

CALEFFI SOLAR



Installation, Operation and Maintenance Manual

Caleffi Solar Water Heater

Models: NAS30020, NAS30020Plus, NAS30040, NAS30040Plus,
NAS30042, NAS30042Plus, NAS30060, NAS30060Plus, NAS30062, NAS30062Plus

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PREFACE

Thank you for buying a Caleffi solar hot water heater. Established in 1961, Caleffi is a global leader in hydronic heating equipment manufacturing. With North American manufacturing headquarters in Milwaukee, Caleffi solar thermal equipment is sold by leading solar, heating, plumbing, and building contractors across the United States and Canada.

The solar collector panel is tested to the Solar Rating & Certification Corporation (SRCC) Standard OG-100 certification, which is required by several governmental and utility entities to qualify the end user for various financial benefits such as tax credits, rebates and loans.

This certification does not imply endorsement or warranty of this product by SRCC.

The installation of this system is intended to be performed by properly licensed and experienced professional contractors in accordance with SRCC Standard OG-100, and must conform to applicable federal, state and local regulations, codes, ordinances and standards governing the installation of solar water heating systems.

This system comes with a pre-mixed anti-freeze heat transfer solution fluid (HTF) containing non-toxic propylene glycol and de-ionized water. Unauthorized fluid substitutions can result in a threat to health, welfare and safety and can result in pipe freezing and equipment damage. All component warranties express or implied, are voided if the HTF is not maintained in accordance with instructions.

When properly installed and maintained, this system will protect against freeze damage to temperatures as low as -75°F (-59°C). The lowest recorded temperature in the Continental US is -70°F (Montana 1954).

Solar water heating systems are climate and site specific appliances. System performance varies as a function of household hot water use, including daily showers and baths, laundry and kitchen uses, local ground water temperatures and ambient air temperatures, your home's roof pitch and orientation and, of course, the seasonal intensity of solar radiation. These variables determine how much energy and money your Caleffi system will save. When sized properly, your solar thermal hot water heater can produce between 50% and 80% of your hot water demand on an annual basis.

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SUPPLEMENTAL INSTRUCTIONS

In addition to this manual, the system comes with three supplemental documents:

- Installation, commissioning and servicing instructions for NAS200 Series SolarCon solar water heater tank (in a bag taped to side of the tank),
- iSolar controller manual (in the controller packaging),
- Installation and commissioning instructions for 255 series and 256 series Pumping Station (in the pumping station packaging)

It is important to read through these documents before beginning installation and operation.

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SYSTEM OPERATING PRINCIPLE

Simply stated, when the sun is shining, heat energy is absorbed by the solar collector's absorber plate and transferred to the HTF circulating through the solar collector. The system pump circulates this heated fluid through the collector piping and integral tank heat exchanger located in the bottom of the storage tank. As the HTF passes through the heat exchanger the heat in the fluid is transferred by conduction to the potable water in the solar storage tank. As this process is continuously repeated, the water temperature in the solar storage tank rises.

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INSTALLATION OPTIONS FOR BACK-UP HEAT

Though many installations will produce 100% of hot water requirements by solar energy on sunny mid-year days, on cloudy days and fall/winter days, back-up heat is required.

Here are the 4 most common options used for back-up heat:

Option #1 – “Single Tank” System

This option uses the built-in electric heating element in the storage tank on single coil tank models. A “single tank” system option is sometimes preferred when floor space is too small to accommodate additional equipment. Single tank systems can also cost less than other options.

Single tank systems require 230 V electrical service. The heating element is located half way up in the storage tank and is controlled by a thermostat located on the tank. The adjustable thermostat is factory pre-set for 120°F. When the tank temperature drops below 120°F, the thermostat activates the heating element to bring the water temperature back up to 120°F.

To maximize solar heat output, your installer may suggest utilizing an programmable control timer. The programmable control disables and enables electrical power to the back-up element at various times of the day. A typical use is to disable the element during times when no hot water consumption is planned, thus allowing more time for the tank to be heated by solar energy instead of electrical energy. A common example is disabling the element in the morning after inhabitants go off to work or school, then enabling the element an hour or so before people are expected to return.

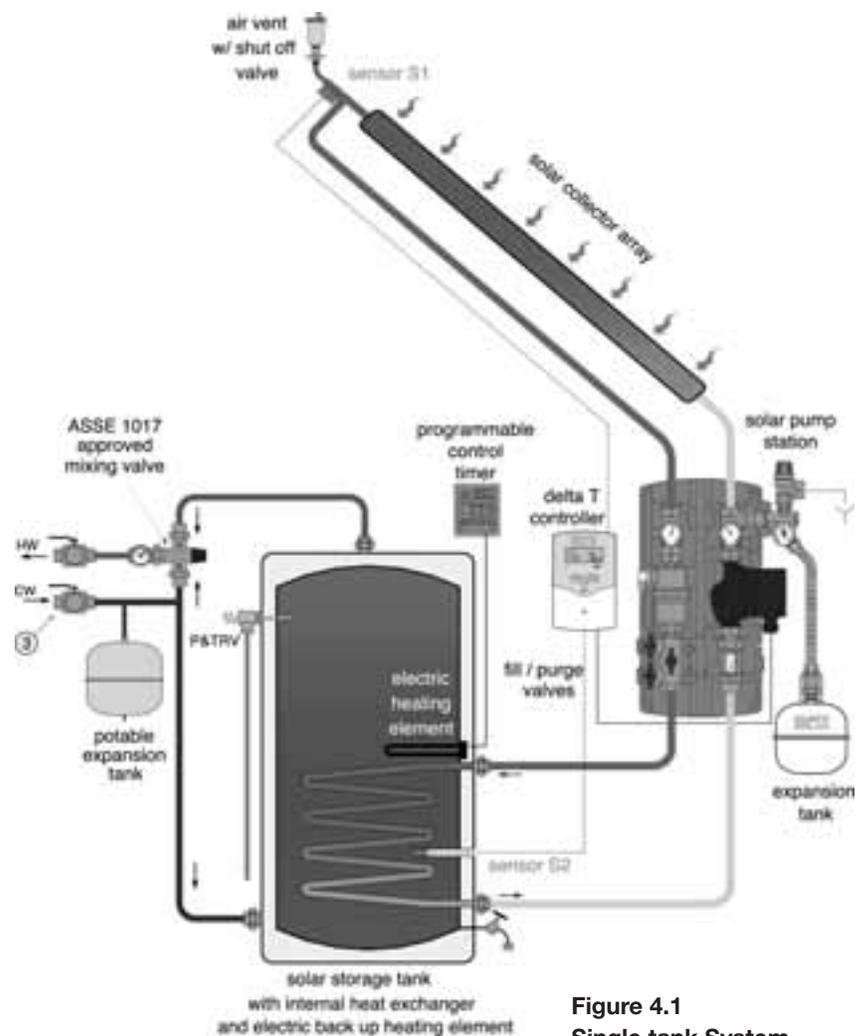


Figure 4.1
Single tank System

Option #3 – Two Tank with Solar Pre-Heat

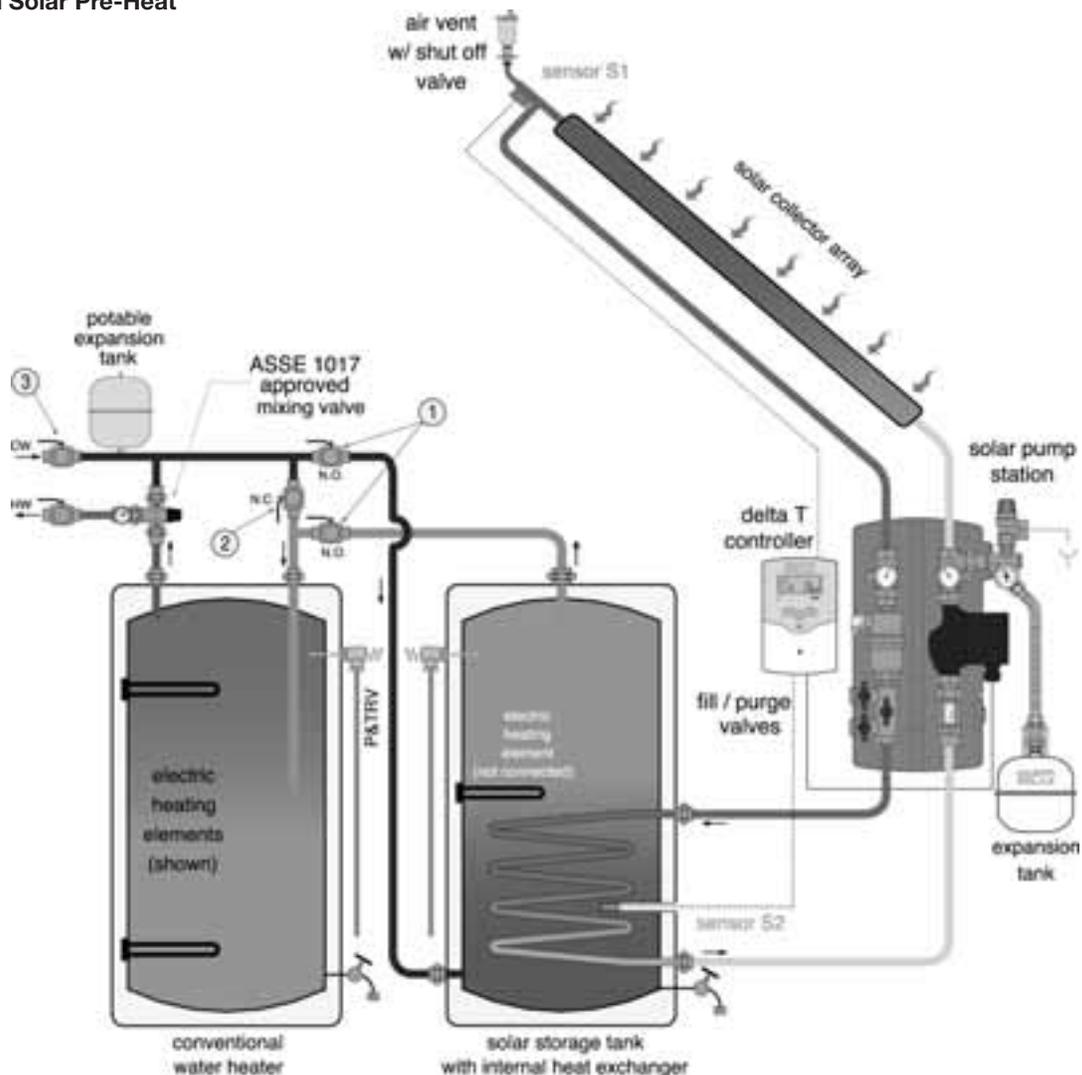
This is perhaps the most common option and uses a conventional direct fired hot water heater as a second tank into which water “pre-heated” by the solar tank feeds. This is referred to as a “**two tank with solar pre-heat**” system. The conventional hot water heater (supplied separately) can be either electric or gas fired.

This is a common configuration for new installations as well as for retrofit applications whereby a conventional hot water heater is already installed. Unlike the first two options, a means to disable back-up heat is not required to optimize solar energy harvest - the entire solar storage tank volume is dedicated to solar heat production.

This option requires a single coil tank solar system model. The electrical element is not required and if desired, can be removed by the installer - although leaving it in has no adverse effect.

Please note in the following schematic the 3 bypass valves (supplied separately) between the two tanks. In two tank systems, it is important to be able to isolate the solar storage tank in the event it requires servicing, and thus continue hot water production. In the event bypass is required, the two normally open valves (item 1) that connect to the solar hot water heater are closed and the normally closed valve (item 2) is opened.

Figure 4.3
Two Tank with Solar Pre-Heat

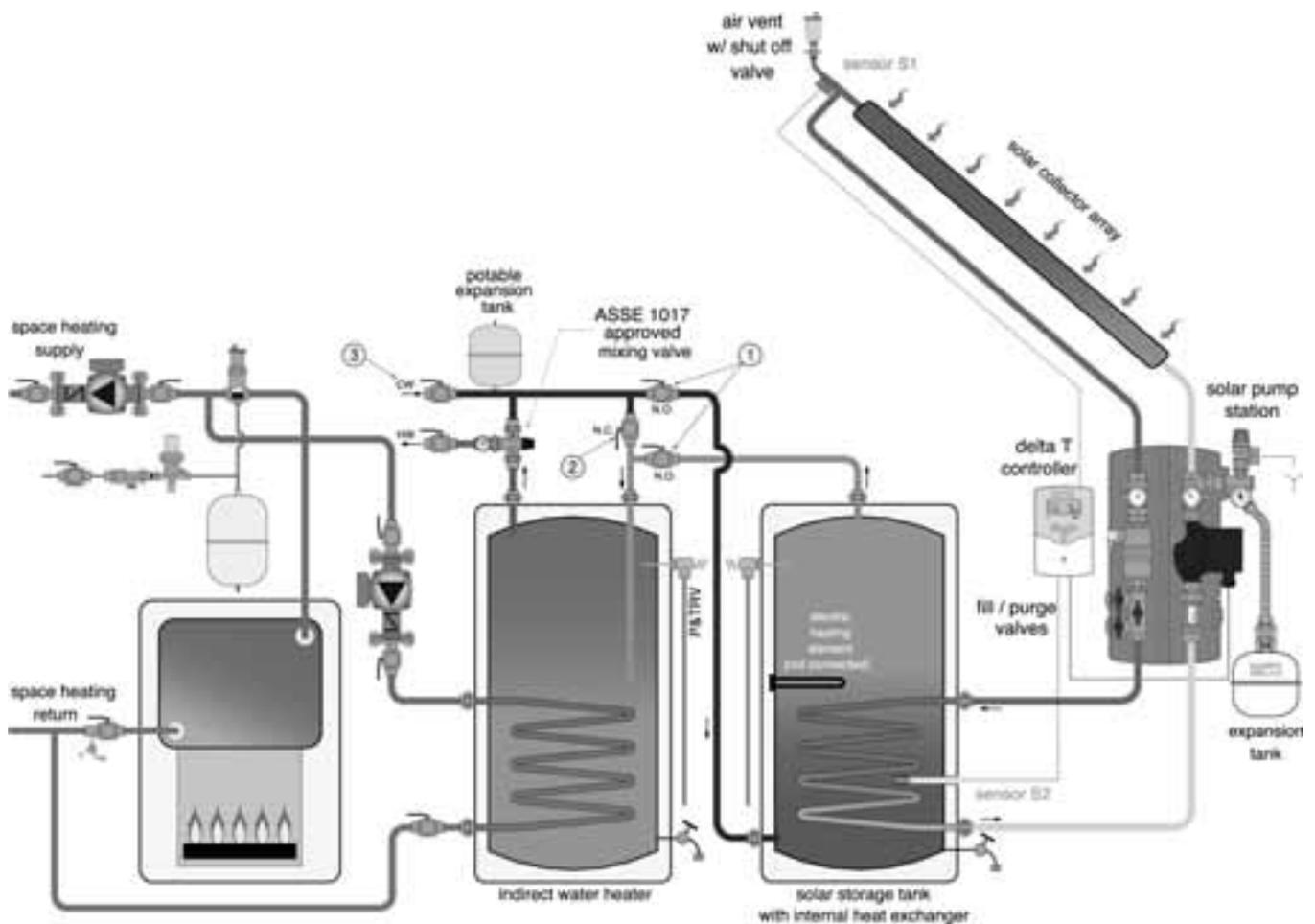


Option #4 – Two Tank with Solar Pre-Heat/Indirect Fired Water Heater

This is a variation to option #3. For back-up heat, an indirect fired water heater is used instead of a direct fired heater. And as in option #3, the solar thermal storage tank delivers “pre-heated” water to the indirect hot water heater.

As in option #3, bypass valves (supplied separately) need to be installed to isolate the solar storage tank in the event it requires servicing.

Figure 4.4
Two Tank with Solar Pre-Heat/Indirect Fired Water Heater



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HOW IT WORKS

To understand how your solar hot water heater works, let's first review each of the primary components. Please reference the above system schematics and also Appendix 2 which shows where the components are.

- ① **Heat Transfer Fluid (HTF):** The Caleffi system design is known as a "forced circulation" type because it utilizes a pump to circulate HTF. The HTF is a mix of non-toxic food grade propylene glycol and de-ionized water. The HTF protects the collector and exposed piping from freezing and also inhibits internal scaling deposits that can reduce performance. Proper application and maintenance of the HTF can protect your Caleffi solar water heating system to minus 75° Fahrenheit. Below this temperature, the HTF would solidify and expand, thus potentially causing equipment damage.

If significant drop in system pressure is noticed, contact your contractor immediately for service. Also, an experienced contractor should periodically check the HTF fluid quality. See maintenance section.

- ② **Solar collector panel(s):** This is the part of the system that harvests the energy (heat) from the sun. Your system will contain one to three panels. They are installed outside facing skyward in a southerly direction. Sometimes the ground is the best place to locate the panels but most often they are placed on the roof or other raised surface. Your installer will position them so as to maximize the solar energy harvested throughout the year and, in snowy areas, maximize the panel's ability to rid themselves of snow build-up.
- ③ **Solar air vent:** Automatically releases air that collects at the top part of the solar system. Once the system has been initially filled with HTF and commissioned, the air vent should be isolated so that if stagnation occurs and the panel HTF vaporizes, the system won't depressurize.
- ④ **Solar air vent ball valve:** Used to isolate air vent.
- ⑤ **Cross assembly:** 4 way brass connection piece that joins together solar panel, Solar Flex, air vent/ball valve, and temperature sensor.
- ⑥ **Universal foot mounts:** Holds panels in place on the roof. 4 mounts are used to secure each panel. Foot mounts fasten to panel using screw clips (furnished).
- ⑦ **Plug and cap:** Used to seal off the two un-used ports on the solar panel ports.
- ⑧ **SolarFlex:** Stainless steel flexible piping with external insulation wrap. Have union ends to make connections to solar panels and to pumping station. Two smaller lengths supplied are used to connect pumping station to solar storage tank.
- ⑨ **Pumping station:** Mounted either on the storage tank or on a wall. Consists of an assembly of important fittings and safety devices for the operation of the solar system:
 - ⑨.1 • **Pump:** Circulates the HTF through the system and activates when the controller detects that fluid temperature in the panel is higher than the water temperature in the bottom of the storage tank. It deactivates when the temperature in the panel and the tank become close to the same value. The pump is rated 115 volt, 60 hertz and is wired by your installer directly to the controller using a "J" electrical cord furnished. The pump has 3 speed adjustment settings to assist your installer in setting the proper flow rate for the HTF.
 - ⑨.2 • **Safety relief valve:** Protects system mechanicals from effects of over pressurization. Opens up in the event rated pressure level is reached. A drain line (contractor supplied) is used to safely direct to the floor any purged HTF.

- 9.3 • **Filling/drain valve:** Contains 3 ball valves and is used to fill or drain the system of HTF. The center valve is also used to adjust pump flow rate.
 - 9.4 • **Pressure gauge:** Indicates system pressure. Contains a dial arm to show previous set pressure.
 - 9.5 • **Flow meter:** Indicates rate of HTF flow.
 - 9.6 • **Air trap and vent:** Collects air in cylinder upon system start up. Air is purged by manually turning vent.
 - 9.7 • **Flow and return temperature gauges:** Round thermometers that indicate temperature of HTF going to the solar panels and returning from the solar panels. The two gauges can allow for a simple diagnostic check of proper system operation. On a sunny day the hot water return line is typically 4 – 13° warmer than the water in the collector supply line.
 - 9.8 • **Pre-formed insulation shell:** Insulates assembly from heat loss.
 - 9.9 • **Shut-off and check valve:** Located directly behind temperature gages. Check valves prevent unwanted thermo-siphoning of HTF. The shut off valves isolate pumping station from solar panel for servicing purposes. Valves can also be set to keep checks open to allow thermo-siphoning to occur.
- 10 **Expansion Tank:** This Caleffi solar system design is referred to as a pressurized type. A system under positive pressure facilitates air removal which in turn improves HTF life and overall performance. Your installer will adjust the pressure to obtain a value of 20 psig at the solar panels. This pressure optimizes the solar panel performance. As the HTF in the system heats and cools through the continuous cycles of solar harvesting, the fluid expands and contracts. The expansion tank absorbs these fluid volume fluctuations while maintaining system pressure. Under stagnation conditions (see discussion below), the HTF in the panel can become very hot causing the HTF in the panel to vaporize. The expansion tank will absorb the displaced HTF fluid. As the panel temperature begins to cool again, the vapor reverts back to liquid and the cooled HTF reoccupies the panel.
- 11 **Expansion tank connection kit:** Joins the expansion tank to the system. Bracket mounts to a wall. Includes a fitting with a double check to allow servicing of expansion tank without having to purge HTF. Upon system start up, internal pressure of the expansion tank is adjusted by installer to be equal to the system pressure.
- 12 **Solar storage tank:** The storage tank is installed indoors, and is the device that the heat produced by the solar panels is transferred into. The transfer of solar heat is accomplished via the HTF circulating through the heat exchanger coil located in the bottom half of the tank. Tanks with a single coil have an electric heating element positioned approximately half way up inside the tank. This heating element provides back-up heat in single tank system applications. In double tank applications, this heating element is not used and is left unconnected from the electrical supply. Tanks with two coils do not have a back-up electrical element, but instead use the upper coil to provide back-up heat to the tank by way of a boiler.
- 13 **Controller:** Your system controller is the “brains” of the system. It acts as a type of thermostat and monitors the temperature of the HTF in the solar panel, as well as the temperature of the water in the bottom of the storage tank.

The controller activates the pump as conditions require by turning on and off an electronic relay (triac) inside it. **A unique feature of the Caleffi system is that the speed of the pump is automatically varied by the controller.** The speed adjusts faster and slower based on the rate of solar energy being harvested by the panels. This automatic speed control feature maximizes the rate of heat transfer to the tank and also minimizes electrical energy consumption in the process.

Depending on the model, the controller may also be used for controlling a second pump or valve. A common application example is controlling a diverting valve to send HTF to a second storage tank if the first storage tank has reached its heat retention capacity.

- ⑭ **Thermostatic mixing valve:** This is an important item. Many state, provincial and local codes require installation of these devices. It is not furnished with the system but is to be furnished by the installer.

All OG-300 certified systems require a thermostatic mixing valve. The specified mixing valve shall be the **Caleffi Model series 521 or series 2521** or equal. Install a temperature gauge (accessory available from Caleffi) directly after the mixing valve above the solar storage tank on a single tank system, or on the back-up water heater on a two tank system.

WARNING: SCALDING CAN OCCUR WITHIN FIVE SECONDS WHEN WATER TEMPERATURES APPROACH 140°F. THE MIXING VALVE SHOULD BE ADJUSTED BY YOUR INSTALLER TO PROVIDE WATER TO YOUR FIXTURES AT NO MORE THAN 120°F.

- ⑮ **Surge Protector:** This item interfaces between the temperature sensors and the controller. It comes standard with PLUS models and is used to protect the controller from damaging electrical surges caused by lightning. It is also available as an accessory from Caleffi for use with non-PLUS models.

OPERATING SEQUENCE: With the primary components now understood, let's discuss how the system works. We'll start by assuming the system has been installed and is in operation. It is early in the morning, the sun is not up yet, and the water temperature in the bottom of the tank is cool. In this state, the system is idle. The sun starts to rise.

As the sun's rays strike the solar collector, they are absorbed. The heat produced transfers directly to the HTF in the panel and causes the panel temperature to rise. Once the temperature in the panel exceeds the temperature in the tank bottom by approximately 12°F, the controller activates the pump and circulates the heated fluid from the panel down into the tank coil. The heat from the HTF circulating through the coil is absorbed by the water in the tank. The (now cooler) HTF exits the coil and flows back to the solar panel where it absorbs more heat, thus starting the cycle over again.

Heat continues to be delivered to the solar tank until either:

- A) The temperature difference between the panel and tank drops below approximately 8°F. This is the typical condition and occurs due to the sun going down, or to clouds passing over;
- B) The storage tank temperature reaches its maximum set limit (factory default set at 140°F).

Both A) and B) conditions cause the pump to turn off.

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OVER HEAT PROTECTION

If the HTF temperature in the panel rises to approximately 270°F, the HTF will begin to transform to vapor. Then, after cooling, it will revert back to a liquid state. The anti-freeze properties of the HTF could deteriorate over time if this "change-of-state" occurs repeatedly over and over. Thus, to protect the HTF properties, the Caleffi solar systems have built-in features to minimize chances of overheating the HTF.

System Cooling Protection: Your system comes with this feature already enabled – there is no need to make a controller adjustment. If under condition B) above, the sun continues to generate heat in the panels, the controller will allow the HTF temperature in the panels to rise. If the HTF temperature rises to 250°F, the controller activates the pump, circulating the heated HTF through the tank coil and thus cooling the HTF. The pump then turns off when the HTF cools down to 240°F. If the panel continues to absorb heat and the HTF rises back to 250°F again, the pump re-activates and cools the HTF. This process continues repeatedly if necessary until one of the following conditions occurs:

- the HTF ceases climbing to 250°F (the desired and usual condition),
- the panel reaches 285°F,
- the tank reaches 200°F.

Conditions b) and c) are referred to as **stagnation**. During stagnation the pump stays off to protect the system mechanicals. In this state, it is possible for the HTF in the panel to turn to vapor. If so, the displaced HTF liquid pushes down into the expansion tank, thus protecting the system from over-pressure. Once the panel temperature cools back down below 270°F and the tank temperature drops below 190°F, the system cooling protection mode becomes re-enabled.

Stagnation can also occur if a prolonged period of **electrical outage** occurs on a day of high solar intensity. Since there is no electrical power, the pump can't circulate the HTF.

It is very difficult to detect if your system has stagnated without checking the glycol. Thus it is recommended that the glycol be checked at least annually (see maintenance section). An ideal date for checking glycol is late summer/early fall before hard freezing conditions can occur.

Recooling Protection: Your system comes with this feature “default disabled” meaning the feature must be turned on in order to activate. The feature uses the cooling effects of the night-time sky to provide added safeguarding from overheating the HTF. The feature is sometimes referred to as “**vacation mode**” because it is invoked when there is no hot water use expected for consecutive days – a typical situation when a household goes away on a **summer vacation** for example.

When this feature is enabled, if the tank temperature rises to the maximum tank temperature setting (typically 140°F), the pump will remain activated to avoid overheating of the panels. The tank temperature might continue to increase, but only up to a maximum of 200°F. As the solar intensity decreases due to the setting sun, the panels will cool down to a lower temperature than the storage tank. As a result, the panels release heat (instead of absorb) to the nighttime sky, thus cooling down the tank. When the tank temperature cools back down to the maximum tank temperature setting (typically 140°F), the pump turns off.

In the event the tank temperature rises to 200°F, the pump turns off and the system stagnates. After the panel temperature cools down below 200°F, the pump reactivates and recooling resumes

To minimize the chance of stagnation when there is an expected **extended period** of no hot water use (such as a long summer vacation), it may be beneficial to have the maximum tank temperature adjusted down to a reduced setting - such as 40°F for example. This allows maximum heat emission to the night sky and also allows the solar storage tank to absorb significantly more heat throughout the day - thus helping cool the HTF.

IMPORTANT: When returning from vacation, the maximum tank temperature should be adjusted back to the original setting (140°F typical).

*NOTE: If your system configuration is per installation option 1), 2) or 4), the back-up heat source should also be disabled when enabling the Recooling feature. This is to prevent from back-up heating the solar storage tank during a time when you want to keep it cool. **IMPORTANT:** Remember, if back-up heat source is temporarily disabled, be sure it is re-enabled after returning.*

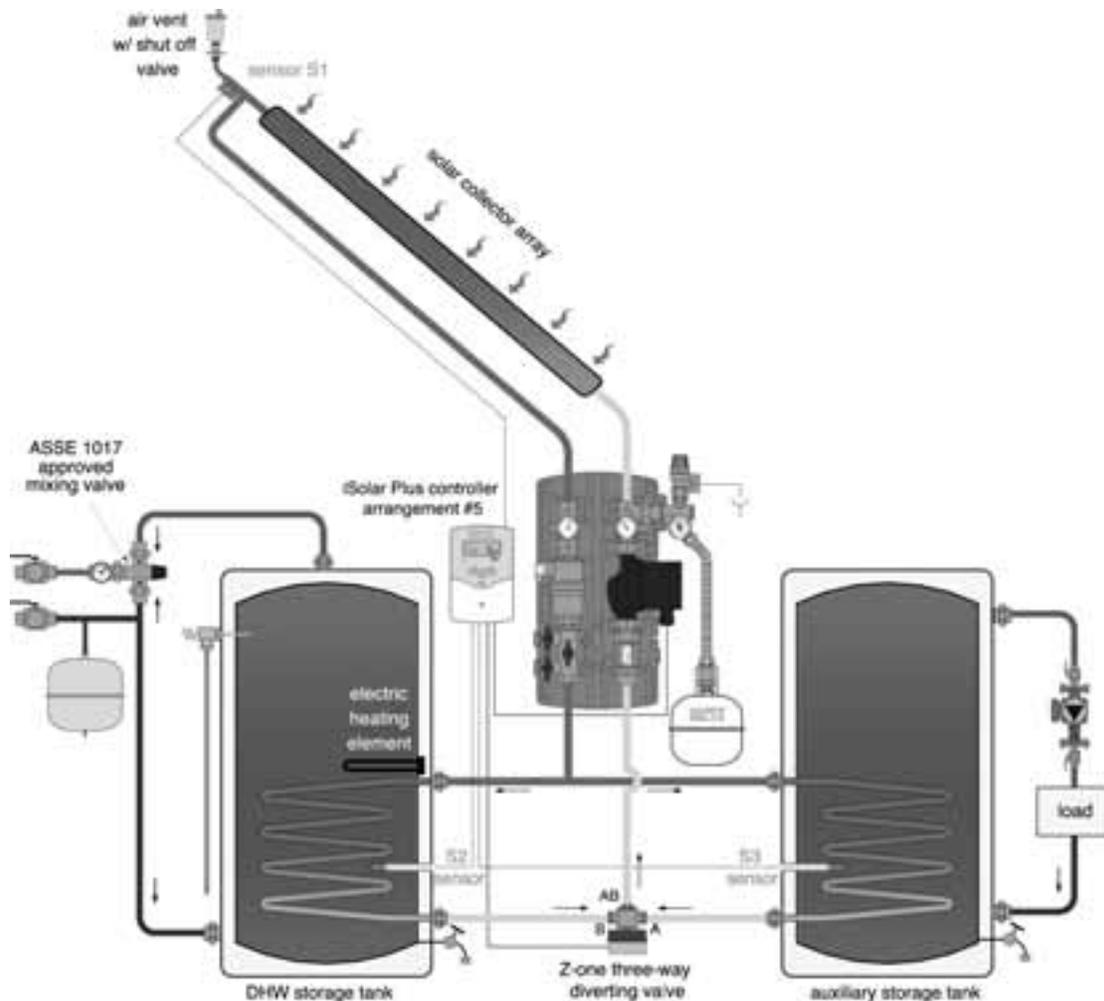
Thermo-siphoning Protection: A 3rd method to provide HTF overheat protection is quite straight forward. This method should only be used when there is an **extended electrical power outage** during a very sunny day. By manually opening the two valves in the supply and return side of the pumping station (see section 10.3) thermo-siphoning action will naturally occur. As the HTF in the panel heats up, it becomes lighter and rises. This causes the HTF to slowly circulate in the system. As heated HTF passes through the tank coil, the HTF cools.

IMPORTANT: Once power resumes, the the pumping station valves should be set back into the original position. If this is forgotten, natural circulation will occur whenever the panel is cooler than the tank, thus wasting heat to the night time sky.

Heat Diverting: Though the three methods above provide a high level of protection against stagnation, they depend on installation conditions, water use and geography and thus do not provide guaranteed protection. For maximum protection (except black-out), your installer may specify a Caleffi model (**PLUS** model). These models offer the ultimate in protection by means of a 4th method: **diverting excess heat**.

Referring again to condition B) above, when the solar storage tank reaches its maximum set limit, the controller activates another device (a 3 way diverting valve available from Caleffi as an accessory) that redirects the HTF to a second heat storage location. Commonly, the second storage location is a 2nd tank. It could also be a swimming pool heat exchanger for example. In addition to protecting the HTF, these applications utilize excess solar heat for beneficial purposes. Oftentimes however, the installer may simply use as a “second storage” location, a fan coil or some other heat dissipating device to simply **“dump”** any excess heat. The three schematics below illustrate possible heat diverting applications.

Figure 6.1
Diverting Heat to Second Tank



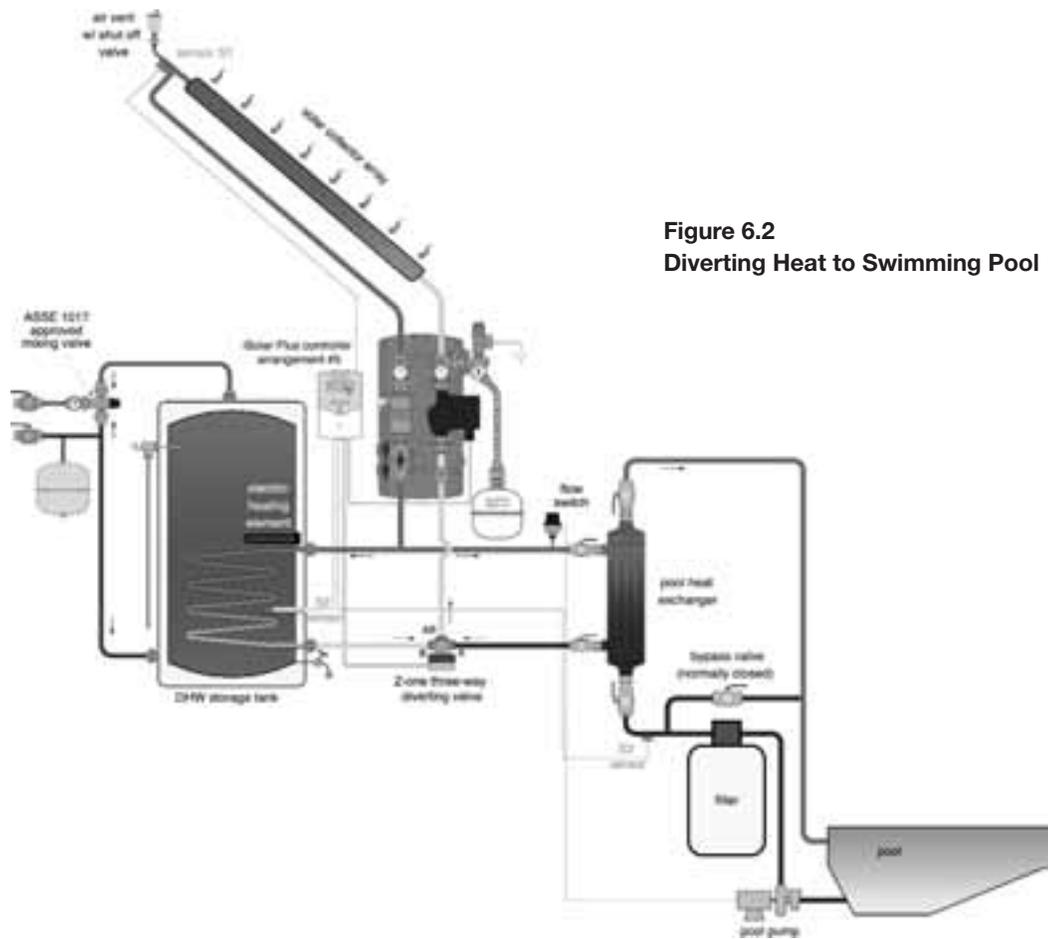


Figure 6.2
Diverting Heat to Swimming Pool

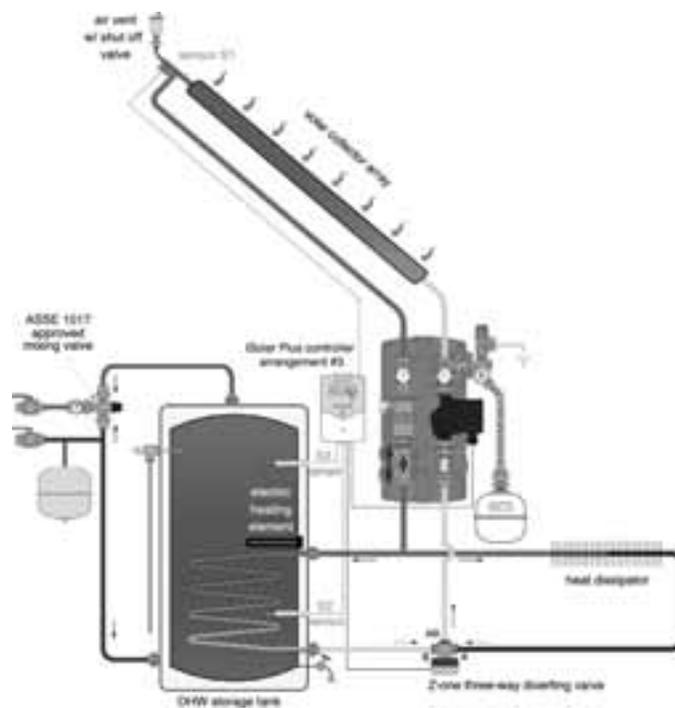


Figure 6.3
Diverting Heat to Dissipator

7

INSTALLATION – SAFETY FIRST

- 7.1 The installation shall conform to all federal, state and local regulations, codes, ordinances and standards governing solar water heating system installations, and the contractor shall adhere to sound building safety and trade practices. Special consideration must be given to building code requirements for the penetration of structural members and fire rated assemblies.
- 7.2 The installer should consult www.osha.gov 2001 Code of Federal Regulations, Chapter 29 Part 1926 Safety and Health Regulations for Construction.
- 7.3 The installer shall have proper safety equipment when working on elevated surfaces, as per OSHA requirements. Fall protection equipment must be used with the proper training. Having a helper or two on site will ease installation.
- 7.4 The homeowner and installer shall confirm the location of all roof mounted components in advance of the installation.
- 7.5 The solar panels must be located in a structurally sound area of the roof that will be un-shaded for the majority of the day all year round. Adjacent buildings and trees should be checked for possible winter shading.
- 7.6 Before the installation the installer shall inspect the condition of the roof and notify the homeowner of any existing roof damage or necessary repairs.

8

INSTALLATION – SPECIFIC REQUIREMENTS

In section nine, step-by-step procedures for installing a typical Caleffi system in a home are given. Several helpful photos and illustrations are included. The remainder of this section lists important general requirements for your solar system installation.

- 8.1 **Panel Orientation** -The performance of solar water heating systems in North America is optimized when the panels are mounted facing True South. Performance, however, suffers little when the solar panels are oriented less than 30° East or West of True South. The panels should be un-shaded by any permanent obstacle between 9:00 a.m. and 3:00 p.m. on any day of the year.
- 8.2 **Panel Tilt** - For solar hot water, optimal annual efficiency is achieved by tilting the solar panel at an angle that equals your latitude.
- 8.3 **Basic Panel Mounting Guidelines** -The solar panels in your Caleffi system are intended to be mounted in a vertical orientation on the roof. Although the panels are protected from freeze conditions by the HTF and does not normally need to be drained, sloping the panels just slightly will make drainage easier if it becomes necessary. The recommended slope is 1/4" per foot of horizontal run.

The location, orientation, and position of the collector relative to nearby objects and surfaces shall be such that water run-off from the solar panel is not impeded nor is excessive build-up of snow on lower portions of the solar panel glass permitted to occur.

To ensure proper water drainage from the glass, the panels should be inclined a minimum angle from horizontal of at least 10°. In regions that get heavy snowfalls, a minimum 40° is recommended to facilitate snow melting from the panels.

Never mount the panels directly onto a flat roof surface. Always use the included Caleffi universal foot mounts. Tilt mount kits (accessory) are available to incline the panels. Reference section 9.11.

The panels should be mounted as close to the storage tank as possible to minimize heat loss in piping runs. If the home has attic access, mounting the panels near the roof peak provides maximum attic workspace. In snowy areas, this position also minimizes snow accumulation at the top of the panels (if they are to be flush mounted).

Roofing Considerations: The solar panels should be mounted on the roof in accordance with these principles:

- The most important structural consideration is to securely anchor the solar panels and universal foot mounting hardware to the structural members of the roof with stainless steel fasteners. Please reference sections 9.5, 9.6, 9.7.
- Using the universal foot mounts will raise the panels from the roof surface to allow rainwater and debris to pass under the panels and allow proper ventilation of the roofing material. If the roof design or shape prevents the use of the Caleffi foot mounts, the panels must be raised from the roof by at least 1 1/2" of clearance.
- In selecting mounting hardware and fasteners it is important to avoid galvanic corrosion resulting from the direct contact of incompatible metals. Use of Caleffi aluminum mounting hardware and stainless steel fasteners, lock washers and round washers is recommended wherever possible. In climates subject to severe winters or high humidity use of galvanized fasteners is prohibited.
- Preserving the integrity of the roof membrane is important. Ensure that all roof penetrations required to plumb and mount the solar panels are properly flashed and sealed in accordance with standard roofing practices. Reference section 9.7 for recommended sealants.
- If the region is subject to hurricane conditions, additional steps may be required to secure the panels and mounting hardware to the structural members. In certain areas of the country, local building codes may require panel wind load testing or prescribe specific mounting procedures. Consult your local building department.

8.4 Panel Loop Pipe Insulation - Solar Flex is used for the solar panel cold supply and hot return lines. Solar Flex comes pre-insulated and includes union connections. Exposed connections should be insulated using the supplied UV resistant insulation and tape. Reference section 9.20.

8.5 Panel Plumbing - All vertical runs of SolarFlex between the storage tank and the panels should be supported at each story or at maximum intervals of ten feet (10'). Caleffi provides 4 specialized mounting brackets for support. The brackets hold the SolarFlex securely without compressing the insulation. Reference section 9.14.

8.6 Back-Up System Connections - Interconnection of the back-up heating portion of the system to the solar portion of the system shall be made in a manner which will not result in excessive temperature or pressure in the back-up heating system or bypassing of safety devices of the back-up system.

8.7 Low Voltage Wiring - The low voltage wiring used to connect the sensor wires is included with the SolarFlex – the wire is imbedded in the middle of the SolarFlex. Joining the sensor wire to the SolarFlex wire should be done using waterproof butt splices, or soldered connection with heat shrink protection, or waterproof telecom splice kits. Reference section 9.14.

8.8 Installing Solar Storage Tank, Expansion Tank and Pumping Station - When plumbing the solar storage tank and expansion tank, make sure all the components are accessible and easy to reach. Provide for clear access to the storage tank, pumping station, expansion tank, mixing valve (available as an accessory), controller and other key components. The controller should be located in close proximity to a 115 volt electrical receptacle.

The storage tank should not be placed directly on an un-insulated floor or concrete slab. The tank should be placed on a well insulated pad with a minimum R-value of 10. A 2" rigid polystyrene insulation pad is a good solution.

For a two tank system, position the solar storage tank in close proximity to the back-up hot water heater or boiler to simplify plumbing.

If a component in the potable water side of the system may require future service or maintenance, make the connections with brass unions. Use only brass nipples and unions and copper and brass fittings in plumbing the solar storage tank. The use of galvanized fittings or nipples, di-electric unions, CPVC, PVC or other plastic pipe is not recommended.

Hard copper connections to the city cold water supply line and the home hot water feed lines are recommended. The gaskets in standard water heater flex hose connectors can become brittle and compressed over time and begin leaking on the water heater. If not detected in a timely manner even a small drip or leak may cause serious damage to the tank's electrical components or, in extreme cases, may cause the tank to leak from the outside in.

All interconnecting hot water piping and the final 5 feet of metallic cold water supply pipe leading to the system, or the length of piping which is accessible if less than 5 feet, shall be insulated with R-2.6 or greater insulation.

8.9 Building Related Installation Requirements

Firestopping - The SWH system components shall be assembled such that fire stopping shall be possible at time of installation, if required by local codes and ordinances.

Space Use - Solar components should not reduce or increase humidity, temperature or thermal radiation beyond acceptable levels or interfere with required headroom or air circulation space.

Building Penetrations - Penetrations of the building through which piping or wiring is passed shall not reduce or impair the function of the enclosure. Penetrations through walls or other surfaces shall not allow intrusion by insects and/or vermin. Required roof penetrations shall be made in accordance with applicable codes and also by practices recommended by the National Roofing Contractors Association.

Water Damage - Collectors and support shall be installed in such a manner that water flowing off the collector surface will not damage the building or cause premature erosion of the roof.

Structural Supports - Neither wind loading (including uplift) nor the additional weight of filled solar panels shall exceed the live or dead load ratings of the building, roof, roof anchorage, foundation or soil. Solar panel supports shall not impose undue stresses on the solar panels. The design load shall be as specified by the codes in force at the installation site and shall include an additional load due to snow accumulation for applicable locations.

Penetration Of Structural Members - When penetrations are required in structural members to accompany passage of solar components, those modified structural members shall comply with local building codes.

Protection From Thermal Deterioration - Building materials adjacent to solar equipment shall not be exposed to elevated temperatures which could accelerate their deterioration. Many non-metal roofing materials will soften in the temperature range of 140-180°F and begin to degrade above this temperature.

Penetrations Through Fire-Rated Assemblies - Penetrations through fire-rated assemblies etc. shall not reduce the building's fire resistance required by local codes, ordinances and applicable standards.

Emergency Egress and Access - The design and installation of systems shall not impair emergency movement of the building occupants.

Illustrative Installation Steps

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9.1

Overview

This section is a step by step photo instruction of a typical residential solar hot water heater installation. A 45 minute DVD video is also available showing these installation steps and is included with the Caleffi solar system.

We show only the solar side of the system being installed. Since the back-up equipment and installation procedures are site and application specific, these are not included.

Though not representative of every installation, these instructions will greatly simplify the task of installing any Caleffi solar system.

9.2

Tools and Supplies Required

- Ladder(s) for roof installs
- Fall protection gear
- Ropes, slings or webbing to lift panels from ground to roof
- Tape measure
- String or chalk line
- Drill and screw gun
- Miscellaneous wrenches and channel lock pliers for mounting hardware and connecting unions
- Small flat head and Phillips screw drivers
- Wire splices and wire crimpers
- System filling pump and fill/purge hoses
- Large bucket (5 or 10 gallon)
- Roofing sealant



9.3

Specialized Materials to be Supplied by Contractor

- Stainless fasters for mounting solar panels onto roof (see instructions below explaining options).
- Roof jack components. (Your choice of these parts will depend on what kind of roof the Solar Flex piping will be routed through. Because of the myriad roof types and materials used, these components are installer determined and sourced.)
- Electrical wire crimp connections.
- Electrical wire waterproof butt splices, or waterproof telecom splices.
- Hand pump or air compressor.
- Caleffi solar accessories (if required) including solar panel tilt braces, pumping system mounting kit, thermostatic mixing valve, diverting valve, additional temperature sensors, etc.



9.4

Parts Check and Uncrating

- At the installation site, unzip the protective cover off of crate. Keep the cover available in case it can be used later to place over panels and prevent hot union connections while working.
- Open end of the crate with a hammer or pry bar and remove individual component cardboard packages. Open each carton and familiarize yourself with their contents.
- Remove solar panels by sliding them out of the crate from either end. Remove the 4 protective wooden blocks and yellow protective plastic caps.

9.5

Locating the Panels on Roof and Marking Lower Position

- Outline with chalk or marking pen where the panels are to be mounted on roof. Panel dimensions are 4ft x 6 ½ ft. If more than one panel will be mounted, the union spacing between the panels will take up 3 ½ inches.
- In determining the outline, care should be taken to insure the Solar Flex can be routed through the roof without obstructions from below. In some installations, the installer may elect to route the Solar Flex down the side of the building rather than through the roof.
- Panels ideally should be mounted at least 12 inches down from the roof peak. This will keep them away from potential up-lifting wind conditions, and away from ridge cap venting and or flashings.
- With the panel location outlined, use chalk line to snap a horizontal line where the panel bottom(s) are to be positioned. Along this line, you will next mark off where the rafters underneath intersect and where you will sink your fasteners to secure the lower brackets.



9.6

Locating Joists and Marking Lower Fastener Locations

Extra care should be taken to make sure your mounting screws are located properly and attach securely into rafters (or suitable mounting blocks).

- If there is access from the attic below, you may chose to measure off from a plumbing vent, chimney or other roof penetration. If not, use a small diameter 3/16" by 12" long drill bit to make a small pilot hole just next to the rafter. This "locator" hole can then be used to measure off where the rafters are located. (After being used, the hole should be sealed with silicone caulk or roofing patch material, depending on roof material type).
- Alternatively, an electronic stud sensor can help locate the rafters from the roof side.
- Mark off along chalk line where rafters intersect. Commonly, rafters are spaced 16" on center.





- For each panel, choose the best intersections to place 2 mounting brackets and ensure good panel support. Bracket locations should be no more than approximately 12” away from the panel side.

9.7

Mounting Lower Brackets



- With the locations for each lower bracket determined, place roof sealant on the underside of the brackets. *“EternaBond”* double stick roofing tape is an excellent product for sealing the mounting hardware to a wide variety of roofing materials. *“Through the Roof”* is another good roofing caulk available in squeeze or caulk gun tubes. Check with a roofing supply company for these or comparable products.



- Secure the brackets into the roof. Each bracket has two holes – for convenience, either hole may be used. Stainless steel lag or anchor bolts or corrosion resistant anchor screws for mounting to rafters are suggested.
- Always drill a pilot hole into the rafter before screwing into them with a bolt. A drill 1/3 the diameter of the lag screw diameter is recommended. Example: a 1/8” pilot hole for a 3/8” lag bolt. Consult with a fastener supplier for additional hardware advice.
- Be sure the brackets are mounted securely to provide strength against sliding and up-lift forces.



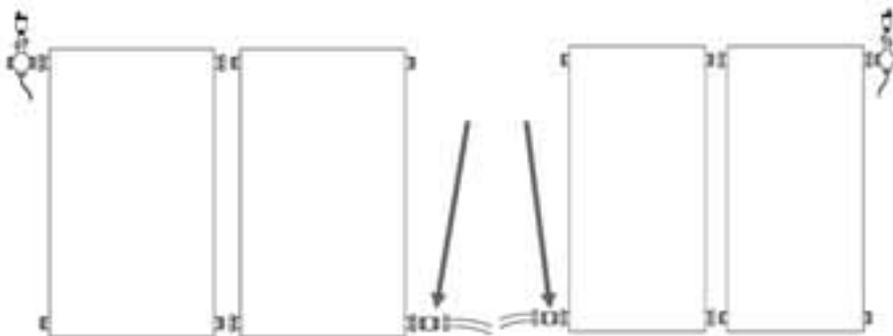
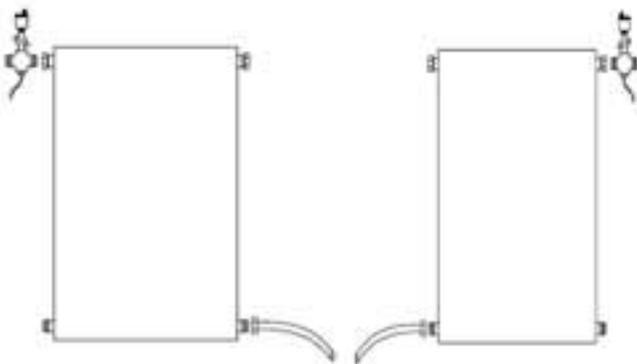


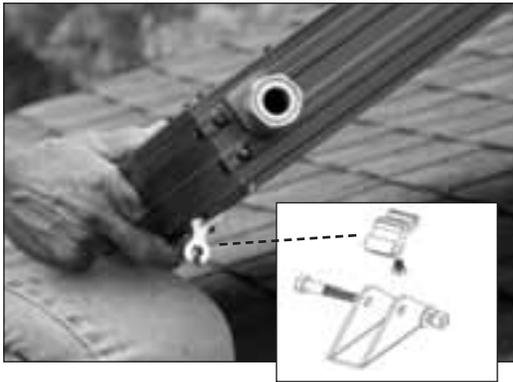
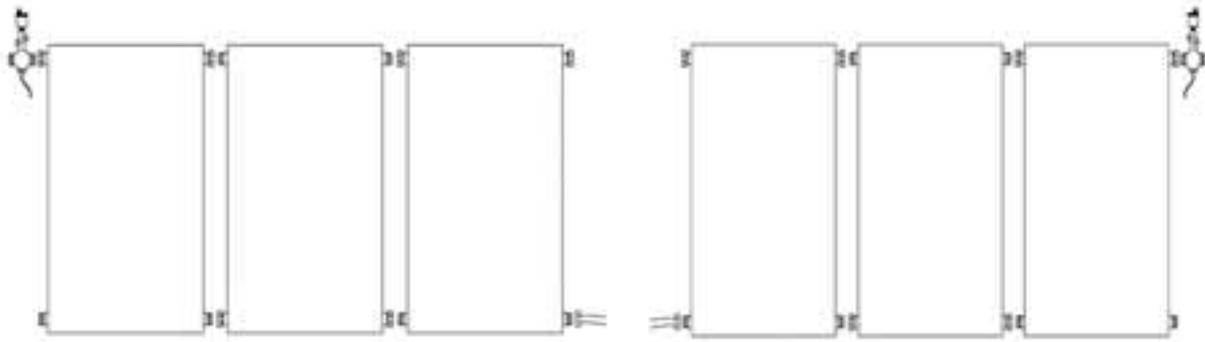
- If you cannot locate the center of a rafter, an alternative approach is to use a 2X4 block across two rafters. You will need bolts or threaded rod to reach from the roof, across the width of the rafter and block. Use stainless steel or plated threaded rod and a block between the roof and lower spreader.
- Another alternative is to use an L or J bolt under the rafter and through the roof. This picture shows a typical foundation bolt with a piece of perforated tape to hold it in place until the panel bracket is mounted and tightened from above.
- Consult with a roofing contractor if you are unsure about the correct way to seal any penetrations. They will have specialized roof flashing or compatible sealants to assure a leak free, professional installation.

9.8

Panel Orientation

- All Caleffi panels have union fittings pre-installed on the manifolds for quick and easy assembly. A green fiber washer must be used on every connection.
- Below is how to orientate the panels depending on whether you are installing a one, two, or three panel system. Orientation also depends on the direction you are bringing Solar Flex into the panel from.
- Note that adjoining panels are rotated 180 degrees from one another to allow the male and female unions to line up.
- Also note that when installing a two panel system, a male to male union nipple is used to connect between the lower panel female union and Solar Flex. This nipple is included in the parts box.





9.9

Putting Panels into Place

- Before placing panels on roof, install the 4 clips onto each panel. Allow each clip to slide in the groove by not fully tightening the fastener screw. Do not tighten clips down securely until after all union connections are made.



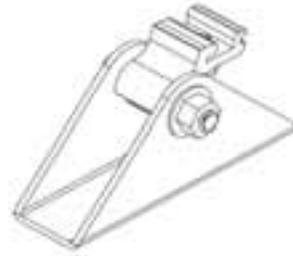
- Web (or rope) lifting slings are suggested for lifting panels onto a low single story roof. Using a ladder facilitates lifting. A typical method is two people on a roof pulling ropes while a third person on the ground helps push the panel upwards.



- For higher roofs, scaffolding can be used - especially for higher surfaces. Or, truck mounted cranes are another method. Sign companies or crane operators are generally able to lift panels onto a roof.



- Starting with first panel, move the panel into place on the bottom brackets and install the mounting bolts.



- With the lower brackets mounted onto the first panel, place the second panel (and then additional panels if applicable) into its respective mounting brackets and install mounting bolts through clips.

9.10

Connecting Panels Together



- Slide panels close together. With the mounting clip screws still loose, the panels should slide easily. If not, check that the clip screws haven't been accidentally tightened down.



- Connect the union fittings. Again, be sure to include a green washer for each connection.



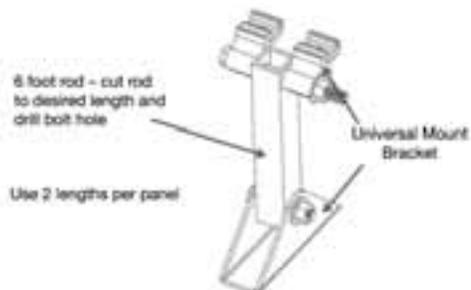


Note: there will always be two ports left unused once you have made the Solar Flex and cross assembly connections. To seal these off, locate the plugs or caps in the parts box. Fasten the appropriate fitting into the unused ports. Again, be sure to use a green washer.

9.11 Mounting Upper Brackets

- With the panels now connected together, the top mounting brackets can be fastened into the roof. With the brackets mounted to clips, mark on the roof where the fastener should penetrate. Separate the clips from the brackets, and then screw the brackets into the roof. Lower the panel and fasten clips into brackets.
- If the pitch of the roof is insufficient for the desired panel inclination, a “tilt mount” accessory brace is available as an extension between the brackets and clamps.

Tilt Support Accessory



9.12

Connecting the Cross Assembly to Upper Manifold



- Locate the 4 port cross assembly and assemble the **black** wired temperature sensor probe into the dry well port.



- Screw the partially assembled cross into the upper manifold female union.



- Install the solar air vent and isolation valve into the top of the cross.



- Level air vent to vertical position. Keep isolation valve in the open position for now. After air has been purged from the system, you will be closing the isolation valve.

9.13

Running Solar Flex through Roof and Connecting to Solar Panel

- For flashing the Solar Flex through the roof we suggest using a PVC or ABS sleeve to route the Solar Flex. We chose for this installation to make two roof penetrations – one to be made near the panel outlet and one to be made near the panel inlet. (Alternatively, we could have chosen to make only one **larger** hole penetration and run the Solar Flex up through the roof, and then split it to connect to the supply and return ports on the panel).

Note: a 4" sleeve will accommodate Solar Flex that hasn't been split into supply and return. Split sections of Solar Flex will fit inside a 3" sleeve.



- The roof jack assembly used in this example includes a 3" PVC sleeve glued to a 90 degree PVC elbow. The pipe is pushed down through a standard plumbing asphalt roof jack cover. At the elbow we show using a Fernco rubber cap where we cut a hole out of the center. The Fernco cap is secured in place with a metal band clamp.

Note: If you have minimal internal obstructions, you may chose to run the sleeve from the roof all the way down to the pump station location in the building. This is often possible with new construction and makes routing Solar Flex simpler.

- Standard plumbing roof jacks work well for asphalt roofs. For metal roofs look for a **"Master-Flash"** or equivalent brand flashing. For tile, gravel, or membrane roofs, consult with a roofing professional for the proper flashing and installation procedure.



- Locate where to penetrate the roof to allow the most convenient connection. Plan a roof penetration that misses any rafters or other obstructions. Have the roof jack on hand, and assure it fits the tube **BEFORE** you cut into the roof.



- Cut a hole appropriately sized for the diameter of PVC or ABS used.



- Lift asphalt shingles and place roof jack assembly under shingles.



- Seal underside of roof jack and nail into place.



- Under the roof, use suitable wood blocking and a PVC “J” clamp to firmly secure the roof jack assembly.
- Routing the Solar Flex piping is next. Inside the building, run the Solar Flex up from where the pumping station will be located, through the building to under the roof where the panels are located. (Alternatively, if easier, run the Solar Flex **down** from the under roof to pumping station location.)

- In many applications, there will be excess length of Solar Flex from the 50 foot coil provided. If so, cut off what is not needed. Use standard pipe cutters to cut the stainless steel tubing.



- With Solar Flex now run through the building, under the roof you can split the supply and return lines. Simply pull the sensor wire to unzip the insulation on one side. A sharp knife will cut the opposite side. Use caution to not cut into the sensor wire. Note that there are lines on the outer surface of one side. This is to keep track of what is **supply** and what is **return** at connection points.



- Have a helper assist in pulling one side of the split Solar Flex up through the hole (or holes) in the roof. Attach the union nut and stainless clip ring using the following procedure.





Cut pipe with tubing cutter. Do not use a hack saw.



Slide on 1" union nut and close segment ring around pipe groove.



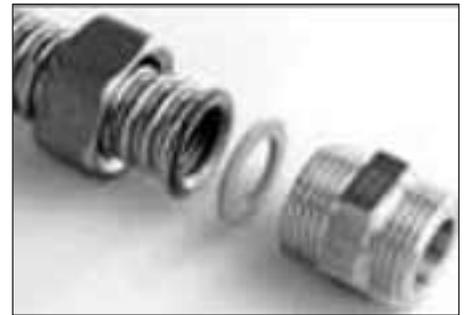
Connect 1" nipple with 1" union nut without flat-sealing washer.



Tighten 1" nipple to 1" union nut. Forming a flat-sealing surface.



Remove union nipple to inspect flat-sealing surface.



Insert flat-sealing washer and connect to other fittings.



- With the Solar Flex union now assembled, connect to the cross.





- Put Fernco cap in place. Seal off using any remaining openings with roof cement. Tighten up clamp. Run the panel sensor wire down through roof. A helper can simplify this task.



- With this first roof penetration and connection done, repeat the process for the other connection. Caleffi offers various fittings used to simplify connections. In the photo we show an optional elbow accessory being used.



Before leaving the roof, double check that all connections are tight and secure. Use Fire caulk to seal any penetrations into the building envelop as per building codes.

9.14

Splicing Sensor Wire to Solar Flex Wire



- Connect the Solar Flex wires to the panel sensor wires. The wires are polar neutral.



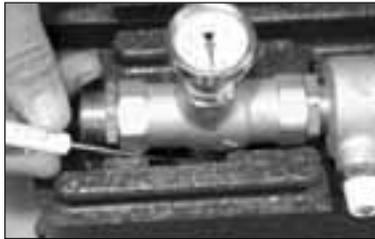
- Any piping through the attic or basement should be properly supported. We recommend supporting Solar Flex every 36 inches. A hanger kit of 4 brackets is included in the parts box.

9.15

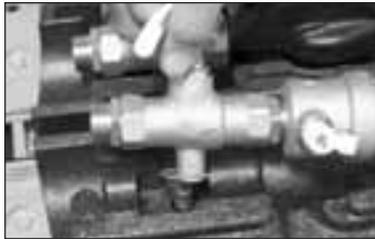
Storage Tank and Pump Station Installation



- Position the storage tank in place. Locate tank where there is 120 volt outlet available.



- Remove the components from the Solar Pump Station by sliding the spring clips out.



- With the components removed you can mount the bracket and then the pumping station to a nearby wall.



- Alternatively, you can use the Caleffi tank mounting kit to mount the pumping station onto the tank. We show that procedure here. From the kit, locate the angle bracket and bolt it to the pump station bracket with the two bolts included.

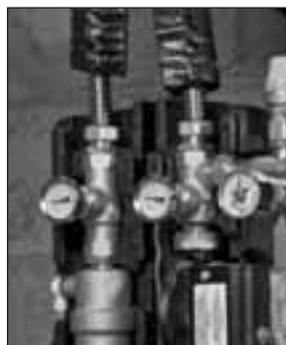




- Place the angle bracket on top of storage tank where you want to mount the pumping station. This is usually directly above the heat exchanger ports to simplify piping. Drill 3 shallow pilot holes, and then use the supplied self tapping screws to mount the bracket assembly to the tank.



- The pump station components can now be re-assembled to the bracket. First install the rear foam cover over the brackets. Then push the two pump station assemblies onto their respective pins on the mounting bracket. A click sound will indicate the components are locked securely onto the pins.



- With the pump station mounted onto the wall or solar storage tank, cut to length and install the Solar Flex coming from the roof onto the top connections. The Solar Flex has a marking along one side to indicate the supply and return. Be sure the pipe coming off the solar panel top (**hot side**) connects to the **left** side of the pump station above the air removal and valve assembly. The pipe coming off solar panel bottom (**cool side**) connects to the **right** side of the pumping station.



- Locate the two 6 foot sections of Solar Flex for connecting the pumping station to the tank.



- **The bottom left** connection on the pump station connects to the **top coil** connection on the solar tank. **The bottom right** connection on the pumping station connects to the **bottom coil** connection on the storage tank. You may want to shorten the Solar Flex lengths. If so, cut and reattach the union connections using the procedure detailed on page 15.



- With the section lengths now cut, install the brass street elbows onto the upper and lower tank coil connections. Turn the elbows to face up.



- Make the 4 connections.



9.16

Expansion Tank Installation

- Mount the solar expansion tank bracket, and then connect the expansion tank to the brass double check valve. Be sure to use green washer at all connection points.
- Connect the expansion tank hose ends to the pumping station and check. Remember to use washers.

Note: The expansion tank is for the solar system. A separate DHW thermal expansion tank may be required on the potable water side as per plumbing codes. Check with a supplier for correct sizing of this tank.

This tank is not included in the Caleffi package.

9.17

Controller Installation

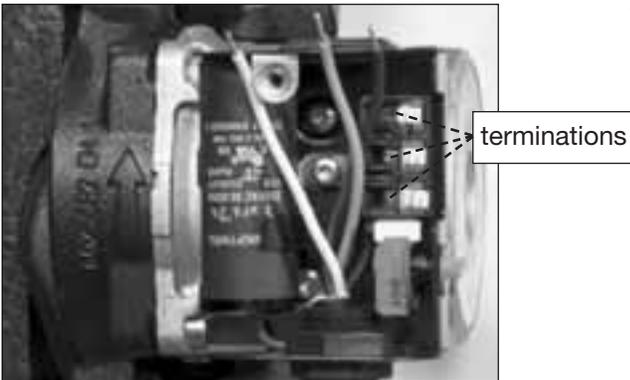


- Mount the controller into the pumping station insulation front. The power cord routes through the lower right hole in the insulation.



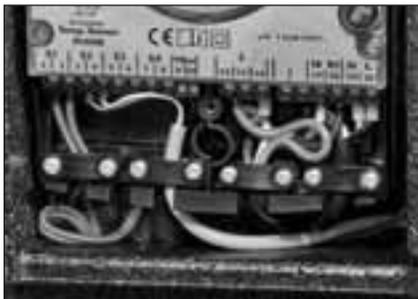


- Fasten temperature probe (the one having grey cord) into the bottom tank sensor well.



- Unscrew plate from front of pump. Run 18 inch “J cord” that comes with kit up through the bottom strain relief port. Connect the 3 wires into the motor. Consult the included Pumping Station installation instructions for more details on wiring motor.

Note: depending on local electrical code, and where the pumping station is in relation to the ceiling, a heavier gage wire may need to be used. Check local electrical code.



- Connect the other end of “J cord” into the controller. Connect the sensor wires. Consult the included **iSolar** controller installation instructions for more details on wiring controller.



- Place controller into the insulation and secure with screws from the back.



- You have now finished installing the basic plumbing portion of the solar panel loop of your solar system. Finish plumbing the back-up heat side of your system portion including the thermostatic mixing valve. Refer to section 4 for guidance.

Double-check for adequate tightening of all fitting connections at the solar tank, pump station, and solar panel connections. You are now ready to fill the solar storage tank with water followed by adding the HTF to the solar panel loop.

9.18 Filling & Flushing

Filling Solar Storage Tank

First, open up a hot water faucet within the house. Then open the cold water isolation ball valve to the solar tank. After the tank is filled, close the hot water faucet and inspect all threaded fittings and solder joints for leaks.

Warning: For a single tank system, never activate the circuit breaker controlling the electrical heating element until the solar storage tank is completely filled with water. This will prevent “dry firing” of the heating element. The electrical heating element can be destroyed almost instantaneously if not completely submerged in water when activated. Make sure the water heater circuit breaker is off until the solar storage tank is completely filled.

Flush and Pressure Test Solar Loop

Though the Caleffi solar system components come capped at the ports and minimize chances of dirt getting in, you may want to flush the system to insure dirt is not present.

A convenient method is to simply use a garden hose with at least 30 psi pressure. First, make sure the air vent ball valve is closed on the solar panel. Open up the two check valves on pumping station. Ref section 10.3 Attach garden hose to the bottom bib on the pump station. Connect another hose to the top bib and put the end into a drain. Close the middle isolation valve. Turn on the water and let it run for 5-10 minutes. By this

time, the water draining out of the hose should be void of air bubbles.

Close off the top bib valve. Check for leaks at all connections. Tighten down if necessary. Turn off water and let the water in the loop drain back out of the top and bottom bibs. Loosen the solar flex connection to bottom of storage tank to drain the remainder of the water. Tighten solar flex connection back up. Insulate the two brass elbow connections to the storage tank. Reset the two check valves on pumping station.

Note: if the outside temperature is below freezing, use a pressurized air test method to avoid any water freezing problems.

Filling & Pressurizing Solar Loop

- You are now ready to fill the solar loop. First, determine the pressure to set the solar loop to. You will want to obtain 20 psi gage pressure at the loops’ highest point. This pressure will keep the system working optimally, and prevent glycol from flashing into vapor in the panels.

Procedure:

- Starting with 20 psi, for every floor level between solar panel and storage tank top, add another 5 psi
- Example: Tank is in basement and panels are on roof of one story home. Set pressure to = 20 psi + 5 psi/floor * 2 floors = 30 psi



- Adjust expansion tank pressure to equal the solar loop pressure. Black cap spins off revealing valve.

Note: expansion tanks are typically pre-charged in the 30 to 60 psi range.



- For filling the solar loop, use a hose capable of handling high pressure as your fill hose. A washing machine hose works well. For your purge hose, we recommend you use a clear hose. This is so you can see the presence of air bubbles in the glycol as it is purged from the loop.



- If you do not already have the proper hose connections, the pump station conveniently includes two spare ones. These incorporate barb connections that you can place in a hose end and clamp.



- Turn the center valve to the closed position. Connect the fill hose from the fill pump to the bottom connection and open this valve. The fluid will be pumped down through the solar tank coil back up to the solar panel and back down to the return (left) side of the pump station.
- Use the clear vinyl hose on the upper valve as the purge hose. Open the purge valve after connecting.



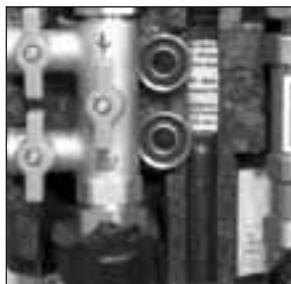
- Open the glycol pails (the kit typically contains two). Place your fill hose into first pail. Place your purge hose into a large empty bucket. Turn the pump on and begin pumping into the solar loop. As you finish emptying a pail, quickly begin pumping from another glycol pail.



- Sometime during the step above, glycol will begin coming out the purge hose. Place the fill hose in the drain bucket so you are pumping out of it and purging back into it at the same time. Keep circulating the fluid until a full stream is coming out and there is very little air remaining. The more air you get out, the easier the following air purging process will be.



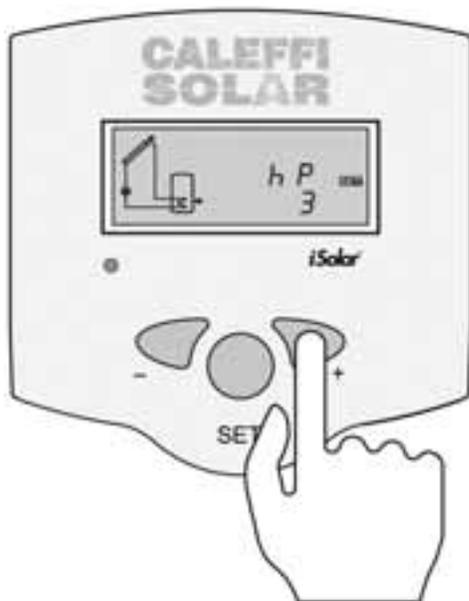
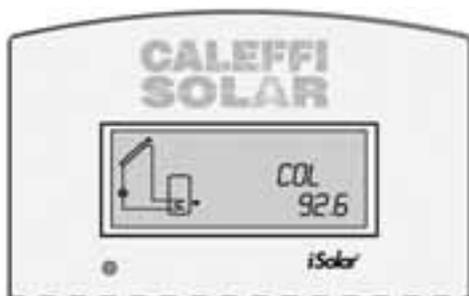
- With most of air in the system removed and the pump still running. Pressurize the system up to the desired value calculated earlier.



- With the desired pressure set, close off both the fill and purge valves, and open up the balancing valve. Turn fill pump off.
- Remember to set the expansion tank pressure to the system pressure. If expansion tank pressure needs increasing it can be done with a simple hand pump or a compressor. The red dial on the pressure gage can be set as a reference for future pressure checks.
- You are now ready to begin purging the system of air.

9.19

Purging Air



- Locate the Installation manual for the iSolar controller. Out of the box, the controller is preprogrammed to not require adjustments for many applications. However, this this iSolar controller manual will detail the specific instructions on how to make changes to any of the default settings.
- Plug the controller power cord in. The control will illuminate. The screen will look like this. (The 92.6 in this example is the temperature at the collector.) Navigate through the menu items to familiarize yourself with the control.
- Scroll through the control by pushing the "+" button until it stops at the pump hours "h P" screen. Hold the "+" button for 2 to 3 seconds to enter the programming mode.
- Scroll the control over to the "HND 1" menu. It will look like this. Push the "SET" button to change setting.
- Set it for "On" by pushing the "+" button to "On" and then push the "SET" button. The screen will look like this.
- You will notice the pump activate. Set the pump to the highest of the 3 speed settings.
- Purge the air per the following procedure. You will want to come back to the job over the next couple of days and then periodically afterwards. The procedure addresses purging air then too.



1) *If it is used, open up the air vent ball valve on solar panel. You will likely hear air being expelled from air vent.*



2) *Manually open air vent located in pumping station. Air should also expel from here. When fluid begins to expel, close vent.*

3) *Within the next few days after fluid as had a chance to heat up from the sun,*

Repeat step 2) above after manually turning on pump. When only fluid expels when manual vent is opened, system air has been sufficiently removed. Check that pressure hasn't changed.

Close air vent ball valve on solar panel. The air vent is no longer needed and can be removed if desired for aesthetic purposes.

4) *Repeat step 2) approximately every 12 months and expel any trapped air. Check pressure gage to ensure pressure hasn't dropped below desired level. If so, re-pressurize system to maintain optimal performance.*

9.20

Setting Flow Rate

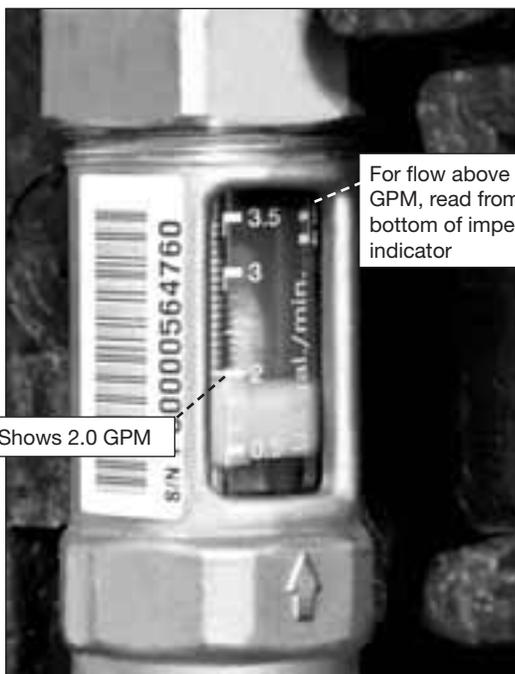
- With the air now purged, set the pump flow rate. Use the site gage located underneath the pump to see flow. The photo example shows 2.0 GPM.

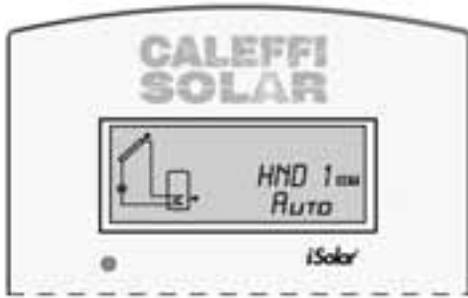
- For a one panel system set flow to 1.5 GPM, for a two panel system set flow to 2.0 GPM, for a three panel system set flow to 3.0 GPM. If you are adding additional panels onto system, increase flow rate 1 GPM for each panel added.

- Make sure balancing valve is fully open. Set pump speed to lowest speed setting.

- If flow rate is greater than desired value, use balancing valve to adjust back to obtain desired value.

- If flow rate is less than desired value, set pump to second (or third if needed) speed setting and adjust balancing valve back to obtain desired value.





- With the air purged and flow rate set, set the control back into the Auto mode. **If you forget to do this, the pump will continue pumping regardless of sensor temperatures.**

Electrical and Wiring

The back-up heating system can now be wired up. A properly licensed contractor must make any required 230 volt electrical connections (to the back-up heating element or electronic time switch for a one tank system, or to an electric back-up water heater).



- Your solar system is now ready to begin harvesting energy.
- Over the next few days when you come back to finish air purging, double check that all connections are sealing properly. Then, using the supplied insulation roll and tape, insulate the cross assembly and any other exposed connections.



OPERATING INSTRUCTIONS

10.1 Changing Controller Default Settings - With the exception of manually turning the pump on and off (ref section 9.19) , the default control settings allow plug and play capability for the majority of basic hot water heating applications. To change any default settings on the controller, reference the *iSolar Controller* installation manual. However, here are some of the more common changes an installer might invoke when using the *iSolar 2* or the *iSolar Plus* controllers:

Storage Tank Max Temperature - The default setting is 140°F. Some installers might choose to adjust as low as 120°F, or as high as 160°F. In all cases where outgoing water from a water heater can exceed 120°F, using a 3 way thermostatic mixing valve guards against temperatures of potentially scalding levels.

Recooling Protection – Described earlier in section 6.

Minimum Pump Speed – The Caleffi controller automatically increases and decreases pump speed from 40% to 100% of maximum to correspond with how much heat is being harvested by the solar panels. This feature minimizes electrical consumption by the pump, and optimizes the heat transfer efficiency in the storage tank. In installations with Solar Flex runs greater than the standard 50 feet coil length, 40% may be too low to keep the check valves fully open. The installer may elect to increase the minimum value to 50 or 60% to create sufficient pump head to keep the checks open and deliver specified flow.

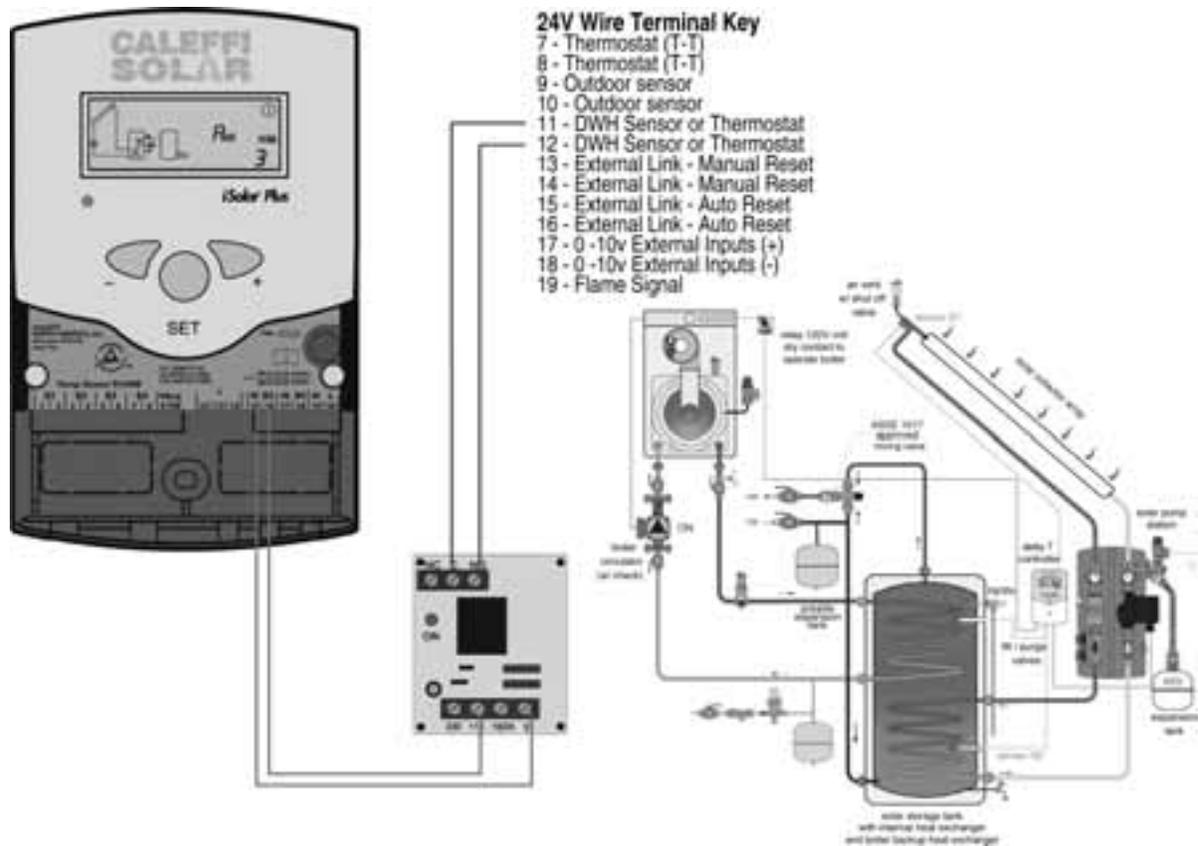
Heat Metering – The control can be programmed to measure the amount of heat that has been produced by the solar panels. Some solar system owners might desire knowing how much energy their investment is producing. The heat measurement units are KWh. To enable Heat Metering, a third sensor (accessory) must be used and wired to the controller and connected to the S4 sensor input. The sensor should be placed on the pipe leading out of the storage tank to the panel. The heat measurement is on a total accumulated basis and the control can be re-set to value 0.

10.2 iSolar Plus Controls Programming - Caleffi Solar systems featuring the iSolar Plus controller give additional application flexibility. Please consult the iSolar Plus Controller manual for detailed steps to program the controller.

Heat Diversion – Described earlier in section 6.

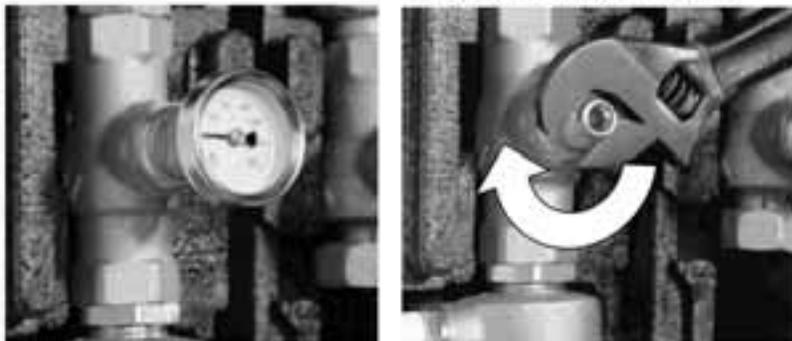
Boiler Delay – In “Boiler Back-Up” systems using two coils in the storage tank, the top coil is used for providing heat back-up using a boiler. If the tank is cool when the sun comes up, the boiler will attempt to heat the storage tank regardless. This effectively reduces the energy savings potential of the solar system. To “**disable**” the boiler from heating the tank when the sun is out, the iSolar Controller has a Time of Day feature that will prevent the boiler from firing. To perform Boiler Delay, Arrangement 3 needs to be selected on the controller, and a separate relay accessory (installer sourced) is required. Boiler delay enabling should only be performed by a contractor familiar with the hot water priority scheme of the back-up boiler.

Figure 10.1
Example Schematic Showing Boiler Delay



10.3 Draining Panels and Piping - If panel draining is ever required, the check valves in the solar pump can be manually opened. Remove the temperature gauges located in the two isolation valves. With a wrench on the flat spots of the valve, turn 45 degrees. This will hold the internal spring loaded checks in the open position. The system can now be drained by opening the pumping station fill and purge bibs. ***Don't forget to turn back after refilling the system.***

- 45 deg turn holds check valve open
- 90 deg turn closes valve



10.4 ISOLATING THE MAJOR COMPONENTS AND SYSTEM SHUT DOWN PROCEDURES

Your solar water heating system is designed so key components can be easily isolated for emergency repairs or routine maintenance. By shutting a single valve you can isolate the entire system from the pressurized cold water supply line (reference item 3 in figures 4.1, 4.2, 4.3, 4.4).

The solar loop can be isolated from the solar storage tank by closing the two isolation valves on the pumping station. See figure 10.3 above. If the pressure in this loop drops or you find a glycol leak shut these valves and contact your installation contractor. Turn the circulating pump off by either unplugging the controller, or setting the controller to the “off” position.

In two tank systems the solar storage tank can be isolated from the back-up water heater. Reference figures 4.3 and 4.4. In the event isolation is required, the two normally open valves (item 1) that connect to the solar hot water heater should be closed and the normally closed valve (item 2) should be opened.

10.5 EXTENDED SUMMER VACATION

Solar water heating systems can build up very high temperatures when there is no daily draw on the system. If your system isn't set up to perform heat diverting and a short summer vacation is planned, heat can be dissipated in the system by enabling Recooling (ref section 6).

During extended summer vacations (4 weeks or more) it is advisable to either cover the solar collectors with an opaque material or to manually drain the HTF from the solar panels. Caleffi recommends that you cover the collectors if practical.

If draining the HTF in the solar loop is chosen, follow instructions in section 10.3 above. Only the fluid volume in the panels need to be drained out - there is no need to drain the entire system. **DO NOT DUMP HTF INTO A STORM SEWER, ON THE GROUND OR INTO ANY BODY OF WATER. BE CAREFUL. THE HTF MAY BE EXTREMELY HOT!**

When you return home contact your service contractor to recharge the system with HTF. After the system has been recharged, have the controller reset to the “automatic” position.

10.6 Solar Loop Pressure

On a sunny day when the system is operational, the pressure in your solar loop should not exceed 60 psig. Contact your solar contractor if the loop pressure exceeds this threshold.

11

MAINTENANCE

11.1 Heat Transfer Fluid Quality

The chemical composition of the HTF may change over time. The HTF quality should be monitored on a periodic basis – at least annually. After summer and before any chance of the first freeze is an ideal time. A drop in pH can indicate the system has been stagnating frequently. The cause should be determined and corrected. Consult with a qualified contractor for the correct course of action.

To test the pH level, use a digital pH tester or tight range litmus paper. Remove a small sample of the fluid from the purge valve on the pump station (see 255/256 series Pumping Station manual for valve location.) A small sample of several tablespoons in a clear jar is sufficient. pH should be between 8.1 and 12.0. Fluid with pH between 7.5 and 8.1 can be conditioned by your contractor using an inhibitor boost. Fluid with pH above 12.0 or that is dark, dirty or has an acidic smell should be replaced.

The HTF freeze protection level should be checked annually. A refract meter is the best tool for this. Freeze/ burst protection should be - 75°F.

Reference Appendix 1 which shows details on HTF maintenance.

11.2 Piping and External Insulation

On an annual basis, all piping should be checked for leakage at joints, shut-off valves, and unions. Any damaged external insulation should be repaired or replaced.

11.2 Wiring and Connections

On an annual basis, check wiring and connections, including sensor wiring and splices. Look for signs of overheating, discoloration, corrosion or loose connections. Any damaged wiring should be repaired or replaced.

11.3 Fluid Leaks

If you detect a glycol or water leak, or the glycol loop pressure drops unexpectedly, contact your installation contractor immediately to diagnose the problem and recharge the system.

11.4 Solar Storage Tank T&P Relief Valve

On an annual basis, the temperature and pressure relief valve should be checked for proper operation. First, attach a drain line to the valve to direct the water discharge to an open drain. This is very important because the temperature of the discharge could be very hot. Second, lift the lever at the end of the valve several times. The valve should operate freely and return to its original position properly. If water does not flow out of the valve, remove and inspect for corrosion or obstructions. Replace with a new valve if necessary. Do not repair the faulty valve as this may cause improper operation.

11.5 Solar Storage Tank Anode Rods

Anode rods should be inspected twice in the first year and at least yearly once a time interval for inspection has been developed. It is recommended to check the rod(s) six months after the heater is installed. If the anode rod has reduced in size by two-thirds of its original diameter of 3/4" or shows signs of pitting, it is time for replacement. Take the following steps when changing the anode rod(s):

1. Shut off cold water supply.
2. Open any faucet to relieve tank pressure.
3. Remove caps on water heater top; push insulation aside.
4. Use a 1 1/16" six-sided socket wrench and a breaker bar. Snap hard to break the anode rod seal.
5. Remove rod(s) and replace with new rod(s).
6. Turn water supply back on and leave faucet open until air is out of line.
7. Turn faucet off and check that new rod(s) doesn't leak.
8. Snap caps back into place.

11.6 Solar Storage Tank Flushing

The solar indirect water heater is glass lined. Elements in the water such as lime, iron and other minerals may accumulate in the heater. It is recommended that the tank be drained and flushed thoroughly once a year to prevent buildup in the tank.

11.7 Solar Panel Clarity

If you live in a dusty climate, once a month wash off dirt that settles on the solar panel glass. Clean glass allows the solar panel to maintain a high level of thermal performance.

11.8 Expansion Tank

Annually check condition of the solar expansion tank. Check to see if it is waterlogged by quickly pressing schrader valve stem at bottom of the tank. You should get a quick burst of air. If fluid shows up, the tank may be waterlogged and need replacement. Contact a qualified solar installer if the tank needs replacement.

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TROUBLE SHOOTING

Solar Storage Tank

Trouble shooting is detailed on page 17 of the *Installation, commissioning and servicing instructions for NAS200 Series SolarCon solar water heater tank*.

System Performance

Trouble shooting is detailed in the back of the *iSolar controller manual*.

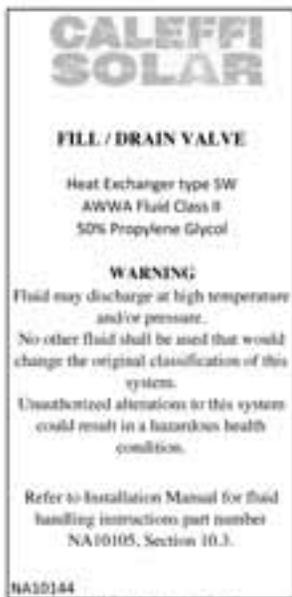
13

PARTS, SERVICE AND WARRANTY

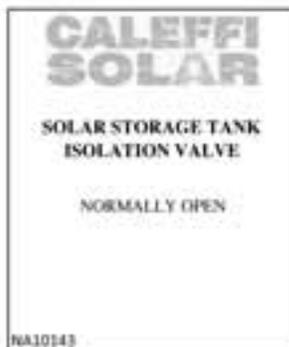
Please see Appendix 3 for warranty coverage. To obtain warranty service, contact your installation contractor or call Caleffi North America, Inc. at 414-238-2360 (8-5 CST) for the name of an authorized contractor near you.

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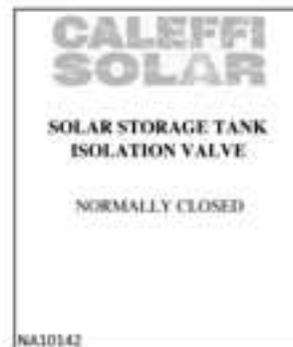
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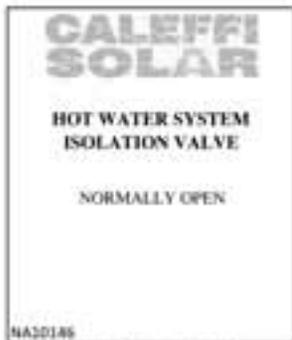
Insert in plastic bag provided and secure with wire to Filling/Drain Valve on Solar Pumping Station.



Insert in plastic bag provided and secure with wire to Normally Open Solar System Isolation Valve, Item 1 Figure 4.3 and 4.4. (2 required)



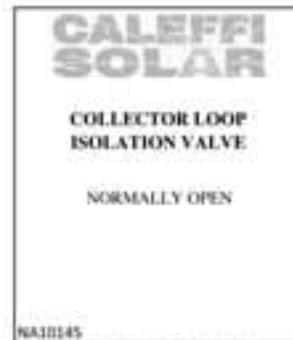
Insert in plastic bag provided and secure with wire to Normally Closed Solar System Isolation Valve, Item 2 Figure 4.3 and 4.4.



Insert in plastic bag provided and secure with wire to HW sys isol valve Item 3 Figure 4.1, 4.2, 4.3, 4.4.



Insert in plastic bag provided and secure with wire to Relief Valve on Solar Pumping Station.



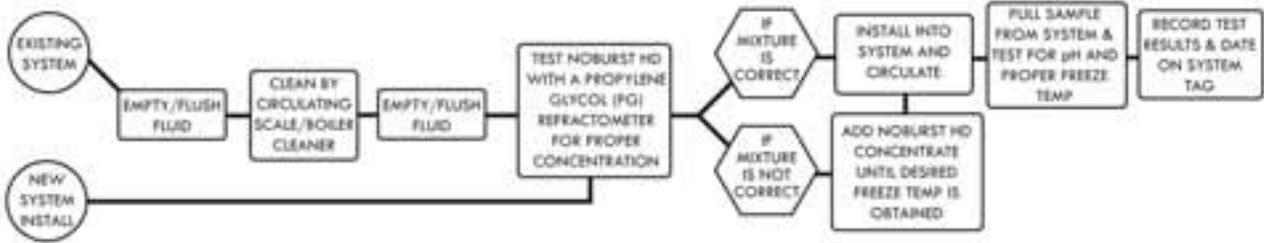
Insert in plastic bag provided and secure with wire to Pump Station supply and check valves (2 required)



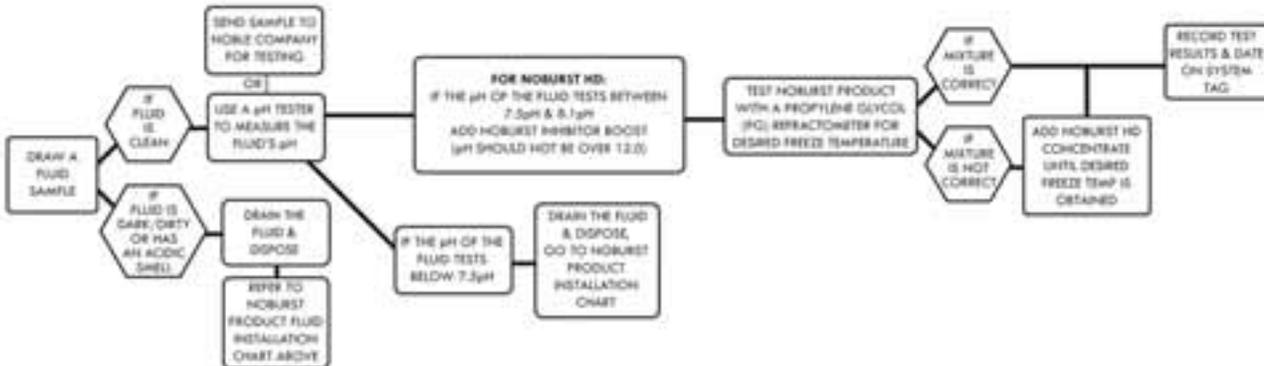
NOBURST® HD

Antifreeze & Heat Transfer Fluid
for CALEFFI SOLAR

NOBURST HD Fluid Installation

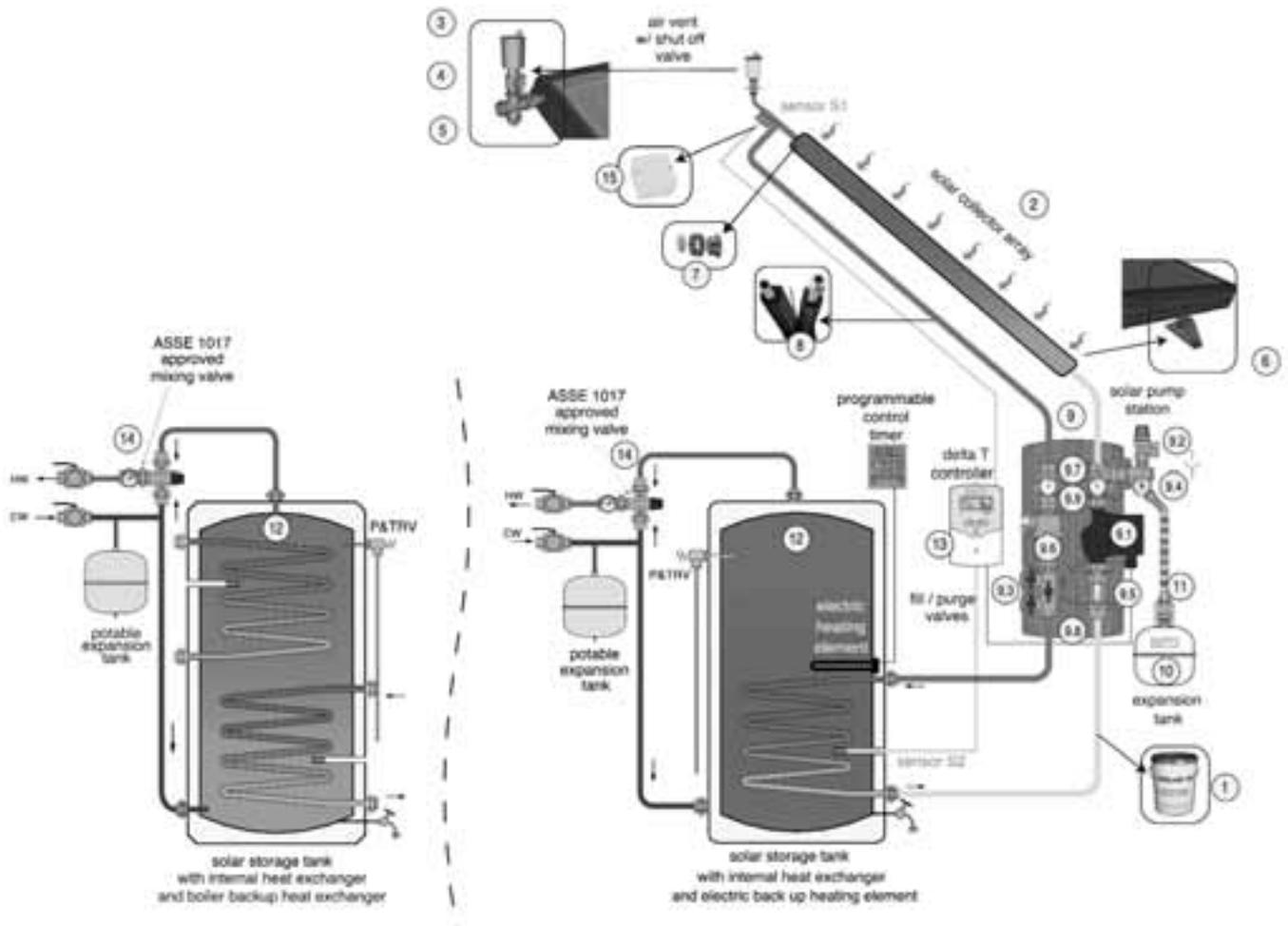


NOBURST HD Fluid Maintenance



NOTE: NOBURST HD is intended for use with cast iron, steel, brass, copper, stainless and solder only.

Appendix 2 – Solar System Parts



System Operating Procedures:

- Pressure gage should typically read between 30 and 60 psi
- Flow meter should typically read between 0.5 and 3.0 GPM
- Supply and return temperature difference in solar loop on a sunny day when pump is active is typically between 4° and 13°F.

Drawing Reference		Replacement Part Number	NAS30020	NAS30020Plus	NAS30040	NAS30040Plus	NAS30042	NAS30042Plus	NAS30060	NAS30060Plus	NAS30062	NAS30062Plus
	Item Description											
1	Heat Transfer Fluid	NA10103	X	X	X	X	X	X	X	X	X	X
2	Solar Collector Panel(s)	NAS10406	X	X	X	X	X	X	X	X	X	X
3	Solar Air Vent	250041A	X	X	X	X	X	X	X	X	X	X
4	Solar Air Vent Isolation Valve	NA29284	X	X	X	X	X	X	X	X	X	X
5	Cross Assembly	NAC62TT6241	X	X	X	X	X	X	X	X	X	X
6	Universal Foot Mounts	NAS10001	X	X	X	X	X	X	X	X	X	X
7	Plug and Cap											
	1" male threaded plug	NA10083	X	X					X	X	X	X
	1" female disc	NA10104	X	X	X	X	X	X	X	X	X	X
	1" nut	R61008	X	X	X	X	X	X	X	X	X	X
	1" Fiber Washer	R50055	X	X	X	X	X	X	X	X	X	X
8	Solar Flex											
	50 foot coil	NA3540-16	X	X	X	X	X	X	X	X	X	X
	6 foot tank to pump station	NA3140-02	X	X	X	X	X	X	X	X	X	X
	Pipe hangers	NA12133	X	X	X	X	X	X	X	X	X	X
9	Pumping Station	255060A	X	X	X	X	X	X	X	X	X	X
10	Expansion Tank											
	3 Gallon	259012	X	X								
	5 Gallon	259018			X	X	X	X				
	7 Gallon	259025							X	X	X	X
11	Expansion Tank Connection Kit	255001	X	X	X	X	X	X	X	X	X	X
12	Solar Storage Tank											
	50 Gallon, single coil	NAS20053	X	X								
	80 Gallon, single coil	NAS20083			X	X						
	80 Gallon, double coil	NAS20082					X	X				
	119 Gallon, single coil	NAS20123							X	X		
	119 Gallon, double coil	NAS20122									X	X
13	Controller											
	iSolar 2	257220A	X		X		X		X		X	
	iSolar Plus	257260A		X		X		X		X		X
15	Surge Protector	NA15006		X		X		X		X		X
	Additional Parts											
	Insulating EPDM Solar Tape	NA35001	X	X	X	X	X	X	X	X	X	X
	UV Resistant Black Film Tape	NA35002	X	X	X	X	X	X	X	X	X	X
	Brass elbow connection to solar tank	NA10093	X	X	X	X	X	X	X	X	X	X
	FKP6 collector sensor with 5' black cable	257205	X	X	X	X	X	X	X	X	X	X
	FRP6 storage tank sensor with 8' gray cable	257206	X	X	X	X	X	X	X	X	X	X
	Accessories											
	6' flexible SS extension for expansion tank	NA255002	X	X	X	X	X	X	X	X	X	X
	6' extension 1" square tube to tilt collectors	NAS10002	X	X	X	X	X	X	X	X	X	X
	Double nipple for 3/4" Solar Flex, 1" m thread	NA12123	X	X	X	X	X	X	X	X	X	X

For more parts, contact Caleffi

LIMITED WARRANTY

Caleffi North America Solar System Components

Caleffi North America (CNA) warrants to its “Customers” that all CNA products sold in accordance with these warranty provisions shall be free from defects in material and workmanship, or other malfunction or failure to perform, under normal use and services. “Customer” as used herein shall mean an end-user of CNA products. This warranty is valid for the time listed below from the date of manufacture by product classification listed below:



See warranty for details

Standard Components
2 years



See warranty for details



See warranty for details

**Solar Storage Tank
and SolarFlex piping**
6 years



See warranty for details

Solar Panel
10 years

CNA's sole obligation hereunder shall be, at its option, to issue credit, repair or replace any component which is proved to be defective. This limited warranty does not cover the cost of transportation or labor charges, including installation and removal, unless such charges are authorized in writing in advance by CNA. The solar antifreeze and heat transfer fluid, and maintenance schedule, must be per Caleffi system specification. Specifically excluded from this warranty are glass breakage and the effects of frost or acts of God (force majeure) responsible for system or component malfunction. Caleffi is not responsible for system malfunction resulting from any unauthorized alterations made to the collector panel or any Caleffi system components. Caleffi assumes no responsibility for damage to any solar system component caused by neglect, abuse, faulty installation, misuse, handling or cause not in Caleffi control or not an inherent defect. Caleffi is not liable for consequential damage or expenses, the total liability shall be limited to replacement and repair as stated above.

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