INSTALLATION OPERATION MAINTENANCE MANUAL

Direct-D-System Manual
System Model Numbers:
TS-EZ 65-32 DPV
TS-EZ 65-32 Direct
TS-EZ 80-40 Direct
TS-EZ 80-32 Direct
TS-EZ 120-64 Direct

Techno-Solis, Inc
301 20th Street South
St. Petersburg, FL 33712

Phone: (727) 823-6766
Toll Free: (888) 99-SOLAR
Fax: (727) 823-6768
Email: info@techno-solis.com
Web: www.techno-Solis.com
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INTRODUCTION & DESCRIPTION

We at TSI would like to extend our congratulations on your purchase of a Techno-Solis System. Years of research and development backed by critical engineering have brought you the finest solar products you can buy. Please take time to read this booklet thoroughly. Each step is outlined completely and clarified by diagrams where necessary.

BASIC TOOLS AND MATERIALS

Electric Drill
Drill Index (w/ ½” and ¾” Wood Bits)
Hack Saw
Tubing Cutter
Tin Snips
16’ Tape Measure
24” Level
Flashlight
Extension Cord
Slip Joint Pliers
Needle Nose Pliers
Pipe Wrenches, 10” & 14”
Open End Wrenches, 9/16 & 7/16
Screw Driver 6” Flat Blade
Screw Driver 6” Philips
Wire Stripper or Knife
Wire Cutters

Adjustable Wrenches 8” & 10
Torch and Striker
100 PSI Pressure Gage
Putty Knife
High Temperature Pipe Joint Compound
Wire Nuts or Connectors
Miscellaneous Copper Pipe & Fittings (3/4”)
Solder Flux
Emory Paper
Silicon Caulk and Roof Tar
½” I.D. Copper Tubing & Installation
Angle Iron
Threaded Rod, Nuts, & Washers
Stainless Screw Clamps
Thermal Adhesive
Aluminum Flashing Sheet
COLLECTOR LOCATION

Proper location and orientation of the solar collectors is important for maximum system efficiency. The collectors should be unshaded for the middle six hours of the day in each month of the year and should be located as close to the storage tank as possible to minimize heat loss in the piping runs. The best orientation is achieved when the collectors are facing due south and tilted at an angle from the horizontal of latitude + 10°. Figure 1 below shows many alternatives for collector mounting. When roof mounting, placing the collectors as close as possible to the peak of the roof will make installation easier due to increased attic access.

COLLECTOR ORIENTATION

Proper tilt angle for solar collectors is latitude plus 10° (see latitude map). This favors the winter sun because ambient temperatures are lower during the winter and collector efficiency suffers. This 10° additional tilt equalizes year round performance. Spacing can be determined from Table 1. When collectors are mounted one behind the other, they are spaced apart so that in the morning and afternoon on December 21, when the sun is at its lowest altitude, the collectors will not shade each other and cause efficiency loss.
MOUNTING HARDWARE

There are two types of roof mountings. Flush mount & angle mount.

Flush Mount: Flush Mount Installations are recommended when the roof’s slope conforms to the orientation. This is the easiest and most aesthetically pleasing installation method. The flush mounting material consists of four “L shaped brackets” per collector. The specially designed Ezinc clips grap on the collector as shown on the right.

Tile roof drawings:

![Tile roof drawings](image-url)
Shingle roof drawings:

**MISSED TRUSS NAILER INSTALLATION**

(scale: 1-1/2" = 1'-0"

**SHINGLE/METAL/ BUILT UP ROOF**

(scale: 1-1/2" = 1'-0"

**MISSED TRUSS SPANNER INSTALL**

(scale: 1-1/2" = 1'-0"

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**EZINC MOUNTING BRACKET**

**ROOF SHEATHING**

**EZINC BRAND COLLECTOR**

4X LOCATE BETWEEN TRUSSES AND NAIL WITH 4 16D NAILS AT EACH END

3/8" DIA STAINLESS STL LAG BOLTS AT EACH EZINC BRAND CONN TYP.

NOTE: ROOF FINISH OMITTED FOR CLARITY

2x PT OR UNISTRUT CONTINUOUS ALONG PANEL FOR MOUNTING W/ 3/8" ST STL ALL-THRD ROD W/ NUT & WASHER EA END - PROVIDE "LOCTITE" AT ALL NUTS. CENTER RODS @ 3'-0" O/C MAX SPACING

WOOD TRUSS SYSTEM #2 SYP OR BETTER

SEE NOTE 3

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WOOD TRUSS SYSTEM #2 SYP OR BETTER
**Tilted (angled) mount:**

Tilted installs are not parallel to the roofline, normally used on flat roofs and ground mounts, as illustrated on the right. Angle Mount Installations involve positioning the collector(s) at an angle so that the upper part of the collector is higher than the lower in reference to the mounting surface. The “angle mounting” is used on horizontal surfaces or on roofs that slope in directions other than south ±55 degrees.

1) Use the Angle Mounting kit. Connect the U-channels to the roof just like in the Flush Mounting method. Assemble the mounting clips to both U-channels utilizing the provided bolts.

2) Screw the mounting clips to the BOTTOM part of the collector (the weep hole side) using two (2) stainless steel or aluminum screws each. (below picture)
3) Assemble both rods and top mounting clips (bottom pictures). Connect the clips to the collector’s top by stainless steel or aluminum screws.

4) Connect to the U-channels to the opposite side of the rod, using the provided nuts and bolts. (bottom left picture)

5) Lift the collector’s top with the assembled rod kits and anchor the U-channels to the roof, ensuring the proper angle to the collectors (bottom right picture)

Install all components in accordance with local code so that the performance of any structural member or fire rated assembly is not reduce
COLLECTOR PIPING

The piping of the system should be considered before a final decision is made on how the collectors are mounted. Piping should be made of copper tube of the type meeting local codes, insulated with Armaflex or similar, and painted or wrapped with aluminum tape where exposed to ultraviolet radiation. Care should be taken in the spacing of collectors as attachment of piping is easiest with properly aligned collectors. The collectors and piping to the storage tank should be slightly sloped downward (3” in 8 feet) to allow draining in case of freezing conditions. Soldered connections should be made with 95/5 solder.

![Figure 11](image1)

Figure 11

COLLECTOR PIPING DETAIL

The outlets of the collector are 1” copper pipe nipples (Figure 13). They should be piped as shown with provisions for an automatic air vent. This will prevent air lock and subsequent loss of system efficiency. The copper union makes attachment of piping to collector easy. Teflon tape or high temperature, high quality pipe sealant should be used when making threaded connections. The collector inlets should be piped similarly but without the automatic air vent.

![Figure 12](image2)

Figure 12

![Figure 13](image3)

Figure 13
SENSOR MOUNTING AT COLLECTOR

The controller heat sensor is mounted to the nipple outlet of the collector (right picture). A stainless steel screw clamp should be used. The entire nipple should be wrapped thoroughly with insulating tape so that the sensor is isolated from the outside air. Some Ezinc collectors also come with special hole designed to slide in the temperature sensor for easy install.
PIPING THROUGH THE ROOF

Piping through the roof should be weatherproofed as shown below.

(a) One inch holes are drilled through the roof on the same plane as the supply and return header nipples. Do not drill the hole above the supply header of the collector. This will prevent the collector from draining. Placing the hole below the supply header is acceptable, but it is more aesthetic if it is located on the same plane.
(b) A copper flashing is placed around the hole with its base cemented to the roof and its upper edges slid under the adjoining shingle.

(c) The copper tube supply and return line is then pushed up through the hole in the flashing.
(d) A “coolie cap” is then slid over the copper tube till it meets the flashing. After piping to the collectors is completed, the “coolie cap” is soldered to the copper tube.
(e) Polybutaline adhesive is then placed on the top and bottom of the flashing, providing a weatherproof seal. The sensor wire should also be run through the return flashing.
STORAGE TANK & SENSOR MOUNTING

The open loop solar tanks are not much different than most electrical water heaters. Solar tanks do not come with lower heating element and they usually come with dip tubes. Solar tanks are also better insulated than most regular electrical tanks. On most of the open loop solar tanks the heat sensor should be located behind the bottom front cover.

Procedure:
1.) Remove the two screws that secure the bottom cover to the tank.
2.) Remove the fiberglass insulation until the shell of the tank is visible.
3.) Locate the ¼" threaded stud and nut and the two sensor wires that were factory run from the top of the tank.
4.) Remove the ¼" nut from the stud and place the 10 K sensors on the stud. Secure it with the nut.
5.) Attach the wires on the sensor to the factory run wires. Note: it does not matter which wire is attached to the other.
6.) Replace the insulation and bottom cover.

OPEN LOOP FLUID HANDLING & PUMP FUNCTION

A Techno-Solis open loop solar water heater operates by circulating water from the storage tank to the solar collectors when the collectors are at a higher temperature than the tank. This function is controlled by a differential temperature controller with heat sensors. When the collectors are warmer than the water inside the tank, the controller switches on the pump. (Figure 16) The pump used in the direct system is a regular AC pump that’s installed on the cold side. For more info on the pump please refer to manufacturer’s manual.

Figure 16
A recirculation feature of the controller provides freeze protection. When the frost sensors at the collector indicate freezing temperatures, the pump is switched on and warm water is circulated through the collectors until warmed. The pump is then automatically switched off. This cycle repeats periodically until freezing conditions no longer exist. When a hard freeze is imminent or a power failure occurs, the system should be drained by closing the two gate valves that isolate the collector loop and opening the two valves that allow the collectors to drain. Automatic air vents in the top of the system prevent air locks. Care should be taken that no air can be trapped in piping to and from the collectors. Water returns to the tank from the collectors via a drop tube that extends halfway down the interior of the tank. This allows the returning water to stratify properly.

A ½” check valve is given in every system. The check valve is located on the return line from the collectors. This prevents thermosyphon losses during the night. In the system you will also find a ¼” pressure relief valves which protect the system from damage. Below you will see typical pictures of both valves that should be given with every system. In addition the system also comes with 2 ball valves and 2 boiler drains. Please see figure 18 in the next page in yellow.

**OPEN LOOP DIFFERENTIAL TEMPERATURE CONTROLLER**

**NOTE:** When instructions are provided in the controller package, follow those and disregard the following.

The open loop differential temperature controller controls the pump to gain maximum system efficiency. When one of the two heat sensors provided wit the unit rises nominally 10°F above the other sensor, a power control relay is energized. Then, when the first sensor drops to within 5°F of the second sensor, the control relay remains energized holding its power contacts closed; however, when the temperature difference sensed is 5°F or less, the relay contacts open. (The 5°F value is designated as the “turn-off differential.”) The first sensor is called the COLLECTOR SENSOR, since when properly installed monitors the temperature of the water in the solar collector. The second sensor is called the STORAGE SENSOR. The frost sensors activate the relay when freezing conditions exist. Mount the controller in any position or location that is convenient and sheltered from the elements. Aesthetics and economy of running power leads should dictate the location, since there is no restriction on the length of leads to the sensors. Connections to the circuit terminal strip inside the controller enclosure should be made according to Figure 17. ALL CONNECTIONS SHOULD BE MADE WITH ACCORDANCE WITH LOCAL ELECTRICAL CODES.

**Specifications:**

**OPERATING VOLTAGE**

105 to 125 vac, 60 Hertz

**CONTROL RELAY CONTACT RATING**

One third HP inductive load.

**TURN-ON DIFFERENTIAL**

10°F (+1°F) for Storage Sensor at 135°F

**TURN-OFF DIFFERENTIAL**

5°F (+1°F) for Storage Sensor at 135°F

**SENSOR MATCHING ACCURACY**

1°F or less at 135°F

**MAXIMUM SENSOR TEMPERATURE**

300°F
OPEN LOOP START-UP

After visual inspection of the complete system, it is ready for filling and pressure testing. All drain valves should be closed, all other valves opened. The air vent caps should be loosened two turns to allow air to escape the system. The cold water inlet valve should then be opened slowly and system checked for leaks as it fills. When the system is completely full, indicated by water escaping from the air vent when the valve is depressed it should be pressure checked with normal pressure for 30 minutes. Final inspection should then be made and power to the controller turned on. If the sun is shining and the storage tank is cool, the pump should come on and water should flow through the collector. The first water through the collectors will be very hot but should stabilize in about 15 minutes. The return lines from the collectors should be hotter than the inlet lines and the collector glass should be slightly warmer than ambient temperature.

Testing of the frost sensor can be made at night when the pump is not normally working. A piece of ice set on the sensor should be sufficient to turn the pump on. The pump should turn off as soon as the sensor has a few seconds to warm back up when the ice is removed. Caution should be exercised when working on the roof at night. The system should more or less look like figure 18.

OPEN LOOP MAINTENANCE

Maintenance of an open loop system is straightforward. The tank should be partially drained every 6 months to allow minerals to be removed preventing scale build up (this is recommended for all water heaters). The wye strainer should be cleaned at least once a year or more often if harsh water conditions exist. The power should be switched off, the piping drained, and the screen removed and cleaned. The collector glass should be kept clean for best system performance. Rainwater will usually suffice but a garden hose can be used during dry weather. The air vent caps should be loosened two turns for proper operation and best system performance.
DIRECT PV SYSTEM

The single photovoltaic module, attached to the top of the solar collector (Figure 19) operates a brushless 12 VAC or 24 VAC pump at a speed relative to the amount of available sun. When clouds pass over, the pumping operation slows to allow the water to remain in the collector longer for continued heating. When the sun goes down in the evening the pumping action will stop.

The solar system is installed as per the open loop installation manual. The photovoltaic module will replace the differential control and sensors. Be sure to mount the panels on the same plane as the solar collector.

When wiring the photovoltaic module to the circulating pump use 16 gage stranded double exterior PVC jacketed wire for lengths up to 85 feet for 10 and 25 watt modules. Use 14 gage for over 85 feet for a module over 1.4 amps. When wiring the module to the pump remember that the black wire is always ground and the red wire is the hot wire. Do not reverse the polarity.
OPERATIONAL CHECKLIST

Before the system is turned on, the piping and electrical systems should be evaluated to see if they match the supplied drawings. If you are satisfied that the system is installed correctly, it should be filled and powered according to the preceding instructions. When the system is in the operational mode, care should be taken to check all piping for leaks and to make sure sufficient insulation has been used to provide maximum system efficiency. All modes of operation should be checked by the installer to assure proper functioning under all conditions.

TROUBLE SHOOTING & HAZARDS

Problems with systems usually fall under two categories: system leaks or lack of sufficient solar heated water.

SHUT DOWN FOR LEAKS

If leaks exist the system should be shut down for repairs. Make sure the electrical circuit to the controller is off. Close off the cold water inlet or in case of a leak in the closed loop system, isolate as much of the system as possible and then drain and repair the affected area.

There is a possibility that what appears to be leaks may be condensation on the pipes. Also water escaping for the T & P valve may be an indication of proper function as they are designed to vent off excess temperature and pressure.

INSUFFICIENT HOT WATER

If insufficient hot water is available a system malfunction may not be indicated. A low amount of solar radiation or heavy water demand can be the cause.

If no excessive demands are put on the system and ample solar radiation is available, the system should operate properly. The pump should run each sunny day until a full supply of hot water is stored. If the pump does not run, there is a problem on the electrical end of the system. Either the pump, controller, or sensors are malfunctioning. The controller can be bypassed by running a power cable directly to the pump and checking its function separate from the control system. Make sure that the problem is not a blown fuse or a tripped breaker. If the pump runs normally when powered externally, the control circuit is the problem area. Eagle Sun controllers use thermostor sensors to determine modes of operation. A controller testor is available from TSI for checking differential function. Check sensor wiring. If no faulty wiring can be discovered, replace sensors.

If the pump is running all the time, even when the collectors are cool, then the storage sensor or collector sensor may be open. It is also possible that the sensor wire itself is at fault. To check this, test the continuity with an ohm meter. Be sure to disconnect the sensor when performing this test. Test the wire with both ends open, then test often twisting the 2 sensor wires together at one end. The system can be set on a timer or switched on manually until the controller is properly functioning.

CONDENSATION ON COLLECTORS

If condensation occurs inside the collectors, ¼" vent holes should be drilled in the lower side of the collector. Three holes should be drilled, one at each end of the bottom of the collector and one in the center. These holes should be drilled 1" from the base of the collector.

This should clear up any condensation within three days.

OTHER PROBLEMS

A noisy pump is an indication of worn bearings obstruction or loss of prime. As a rule of thumb about 8 to 12 degrees should be expected as a normal gain across a collector in bright sun at proper flow rate.

SYSTEM PARTS LIST

Solar Collectors
Set of Mounting Hardware for each collector
Hot Water Storage Tank
Circulator Pump & Diff Controller
Controller Sensors
Fluid circulation components (valves and fittings) Installation Manual

ORDERING PARTS: If for some reason you need to order any replacement parts, or need service, feel free to call our office at (888) 99 SOLAR and we will be happy to find the nearest distributor or service center to help you satisfy your need.