

Installing Solar Water and Pool Heating Systems

Objectives and list of tasks for Solar Water and Pool Heating Systems Installation Contractors

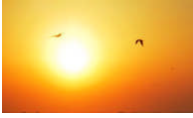
Introduction

This document presents a comprehensive list of tasks for contractors installing *Free Fuel Forever* solar water and pool heating systems.

These tasks are a list for installation contractor - not to the system designer. This task list assumes the installation contractor starts with a solar system design package, complete with major components, installation manual, system schematics, and assembly instructions. For system design see the www.freefuelforever.com "downloads" section. Separate installation and design manuals are provided for solar pool heaters, split system installation, and integrated system installation.

Installer **will be expected to have basic plumbing, electrical, and roofing skills.** Specifically, knowledge of basic plumbing tasks such as soldering pipe joints, gluing pipe joints, sealing fittings, and testing for plumbing leaks. In regards to electrical, the installer should be familiar with basic electrical concepts and terms and with the operation of a multi meter. Also included is the ability to connect wiring and create weather sealed connections. Regarding roofing knowledge, the installer should be familiar with basic roof materials, terminologies as well as flashing and sealing methods.

1. Working Safely With Solar Hot Water and Pool Heating Systems	
Task/Skill	
As part of safety considerations associated with installing and maintaining solar thermal systems, any solar thermal installer must:	
1.1	Maintain safe work habits and clean, orderly work area
1.2	Demonstrate safe and proper use of required tools and equipment
1.3	Demonstrate safe and accepted practices for personnel protection
1.4	Demonstrate awareness of safety hazards and how to avoid them
The installer must identify plumbing, electrical and other hazards associated with solar thermal installations, and implement preventive and remedial measures to ensure personnel safety:	
1.5	Identify and implement appropriate codes and standards concerning installation, operation and maintenance of solar thermal systems and equipment
1.6	Identify and implement appropriate codes and standards concerning worker safety and public safety
1.7	Identify personnel safety hazards associated with solar thermal installations
1.8	Identify environmental hazards associated with solar thermal installations through demonstrated awareness of pertinent Material Safety Data Sheets and other appropriate documents
2. Identifying Systems and Their Components	
Task/Skill:	



Given the components required for an installation, the installer shall identify the typical tools and components required for conducting the solar system installation. (This includes all components – collectors, pumps, controllers, sensors, heat exchangers, piping, valves, heat transfer fluids, etc.)

<p>2.1 Identify components specific to the solar system. Read the installation manual, check parts list. For example, this would include: collector, tank, pump, controller, sensors, isolation and drain valves, pressure and temperature relief valves, air vent, piping, insulation, flashing.</p>
<p>3. Adapting a System Design</p>
<p><i>Task/Skill:</i></p>
<p>Given a solar system design package - including collectors and subsystem components and building on the site</p>
<p>3.1 Determine Solar System components' location and system layout and configuration</p>
<p>3.2 Draw out the design schematic, then apply for building permits</p>
<p>3.3 Estimate time, materials, tools and labor required for installation</p>
<p>3.4 Determine installation sequence to optimize use of time and materials</p>
<p>3.5 Inspect all provided system components for damage prior to installation</p>
<p>4. Conducting a site assessment</p>
<p><i>Task/Skill:</i></p>
<p><i>Given a selected site, the solar installer shall:</i></p>
<p>4.1 Determine the required installation area, orientation, and tilt for proposed collector installation. This information comes from the system design using the www.RETScreen.net program.</p>
<p>4.2 Establish whether there is suitable installation area with unobstructed solar access for installing collector</p>
<p>4.3 Determine the extent of current and future shading for any proposed collector location using typical sun path calculators or similar methods</p>
<p>4.4 Assure structural integrity and suitability of collector site. Determine soil conditions and integrity for footing design and pipe path. (Local codes or site conditions might then require involving an engineer).</p>
<p>4.5 Determine suitable location for installing all subsystem components (This includes piping, water heater, valves and ancillary equipment required for complete system installation.)</p>
<p>4.6 Practice all personnel safety requirements</p>



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4.7	Identify any other constraints and options for the installation related to local and state code requirements
4.8	Verify that system to be installed is appropriate for the building and climate. In other words, determine if there are obvious problems, such as vandalism, future construction or local politics.
4.9	Verify with the owner the proposed location of the collector and other major components
5. Installing Solar Collectors	
<i>Task/Skill:</i>	

<i>Given roofs of various types (tile, asphalt shingle, built-up gravel, etc.) and of varying pitch, the installer:</i>	
5.1	Identify specific manufacturer's mounting design and materials
5.2	Identify acceptable roof mounting and penetration methods, if mounted on roof.
5.3	Identify different collector mounting methods suitable for roof types or other installation areas
5.4	Identify different system (in the case of integrated and thermo siphon systems, due to extra weight and components) mounting methods suitable for roof type
5.5	Identify locations for roof/ wall, foundation penetrations, and structural attachments
5.6	Evaluate the suitability of selected mounting structural attachments and compliance with applicable local codes
5.7	Determine multi-collector piping strategy
5.8	Install collector mounting device to installation area
5.9	Weather seal roof penetrations and other structural devices with flashings and sealants
5.10	Lift collectors to installation area
5.11	Attach mounting bracket and struts (if required) to collector
5.12	Secure collector to collector mounting device
5.13	Connect collector to piping

6. Installing Water Heater and Storage Tanks (if required)	
<i>Task/Skill:</i>	
<i>Given a water heater and/or storage tank to be installed and the system design, the installer shall:</i>	



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6.1	Prepare the environment for tank installation (water and power source)
6.2	Determine by inspection that the new water heater and/or storage tank and required subcomponents are damage free
6.3	Determine tank ports to be used for plumbing lines
6.4	Determine dip tube strategy
6.5	Determine plumbing retrofit method to be used if conventional water heater tank (electric or gas) is used
6.6	Install drain pan per local codes
6.7	Remove the old conventional water heater tank, if required
6.8	Install dip tubes
6.9	Install port fittings if required
6.10	Install tank valves (drain, pressure temperature relief, etc.)
6.11	Connect plumbing and valves between solar tank and conventional auxiliary tank (if required)
6.12	Connect water heater and/or storage tank to water source
6.13	Fill tank with water
6.14	Connect the water heater and/or storage tank to power source
6.15	Determine that water heater and storage tanks are installed per manufacturers' recommendations and code
6.16	Determine that installed tank and fittings have no leaks
6.17	Install exterior tank insulation blanket if required
6.18	Install thermo siphon solar tank
7. Installing Piping , Pipe Insulation and Connecting System Piping	
Task/Skill:	
Given copper pipe, fittings, a pipe cutter, acetylene torch, solder, wire brush, sand cloth, and flux, the installer shall (for solar water heating system):	
7.1	Determine the extent of, and make allowances for expansion of pipe and its effect on hangers and the integrity of the pipe
7.2	Determine type, length, and diameter of copper piping required



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7.3	Cut copper pipe to desired length
7.4	Solder copper piping connections
7.5	Test soldering fittings for leaks
<i>Given plastic pipe, fittings, pipe cutter, plastic pipe cleaner and glue, the installer shall (for solar pool heating system):</i>	
7.6	Determine type, length, and diameter of plastic piping required
7.7	Cut plastic pipe to desired length
7.8	Glue plastic piping connections
7.9	Test glued fittings for leaks
Given a run of piping insulation, a cutting tool, and adhesive material, the installer shall be able to:	
7.10	Determine type, diameter, and length of insulation required
7.11	Cut insulation and install over piping and plumbing fittings
7.12	Miter insulation ends, where appropriate
7.13	Glue and seal insulation joints, as required
7.14	Select ultraviolet radiation protective method
7.15	Protect insulation from ultraviolet degradation
Given a standard tool set, sealant, and copper pipe or tubing, the installer shall be able to:	
7.16	Determine type of pipe flashing to use for specific roof type
7.17	Determine the area where pipe flashing will be installed
7.18	Make roof penetrations
7.19	Install pipe flashing and sealant
Given a standard tool set, a pipe cutter, solder and soldering equipment (solar water heating), pipe cleaner and	
7.20	Determine slope strategy of piping to avoid traps on horizontal runs
7.21	Slope piping to avoid traps in horizontal pipe runs
7.22	Attach pipe hangers and supports



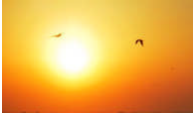
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7.23	Install stand-off hangers beneath piping on roof if needed
7.24	Connect all system piping to water heater tank, collector, valves, pumps, etc.
7.25	Determine under-ground piping method
7.26	Install under-ground piping
8.	Installing Mechanical/Plumbing Equipment and Other Components

Task/Skill:	
<i>Given system valves and monitoring components and the system installation manual, manufacturers' product directions, piping, fittings, and a standard tool set, the installer shall:</i>	
8.1	Determine system plumbing, valves and other components required
This includes the following: valves, air vent, check, drain, auto drain down, expansion tanks, flow control, isolation, diverting, solenoid, mixing, anti-scald, pressure relief, temperature pressure relief, vacuum relief, balancing, freeze, as well as the following monitoring components; flow meter, temperature gauge, pressure gauge.	
8.2	Determine location of plumbing valves and other components
8.3	Install system plumbing valves and monitoring system components as specified in component manufacturer's or solar installation manual and schematic
<i>Given a heat exchanger and installation manual, manufacturer's direct (open loop)ions, piping, solder and soldering</i>	
8.4	Determine the heat exchanger location
8.5	Install heat exchanger and heat exchanger fluids as specified in manufacturers installation manuals and schematics
<i>Given a circulating pump and manufacturer's direct (open loop)ions, pipe, fittings, solder and soldering equipment, electrical</i>	
8.6	Determine pump location
8.7	Install the pump according to the manufacturer's installation manual

9. Installing Electrical Control Systems	
Task/Skill:	
<i>Given a system controller, manufacturer's direct (open loop)ions, and a standard tool set, the installer shall:</i>	
9.1	Determine the location of the controller
9.2	Install differential controller and sensors
9.3	Install photovoltaic module controller and pump if this is the controller



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9.5	Install control wiring
9.6	Select ultraviolet radiation protective method for external wiring
9.7	Protect external wiring from ultraviolet degradation
9.8	Test operation of controller
Given flashing, sensor wires, sealant and a standard tool set, the installer shall be able to:	
9.9	Determine type of flashing to use for specific roof type
9.10	Determine the area where wire flashing will be installed
9.11	Make roof penetrations
9.12	Install wire flashing and sealant
9.13	Install control wiring

10. Installing operation and identification tags and labels	
<i>Task/Skill:</i>	
<i>After completing the installation of the solar system equipment and prior to operating the system, the installer shall:</i>	
10.1	Determine components that require identification tag and/or label. This would include the hot and cold water lines, wiring and sensors.
10.2	Install identification tags and/or label