

• If using the P24070(M) Solar Pump™, use a single 10 – 32 Wp (Wp = peak wattage, i.e., the rating of the PV module), 12-VDC PV module. A short pipe run with a single solar collector may only require a 10-Wp module. A long run with two or three solar collectors may require a 32-Wp module.

• For higher flow rates (up to 1.5 GPM; 5.7 L/min), the P24070(M) Solar Pump™ can be driven by a 24-VDC PV array with two PV modules wired in series. In this situation, total PV wattage may be as high as 80 Wp when using the P24070(M) Solar Pump™. Check the performance curves for the P24070(M) and P50140(M) pumps to determine if it is better to use a P50140(M) pump at 12 VDC or a P24070(M) pump at 24 VDC.

P50140 or P50140M Solar Pump™

• If using the P50140(M) Solar pump™, use a single 20 – 60 Wp, 12-VDC PV module. The correct wattage depends on the length and size of the solar collector pipe run. Single PV modules can be combined in parallel to obtain the correct wattage, e.g., two 20-Wp modules can be wired in parallel to provide 40 Wp at 12 VDC.

• For higher flow rates (up to 2.6 GPM; 10.0 L/min) use the P50140(M) Solar Pump™ with a 24-VDC PV array. In this situation, total PV wattage may be as high as 100 Wp when using the P50140(M) Solar Pump™. Check the performance curves for the P50140(M) and P118330 pumps to determine if it is better to use a P50140 pump at 24 VDC or a P118330 pump at 12 VDC.

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P118330 Solar Pump™

• If using the P118330 Solar pump™, use a single 20 – 60 Wp, 12-VDC PV module. The correct wattage depends on the length and size of the solar collector pipe run. If is also possible to combine single PV modules in parallel to obtain the correct wattage.

• For higher flow rates (up to 5.7 GPM; 22 L/min) use the P118330 Solar Pump™ with a 24-VDC PV array. In this situation, total PV wattage may be as high as 120 Wp, e.g., two 60-Wp PV modules in series.

Selection of PV Cable

• The cable used to connect the PV module to the Solar Pump™ should have a red (+) and black (-) conductor.

• If you use a cable having colours other than red and balck, note the polarity of the conductors in the space provided at the end of this Installation Manual.

• Select the proper gauge (AWG), in accordance with the tables below. These recommendations are based on a cable length of 50 feet (15 m). If the actual cable length is significantly longer or shorter than this reference length then the gauge of the cable can be adjusted up or down by one gauge size.

12 V PV module power (watts)	Wire Gauge (AWG)
<15	16
15 - 30	14
30 – 50	12
50 – 80	10

• For a 12 VDC (12 V nominal; 15 V actual) PV module, the peak voltage drop between the PV module and the Solar Pump™ can be calculated using $\Delta V = 0.12$ Wp R L/1000

• Wp is the peak wattage of the PV module(s), R is the resistance of the cable, from the table below, and L is the length of the cable in feet. Choose a gauge that yields a voltage drop (ΔV) of less than 0.5 volts.

AWG	R (Ω/1000 feet)
8	0.6
10	1.0
12	1.6
14	2.5
16	4.0

Example: Cable is 75 feet; 12 VDC PV module wattage is 40 Wp
14 AWG: $\Delta V = 0.12$ Wp R L/1000 = 0.12 x 40 x 2.5 x 75/1000 = 0.9 V
12 AWG: $\Delta V = 0.12$ Wp R L/1000 = 0.12 x 40 x 1.6 x 75/1000 = 0.6 V
10 AWG: $\Delta V = 0.12$ Wp R L/1000 = 0.12 x 40 x 1.0 x 75/1000 = 0.4 V

• In this case, 12 AWG cable should be selected. There is little improvement with 10 AWG, and the cost of 12 AWG and its ease of installation relative to 10 AWG, makes it the logical choice.

• If you are using a 24 VDC (24 V nominal; 30 V actual) PV system, then the ΔV is 50% of the value calculated using the above formula. However, with a 24-VDC PV array, a 1.0 V drop in voltage is reasonable. Use the following formula: $\Delta V = 0.06$ Wp R L

Example: Cable is 75 feet; 24 VDC PV array wattage is 80 Wp
16 AWG: $\Delta V = 0.06$ Wp R L/1000 = 0.06 x 80 x 4.0 x 75/1000 = 1.4 V
14 AWG: $\Delta V = 0.06$ Wp R L/1000 = 0.06 x 80 x 2.5 x 75/1000 = 0.9 V

• The appropriate gauge to use is 14 AWG cable.

Installation of PV Module

• Install the PV module in the proper position. If the Solar Pump™ is employed in a solar water heater, the PV module must be mounted in the same plane as the solar collectors. E.g., if the solar collectors are facing 10° east of south and are inclined at 45° to the horizontal, then the PV module must also be mounted in the same position.

• Do not install the PV module where it may be subjected to shading during the day or where it may be subjected to drifting snow.

• If the Solar Pump™ is being used for other purposes, then mount the PV module at the slope and direction that will maximize solar energy gain by the PV module for the period of the year during which maximum performance is required. For year round operation the PV module should be mounted at a slope equal to your latitude and facing true south. For maximum performance in the summer, the slope should be latitude less 15°; for maximum performance in the winter, the slope should be latitude plus 15°C.

• Connect the cable to the terminals at the PV module, connecting the red conductor to the **+** terminal and the black conductor to the **-** terminal. Run the cable from the PV module to the Solar Pump™.

• Use a DC voltmeter to confirm that the conductors at the Solar Pump™ end of the cable supply PV power. With no electrical load on the PV module, the open circuit PV voltage should be 18 - 22 VDC, depending on the temperature of the PV module. In hot weather the voltage will be lower (18 VDC); in very cold weather the open circuit voltage may approach 22 VDC.

• With a 24-VDC PV array the open circuit voltage should be between 36 and 44 VDC.

• Use the voltmeter to confirm that the cable has been wired correctly: red must be positive; black must be negative.

• Use a DC ammeter to measure the short circuit current of the PV module. Depending on the PV module wattage, and the intensity of the sunlight, the current should be between 0.1 and 4 amperes. If the PV currrent is less than 0.1 – 0.4 amperes, there may be insufficient current to start the Solar Pump™. The P24070(M) Solar Pump™ should start with 0.10 – 0.20 amperes of PV current; the P50140(M) should start with 0.15 to 0.30 amps, and the P118330 Solar Pump™ with 0.20 to 0.40 amps.

• Before connecting the PV module to the Solar Pump™, ensure that the DC motor is connected to the linear current booster (LCB) wired between the motor and the PV module. Refer to the Technical Notes for the TDL LCB's, the Jolter™ or the Booster™, provided with your Solar Pump™.

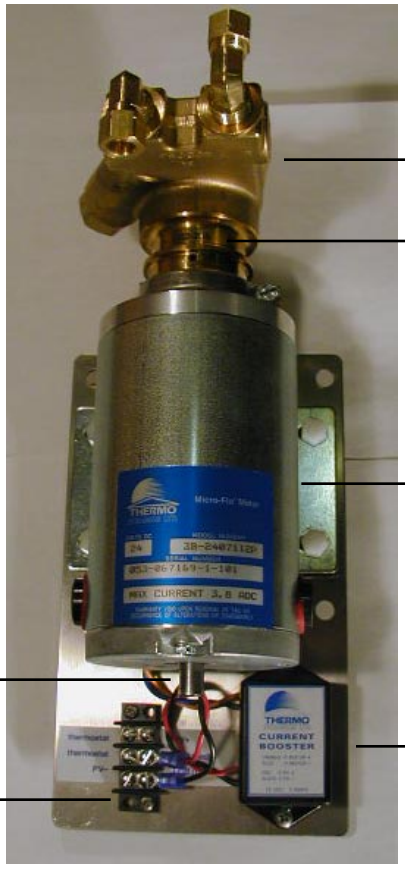
• Observing polarity, connect the cable from the PV module to the terminal block supplied with the Solar Pump™, if so equipped.

•If you use an external thermostat to control the operation of the Solar Pump™, remove the jumper wire on the "thermostat" terminals. Connect the thermostat wires to these two terminals.

• With the PV module wired to the DC motor, measure the PV voltage

at the terminal block on the Solar Pump™. The PV voltage should be 15 VDC with a 12 VDC system and 30 VDC with a 24 VDC system.

• The Solar Pump™ should turn if there is adequate current, as noted above. If the Solar Pump™ motor does not turn, twist the motor shaft extension at the end of the DC motor. This may cause the Solar Pump™ to turn.



P24070 Solar Pump™

• A DC power supply can be used to test the Solar Pump™. If a DC power supply is used, connect it directly to the DC motor. Do not connect the current booster to a DC power supply, unless you have a current controlled and regulated DC power supply. **Note that most DC power supplies are voltage controlled, NOT current controlled.**

• A 12 VDC battery can be connected directly to the motor to test the Solar Pump™. Do not connect the current booster to the DC battery.

• With adequate PV power supplied to the Solar Pump™, or power from a DC power supply or 12 VDC battery, confirm that the DC motor is turning and the pump is pumping liquid. It may be necessary to loosen the pump outlet connection to allow air to escape from the pump body. An air-filled pump body may prevent the pumping of liquid.

• The motor shaft extension should never be turned using pliers or "vise-grip" type pliers. If must only be turned by hand. If it is impossible to turn the motor shaft extension by hand, then the pump or motor may be seized. Remove the pump head from the motor and attempt to turn the motor shaft and pump shaft by hand, to determine which component is seized. A seized pump may be loosened up by gently turning the pump shaft back and forth while flushing with clean water. Otherwise, return it to TDL for repair, after obtaining a returned merchandise number from TDL.

The following information applies to direct drive, i.e., non mag-drive, Solar Pumps™..

• Direct drive Solar Pumps™ are equipped with mechanical seals. These seals may weep a few drops of liquid during normal operation.

• The pump body has weep holes at the 6 and 12 o'clock positions on the pump body near the stainless-steel V-band coupling. These holes allow weepage to escape from the pump housing. The weep holes should be free of obstructions.

• If a pump leaks more than a few drops each day, stop using it. Disconnect the power to the pump motor and clean up the leakage. Replace the leaking pump with a new pump or have the pump rebuilt.

• Prevent leaks by following these rules:

1. Do not let the pump run dry for more than 2 minutes. The self-lubricating, internal parts protect the pump against brief dry runs. Running the pump dry may score or wear the internal parts. It may also damage the mechanical seal, causing the pump to leak.
2. Do not run the pump against a closed or blocked discharge. This may cause pressure to rise to an excessive level if there is no relief valve. Heat will build up in the pump and may cause damage to the internal parts, including the mechanical seal.
3. Do not tamper with the setting of the relief valve, if the pump is equipped with one. The relief valve is set at the factory.

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Please record the following information.

Solar Pump™ model: ____________________________________
Pump head model: ______________________________________
Pump head serial number:_________________________________
Inlet/outlet line size: ____________________________________
Date of installation: ____________________________________

PV module manufacturer: _________________________________
PV model number: ______________________________________
PV model wattage: ______________________________________
PV voltage (nominal: 12 or 24 VDC): ________________________
PV cable AWG size:______________________________________
Colour of PV positive (+) wire: ____________________________
Colour of PV negative(-) wire: ____________________________

LCB model: ____
LCB serial number: ______________________________________

Test data

Power in watts is voltage x current. Estimate the temperature of the return line, after the pump has been running for at least 5 minutes.

Date of test: ______________________ Time: _________________
Weather conditions: ____________________________________
PV voltage:________ PV current: ________ PV power: _________
Motor voltage:______ Motor current: ______ Motor power: _______
Motor turning (yes: fast, low, etc. OR no): _____________________
Temperature of return line from solar collectors: _______________

Date of test: ______________________ Time: _________________
Weather conditions: ____________________________________
PV voltage:________ PV current: ________ PV power: _________
Motor voltage:______ Motor current: ______ Motor power: _______
Motor turning (yes: fast, low, etc. OR no): _____________________
Temperature of return line from solar collectors: _______________

Date of test: ______________________ Time: _________________
Weather conditions: ____________________________________
PV voltage:________ PV current: ________ PV power: _________
Motor voltage:______ Motor current: ______ Motor power: _______
Motor turning (yes: fast, low, etc. OR no): _____________________
Temperature of return line from solar collectors: _______________

Trouble shooting the Solar Pump™

The Solar Pump™ does not turn.
• Check the polarity of the PV/DC power supply.
• If the LCB is equipped with LED's, is any LED illuminated.
• Check the power supply to the LCB. Is there voltage and current? If there is no voltage check the cable to the PV module, or other power supply. If there is voltage, and it is correct, measure the short circuit current from the PV module.
• Check the power supply to the motor? Is there voltage and current?
• If there is about 0.5 or more amperes of current to the motor if should start, or start if given a twist on the motor shaft extension. This cuurent may not be enough to keep the motor turning.

The DC motor is supplied with enough current, but it will not turn.
• Is the motor difficult to turn or is the pump head seized, or partially seized?
• Remove the pump head from the DC motor and determine which component is difficult to turn.

Does the motor start to turn, and then gradually slow down until it stops?
• This may indicate that the lines are blocked. The pump cannot push the liquid through the piping. Remove the inlet and outlet lines and try to run the Solar Pump™, while disconnected from the piping loop.

The Solar Pump™ turns, but no liquid is being pumped.
• This usually indicates that the pump head is air locked. With the Solar Pump™ running, loosen the outlet fitting and allow any air to escape, that wishes to escape.
• If the pump still does not pump, then perhaps the pump is completely dry inside, which prevents the pump from creating suction.
• Remove the inlet line to the pump, and test for suction at the pump inlet with the pump turning. If there is no suction, or little suction, use a dropper or a small funnel to place some liquid inside the pump.
• Run the pump again and test for suction at the pump inlet. If there is suction, reconnect the inlet line, and try running the pump once more.

The Solar Pump™ makes a gurgling noise while running.
• This may indicate that the Solar Pump™ is running low on fluid. Check the level of liquid in the system/reservoir.
• Sometimes a noisy pump (fluid noises) may be due to low pressure at the pump inlet. Sometimes,a partial vacuum canbe created in the piping loop if the system was filled while very hot, and then sealed and allowed to cool down.
• Open the fill tube to check for a vacuum. Opening the fill tube will eliminate this vaccum. It is preferred to operate with a slightly positive pressure in the piping loop. This could be 5 to 30 psi (0.5 to 2 bar).

The Solar Pump™ makes grinding noises while running.
• This could indictae that some foreign material has been ingested by the Solar Pump™. The pump head will have to be removed and flushed thoroughly.
• The noise could also be produced by a bad motor brush, or a worn motor brush. Remove the brushes from the motor and check for wear.
• The noise could also be due to some foreign material i the motor, that has become lodged between the armature and the permanent field magnets. Check this situation with TDL.