Installation & Operation Manual for *PROPAC™* Drainback Solar Water Heating System numbers:

This Manual Contains:

Installation Instructions
Operating Instructions
Maintenance Procedures
Safety Precautions

IDS-12096
IDS-12080
IDS-12064
IDS-8064
IDS-8052
IDS-8040
IDS-6532
IDS-502632

PLEASE READ
THIS ENTIRE MANUAL BEFORE BEGINNING INSTALLATION OR ATTEMPTING TO OPERATE THESE SYSTEMS

Safety Information are posted as **WARNINGS** or **CAUTIONS** in text boxes and **CAPITAL LETTERS**

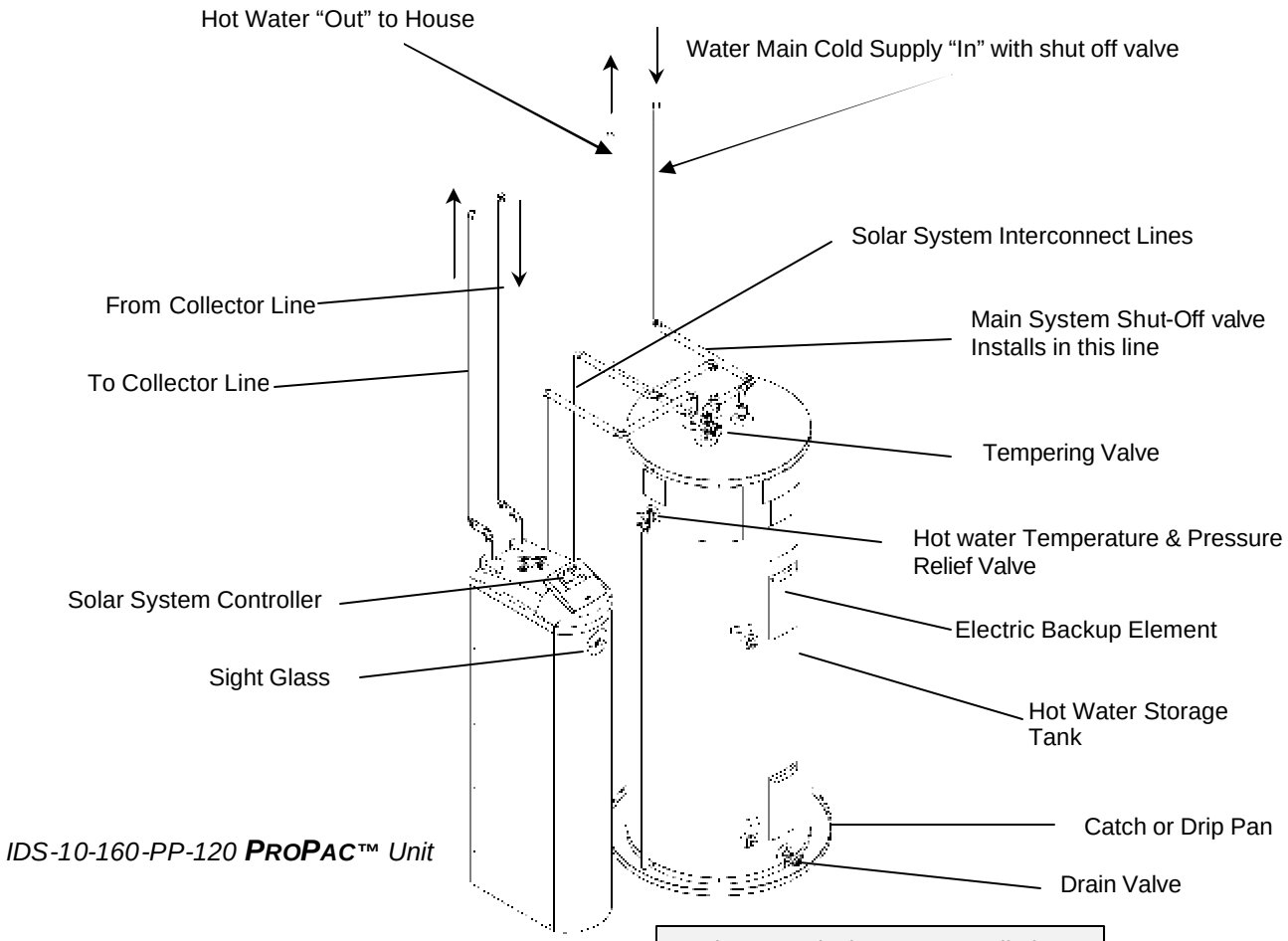

Fig. 1 Typical System Installation

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"The solar energy system described by this manual, when properly installed and maintained, meets the minimum standards established by the Florida Solar Energy Center, in accordance with Section 377.705, Florida Statutes. This certification does not imply endorsement or warranty of this product by the Florida Solar Energy Center or the State of Florida."

General Information for Owners:

The Drainback Solar Water Heating System you have purchased consists of three (3) major components:

1. Water Heater Storage Tank (WHST)
2. ***PROPAC***™ Heat Transfer Unit
3. Solar Collectors

The parts in these Systems are designed for use in indirect solar water heating systems. Use in other applications, without written factory approval, will void all warranties.

The installation of solar water heating systems should only be undertaken by qualified individuals. Solar water heating systems involve components and operating principles not found in standard household plumbing installations. High operating temperatures, alternate fluids and unusual plumbing techniques are an integral part of solar systems. Failure to understand good installation practices can affect the health and safety of the system user. Poor practices will also reduce system performance.

Each of the 3 Major Component has a dedicated section in this manual for Installation Guidelines, Operation and Maintenance. Please read the entire manual before attempting to install and operate your system. Failure to install and operate the system in accordance with the information provided in this manual and the supplemental system component manuals can result in partial or complete voiding of all warranties.

Know Your Installer:

In many areas a certified licensed installation contractor's license is required for installation of solar water heating systems. Take time to research and get to know the installing contractor before allowing anyone to begin installation of the system components. It is highly recommended the contracting company be insured and bonded to work in private residences.

The Water Heater Storage Tank and ***PROPAC***™ Unit must be installed indoors in an area that does not experience direct contact with the outside weather. ***The area must never experience temperatures at or below 32^{O}F.***

The ***Warranties*** on your system are only in effect when the system has been installed and operating in accordance with all Local Codes and the associated component manuals. The provider of this system will not be liable for any damage resulting from the improper installation and operation of the system. In the absence of Local Codes install the system in accordance with N.E.C. and IAPMO codes, latest editions.

Your solar system main components are made by different manufacturers. A separate Manufacturers Installation and Operations Manual is provided with the major components. This Manual is the main guide for installation for the complete system. The Water Heater Storage Tank and Solar Collectors have separate Manuals that must be used during the installation.

The recommended steps for installation are in the following order:

1. Locate the proper site for installation of the Water Heater Storage Tank (WHST) and set it first.
2. Set the ***PROPAC***™ Unit as close to the Water Heater Storage Tank as possible
3. Make the Interconnect Plumbing Connections between the WHST and ***PROPAC***™.
4. Charge the WHST and ***PROPAC***™ potable water side.
5. Locate and install the solar collectors trying to place them as close to the WHST as possible.
6. Make the Interconnect Plumbing Connections between the collectors and ***PROPAC***™ unit.
7. Follow the Start Up and Operating Procedures

Quick Start Information:

This Section gives a brief overview of the generally recommended steps that should be taken to install the ***PROPAC***™ solar water heating systems. These are not detailed procedures and are only provided to establish initial steps that can be undertaken quickly to get the installation started.

LOCATION:

Before all else make sure the location for the major components has been established. This will eliminate unnecessary re-work later on. There are three major components to the system:

1. The Collector(s)
2. The Water Heater Storage Tank (WHST)
3. The ***PROPAC***™ sometimes referred to as the Heat Transfer Unit or HTU

Most often the location of the Water Heater Storage tank has been predetermined by the location of the current water heating appliance. In some cases the existing water heater may be used but in general the old water heater will be replaced with a new WHST. Once this is determined, proceed to selecting the location for the collectors.

Select the best location for the collectors based on a clear unobstructed southern exposure trying to place the collectors as close to the Water Heater Storage Tank as possible.

The last step is to locate the ***PROPAC***™ unit as close to the WHST as possible. Once it is set it can be immediately filled with **distilled water** per the instructions in this manual. This step is called “Charging the System”.

LITERATURE:

Each system comes with a bag containing all information available on the various parts and components that make up the system. DO NOT attempt installation without this information. Contact Energy Laboratories, Inc. immediately if it missing.

INSTALLATION:

The following steps are then ready to be taken. Prior to beginning these steps the final location for all three major components must be determined.

1. Install the Collectors in accordance with the manufacturer’s written instructions. At this point you will be:
    a. Mounting the collectors to insure proper draining
    b. Installing a collector sensor
    c. Running sensor wire
    d. Installing flashings for the pipes and wire
    e. Running pipes into the attic void and to the location above the ***PROPAC***™
    f. Insulating and UV protecting all piping and wiring

2. Set the WHST and install according to written instructions provided by the manufacturer.
    a. Make plumbing connections
    b. Make electrical connections
    c. Install the tank sensor(s)
    d. Make the interconnections to the ***PROPAC***™ unit. This will include plumbing and sensor wiring
    e. Fill the WHST
    f. Check all connections
    g. Apply power to the WSHT

3. Set and then install the ***PROPAC***™ unit in order with these general steps:
    a. Fill or “Charge” the ***PROPAC***™ unit with DISTILLED WATER per instructions in this manual
    b. Connect the piping to and from the collector(s)
    c. Connect the sensors
    d. Plug in the line cord from the ***PROPAC***™
    e. Check to see the system is operating.

Systems described in this manual have been Rated and Certified by the ***Solar Rating and Certification Corporation, SRCC.*** If the system being installed requires an SRCC Rating and Certification for any reason, ***the system must be in the list below and installed with all criteria in this manual being met.*** Only those systems listed in the Label below are Rated and Certified by SRCC. ***All Collector Models installed for these systems must have the SRCC OG100 Certification and Rating.***

THIS SPACE FOR SRCC OG300 LABEL INSERTION

Fig. 2. SRCC Information

INSTALLATION INSTRUCTIONS

!DO NOT SKIP ANY INSTRUCTIONS!
Read the entire Manual before proceeding

Installation of solar water heating systems should only be undertaken by qualified individuals. Solar water heating systems involve components and operating principles not found in standard household plumbing installations. High operating temperatures, alternate fluids and unusual plumbing techniques are an integral part of solar systems. Failure to understand good installation practices can affect the health and safety of the system user. Poor practices may also reduce system performance.

SOLAR COLLECTOR LOCATION and INSTALLATION GUIDELINES:

General rule of thumb on placement: if you're in the northern hemisphere, then the collectors should face south. If you're in the southern hemisphere, the collectors should face north.

PROPAC™ systems by Energy Labs are approved for use **with only SRCC OG100 certified collector brands.** The list below contains the brands that may be installed with these systems.

- ***APRICUS***
- ***CHROMAGEN***
- ***HELIODYNE***
- ***SOLAR HOT***
- ***SOLAR ROOFS***
- ***SUN EARTH***
- ***TCT SOLAR***

Consult the collector manufacturers' Installation & Operating instructions before attempting to install the collectors. Following are general guidelines for the installation of flat plate solar collectors.

Collector Orientation

The performance of solar water heating systems in the Northern Hemisphere is optimized when the collector is mounted facing True South. Performance output suffers when collectors are oriented more than 30° East or West of True South. The collector should be un-shaded by any permanent obstacle between 9:00 a.m. and 3:00 p.m. on any day of the year.

Collector Tilt

Optimal annual efficiency is achieved by tilting the solar collector at an angle that equals your latitude plus an additional 10°. This tilt angle favors the lower winter sun when collector performance is at its lowest and minimizes overheating during the hottest summer months.

The solar collectors in a two collector staggered mount installation must be spaced far enough apart to prevent winter shading. The correct spacing between collectors should be sufficient to prevent shading on December 21st, when the sun is at its lowest angle.

Basic Mounting Procedures

The solar collectors in your ***PROPAC™*** Drainback system should only be mounted in a vertical orientation on the roof (Figure 3). **Because the freeze protection method is Drainback the collector must always be mounted in vertical orientation. Horizontal orientation may also void collector warranties.** It is important to slope the collectors just slightly toward the inlet to allow for complete drainage during off mode. The required slope is at least 1/4" vertical rise per foot of horizontal run.

Figure 3.

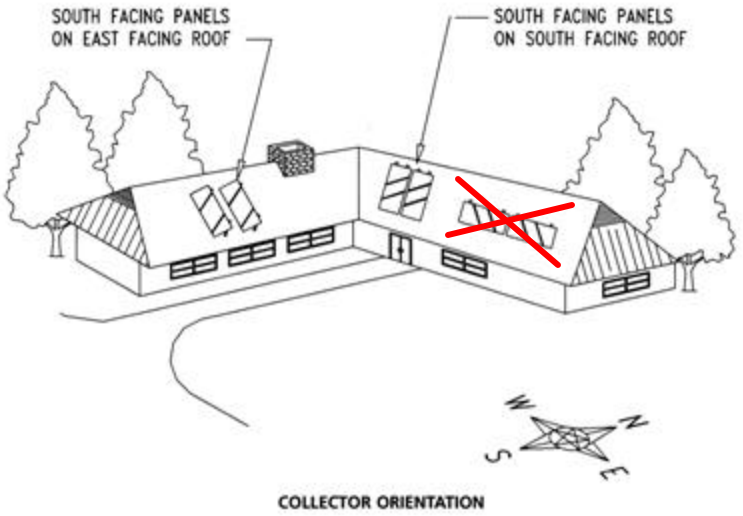
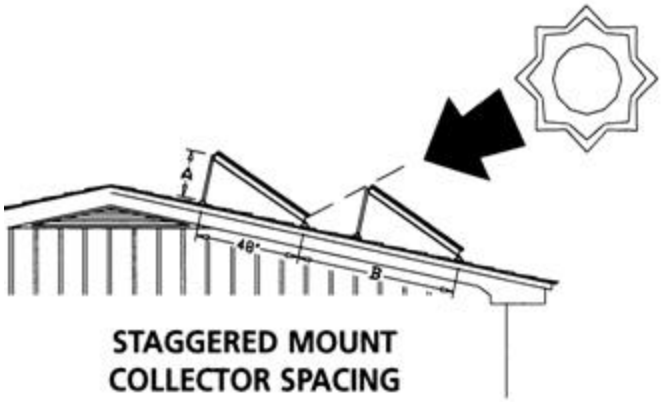


Figure 4.



The solar collector should be mounted on the roof in accordance with the following general principles:

The most important structural consideration is to securely anchor the solar collector and the associated mounting hardware to the structural members of the roof with stainless steel hanger or lag bolts. The solar collector must be attached to the mounting hardware as detailed in Collector Manufacturers' I&O Manuals.

Collectors must be raised from the roof surface to allow for rainwater and debris to pass under the collectors and for proper ventilation of the roofing material. There should be at least 1 1/2" of clearance between the roof surface and the bottom of the solar collectors.

In selecting mounting hardware and fasteners it is extremely important to avoid galvanic corrosion resulting from the direct contact of incompatible metals. Use of powder coated or anodized aluminum mounting hardware and stainless steel lag or hanger bolts, lock washers and round washers is recommended. In climates subject to severe winters or high humidity, the use of galvanized fasteners is prohibited.

Preserving the integrity of the roof membrane is the most important roofing consideration. Ensure that all roof penetrations required to plumb and mount the solar collector are properly flashed and sealed in accordance with standard roofing practices. Tremco *"POLYROOF"* is the recommended elastomer for sealing roof penetrations. Henry Co. 204, 208 or 209 roof mastic or Dow Corning Glazing Sealant and Sikaflex are also are acceptable sealants.

If the region is subject to hurricane conditions, additional steps may be required to secure the collector and mounting hardware to the structural members. In certain areas of the country, local building codes may require collector wind load testing or prescribe specific mounting procedures.

Collector Plumbing

Energy Labs ***PROPAC***™ systems require the use of all copper and/or brass fittings in the collector array plumbing. Couplings rather than unions should be used to join the collectors to avoid leaks and fluid loss. Use only lead-free solder. ***Use of 95/05 or 50/50 lead solder is expressly prohibited.*** **Use of galvanized steel, CPVC, PVC, or plastic pipe other than PEX is prohibited.**

PEX tube is SRCC approved for all non-pressurized drainback systems. If PEX is used, a 60" copper transition pipe from the return side of the collectors and a 24" copper transition pipe on the feed side of the collector are required before connecting PEX. The minimum size for the "To" and "From" collector piping is 3/4".

Piping in new solar installations can be contaminated with dirt, grease, solder flux or other impurities that over time affect the quality of the distilled water heat transfer fluid (HTF). A thorough cleaning is required before charging the system. Carefully review the cleaning procedures in "Charging the System".

Note: PEX tube is not rigid. When using PEX, the tubing should be supported sufficiently to insure there are no low areas along the length of the run. A low area may allow water to collect and present a freezing or a dangerous over-temp condition.

Collector Loop Pipe Insulation

The collector loop cold supply and hot return lines must be well insulated with high quality flexible closed cell insulation to minimize heat loss. The wall thickness of the pipe insulation should not be less than 3/4". A 1" wall thickness is required in all areas prone to annual hard freeze conditions. When it comes to pipe insulation the rule is simple: thicker is better. The specified insulation material is Rubatex Insul-Tube 180, Armaflex, K-Flex or equal brands.

To the extent possible, slide the insulation material over the pipe without cutting or gluing. All butt joints must be sealed with contact adhesive. The use of rigid polyethylene pipe insulation is prohibited. The temperatures generated by your collector in the summer months or under stagnation conditions can melt this type of material.

ANY ABOVE GROUND EXTERIOR PIPE INSULATION IS SUBJECT TO ULTRA-VIOLET (UV) DEGRADATION. IT MUST ALL BE WRAPPED WITH FOIL TAPE OR PAINTED WITH TWO COATS OF HIGH QUALITY WATER-BASED ACRYLIC RESIN COATING AS SUPPLIED BY THE INSULATION MANUFACTURER. RUBATEX UV PROTECTIVE COATING OR ITS EQUAL IS THE REQUIRED COATING MATERIAL.

MOUNTING COLLECTORS WITH THE PARALLEL FLOW TUBES IN THE HORIZONTAL POSITION IS NOT ALLOWED.

THIS IS A DRAINBACK SYSTEM. ALL PLUMBING "TO" AND "FROM" COLLECTORS AND COLLECTORS THEMSELVES MUST BE SET SO THEY WILL DRAIN COMPLETELY WHEN THE SOLAR PUMP IS OFF. A MINIMUM OF ¼" OF DROP PER HORIZONTAL FOOT OF RUN IS MANDATORY.

The installation of all horizontal and vertical piping may not reduce the performance or rating of any structural member or fire rated assembly. Adhere to all applicable local codes and ordinances.

Interconnect Plumbing:

Piping **"To"** and **"From"** the solar collector array and the hot water storage tank is called the solar array interconnect plumbing. Because this solar system is a Drainback Type it requires minimal plumbing. The main Issue in Drainback systems is that the interconnect plumbing to the collectors must slope from the collectors back to the drainback reservoir with no change in the slope that would cause water to stay in the lines when the pump is not running.

All vertical piping between the storage tank and the collector shall be supported at each story or at maximum intervals of ten (10) feet. Copper plumbers tape or tube strap is required. The pipe insulation may not be compressed or crimped by the strapping material.

From the two-collector interconnect fittings on the ***PROPAC™*** unit only ¾" hard copper or ¾" PEX tubing should be used. "Shark Bite™" couplings are supplied with the system. Measure a distance from the top of these two couplings to a point inside the attic space that is 2" above the level of the top of the bottom cord of the roofing trusses. Cut two pieces of hard copper tubing or PEX to this length. If copper tubing is used you may want to sweat couplings to the top end of the sections prior to inserting the pieces of copper tubing through the ceiling. Using Rubatex pipe insulation cut two pieces the length of the distance from top of the ***PROPAC™*** couplings to the ceiling where the tubes will penetrate. Install the Rubatex on the tubes and insert the two pieces of tubing into the ceiling holes cut directly above the **"To"** and **"From"** Collector fittings on the ***PROPAC™*** system assembly. From the top of these two pieces of tubing, soft copper or PEX tubing can be run in the attic spaces to the point where the piping must transition through the roof. The entire length of the piping should be insulated. **Remember: Collectors and all solar array interconnect piping must slope downward from the collectors to the *PROPAC™* unit with at least ¼" per foot of slope.**

DO NOT INSTALL THE VERTICAL "TO and "FROM" COLLECTOR LINES INTO THE *PROPAC™* AT THIS TIME.

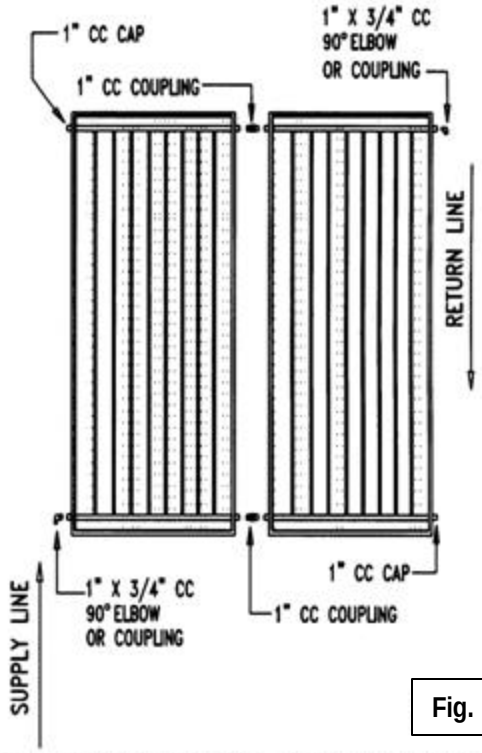


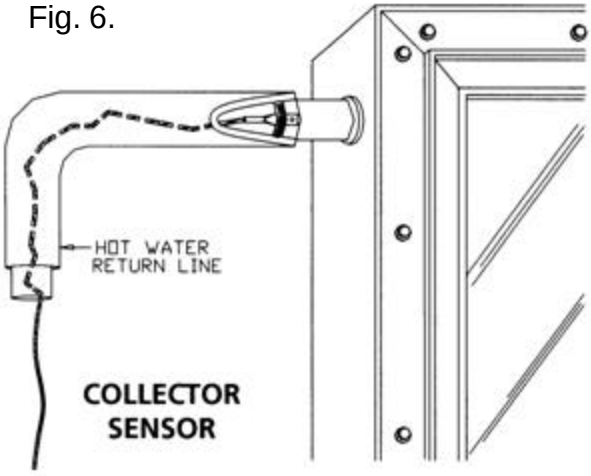
Fig. 5

COLLECTOR PLUMBING - VERTICAL MOUNT

Collector Sensor Placement:

The collector sensor must be located on the hot water return line as close to the collector as possible. Sensors are typically accurate to +/- 1/2°F if properly installed and weatherized. To maximize sensor accuracy, attach the flanged portion of the sensor to the collector header pipe, as close as possible to the collector outlet, with a stainless steel hose clamp. Wire nuts used to connect the sensor and low voltage wiring shall be all plastic, sealed with silicone and thoroughly wrapped in electrician's tape.

Fig. 6.



The sensor "bundle" must be placed under the rubber pipe insulation covering the collector header. Thoroughly wrap and weatherize the insulation with electrician's tape or insulation tape as provided by the manufacturer (Rubatex Insul-Tape or equal). See Figure for collector sensor installation detail.

Low Voltage Wiring:

The low voltage wiring used to connect the collector sensor to the controller should be a minimum 18 AWG. The wiring should be bare or tinned copper, two-conductor, PVC insulated, with a PVC UV rated gray jacket suitable for exterior use. Use Eastman Wire & Cable No. 5704, Belden Wire and Cable No. 8461 or equal. The system comes pre-wired for the tank and collector sensors.

WATER HEATER STORAGE TANK Installation Guidelines:

The UL Listed water heater storage tank in your system is equipped with an electrical heating element. This qualifies the system as an electric storage water heater and as such must be installed in accordance with all federal and local codes. The location chosen for the system should be as close as possible to the faucets most frequently used, and the piping should be insulated. The ***PROPAC™*** unit should be located as close to the storage tank as physically possible.

CAUTION: The water heater storage tank should not be located where leakage of the tank or fittings could result in damage to the area or lower floors. If this is not possible, a catch pan is required under the water heater. See Figure 1. Consult Local Codes regarding catch pans.

All potable water connections must be made prior to installation of the other system components. Follow the steps below for proper sequence. With the exception of the storage tank drain valve, and in some cases the T&P relief valve, all potable water connections are located on the top of the tank. Locate and identify connections before proceeding with the installation.

WARNING: The hot water storage tank should not be installed in an area where flammable liquids are stored or vapors are present from combustible liquids. An arc drawn within the water heater's electric element thermostat could ignite them when it cycles.

"COLD" Connect the main cold water supply to the connection marked "COLD" on the top of the hot water storage heater tank. Install a shut off valve in the cold water line near the water heater. See Figures 1 on the cover and 2 below.

"HOT" Connect the hot water line to the house to the connection marked "HOT" on top of the water heater tank. (See Figures 1 &2)

"**MIXING VALVE**" If not already installed on the tank, install the Mixing Valve as specified by the valve manufacturer.

"TEMPERATURE & PRESSURE (T&P) RELIEF VALVE" If not already installed, a T&P Relief Valve is to be installed in the marked opening on top of water heater. The pressure rating of the relief valve must not exceed the working pressure rating of the water heater tank (150 psi for standard glass-lined tank). If other components in the system have a lower working pressure, the T&P relief valve should be selected accordingly. The BTUH Rating of the relief valve must not be less than the input rating of the water heater. The outlet of the relief valve should be directed to a suitable open drain so a discharge cannot contact live electrical parts and to eliminate potential water damage. The discharge line must be no smaller than the outlet of the relief valve. Material for the discharge line shall be of the type used for hot water distribution. The valve and the line must drain fully by gravity. The end of the discharge line should not be concealed and should be protected from freezing. No valve of any type shall be installed between the relief valve and tank or in the discharge line.

As protection against excessive pressures and temperatures, install temperature-and-pressure protection devices required by local codes, but not less than a combination temperature-and-pressure relief valve certified as meeting the requirements of ANSI Z21.22-1979 and ASSE 1017.

At this point in the installation interconnections to the ***PROPAC™*** unit must be made.

WARNING: DO NOT Connect potable water lines to the "To" and "From" connections for the solar collectors. Serious injury and damage can occur. DO NOT introduce heat transfer fluids to potable water lines

WHST to *PROPAC™* Interconnect Plumbing:

The ***PROPAC™*** unit has two "Shark Bite™" fittings located near the center of the rear panel. (Shark Bite™ is a trademark of the CASH ACME company) Refer to Figures 1 – 4 on page 2 of this manual for this section. These are marked **"From Storage"** and **"To Storage"**. The **From** Storage fitting is the **lower** one. Hot water storage interconnect piping can be either ¾" copper water tube, ¾" PEX hot water tubing or stainless steel reinforced hot water hoses as provided by Energy Labs.

The From Storage interconnect line comes from either the lower solar outlet fitting on the side of the hot water storage tank or from a fitting on top that is designated **"To Collector"**. Connect this line to the lower Shark Bite™ fitting on the rear of

the ***PROPAC™*** unit. Connect the top Shark Bite™ to the port on the hot water storage tank marked **"From Collector"**. This fitting will be either on the side of the hot water storage tank near the middle or on top. When possible use the side inlet and outlet fittings.

On hot water storage tanks with top fittings only, it may be necessary to install an air vent valve. Isolation and drain valves must be installed per the system schematic or as shown in Figure X below.

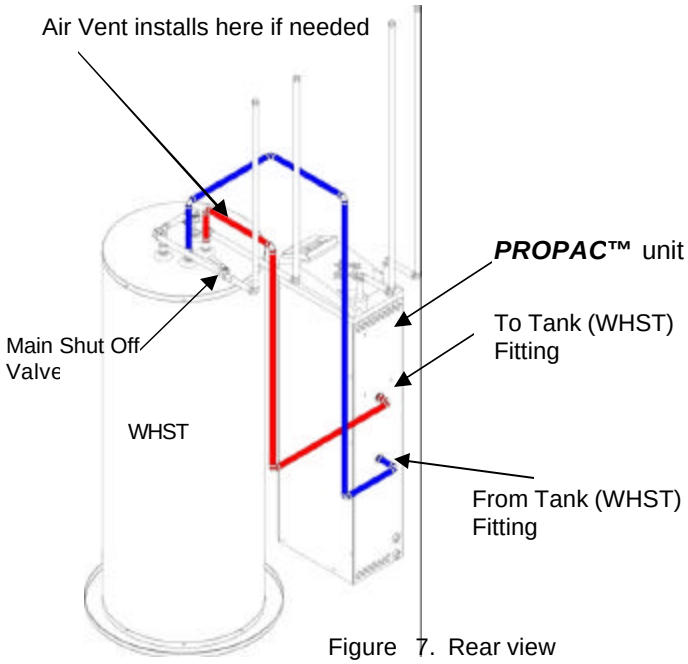


Figure 7. Rear view

FILL the STORAGE TANK. After making sure the Drain Valve is closed, open the Shut-Off Valve in the cold water line. Open a hot water faucet in the highest location in the dwelling and keep it open until water flows from it in a steady stream without air sputtering for at least 2 minutes. Close the faucet.

CAUTION: Hydrogen gas can be produced in a water heater that has not been used for a long period of time (generally two weeks or more). HYDROGEN GAS IS EXTREMELY FLAMMABLE. To dissipate such gas and to reduce the risk of injury, it is recommended that the hot water faucet be opened for several minutes at the kitchen sink before using any electrical appliance. If hydrogen is present, it usually sounds like air escaping through the pipe as the water begins to flow. *Do not* smoke or use an open flame near the faucet at the

Storage Tank Electrical Connections:

All connections for power to the electric element are to be made to the junction box on top front of the tank in accordance with Storage Tank Manufacturers written instructions. A separate branch circuit from the electrical distribution panel that uses copper conductors, an over current protective device and suitable disconnecting means must be provided by a qualified electrician. (Refer to Table 2) All wiring must conform to local codes or National Electrical Code NFPA No. 70 - 1981.

CAUTION: Storage Tank MUST BE FULL OF WATER BEFORE power is turned on to heating element. Heating element WILL BE DAMAGED if energized for even a short time while tank is dry, thus voiding the limited warranty for the electric element.

Adjusting the Thermostat: The thermostat is preset at the factory to **120°F.** This setting is for average household use. If water of a different temperature is required, set the indicator on the thermostat to the desired temperature. Households with small children, elderly people or invalids may require lower temperature settings to prevent accidental contact with "HOT" water. Adjustments to the thermostat setting of the electrical element can be made through the access panel located behind the upper front panel of the water heater storage tank.

CAUTION: Make certain <u>Power</u> to water heater is <u>OFF</u> prior to opening access panels. Power is only removed by throwing the circuit breaker supplying power.

There is a Hot Water SCALD Potential if the thermostat is set too high and no tempering valve is installed.

TIME /TEMPERATURE RELATIONSHIPS IN SCALDS

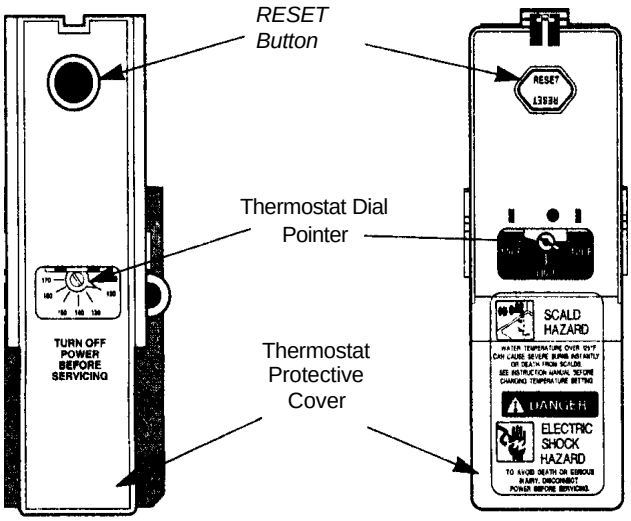
Temperature	Time to Produce Serious Bum
120°F.	More than 5 minutes
125° F.	11/2 to 2 minutes
130°F.	About 30 seconds
135°F.	About 10 Seconds
140°F.	Less than 5 seconds
145° F,	Less than 3 seconds
150°F.	About 11/2 seconds
155°F.	About 1 second

Table courtesy of Shriners Burn Institute

If adjustment of the tank thermostat is necessary, ***turn off*** the power to the water heater. (Throw the breaker) Remove jacket access panel and insulation exposing thermostat. The thermostat protective cover ***should not be removed.*** With a small screwdriver, set thermostat dial pointer to desired temperature. Replace the insulation and jacket access panel. Turn on the power to the water heater.

WARNING: The presence of water in the piping and water heater does not provide sufficient conduction for a ground. Non-metallic piping, dielectric unions, flexible connectors, etc., can cause the water heater to be electrically isolated.
The branch circuit wiring should include either:

1. **Metallic conduit or metallic sheathed cable approved for use as a grounding conductor and installed with fittings approved for the purpose.**
2. **Non-metallic sheathed cable, or metallic conduit or metallic sheathed cable not approved for use as a grounding conductor, shall include a separate conductor for grounding. It should be attached to the ground terminals of the water heater and the electrical distribution box.**



COMBINATION Thermostat-High Limit Control
This water heater is equipped with a combination "Thermostat-High Limit Control" which is located above the heating element. If for any reason the water temperature becomes excessively high, the "High Limit Control" breaks the circuit to the heating element. Once this switch opens, it must be manually reset. However,

THE CAUSE OF THE OVER TEMPERATURE CONDITION MUST BE CORRECTED FIRST.

To Reset — Press the "Red" reset button in toward the tank.

!!! DANGER !!! Changing the setting of the electric backup element does not reduce the temperature to which the solar energy can raise the hot water. This can only be done by changing the high limit setting on the solar controller or by the installation of an approved tempering valve in the HOT water line to the house.

The final step in the electrical installation procedure is to plug in the solar controller which is done at the end of the solar equipment installation and after the Drainback tank has been filled.
Do-not plug in the controller prior to this.

WATER HEATER TANK SERVICE:

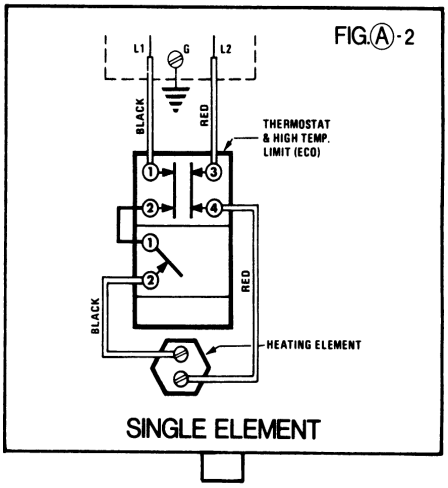
It is recommended that up to 20 gallons of water be drained from the water heater every two months. This will flush lime and sediment deposits from the bottom of the water heater and lengthen the water heater's service life.

To flush the tank:

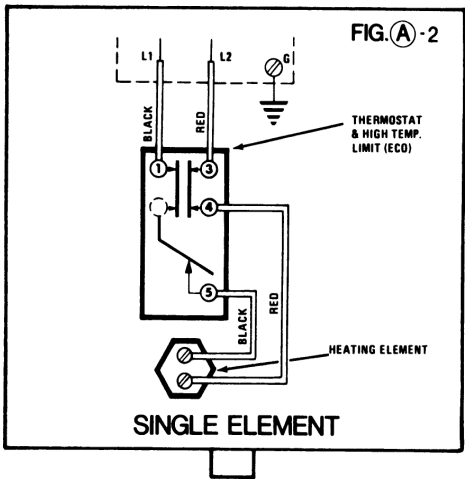
1. DISCONNECT POWER TO THE WATER HEATER
2. Attach a hose to the 3/4" hose connection on the Drain Valve.
3. Place hose so that water is directed to a drain where it will not cause damage.
4. Open the Drain Valve and allow several gallons to purge.
5. Close Drain Valve **Caution: Water released by this valve CAN BE HOT.**

Wiring Diagrams:

THERM-O-DISC THERMOSTATS



ROBERTSHAW THERMOSTATS



Watt Load	Recommended Over Current Protection Rating			Copper Wire Size - AWG Based on N.E.C. Table 310-16 (60°C.)			Approx. Recovery Gal. Per Hour@ 100° F. Rise
	120 V	208 V	240 V	120 V	208 V	240 V	
1500"	15	15	15	12	14	14	6.1
2000	20	15	15	10	14	14	8.2
2500	30	15	15	10	14	14	10.2
3000	30	20	15	8	12	12	12.3
3500	—	20	20	—	10	12	14.3
4000	—	25	20	—	10	10	16.4
4500	—	30	25	—	10	10	18.4
5000	—	30	30	—	10	10	20.5
5500	—	35	30	—	8	10	22.5
6000	—	35	30	—	8	8	24.6

Table 2. Branch Circuit Sizing Guide based on N.E.C. NPPA No. 70-1981. •Wattages less than 1500 watts may be wired 14 gauge with 15 amp protection.

Water Heater Storage Tank Sensors:

For proper operation, the system requires at least one sensor on the bottom of the WHST. An optional Top of Tank sensor may be installed to read the temperature of the water in the top of the tank. The sensors must be installed so they contact the bare metal tank which is underneath the insulation. Most water heaters use expanded foam for insulation. Wedging the sensor between the foam and tank is an acceptable procedure. Some tank have a stub bolt at the bottom of the tank for the sensor, use then when provided. The top of tank sensor can be attached to the Hot Water Out Line on top of the tank if it can be insulated.

Charging the System:

Solar Loop Flushing:

It is recommended that the collector loop be flushed to insure all solder fluxes and any other potential contaminants are not present when the final distilled water charge is put in. A flush of regular tap water can be run through the collector loop for several minutes prior to the final operating charge being installed. If there is evidence of severe contamination in the piping, borax cleaner can be added to the tap water charge for a strong flush.

If a strong flush is determined to be needed a 115 volt pump, bucket and connecting hoses or tubes will be required. Borax can be added at 1 TBSP per 2.5 gallons. Fill a bucket with 2 to 3 gallons of hot tap water and add the borax. Stir the bucket to insure the borax is dissolved. Attach a tube from the bucket to the pump and from the pump to the **"To"** collector line above the ***PROPAC™*** unit. Attach another line from the **"From"** collector tube and place opposite end into the bucket. When ready, plug in the pump. The pump should be turned on and off several times at 5 minute intervals to flush the system piping. When this is completed allow the solar loop to drain completely. Fill the bucket with fresh water and repeat the pumping sequence to rinse the piping. Repeat the pipe rinsing step a second time.

As an alternate to the rising procedure above, a hose can be attached to the collector loop and run for several minutes to rinse the pipes thoroughly. After flushing and completely draining the solar loop the system is ready for connection and or Charging.

Charging:

CAUTION: NEVER ! use the solar system drain valve to charge the solar loop of the system.

Use of inhibited propylene glycol, ethylene glycol, plain water or a combination of these fluids as the Heat Transfer Fluid (HTF) in this system is strictly PROHIBITED and will VOID all Warranties.

The solar loop can be charged as soon as the ***PROPAC™*** unit has been set in place. Generally the solar side is charged once all system components are plumbed. This is not necessary for these systems. Charging is done through the **"To"** and **"From"** collector ports on top of the ***PROPAC™*** unit.

Using either the **"To"** or **"From"** collector tube fittings on the HTU located just above the ***PROPAC.*** (If the tubes had already been installed follow the instructions provided for Shark Bite™ fitting operation and remove the tubes.) Move the tubes to one side. Insert the small funnel provided with the unit into the "From Collector" fitting. Perform the following operations in order.

1. Hold the funnel steady and pour DISTILLED WATER into the funnel.
2. Continue adding DISTILLED WATER until the water completely fills the round sight gauge on the front of the unit
3. Add I more quart of DISTILLED WATER
4. Insert the "To" and "From" collector tubes into the SharkBite™ fittings

The system is now charged.

This completes the system installation procedure.

OPERATING INSTRUCTIONS

(Refer to the system schematics at the end of this manual for references in operating this system.)

Initial System Start Up:

Drainback type systems are the simplest of the active type systems to start up and operate. At this point all that remains is for power cord to be plugged into a 115 volt outlet. The display on the controller will light up .If not, check to see that power is present at the outlet.
If sufficient solar energy is present the system will begin to operate automatically. When the collector is hotter than the tank by 16^{O}F or more the display graphics will simulate fluid moving through the system. Sensors T1, T2 and (optional) T3 will display current temperatures. The controller supplies power to the pumps Water is lifted by the solar pump to the collector where it picks up heat and is returned to the heat exchanger and then the drainback tank. The drainback tank water then continues to supply water to the pump. When it passes through the heat exchanger, the solar heated water gives up heat energy to water from the water heater storage tank flowing on the opposite side of the heat exchanger. The storage tank pump moves the potable water. This cycle continues as long as the collector is hotter than the tank by 4^{O} F.

With the pump running, check all lines, fittings and joints for leaks. If leaks are present, unplug the controller, wait for the HTF to drain back and then make repairs. To start up again, plug in the controller.

Explanation of Major Components and Their Function:

COLLECTORS:

The collectors installed with your solar system are flat plate or evacuated tube type. They are designed to maximize the capture of solar energy in the temperature ranges required for domestic hot water. These collectors accomplish this by employing the green house effect. The glass covering permits up to 90% of the visible sunlight to enter the collector. When the light passes through the glass it loses a small amount of energy. When the light strikes the absorbing surface of the flat plate inside, it is absorbed as heat. The combination of the energy loss and the solar absorbing surface of the plate capture the maximum amount of energy. As the absorber plate heats up it begins to radiate energy as infrared (IR) or heat radiation. Glass is opaque to IR wavelengths so the heat is trapped increasing the temperature.

HOT WATER STORAGE TANK OR SOLAR STORAGE TANK:

This is a standard glass lined steel tank or stainless steel tank that is constructed just like any other household water heater. In complete

systems where a solar storage tank is included as part of the system the tank has extra ports to make connections to the ***PROPAC™*** unit. These tanks, called Solar Storage Tanks, have additional side ports or extra top ports used for connection to the heat exchanger. With either tank style the heat exchanger is used to transfer solar heat energy to the potable water.

TANK SYSTEM ASSEMBLY:

Your ***PROPAC™*** Drainback System unit comes pre-plumbed and wired as a complete assembly. The ***PROPAC™*** unit in conjunction with the Storage Tank is called the Tank System Assembly (TSA). The heat exchanger, pump controller, pumps, drainback tank, tank sensor, drain valve, system drain valve and the wiring and piping to make all connections are part of the TSA. The TSA, collectors, and the inter-connect piping make up the complete system.

The ***PROPAC™*** Unit, also called a Heat Transfer Unit or "HTU" is comprised of the following system components.

- Pumps: The system is equipped with two pumps. A TACO 009 Bronze or Stainless steel circulator pump is used for the solar collector loop. A TACO 003 Bronze circulator is used for the potable water loop. They both run on 115V regular AC power which is supplied from the controller. When heat is available in the collector the pumps are energized. The 009 lifts the heat transfer fluid (distilled water) through the interconnect piping to the collectors where it gains heat and returns to the heat exchanger and completes the solar circulation loop. The 003 pump moves the potable water to and from the heat exchanger where the potable water is heated. The cycle continues until:

    1. The collector can no longer contribute heat energy to the storage tank
    2. The 140^{O}F high limit temperature is achieved
    3. Or the collector temperature reaches a pre-set high level

- Controller: The controller is powered by 115V house current and is the device that determines if solar energy is available. Through the sensors, the controller, constantly measures the temperature of the water heater tank and the collector, comparing them to see if the collector is hotter then the tank. When the collector reaches a 16^{O}F higher temperature than the water heater tank the controller energizes the pumps. As stated above the pump will continue to run until the differential temperature (the difference between the collector and the tank) drops to 4^{O}F. When this happens, the pumps are turned off. (See Controller Operation Section for details.)

- Sensors: The system contains 3 sensors:

    1. One for the outlet of the collector
    2. One for the bottom of the water heater storage tank
    3. One for the top of the water heater storage tank.

    The controller uses these sensors to measure tank and collector differential temperatures and temperature near the top of the tank. They are *thermistor* (thermal resistors) type sensors that have an inverse reaction to temperature. As the temperature goes, up the resistance goes down. The controller is calibrated to read this as changes in temperature. When the collector heats up the resistance goes down and at the right point the controller turns on the pumps. The reverse happens when the collector cools off. (See Controller Operation Manual for details.)

- Heat Exchanger: An all Stainless Steel device used to transfer solar heat to the potable water. It is mounted internal to the ***PROPAC™*** unit. It is located in an insulated cell that is part of the drainback tank insulation. It is not in the drainback tank and is serviceable.

- Temperature and/or Pressure Relief Valves: There are two of these devices in the system. One is inserted in the Hot Water Storage Tank (solar storage tank) and the other is in the drainback tank inside the ***PROPAC™*** HTU. The relief valve in the HTU is pressure only set at 50 psi. The T&P relief valve in the Hot Water Storage Tank is preset to open and discharge if either a high pressure or high temperature situation occurs. All water heaters regardless of whether they are solar powered or not, must have this safety device, required by national building codes. These are inserted into the tanks for safety. They are both located at or near the top of the tanks.

- Main Isolation Valve: Also called the "Shut off Valve", this valve is installed in the cold water

service line to the water heater. It is used to isolate the system for maintenance, repairs and service. **THIS VALVE MUST ALWAYS BE OPEN IF ELECTRIC POWER IS "ON" TO THE ELEMENT IN THE STORAGE TANK.** Other types of solar water heating systems have collector isolation valves. Since this system employs Drainback freeze protection, the system does not have collector loop isolation valves.

- Drainback Tank (Reservoir): Inside the unit is 48 inch long, 8" diameter stainless steel Drainback Reservoir. It is mounted in the center of the housing. 3/4" Ports located in the shell of the tank provide outlets and inlet water paths from the solar side of the system. When the pump is turned on, water is drawn from this tank, pumped throughout the collector loop, then to the heat exchanger and then back to this tank where the cycle continues until the pump is turned off. After the pump is de-energized all the HTF drains back into this tank. This system uses distilled water for the HTF. The drainback tank volume is calculated at 1 gallon per 40 square foot of collector area plus, 2.3 gallons per 100' of ¾" pipe or 4.2 gallons per 100' of 1" pipe plus, a base volume of 3 gallons to prevent cavitation of the pump. The Drainback Reservoir is rated at 250°F max temperature and 100 psi maximum pressure.

- Freeze Prevention: The system uses the principle of draining water from the collectors to prevent freezing. No other valves, control functions or devices are required to prevent freezing of the collectors. When the pump is de-energized the water in the collector loop drains back to the Drainback Tank thereby preventing collector freeze damage. Proper installation is key to insuring this type freeze protection works reliably.

  The system has a freeze tolerance limit of 20° (F) below zero, ambient air temperature. When these conditions are reached, during daylight hours, power to the controller should be disconnected by either unplugging the power cord or turning off the circuit breaker at the power panel.

  "Freeze tolerance limits are based upon an assumed set of environmental conditions. Extended periods of cold weather, including ambient air temperatures above the specified limit, may cause freezing in exposed parts of the system. It is the owner's responsibility to protect the system in accordance with the Supplier's instructions if the air temperature is anticipated to approach the specified freeze tolerance limit."

- Heat Transfer Fluid: This is the liquid added to and stored in the Drainback Tank. Distilled water is the recommended fluid. Use of potable tap water is prohibited. **Uninhibited** propylene glycol can be added at a ratio of 8:1, (8 parts water to one part propylene glycol). **This is not required and is at the option of the system owner/contractor.**

- Operating Indicators: Temperature readings on the controller display, an optional flow meter or thermometer are means by which an observer can determine the system is operating properly. The display shows the temperature of the HTF returning from the collector. The temperature should read approximately 7° or more above the outside ambient air temperature while the pump is operating. If installed, the flow meter indicates the pump is running by showing HTF flow rate through the collector loop.

SERVICE:

SHUT DOWN PROCEDURE: Depending on the requirement, not every step needs to be followed.

1. Unplug the controller.
2. If required, attach a hose to the System Drain Valve.
3. Open the System Drain Valve and drain HTF to a container if it has a propylene glycol additive. If not, discharge the HTF to a drain or ground.
4. Close the System Drain Valve.

!!!CAUTION: SYSTEM HTF CAN BE HOT!!!

This is the end of the SOLAR SYSTEM shut down procedure

If the water heater tank is to be shut down follow these steps only after the Shut Down Procedure above for the solar system has been completed.

1. Disconnect electric power to the water heater. (Throw the breaker.)

2. Close the Shut Off Valve.

3. If the water heater tank needs to be drained: Attach a hose to the Drain Valve on the bottom of the water heater.

4. Open the drain valve.
5. Open the T&P relief valve to allow the tank to vent. The T&P valve can be opened by lifting the lever on top to the vertical position.

To recharge the water heater tank follow the instructions contained in the Installation section.

START UP PROCEDURE: At this point the water heater tank should already be filled and on line for hot water. This includes the electric element connections. Follow these steps:

1. Insure the Drainback Tank is filled to the top of the sight glass on the front.

2. Insure all connections, both plumbing and electrical are secure. Plumbing connections include the "To" and "From" piping to the collector. The electrical connection is the sensor wire from the collector sensor to the controller.

3. Plug in the power cord.

If sufficient solar energy is available the pumps should come on right away.

OPERATIONAL CHECK: If hot water is being supplied the system is obviously producing it. It may not be clear whether the heat is being supplied by the electric element, or by the solar collectors. Follow this procedure to check for solar system operation.

1. During bright sunlight check the display in the controller. The collector pump icon should show operation. If it is the pump should be running and the drainback reservoir should be warm or hot to the touch. This step only shows the controller and pump is working.

2. Check to see the pump is not running at night. If it is consult the troubleshooting guide. When finished locating problem and repairs have been made, repeat this step.

3. In the morning, disconnect power to the electric backup element in the water heater. (DO THIS BY THROWING THE BREAKER).

4. At the end of the day check to see if quantities of hot water are available.

During summer months it may be possible to completely turn off power to the back up element. This is done by throwing the breaker. This is recommended only after it is determined the solar systems is supplying adequate hot water.

SYSTEM FLUID CHECK: A periodic inspection of the system to check the HTF level is recommended. Every month the level should be checked to see that the sight gauge is full when the system is off. If the level drops ue the charging procedure guidelines and add distilled water to bring it back up to full. If propylene glycol has been added to the HTF, a monthly check of the PH of the HTF is required. Using PH strips such as those used for swimming pools, or by using a digital PH meter are acceptable methods for performing the PH check. If the PH drops below "7", follow the Shut Down Procedure and drain the HTF. Then, repeat the Start Up Procedure. (See also Charging Procedure.)

MAINTENANCE:

WATER HEATER TANK: Once each year it is recommended that the water heater tank is purged. To do this, follow the steps below.

1. Disconnect power to the electric element. (DO THIS BY TURNIGN OFF THE CIRCUIT BREAKER)
2. Attach a hose to the Drain Valve on the bottom of the water heater tank.

3. See Figures 1 and 2. Open the Drain Valve slowly to allow water under line pressure to purge the tank for a few minutes.

4. Close the "Shut off Valve".

5. Let the system set for 10 minutes, This allows the sediment to fall back to the bottom of the tank.

6. Now open the T&P relief valve to allow sediment particles to drain out by gravity.

7. Let this continue until the discharge at the end of the hose is clear water. When finished, follow the next series of steps exactly.

1. Close the T&P Valve.

2. Close the Drain Valve and remove the hose.

3. Open the system Shut-Off Valve.

4. Open a hot water faucet in the highest part of the home.

5. Wait until a stream of clear water runs for several minutes with no air escaping.
6. Return power to the backup element.

SOLAR SYSTEM MAINTENANCE:

Drainback type systems are the most trouble free systems available. The only maintenance required is to check and insure the level and PH of the heat transfer fluid in the Drainback Tank are kept within proper limits. See “SYSTEM FLUID CHECK” under SERVICE.

COLLECTOR MAINTENANCE:

Collectors operate best when the glass is clean. If they become dirty wash them with mild soapy water and rinse. Remove any branches or leaves that do not naturally fall off or are blown away by wind. Collectors installed at the proper angle anywhere in the continental United States should not have either of these problems. Dust and dirt build can be a problem in dry desert climates where there is little rain to wash the glass.

VACATION PROCEDURES:

If the system is not to be used for an extended period of time (1 week or more), such as during vacations, it is recommended that the system be shut down and the collector be covered with a tarpaulin or opaque covering. Use the shut-down and start-up procedures detailed in the service section of this manual.

PROPAC™

Heat Exchanger Service Instructions

PROPAC™ Solar Water Heating Systems employ a Stainless Steel Brazed Plate Heat Exchanger (HX) as the means to transfer heat from solar collectors to potable water. This HX is located inside the unit in a closed cell surrounded by insulation. Because of the materials used and the unique design of the HX, the need for servicing is not anticipated. Only in a case where potable water has extremely high mineral contents (hard water) is a need for servicing expected.

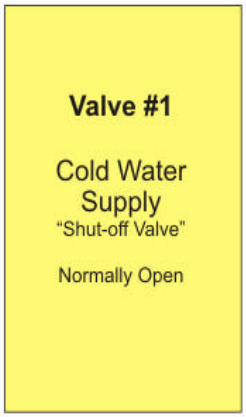
Servicing (Cleaning or Flushing) the heat exchanger by opening the ***PROPAC***™ unit is not recommended. Instead, follow the steps below to clean or flush the unit. If servicing valves were not installed when the system was purchased it will be necessary to drain the Water Heater Storage Tank for service.

Instructions for servicing the HX by the original manufacturer GEA Systems are included in the GEA Service and Installation Manual provided with the system. Follow the “Cleaning” steps on the last page of the manual.

SAFETY LABELING:

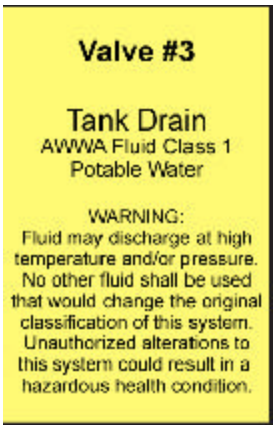
NOTE: Safety Labeling is MANDATORY for these systems. Removal or failure to install these labels is not permitted.

Valve #1 - this label is affixed to the cold water supply, "Shut-Off " valve. This valve is normally open and should **only** be closed when maintenance is performed on the system. Power should be disconnected, at the circuit breaker, prior to service.

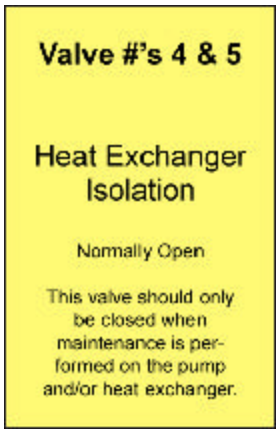


Valve #2 – this label is affixed to the temperature and pressure relief valve on top of the water storage tank. The valve is preset to open and discharge if either a high pressure or high temperature situation occur in the water storage tank.

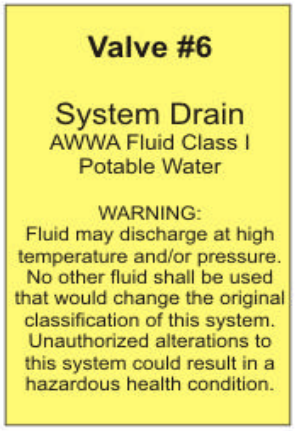
Valve #3 – this label is affixed to the tank drain valve at the base of the water storage tank. This valve is to be used **only** as directed in the water storage tank owner's manual or as directed in this manual. Power should be disconnected, at the circuit breaker, prior to service.



Valve #'s 4 & 5 - this label is affixed to the valves going to and from the Storage Tank to the ***PROPAC*™** unit. These valves are normally open and should only be closed when maintenance is performed on the pump and/or heat exchanger.

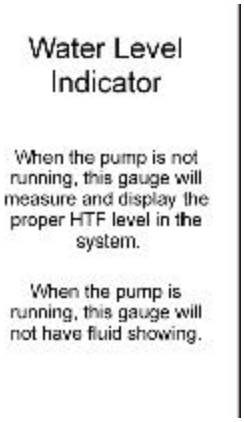


Valve #6 – this label is affixed to the system drain valve at the collector feed port at the base of the water storage tank. This valve is used to drain the solar system when maintenance is performed or for freeze protection as described in this manual.



Temperature Gauge – A label is affixed to a gauge in the collector return line at the top of the unit. This optional temperature gauge will display the temperature of the HTF returning from the collector. The gauge should read approximately 7° or more above the outside ambient air temperature.

Water Level Indicator – this label is affixed to unit next to the round site gauge at the front, top, center of the unit.



Freeze Protection – this label is affixed to the unit near the top. Manual intervention is required as a secondary precaution to protect components from freeze damage, when air temperatures fall below -20° F (-28.9°C).

WARNING: The Tank System Assembly must not be installed in a location that will experience temperatures at or below 32^{O} F.

WARNING / HOT – labels are affixed to the collector supply and return lines, the hot water supply line from the water storage tank and on all system components that could present a safety hazard due to high temperatures.

WARNING: Flat plate collectors can reach temperatures over 300^{0}F. Always be cautious when working around flat plates that are exposed to sun light. Water passing through tubes incorporated in the plate picks up heat to transfer to the water heater. Steam may be present in the collectors when exposed to sunlight with no fluid flowing in them.

TROUBLESHOOTING:

Follow the chart (below) for problem identification and resolution. Additional Troubleshooting procedures for solar systems can be found at the Florida Solar Energy Center web site**:** **http://www.fsec.ucf.edu**

SYMPTOM	CHECK	REPAIR
No hot water	Check to see power is on to backup element	Re-engage power. If power is on replace element.
	Perform solar system operational checks	If pump does not function, replace it. If controller is not working, Check sensors and replace if necessary. If controller does not work, replace it.
	If election is made to operate on “Solar Only”	Check to insure sufficient sunlight has been available.
	Check HTF level in drainback tank	If low, add distilled water.
Pump “On” light is lit, pump does not run.	Unplug pump power line from controller and plug into 115V extension cord	If pump runs, replace controller, if not replace pump cartridge or capacitor.
Pump and controller work but no hot water.	Check for sufficient sun light.	If no sun light is available, reapply power to electric backup element.
	Check to insure proper flow in solar loop.	If HTF water is not flowing call solar contractor who installed the system for service
	If solar loop is working properly but sunlight is not available then check electric backup element.	Replace electric element.
Water is too HOT.	Check high limit setting on solar controller.	Reduce setting if too high.
	If solar supplied water is at preferred temperature	Adjust the setting on the mixing valve between cold and hot lines at water heater.
	Check for thermostat failure on electric element.	If bad replace it.
NO lights on, on controller	Check to insure unit is plugged in.	If plugged in replace unit or call technician
		Call system installer.

PARTS LISTS:

PROPAC - 10D Unit

Component:	Produced by:	Part #:
1. Support Frame	Energy Labs	PPSF
2. Aluminum Outer Shroud	Energy Labs	PPOS
3. Stainless Steel Reservoir	Energy Labs	PPSS10
4. Stainless Steel Heat Exchanger	GEA	PPHX510
5. TACO 009 Stainless Pump	Taco, Inc.	009SSF
6. TACO 003 Potable Water Pump	Taco, Inc.	003BF
7. Solar System Drain Valve	Generic	Any Brand
8. 50 psi Pressure Relief Valve	Watts, Inc.	Z13-50
9. Molded Top Cap	Energy Labs	PPMTC
10. Steca System Controller	Steca, GMBH	TR0301 U

COLLECTORS:

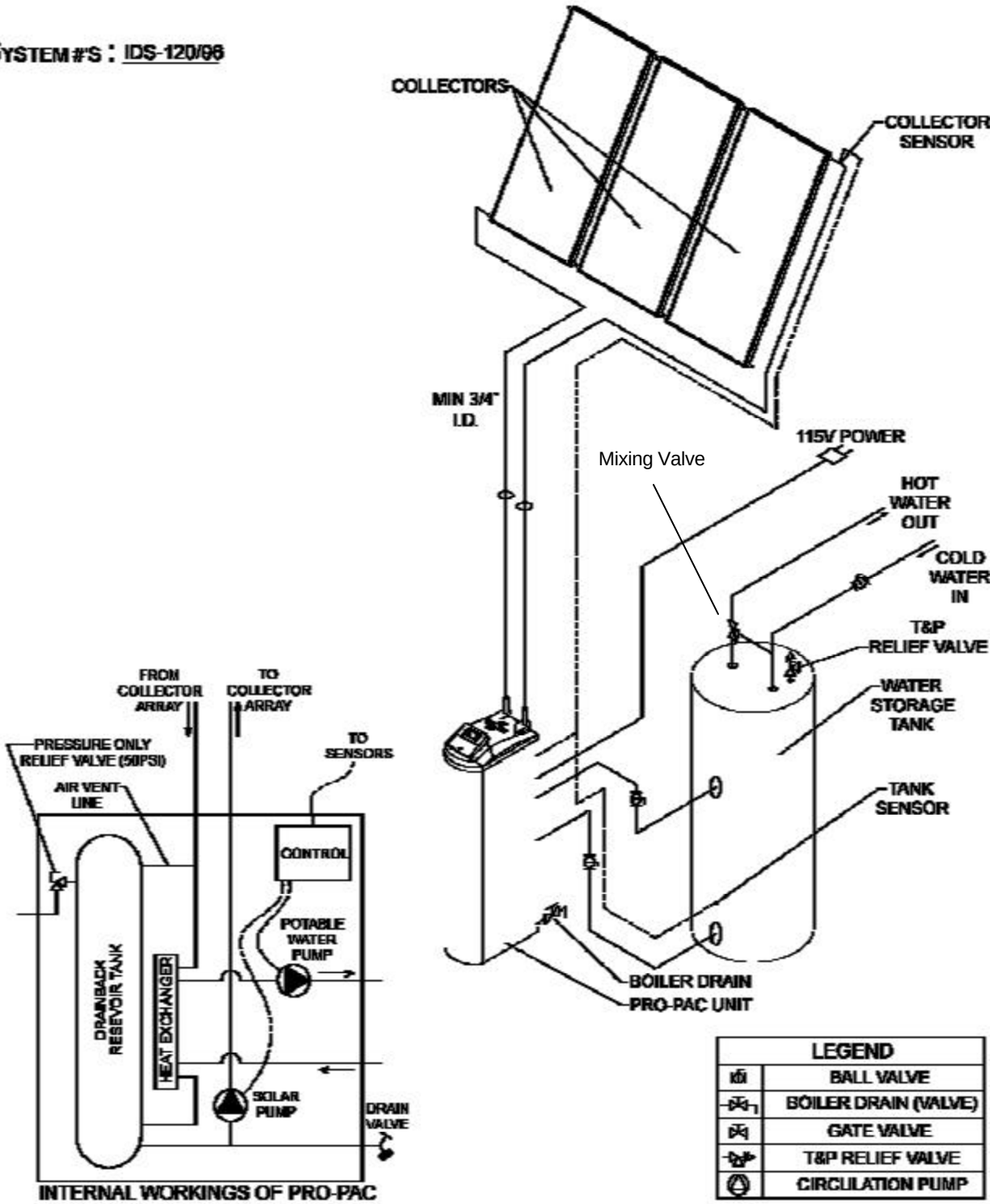
Consult collector manufacturers manual

WATER HEATER STORAGE TANK:

Consult Manufacturers manual

SYSTEM SCHEMATICS FOR ENERGY LABS
PROPAC
DOMESTIC SOLAR WATER HEATING SYSTEMS

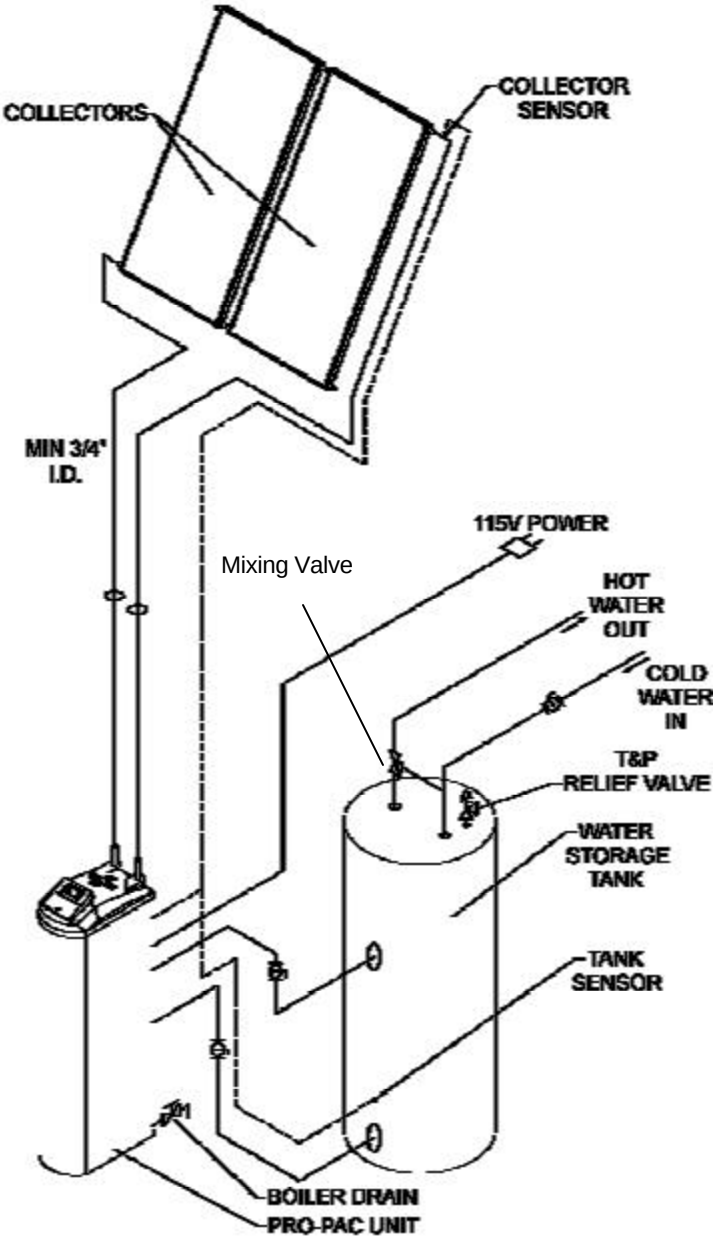
SYSTEM #'S : IDS-120/66

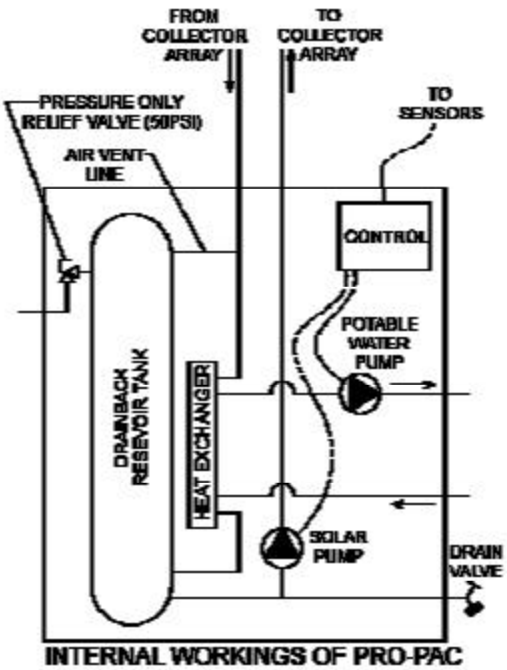


LEGEND	
	BALL VALVE
	BOILER DRAIN (VALVE)
	GATE VALVE
	T&P RELIEF VALVE
	CIRCULATION PUMP

SYSTEM SCHEMATICS FOR ENERGY LABS
PROPAC
DOMESTIC SOLAR WATER HEATING SYSTEMS

SYSTEM #'S : IDS-120/80
IDS-120/64
IDS-60/64
IDS-60/52



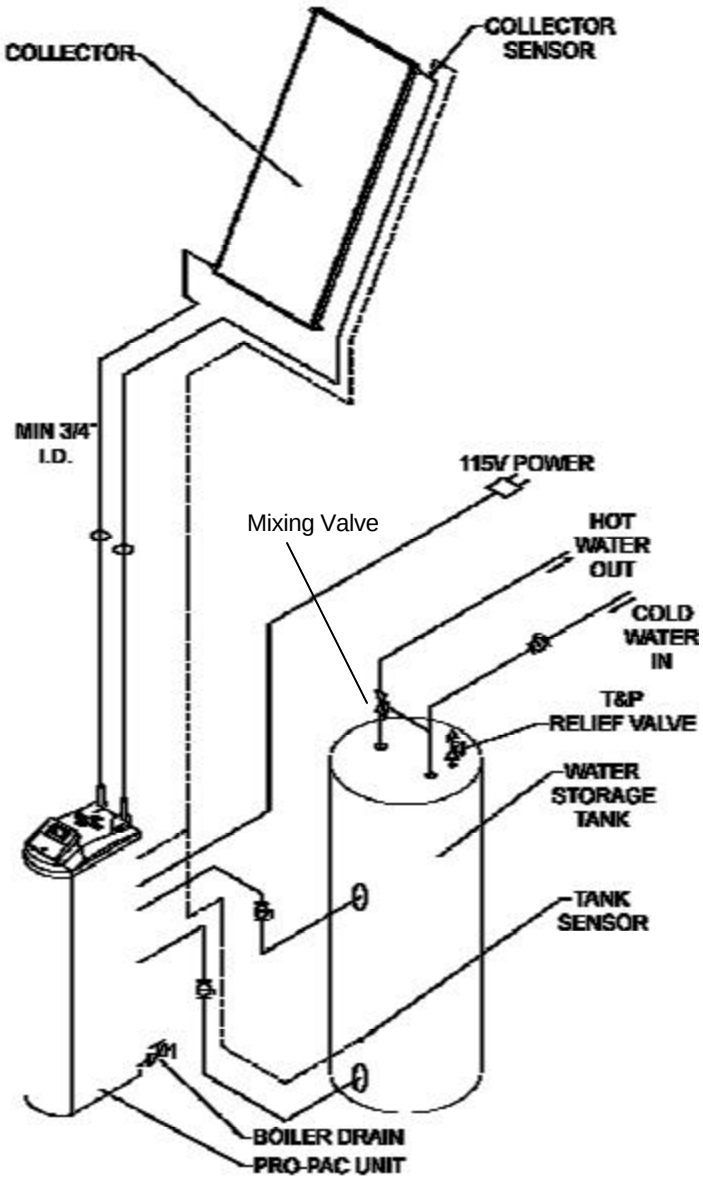


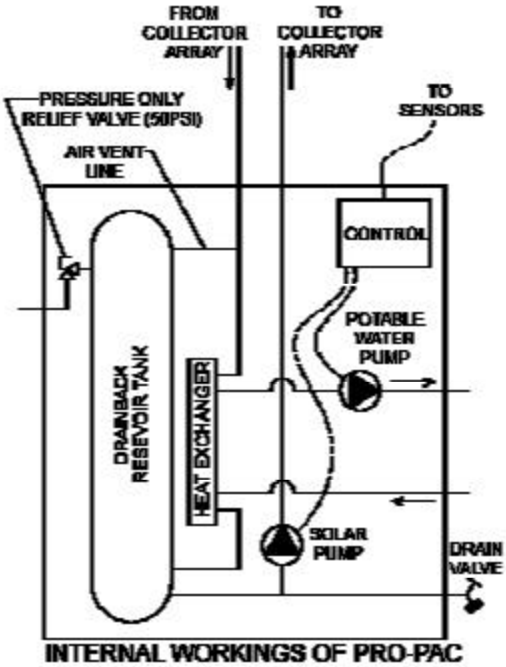
INTERNAL WORKINGS OF PRO-PAC

LEGEND	
	BALL VALVE
	BOILER DRAIN (VALVE)
	GATE VALVE
	T&P RELIEF VALVE
	CIRCULATION PUMP

SYSTEM SCHEMATICS FOR ENERGY LABS
PROPAC
DOMESTIC SOLAR WATER HEATING SYSTEMS

SYSTEM #'S : IDS-80/40
IDS-65/32
IDS-50/26

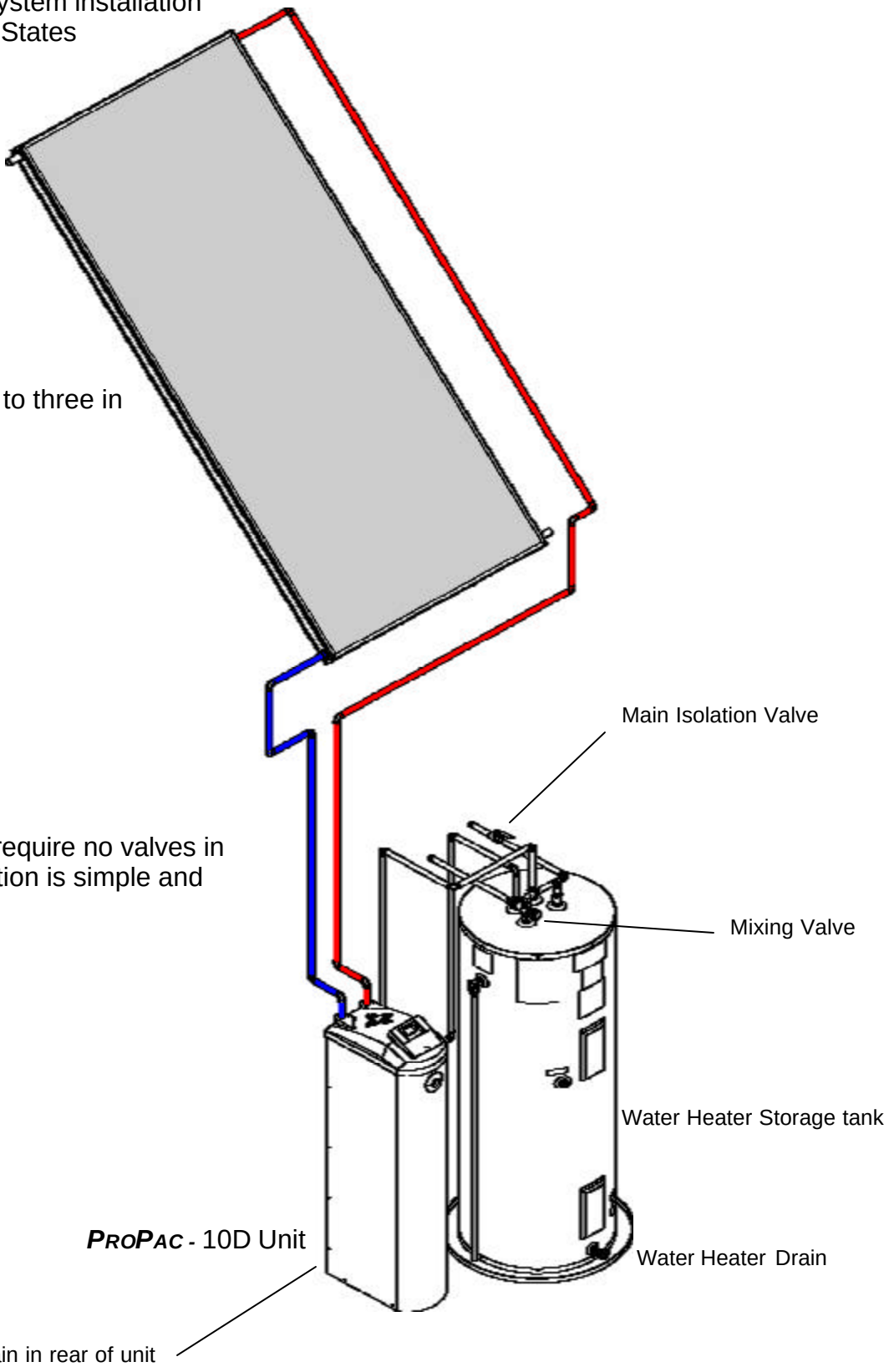




INTERNAL WORKINGS OF PRO-PAC

LEGEND	
	BALL VALVE
	BOILER DRAIN (VALVE)
	GATE VALVE
	T&P RELIEF VALVE
	CIRCULATION PUMP

Typical system Drainback System installation for most areas of the United States

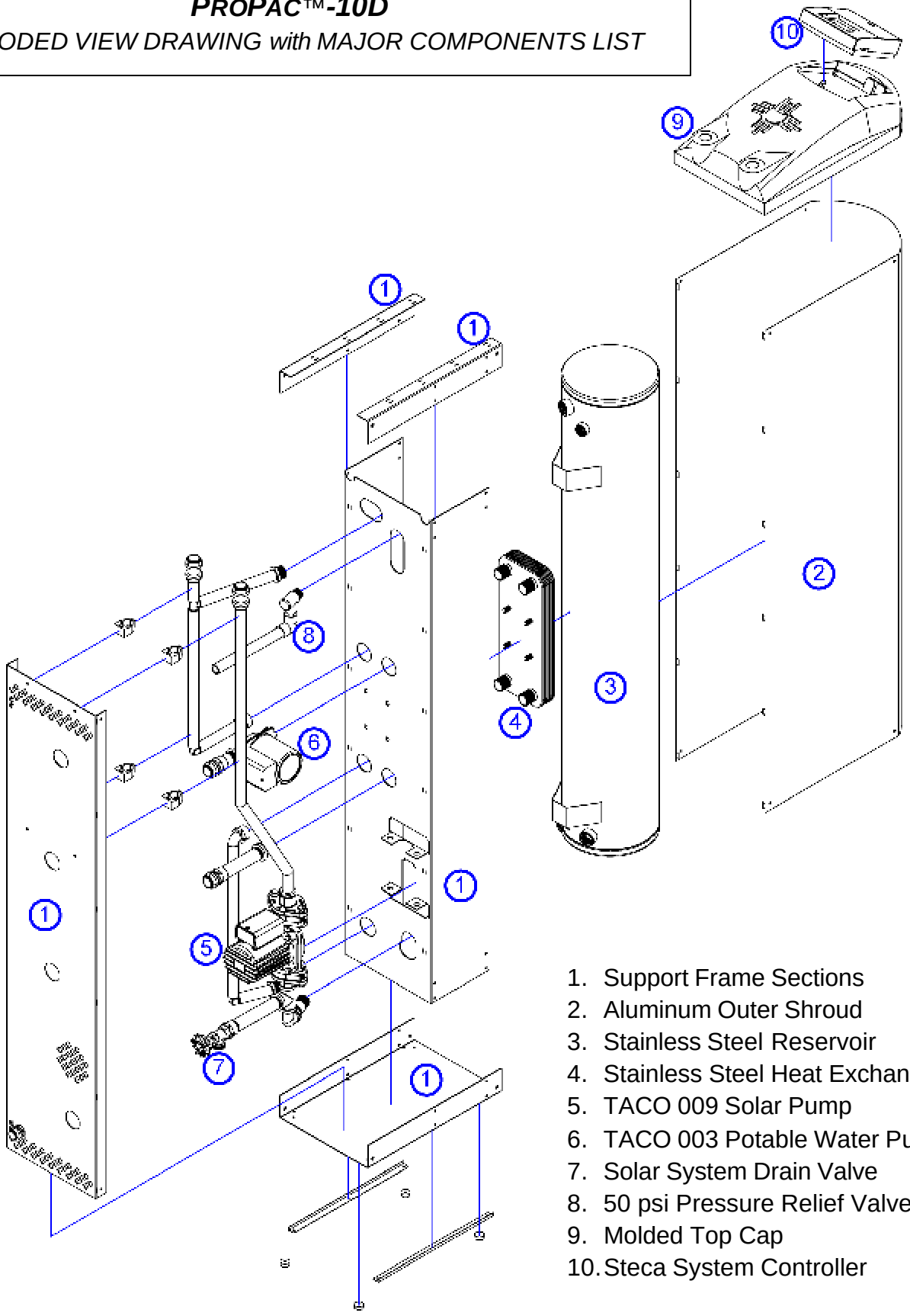


PROPAC Drainback System require no valves in the solar loop piping. Operation is simple and reliable.

PROPAC - 10D Unit

PROPAC™-10D

EXPLODED VIEW DRAWING with MAJOR COMPONENTS LIST



1. Support Frame Sections
2. Aluminum Outer Shroud
3. Stainless Steel Reservoir
4. Stainless Steel Heat Exchanger
5. TACO 009 Solar Pump
6. TACO 003 Potable Water Pump
7. Solar System Drain Valve
8. 50 psi Pressure Relief Valve
9. Molded Top Cap
10. Steca System Controller

The systems in this manual are manufactured

ENERGY LABORATORIES, INC.
5191 Shawland Road
Jacksonville, FL 32254

Ph: 904-693-4555
FAX: 904-693-6999
http://www.energylabsinc.com

And supplied by:

TCT Solar
101 Copeland Street
Jacksonville, Florida 32204
P
Ph: 904.358.3720
Fax: 904.358.3728
www.tctsolar.com

This system has been installed and will be serviced by:

Call this Company for repairs.