# Solar Water Heating Installation Requirements

**Adapted from The Bright Way to Heat Water™ technical requirements**

V 27

# Revisions

Energy Trust updates these installation requirements annually. Many thanks to the industry members and technical specialists that have invested their time to help keep this document current. The current document (v 27) underwent significant changes from previous installation requirements. Much of the redundant commentary material was removed and many requirements were evaluated based on cost effectiveness and removed or relaxed. The revisions table below summarizes many of the new changes however this document should be read in its entirety to understand the changes.

**August, 2012 Revisions**

| Section | Revision |
|---|---|
| 2.2<br>Materials | • Changed requirement for avoiding galvanic action, allowing aluminum to galvanized steel connections. |
| 2.3<br>Equipment and Installation | • Requirements related to overheat and freeze protection were moved to the new Solar Water Heating System Design and Eligibility Requirements document.<br>• Water quality requirements were removed. |
| 2.6<br>Plumbing | • Requirements related to heat exchanger materials were moved to the new Solar Water Heating System Design and Eligibility Requirements document.<br>• Parts of Section 2.10 from v 26 were integrated into section 2.6. |
| 2.8<br>Backup Water Heater | • Backup water heater requirements were removed and/or deferred to code.<br>• Anti-convective piping requirements were removed.<br>• Backup water heater R-10 floor pad was removed.<br>• Parts of Section 2.10 from v 26 were integrated into section 2.8 |
| 2.9<br>Solar Storage Tank | • Storage to collector ratios were revised for single tank systems and moved to the new Solar Water Heating System Design and Eligibility Requirements document. |
| 3.2<br>All Active Systems | • Requirements related to commercial system design were moved to the new Solar Water Heating System Design and Eligibility Requirements document. |
| 3.5<br>Drainback Systems | • Requirements related to commercial system design were moved to the new Solar Water Heating System Design and Eligibility Requirements document. |
| 4.1<br>System Labeling | • Labeling requirements were relaxed including removal of labeling requirements for components within a pump station.<br>• A table was added identifying specific components that still require labels. |
| 4.3<br>Customer Manual | • Revised Customer Manual to simplify requirement and allow more flexibility on content |

# Table of Contents

# 1.0 Purpose

The following document outlines the minimum criteria for a solar water heating ("SWH") system ("System") installed by a Solar Water Heating Program trade ally under Energy Trust of Oregon's Solar Water Heating Program ("Program").

The purpose of these installation requirements is to help promote the performance and longevity of systems that receive Energy Trust incentive funding. Energy Trust reserves the right to require compliance with installation specifications that may differ from those of a manufacturer or exceed applicable codes. Any variations from the Program's installation requirements shall receive prior approval from Energy Trust.

# 2.0 Requirements for All Systems

## *2.1 General*

2.1.1 System shall be installed on real property in Oregon that receives electrical service directly from Portland General Electric or Pacific Power if the installation is displacing electric water heating or gas service from NW Natural or Cascade Natural Gas if the installation is displacing gas water heating.

2.1.2 The installation shall be of industry standard and workmanlike quality.

2.1.3 System should be optimized for annual performance without sacrificing good aesthetics. See ***Section 2.5: Solar Access.***

2.1.4 System design shall be documented with a schematic diagram that accurately describes all components, plumbing design, and relative location of valves and monitoring devices. This may be the manufacturer's system schematic if the system is to be installed accordingly.

2.1.5 Equipment, materials, and installation shall comply with manufacturers' specifications.

2.1.6 The system shall be properly permitted, inspected and in compliance with all relevant local building, plumbing, mechanical, and electrical codes.

2.1.7 System equipment installers shall be licensed according to the Oregon Building Codes Division and shall be working for a contractor that is licensed according to the Oregon Construction and Contractors Board.

2.1.8 Monitoring/maintenance instructions per Energy Trust specifications shall be plainly displayed. See ***Section 4.0: System Documentation***.

## *2.2 Materials*

2.2.1 Materials used outdoors shall be sunlight/UV-resistant and listed for outdoor locations.

2.2.2 Materials shall be designed to withstand the temperatures to which they are exposed.

2.2.3 Dissimilar metals that have galvanic action (such as steel and copper) shall be isolated from one another using industry standard practices (such as brass unions or nipples). Dielectric unions used in the solar loop must be rated to a minimum 220°F).

2.2.4 Only stainless steel fasteners shall be used to secure collectors. Stainless steel bolts shall be coated with an anti-seize lubricant to prevent galling and allow for removal during system maintenance or repair.

2.2.5 Structural members shall be either:

- Aluminum
- Hot-dip galvanized steel per ASTM A123 equivalent or better.
- Coated or painted steel (not allowed in marine environments)
- Stainless steel (recommended for marine environments)
- Outdoor rated nonmetallic materials designed for collector mounting.
- Outdoor rated pressure treated lumber or laminated beams:
    - Shall be installed using roofing flashing methods to prevent water pooling and UV exposure on top surface.
    - Shall not be installed in direct contact with roofing material, soil or where exposed to extended periods of pooled water.

2.2.6 If the collectors are building-mounted, materials in direct contact with aluminum-frames shall be aluminum, stainless steel or outdoor rated nonmetallic materials designed for collector mounting.

## *2.3 Equipment and Installation*

2.3.1 All system components shall be new.

2.3.2 All systems that serve the domestic water load in a single residence shall be listed on Energy Trust's ***Eligible Residential Solar Water Heating Systems List*** and shall have SRCC OG-300 certification.

***NOTE*:** System models that are not on this list shall be submitted via email to robert.delmar@energytrust.org for program review prior to the submission of an incentive application. New systems will be evaluated based on the ***SHW System Eligibility Requirements*** located on the Web at:

http://energytrust.org/trade-ally/programs/solar/resources/

2.3.3 Any building insulation (attic, floor, wall) disturbed due to system installation shall be restored to previous condition.

2.3.4 All penetrations to building shell shall be sealed and fire resistance maintained.

2.3.5 All components, including water storage tanks shall be adequately protected and located to allow access without having to remove fixed building or plumbing components.

2.3.6 The solar storage and backup tanks and related components (excluding collectors and integral passive systems) shall be located in an enclosed weather proof location to protect the system from freezing conditions.

2.3.7 If a pressure reducing valve, check valve, and/or back flow preventer is on potable supply line to the system, an expansion tank shall be installed. The expansion tank shall be sized and installed according to the manufacturer's recommendations or ASHRAE calculations, using the following steps:

- Measure the potable water supply pressure.
- Measure incoming water temperature, and determine maximum system temperature.
- Calculate the total volume of potable water in the solar storage and back-up tanks and interconnecting water lines.

- Use a manufacturer's calculation tool or ASHRAE guidelines to properly size the expansion tank.
- The air charge pressure in the expansion tank shall be adjusted to match the inlet water supply pressure.
- The tank shall be located after the pressure-reducing valve, check valve, or backflow preventer in the cold water supply line subject to thermal expansion created in the solar storage and back-up water heater tanks.

2.3.8 If a hot water re-circulation system exists, return piping is plumbed to the backup water heater or a separate heater dedicated to the circulation loop, not to the solar storage tank. Single tank systems (combined solar storage and backup tank) shall not be plumbed to a hot water re-circulation system.

## *2.4 Collector Mounting*

2.4.1 If roof-mounted, the roofing material shall have at least 10 years of useful life remaining. If in question, evidence of this requirement may be met by providing either a copy of a recent roof inspection or a receipt showing the date of the most recent roof replacement.

***EXCEPTION:*** Systems where the entire collector and all roof penetrations are flashed into the surrounding roof are exempt from the roof life requirement.

2.4.2 If roof-mounted, collectors shall be raised off the roof surface a minimum of 1½ inches or completely flashed to the roof.

2.4.3 All roof penetrations shall be made using roofing industry-standard methods of flashing that protect the warranty of the roof. Sealant compounds shall be appropriate for the roofing material and application and shall not be the sole method of waterproofing.

2.4.4 All mounting equipment shall be installed according to manufacturer specification.

## *2.5 Solar Access*

2.5.1 Solar resource shall be measured with an Energy Trust sun chart or approved shading analysis tool from the point on the collector(s) where shading is most significant. Details on using sun charts and a list of approved shading analysis tools are available on the Energy Trust Solar Trade Ally Forms & Resources web page[1].

2.5.2 Total Solar Resource Fraction ("TSRF") shall be 75% or greater at all points on the collector(s).

2.5.3 Photovoltaic powered systems shall have the module mounted at the same tilt and orientation as and within six feet of the collector(s). TSRF at PV module shall be equal to or greater than the highest TSRF at any portion of the thermal collector(s) it serves.

## *2.6 Plumbing*

2.6.1 All piping in the collector loop shall be copper or stainless steel. All potable water piping shall be copper, stainless steel, or cross-linked polyethylene. All fittings shall be either copper or brass. Cross-linked polyethylene piping connections shall be made with compression fittings.

1 http://energytrust.org/trade-ally/programs/solar/resources/

2.6.2 Potable plumbing in unheated spaces shall be continuous cross-linked polyethylene type piping with no connections.

2.6.3 Piping runs shall be adequately and appropriately supported. Follow the minimum support spacing requirements in Table 2, below.

**Table 1. Maximum support spacing by piping material**

| Pipe Type | Run Type | Maximum Spacing |
|---|---|---|
| Rigid or Flex Copper | Horizontal | 6 feet |
| | Vertical | 6 feet |
| PEX or Flex Stainless Steel | Horizontal | 32 inches |
| | Vertical | 4 feet |

2.6.4 All pipes in the system that contain heated fluid shall be insulated with closed cell elastomeric foam or factory-jacketed fiber glass pipe insulation with a minimum ¾-inch wall thickness. Line sets that have continuous factory-installed insulation may have minimum 5/8-inch insulation. Insulation must meet minimum temperature ratings in table 3 below. Potable water piping exposed to freeze conditions shall be insulated to R-12.

**Table 2. Minimum temperature ratings for insulation**

| Piping Type | Minimum Temperature Rating Requirement |
|---|---|
| Active systems collector loop | 220ºF |
| Passive systems hot return | 220ºF |
| All other piping | 180ºF |

2.6.5 Pipe insulation shall be properly sized. Split seams, joints or other breaks in the insulation should be taped or glued according to manufacturer's recommendations. Pipe insulation located outdoors and exposed to weather and sunlight shall be protected using one or more of the following methods.

Elastomeric Foam or Fiber Glass

- Continuously enclosed in UV inhibited ABS, PVC, or aluminum pipe or jacketing, secured in accordance with the jacket manufacturer's recommendations. Joints shall be applied so they will shed water and shall be sealed completely.
- Continuously enclosed in a chase painted to match house exterior.

Additional options for Elastomeric Foam

- Continuously wrapped in an overlapping manner with aluminum foil tape and painted with an aluminum adhesive paint to match house exterior.
- Continuously wrapped in an overlapping manner with UV-inhibited tape.

2.6.6 Underground piping shall be fully enclosed with appropriately waterproofed R-6 insulation designed for underground application.

2.6.7 If underground piping is used for potable water, it shall be continuous cross-linked polyethylene with no connections along the lengths to be buried. If underground piping is used for non-potable water in a collector loop, it shall be Type L copper.

2.6.8 Full port isolation valves shall be installed enabling bypass of solar storage tank (not applicable to single tank systems).

2.6.9 Temperature actuated tempering valve(s) shall be installed and shall be:

- ASSE Standard 1017 listed.
- On the downstream side of backup water heater(s) and fully compatible with solar storage temperatures.

***EXCEPTION:*** See ***Section 2.8*** for requirements related to some water heaters.

2.6.10 Check valves shall be integrated or installed on hot and cold inlets of tempering valve(s).

2.6.11 If there is a domestic hot water recirculation system, the return water from this system shall be piped to both tempering valve inlets. An aquastat shall be installed to control the on/off operation of the re-circ system circulator and set 5 to 10 degrees lower than the mixed water outlet temperature.

2.6.12 A temperature & pressure relief valve shall be installed on all water storage tanks per local plumbing code requirements.

2.6.13 Means shall be supplied for filling, flushing, and draining the collector loop.

## *2.7 Heat Transfer Fluid*

2.7.1 Heat transfer fluid shall be approved by the manufacturer for use in the system and mixed according to manufacturers' instructions and local weather conditions.

***NOTE:*** Antifreeze solutions may become corrosive over time if not properly maintained. Maintenance instructions shall be provided as described in ***Section 5.2*** and ***Section 5.3***

2.7.2 Antifreeze solution shall be inhibited propylene glycol mixed with distilled or deionized water. As an alternative, glycerin antifreeze may be used if the product is reviewed and pre-approved by the Program. Antifreeze solution shall be rated for usage up to 300 °F (149 °C) minimum.

***NOTE:*** For systems that include a single wall heat exchanger to meet the requirements of SRCC OG-300 and Oregon Plumbing Specialty Code (OPSC) Alternative Method #08-05, any additives to the heat exchange fluid—including corrosion inhibiters—shall be listed in the Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Part 182, "Substances Generally Recognized as Safe," and Part 184, "Direct Food Substances Affirmed as Generally Recognized as Safe." Heat transfer solutions that are known to meet this requirement and are rated to 325 °F are listed in an appendix to the Eligible Residential Solar Water Heating system list.

2.7.3 If antifreeze or a corrosion inhibitor is used in collector loop, fill and drain valves shall have a label which reads:

**Caution: Non-potable fluid. Do Not Drink.**

## *2.8 Backup Water Heater*

2.8.1 If a new backup heater is being installed it shall be sized according to the Oregon Plumbing Specialty Code.

2.8.2 New tankless gas water heaters shall have a thermostatically controlled variable firing rate. Thermostat shall be set to 120ºF.

2.8.3 Some water heaters (such as tankless, hybrid and heat pump) may require means be installed to limit the inlet water temperature per the manufacturer's recommendations. If a tempering valve is required between the solar storage tank and the tankless water heater the following additional requirements must be met to help troubleshoot a failed mixing valve in the future:

- A temperature gauge must be installed immediately downstream of the mixing valve.
- The thermometer shall have label attached that displays the following information:

  **NOTICE: This gauge should match the solar tank temperature or tempering valve set point (whichever is lower, typical range is 55°F to 120°F) while running hot water in the house. A reading below this value indicates that the tempering valve must be replaced.**

2.8.4 If backup water heater is replaced or moved, and located over wood framed floor, drip pan with pipe routed to drain or outside shall be installed.

### *2.9 Solar Storage Tank*

2.9.1 Electric power shall not be connected to a roof-mounted tank or the solar tank (except for wiring to upper element on non-roof-mounted, single tank systems).

2.9.2 If solar storage tank is located over wood framed floor, drip pan with pipe routed to drain or outside shall be installed.

2.9.3 If located on a concrete floor, an R-10 bottom pad shall be installed under solar storage tank.

2.9.4 If tank includes a sacrificial anode rod, means for changing the anode shall be provided.

## 3.0 Requirements for Specific System Types

### *3.1 Passive Thermosiphon Systems*

3.1.1 The potable water inlet and outlet piping on roof-mounted tanks shall be type L copper, brass or stainless and shall be piped to directly above the roof jack, where the connection to cross linked polyethylene piping is made.

3.1.2 A check valve shall be installed in the cold water supply line (before the pressure relief valve and/or system drain port) to prevent emptying of the solar storage tank should the cold water supply be interrupted for service to household plumbing.

3.1.3 A thermometer shall be installed between solar storage and backup water heater tank in the inlet piping to and near the top of the backup tank.

3.1.4 Temperature and pressure relief valve on solar tank shall be piped to drain per Oregon Plumbing Specialty Code (OPSC).

3.1.5 If system uses glycol solution in a closed loop single wall heat exchanger, the potable water supply pressure for the building shall be 40 psi or greater.

### *3.2 All Active Systems*

3.2.1 Collector loop plumbing shall be thoroughly flushed and pressure tested prior to charging with collector fluid and system startup.

3.2.2 Fluid flow rate and direction shall be according to manufacturer's specifications.

3.2.3 Circulation pump shall be installed with shaft oriented horizontally unless otherwise specified by manufacturer.

3.2.4 System shall be designed to allow for isolation of the circulation pump.

3.2.5 Controller shall have correct settings according to manufacturers recommendations and be mounted in an accessible location with wiring securely attached.

3.2.6 If PV powered system, the DC wiring shall meet code requirements, be sized for less than 2% voltage drop, and shall be installed through a dedicated roof jack with exterior conduit. The conduit, current carrying conductors and equipment ground shall be installed as required by the Oregon Electrical Specialty Code (OESC).

3.2.7 If PV powered system, a DC rated on/off switch shall be installed between the PV module and the circulating pump.

3.2.8 If PV powered system, a high temperature limit shutoff function shall be installed in a manner that will interrupt pump operation when 180°F is reached at the top of the tank. The sensor may be attached to the hot water outlet piping at the top of the tank. If mounted on piping, the sensor shall be insulated with pipe insulation per ***Section 2.6.6****.*

3.2.9 Sensors shall be placed according to manufacturer's instructions.

3.2.10 Sensor wiring shall have UV-rated exterior jacketing; shall be continuously attached and protected from abrasion, contact with 110V/220V lines/conduit, weather, and high temperature; and shall have solid connections.

***EXCEPTION:*** Sensor wiring rated to 350+ °F (e.g., silicone-jacketed wire) may be run in contact with hot pipes. The wire rating shall be visible for inspection. Also, a specification sheet for the wire or line set shall be included in the Customer Manual (***Section 4.3.***).

3.2.11 Fill and drain valves shall have brass caps.

3.2.12 Flow meter shall be installed on supply line to collector(s) in a visible location.

3.2.13 For systems with an external heat exchanger, a means of flow detection shall be installed in the potable water loop.

3.2.14 Thermometer shall be provided at hot water outlet port on solar storage tank.

## *3.3 All Active Antifreeze Systems*

3.3.1 Pressure gauge shall be installed in the collector loop and the typical operating pressure shall be within 20-40 psi.Installer may use this formula to calculate the cold fill pressure:

$$P = [(H * 0.43) + 15],$$

where H is the height of the uppermost piping and system components above the gauge, and P is the fill pressure in psi.

3.3.2 A maximum 150 psi pressure relief valve piped to drain shall be installed in the return line from the collector loop.

3.3.3 A check valve shall be installed in the collector return line near the heat exchanger inlet.

3.3.4 An expansion tank shall be installed in the collector loop and sized according to manufacturer's or ASHRAE sizing recommendations with a total tank volume of at least 4.4 gallons. The expansion tank should be charged to the cold fill pressure of the collector loop and installed upstream of the circulation pump close to the pump inlet.

3.3.5 One or both of the following methods of air removal shall be implemented:

1. A threaded plug fitting installed at the high point in the collector loop.
2. A micro-bubbler air separator with manual vent installed in an accessible location on the collector loop. Installer must first thoroughly purge air from the loop for this method to be effective.

## *3.4 Active Antifreeze Systems with Single Wall Heat Exchangers*

3.4.1 The potable water supply pressure for the building shall be 40 psi or greater.

To meet the requirements of OPSC Alternative Method #08-05, the operating pressure within a single wall heat exchanger must be less than the pressure of the potable water system. The rest of the requirements in ***Section 3.4*** are specifically designed to keep the operating pressure within the collector loop of an active anti-freeze system below 40 psi. Therefore, the operating potable pressure at the building shall be 40 psi or greater. If the building has potable water pressure below 40 psi, a vented double wall heat exchanger shall be used, and the requirements in this section shall not apply.

3.4.2 The vertical distance in the collector loop shall be less than or equal to 35 feet.

3.4.3 The collector loop cold-charge pressure shall be appropriate for the height of the collector loop and between 20 and 30 psi.

To ensure collector loop operating pressure remains below 40 psi (the minimum potable water pressure required in ***Section 3.4.1***), the cold charge pressure for an active anti-freeze system with a single wall heat exchanger shall be appropriate for the because charge pressures below 20 psi may allow the glycol fluid to foam, and charge pressures above 30 psi are likely to cause the collector loop operating pressure to exceed 40 psi.

To determine the correct charge pressure, measure the vertical distance between the pressure gauge and the highest points in the collector loop and reference Table 3 below.

**Table 3. Recommended collector loop cold-charge pressures for system with single wall heat exchanger**

| Collector Loop Height (ft) | Charge Pressure (psi) |
|---|---|
| ≤10 | 20 |
| 15 | 22 |
| 20 | 24 |
| 25 | 26 |
| 30 | 28 |
| 35 | 30 |
| >35 | *Do not use single wall HX.* |

### *3.5 Drainback Systems*

3.5.1 If System has multiple collectors, collectors shall be mounted in a single flat plane.

3.5.2 Collectors shall be pitched a minimum of 1/8 inch per foot to inlet. Collector piping shall be continuously pitched with a minimum 1/8 inch per foot to the drainback tank.

3.5.3 A max 150 psi pressure relief valve shall be installed on the drainback tank.

3.5.4 Drainback tank shall have a minimum of R-4 insulation.

3.5.5 Pump shall be sized according to the manufacturer's guidelines for the vertical distance of the collector loop and shall provide a minimum start flow rate of 1 gpm.

## 4.0 System Documentation

### *4.1 System Labeling*

4.1.1 The following system components shall be labeled using permanent tags:

**Table 4. System components that require labeling by system type**

| Active Antifreeze | Active Drainback | Passive Thermosiphon |
|---|---|---|
| Cold water shutoff | Cold water shutoff | Cold water shutoff |
| Tempering valve | Tempering valve | Tempering valve |
| Isolation/bypass valve | Isolation/bypass valve | Isolation/bypass valve |
| Exchanger drain valve | Exchanger drain valve | Temperature gauge |
| Exchanger fill valve | Exchanger fill valve | |
| Flow meter | Flow meter | |
| Temperature gauge | Temperature gauge | |
| Pressure gauge | | |

4.1.2 The tags should contain, or reference with a valve chart, the following information. If a valve chart is used it shall be protected (e.g. laminated or in a plastic sleeve) and mounted in an easily visible location within six feet of the solar storage or backup tank.

- Name/identification of the valve, gauge, or instrument.
- Location of the valve, gauge, or instrument, if not within six feet of solar tank.
- Purpose of the valve, gauge, or instrument.
- Operation of the valve and whether normally opened or normally closed.

***NOTE:*** Tag templates are available on the Trade Ally Forms & Resources webpage[2].

***EXCEPTION:*** If the pump, valves, gauges, and/or instruments are packaged in an enclosed pump station (not accessible for individual tagging) they are exempt from this requirement as long as all components are clearly identified in a valve chart within six feet of the pump station and in the system manual.

4.1.3 System shall have all applicable warning labels required in this document and in the Solar Water Heating System Eligibility Requirements document available on the Solar Trade Ally Forms & Resources webpage[2].

- Systems with a carbon steel heat exchanger shall be labeled with the following:

  **Warning: this system contains components that are susceptible to corrosion. Maintenance of the heat transfer fluid in the collector loop is critical to prevent degradation of the equipment. Contact [company] at [phone number] for service. Next service due: [date]**

- Systems that contain additives to the heat transfer fluid (e.g. propylene glycol or corrosion inhibiter) shall have a warning as described in ***Section 2.7.3***.
- Systems that contain a tempering valve upstream of a tankless water heater shall have a warning as described in ***Section 2.10.3***.

## *4.2 Monitoring & Maintenance Instructions*

4.2.1 Monitoring and maintenance instructions shall be protected (e.g. laminated or in a plastic sleeve) and securely mounted in an easily visible location within six feet of the solar storage or backup tank. The instructions shall include:

[2] http://energytrust.org/trade-ally/programs/solar/resources/

1. Clear instructions on how to monitor system operation.
2. Description and recommended frequency of homeowner maintenance.
3. What to do and who to call in an emergency and when the system needs professional maintenance or repairs.

## *4.3 Customer Manual*

Contractor shall provide a system owner's manual (the "Customer Manual") and provide instruction on proper system operation and maintenance. The Customer Manual shall be bound in a durable binder. Please instruct the participant to have the Customer Manual along with relevant permit(s) (approved electrical and, where applicable, building permit) available on site for the Energy Trust verification. The Customer Manual shall include:

- A copy of the monitoring and maintenance instructions described in **Section 4.2**
- A copy of the valve chart (if used) described in 4.1.2.
- Plumbing as-built diagram accurately depicting all components installed and the location of valves and monitoring devices. This may be the manufacturers system schematic if the installation was installed according to manufacturer's instructions.
- Program trade ally's 2-year (min) full system warranty covering labor and materials
- Material Safety Data Sheets (MSDS) for all chemicals in the system including heat transfer fluid and additives.
- Manufacturer data sheets for the pump (if used), temperature sensors, and any components specified with a non-standard high temperature rating (such as pipe insulation and dielectric unions used in the collector loop).
- A copy of the manufacturers OG-300 manual. The manual must address:
    1. Documentation of operation, maintenance and troubleshooting.
    2. Parts List covering all system components including part numbers.

The following *optional* items are recommended to be included in the Custom Manual and/or provided to the customer in digital format (PDF):

- Written manufacturers' warranties and product registration instructions for collectors, tanks, controller.(may be part of manufacturers OG-300 system manual)
- Manufacturers manual for the controller.
- Manufacturer data sheets for components Including: collectors, tank, valves, heat exchanger, pipe insulation, line set (if factory-insulated), and mounting systems.
- Energy Trust Incentive Application