The

COPPER CRICKET™

OWNER'S MANUAL

Version 2.7 for MODELS 1B and 2B

- **OPERATION & MAINTENANCE**
- **INSTALLATION**

SAGE ADVANCE CORPORATION
P.O. Box 23136
Eugene, Oregon 97402 U.S.A.
(503) 485-1947

95.0101

IMPORTANT NOTICE: PLEASE READ THIS PAGE.

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

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SYSTEM INFORMATION

Please record the following information immediately. It is essential information for any service call. Sage Advance Corporation's phone: (503) 485-1947.

Your Name_____ Phone (____) _____

Installer's Name_____ Phone (____) _____

Purchase date _____Start-up date _____

Copper Cricket: 1 or 2 collectors? _____

Serial number(s)(1)_____ (2)_____

Solar Pad heat exchanger serial number_____

Collector elevation (for example 30° or 7/12 pitch) _____

Vertical height from top of collector to heat exchanger (in feet) _____

Pipe length from top of collector to heat exchanger (one way, in feet) _____

Pipe size and type (for example: 3/4" copper, Type M)_____

Storage tank capacity (gallons) _____

HOW DOES THE COPPER CRICKET™ WORK?

The Copper Cricket is a passive self-pumping, self-regulating solar hot water heater. It operates on the "geyser pumping" principle. Unless the hermetically sealed solar loop has been opened and air allowed in, the Copper Cricket will operate without attention, collecting solar heat in the collector and transferring it to your hot water tank -- with no electric power, no pumps, no moving or electronic parts. Follow the diagram in Figure 1 while you read below to see how it works.

Solar energy absorbed in the COPPER CRICKET heats and boils the liquid in the RISER TUBES. The liquid is an "antifreeze" mixture of methanol and water. Boiling makes vapor bubbles which lift hot liquid into the HEADER (as in a coffee percolator) where the liquid and vapor separate. Hot liquid flows one way toward the HEAT EXCHANGER, and vapor flows the other way toward the VAPOR CONDENSER. The solar loop, filled on both sides to the same level as the VAPOR CONDENSER, stays in balance until the hot liquid from the HEADER begins to build up. The build-up pushes the hot liquid down to the HEAT EXCHANGER, where it gives up its heat to the SOLAR STORAGE TANK, and pushes the cooled liquid back up to the VAPOR CONDENSER. As the cooled liquid enters the VAPOR CONDENSER, it condenses the hot vapor from the HEADER, and the combined flow returns to the foot of the collector. Solar energy again heats and boils the liquid in the RISER TUBES-- and the Copper Cricket chirps on!

The Copper Cricket is evacuated so the liquid in the riser tubes will boil as soon as it's warm, rather than waiting until it reaches its usual boiling point. The vacuum is maintained by the vapor condenser, which re-condenses the vapor after it has done its work of lifting the hot liquid into the header.

Hot water from the Solar Pad heat exchanger rises by convection (thermosiphons) into the solar storage tank. A plumbing schematic for the tank is shown in Figure 2.

FIGURE 1. Schematic showing how the Copper Cricket™ works.

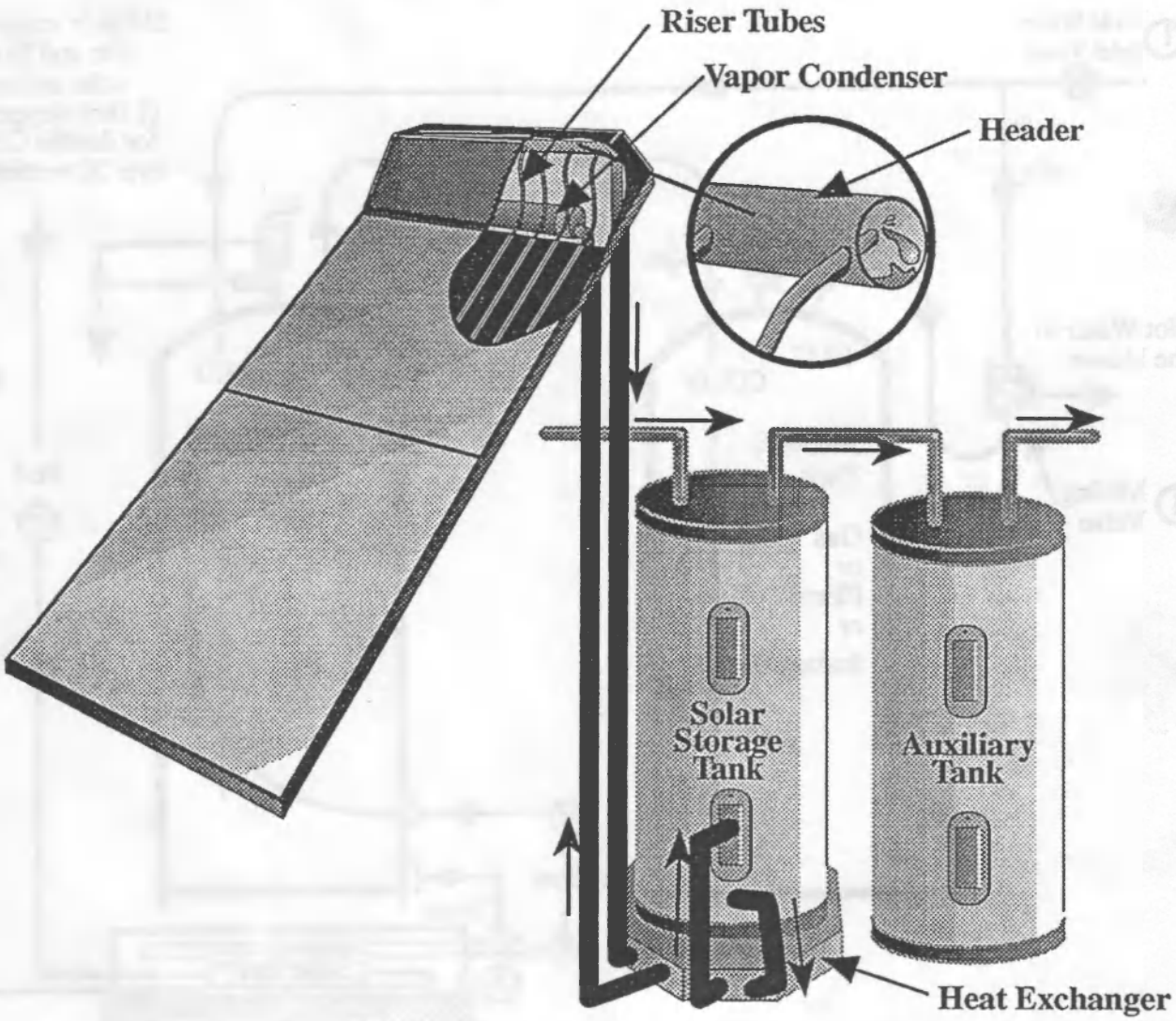


FIGURE 2. **Diagram of the basic water connections between the auxiliary tank, solar storage tank, and the Solar Pad.**

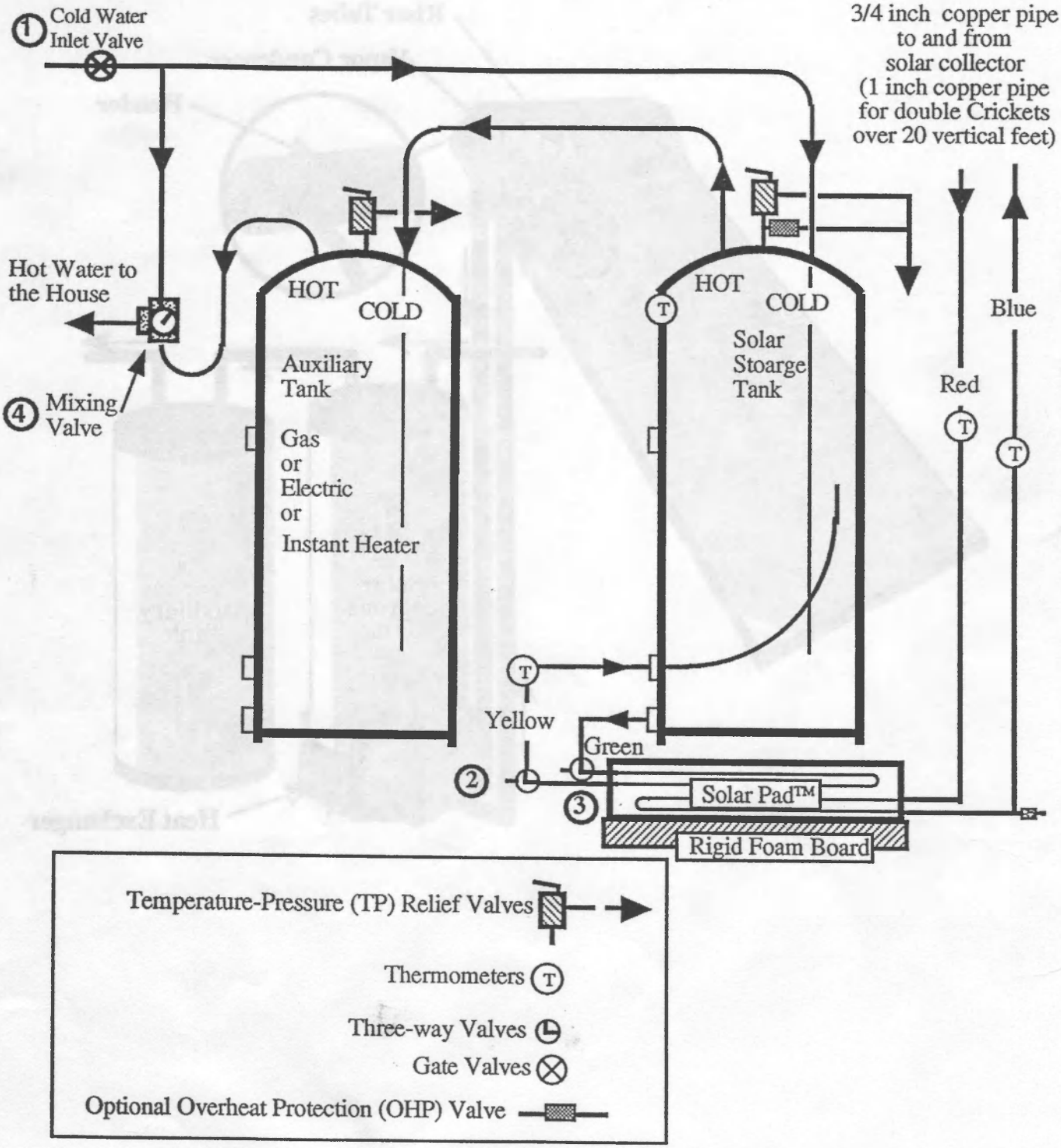


FIGURE 3. **Alternative diagram of the water connections, showing optional by-pass and optional 3-valve isolation.**

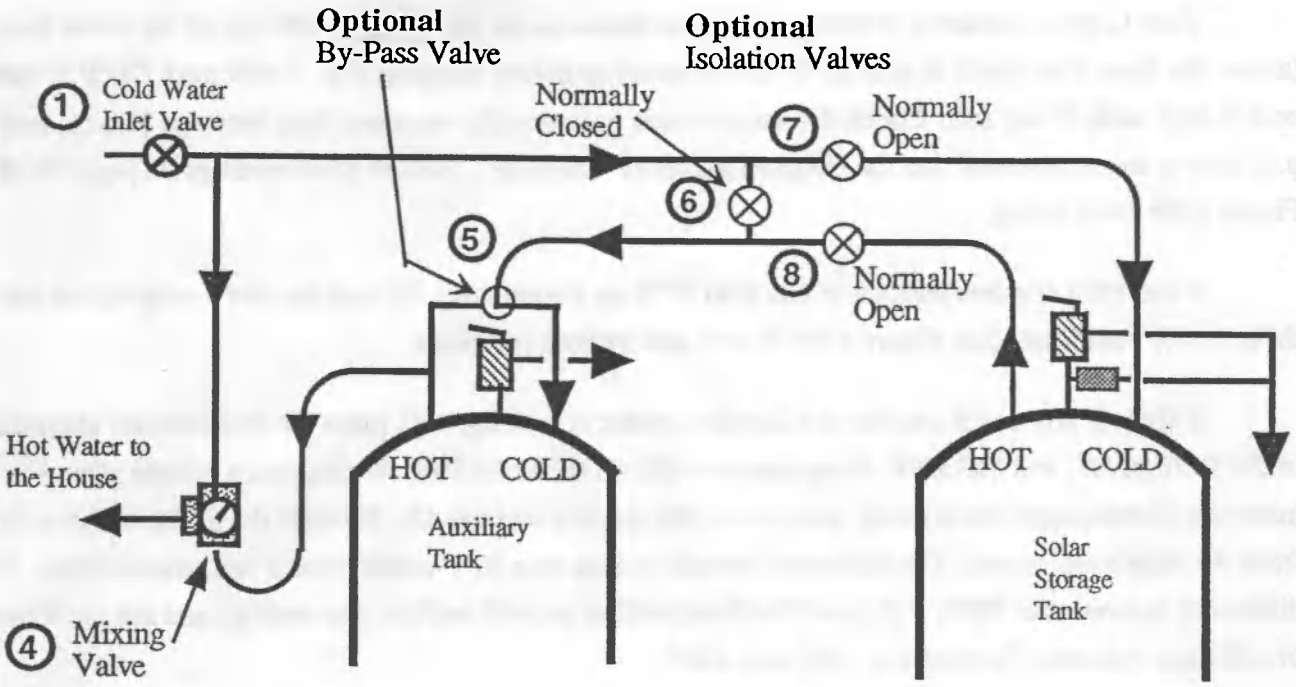
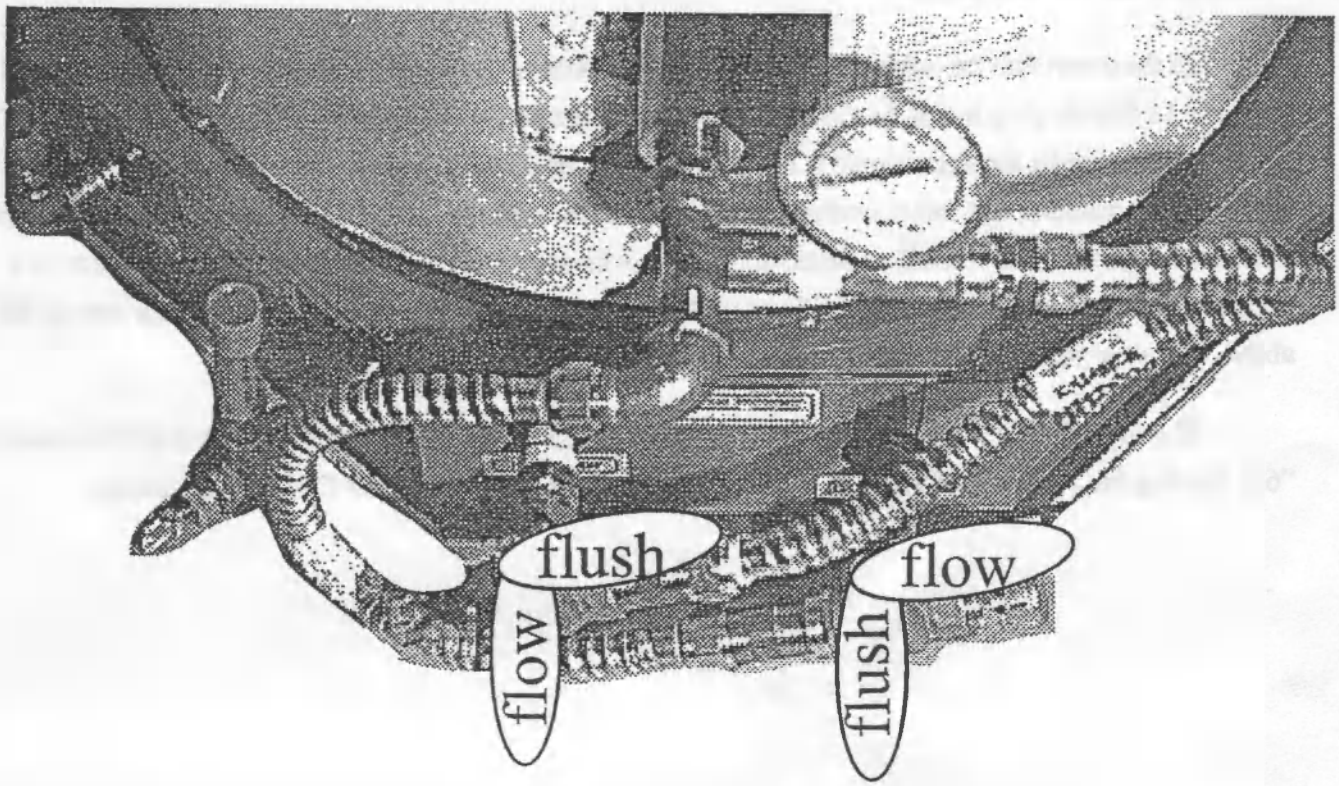


FIGURE 4. **Photograph of the 3-way valves, showing the "FLOW" and "FLUSH" positions.**



TESTING FOR PROPER PERFORMANCE

Your Copper Cricket is working well if the thermometer on the **YELLOW** side of the water loop (above the Solar Pad) reads at least 80°F on any sunny or lightly overcast day. It will read 120°F or more on hot days with strong sun. Check this temperature occasionally on sunny days between 11 a.m. and 2 p.m. just to assure yourself that the Copper Cricket is "chirping". Record your readings on page 13. See Figure 2 for color codes.

If the **YELLOW** temperature is less than 80°F on a sunny day, be sure the two 3-way valves are in their **FLOW** positions. See Figure 4 for **FLOW** and **FLUSH** positions.

If there is any doubt whether the Copper Cricket is running well, place the thermometer alternately in the **RED, BLUE,** and **YELLOW** thermometer wells on the Solar Pad. Wait about a minute after you insert the thermometer into its well, then record the reading on page 13. Subtract the **BLUE** temperature from the **RED** temperature. The difference should be less than 50°F under normal sun around noon. If the difference is more than 50°F, call your Certified Installer and tell her/him the readings and sun conditions; or call Sage Advance Corporation (503) 485-1947.

If the Copper Cricket is working fine (**RED-BLUE** temperature difference is less than 50°F) but the **YELLOW** temperature is below the **BLUE**, it may be time to flush the Solar Pad. See the maintenance instructions on the next pages.

In the event that the solar loop should stop functioning (improper installation, leak in the solar loop, etc.) a fusible plug inside the collector will melt if the collector temperature reaches 283°F (139°C). When the plug melts the solar liquid is released with about 60 psi pressure. You may hear a "whoosh" lasting a few minutes, see steam emitting from around the collector's hood, or see solar liquid draining from the collector. The release of steam and liquid is harmless. Its purpose is to release pressure in a malfunctioning system. The liquid will not damage any roofing material. If you see or hear any of the above, call your installer or Sage Advance Corporation.

If you wish to test further for proper performance, refer to the installation section of this manual, "6.0 Testing for Proper Performance," which probes much deeper into the Cricket's operation.

GENERAL MAINTENANCE

DO WHAT ?	WHEN ?
Clean Glass	Spring, Fall
Flush Solar Pad and Storage Tank	At least once per year

Cleaning the glass

Rain water usually cleans the Copper Cricket. During dry spells, rinse dust from the glass (in the late evening or early morning to avoid strain on the glass) by spraying the glass with water, or by washing with mild detergent followed by a rinse. Repair damage to pipe or tank insulation as necessary.

SOLAR PAD AND TANK MAINTENANCE

The Solar Pad heat exchanger has two liquid pipes, the solar loop pipe and the water loop pipe. The solar loop pipe does not require maintenance because it contains only inert liquids in a vacuum. **The water loop, on the other hand, contains domestic water, which is usually saturated with air and may contain fouling minerals.** Minerals which build up on the walls of the water loop (calcium carbonate, iron rust, sulfates, and sulfides) reduce the Solar Pad's effectiveness by reducing heat transfer from one pipe to the other. Sand, silt, rust and other sediments may deposit in the pipes. **These deposits slow or stop the thermosiphon flow through the water loop, causing the solar loop to overheat, blow the fuse plug, and shut down the system. If the local domestic water is prone to fouling, the Solar Pad must be cleaned periodically.** Once every year is enough for normal water, but you may have to flush more often if your water has a high mineral content. Your local water treatment specialist (for example Bruner, Culligan, Lindsay-Ecowater, or Watersoft) can tell you if your water is prone to fouling.

We recommend that 6 months after your installation that you flush your Solar Pad and Tank as outlined in the next section. As a result of what you collect in the bucket you can judge how often you should flush your system.

Solar pad and Tank flush

Sediment is flushed from the Solar Pad and from the bottom of the tank whenever you follow these instructions. Refer to Figures 2 and 4.

_____A. Remove the hose cap from, and connect a hose to the **YELLOW** 3-way valve #2. Direct the hose into a clean bucket to see what comes out of the tank and Solar Pad.

_____B. Turn the **YELLOW** 3-way valve (#2) to its **FLUSH** position and hold the hose tightly to keep it from whipping about. This forces water from the tank through the Solar Pad and out through the hose. It also flushes the bottom of the tank. After you have collected your water sample in the bucket flush, until the water is clear.

_____C. Return the **YELLOW** 3-way valve #2 to its **FLOW** position, remove and drain the hose, and replace the hose cap.

_____D. Record your observations on page 14.

DE-SCALING FLUSH.

If the water flush does not remove the scale, we recommend flushing with a commercial de-scaling solution. Because water acidity and fouling minerals vary from place to place, you should consult a water treatment specialist (for example Bruner, Culligan, Lindsay-Ecowater, or Watersoft). They can recommend a de-scaler and tell you whether your water needs treatment. Refer to Figures 2 and 4.

_____A. If the sun is shining strongly, either cover the collector or wait until evening to avoid boiling the de-scaler, possibly causing severe burns.

_____B. Remove the hose cap from, and connect a hose to the **GREEN** 3-way valve #3 on the Solar Pad. Direct the hose into a sewer drain.

_____C. Turn both the **YELLOW** and the **GREEN** 3-way valves #2 and #3 to their **FLUSH** positions.

_____D. Remove the hose cap from the **YELLOW** 3-way valve #2 on the solar storage tank. This allows air in so the Solar Pad can drain. Wait until water stops draining from the hose.

_____E. Lift the open end of the drain hose above the level of the **YELLOW** 3-way valve #2. Use a funnel to pour de-scaler into the hose, filling the Solar Pad until de-scaler flows from the hose fitting on the **YELLOW** 3-way valve #2. Keep a can or bucket under the **YELLOW** 3-way valve #2 to avoid a mess.

_____F. Keep the open end of the drain hose above the level of the **YELLOW** 3-way valve #2 to keep the de-scaler in the water conduit for as long as is recommended in the de-scaler instructions.

_____G. Lower the open end of the drain hose and place it in a sewer drain or the chemicals recommended disposal method. Place the hose cap on the **YELLOW** 3-way valve #2.

_____H. Turn the handle on the **YELLOW** 3-way valve #2 to its **FLOW** position. This forces hot water from the tank through the Solar Pad, flushing the de-scaler out through the hose. Flush until the water is clear.

_____I. Turn the handle on the **GREEN** 3-way valve #3 to its **FLOW** position, remove the drain hose, and replace both hose caps.

_____J. Uncover the collector.

Keep a record

Record flush dates and what came out. Read and record temperatures at least once a year. Use the forms on pages 13 and 14 for a convenient historical record. Have the record page, as well as the "System Information Sheet", page 1, available if you call your installer or Sage Advance Corporation.

RE-ROOFING

If you re-roof and want to handle the removal and re-installation of the Copper Cricket yourself, see "7.0 Re-Roofing" in the installation section. If not, call your installer or Sage Advance Corporation.

ABSENCE FROM HOME

Winter:

If you are absent for several days in the winter, no harm will come to your Copper Cricket providing you do not drain your water system. If you must drain your water system to avoid freezing of the water pipes, cover the collector with a tarp or canvas cover. Secure the cover against high wind. The Copper Cricket system is freeze proof and will start up when you turn on the water and uncover the collector, in that order.

Summer:

If you are absent for three or more days in the summer and you live in a climate where summer daytime temperatures exceed ~90°F, there is risk of overheating your storage tank and releasing hot water through the temperature-pressure relief valve (T-P valve). We recommend that you cover your collector with a tarp or canvas, fastened securely in case of high wind. OR, install an overheat protection (OHP) valve which releases hot water from the tank before it can overheat. The OHP valve is designed to open and close safely thousands of times. It is available from Sage Advance Corporation.

SOLAR ACCESS

Some cities and counties have special laws protecting your right to the sunlight which illuminates your home and solar devices. Check with your local building or planning department to see if you have rights under such laws.

SAFETY

EMERGENCY SHUTDOWN PROCEDURES:

A. Leak in the Solar Pad heat exchanger:

_____(1) Isolate the Copper Cricket system from the domestic water system by moving the 3-way Valves #2 and #3 to their flush positions. See Figures 2 and 4.

_____(2) Then cover the collector to keep it from overheating and melting the fuse plug.

_____(3) **Call your installer or Sage Advance's Customer Service (503) 485-1947.**

B. Leak in the solar storage tank. If your tank has no isolation valves.
See Figures 2 and 5.

_____(1) Shut off the water at the cold water inlet valve #1. If water continues to run, shut it off at the water meter.

_____(2) Use a wrench to disconnect both flexes from the storage tank.

_____(3) Couple the flexes using the brass nipple attached to the water line; use 2 wrenches to tighten.

_____(4) Turn the water on at valve #1, and at the water meter if that valve was shut.

_____(5) Cover the collector. Replace the tank.

C. Leak in the solar storage tank. If your tank has isolation valves.
See Figures 3.

_____(1) Shut off the valves #7 and #8.

_____(2) Turn on valve #6.

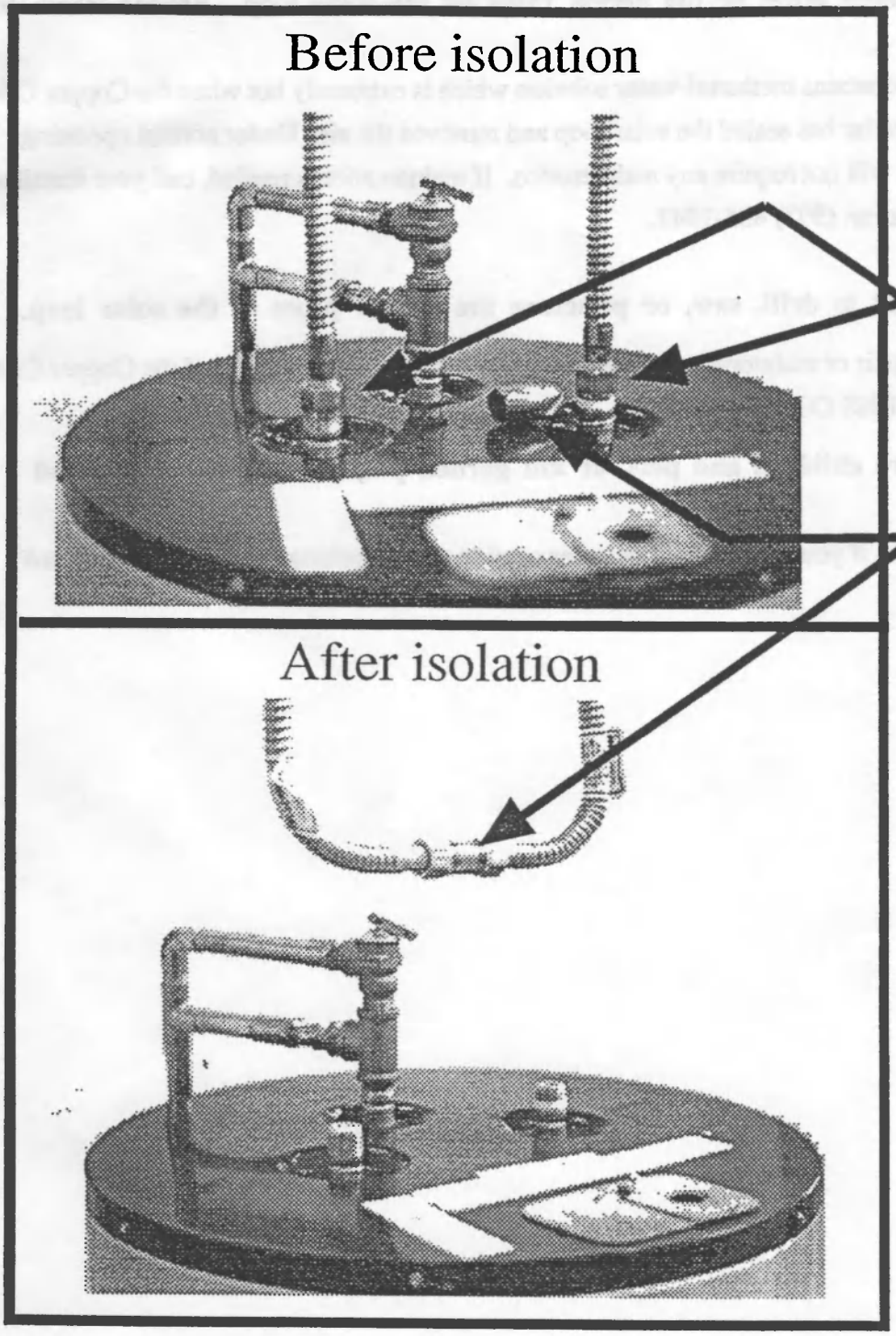
_____(3) Cover the collector. Replace the tank.

D. Leak in the auxiliary tank or the water conduits connecting the tank to the house water system.

You can only stop the leak by CLOSING THE COLD WATER SHUT-OFF VALVE #1 (SEE FIGURE 2). If water continues to run, shut it off at the water meter. Immediately turn off the electricity or gas to the auxiliary tank . Cover the collector. Repair pipes or replace the tank.

E. If in doubt, call a plumber or Sage Advance's Customer Service (503) 485-1947.

FIGURE 5. Isolation of the solar storage tank using the brass nipple.
See SAFETY, EMERGENCY SHUTDOWN PROCEDURE B.



To Isolate Your Solar Storage Tank:

1) Shut off the water at the cold water inlet valve.

2) Use two wrenches to disconnect both flexes from the storage tank.

3) Couple the flexes using the brass nipple, which is wired to the cold water pipe just above the tank. Use two wrenches to tighten.

4) Turn the water on at the cold water inlet valve.

IMPORTANT NOTES

Do not open the sealed plugs or the access valve on the solar loop. Severe steam burns could result.

The solar loop contains methanol-water solution which is extremely hot when the Copper Cricket is operating. Your installer has sealed the solar loop and removed the air. Under normal operating conditions the solution will not require any maintenance. If maintenance is needed, call your installer or Sage Advance Corporation (503) 485-1947.

Take precautions not to drill, saw, or puncture the copper pipes of the solar loop.

When doing repair or maintenance on any other system near the solar loop of the Copper Cricket. SEVERE STEAM BURNS COULD RESULT.

Hot water can injure children and pets, or kill garden plants and grass if directed outside.

Take precautions if you must direct hot water outside while flushing the Solar Pad and tank.

TEMPERATURE RECORD

		<——TEMPERATURES——>					SUN
DATE	TIME	Red	Blue	Red-Blue	Yellow	Tank	(bright, hazy, overcast)
7/7/95	12:10	140	100	40	110	120	Partly Sunny
7/10/95	11:00	160	125	35	125	140	Bright Sun
7/10/95	11:30	160	125	35	130	140	FLUSHED Heat Exchanger, SUN!

SAMPLE

ANNUAL HEAT EXCHANGER MAINTENANCE RECORD

(see page 7)

DATE	OBSERVATION: (WHAT'S IN THE FLUSH WATER?!)
7/10/95	Some rust+sand settled out after letting water sit. 3

SAMPLE

The

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- INSTALLATION

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Please Note:

The vacuum of the Copper Cricket's pumping system requires special care:

1) THE PIPE SOLDER JOINTS MUST BE PERFECT.
2) ALL THE PIPES MUST BE GRADED.

We strongly recommend that you read the text carefully.
There may be suprises for even the most experienced builder or plumber.

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1.0 OVERVIEW

1.1 How to Use this Installation Manual

First, let's get oriented. The **Copper Cricket™** is made up of two major components: a solar collector (or two solar collectors) and the **Solar Pad™** heat exchanger. When we say Copper Cricket, we are referring to the entire system; the solar collector(s), the heat exchanger, and the plumbing between them.

When there's a new part of the system we want you to meet, its name is printed in **boldface type**. Names of things in *italic type* are important related parts or systems, alternative part names, or sometimes the name of a part we've introduced earlier, but to which we want to draw your attention again. We've inserted check-off blanks on the left side of each instruction so you can check off your progress.

For a smooth installation process, read this entire manual before you begin. You may want to get pencil and paper to write down questions or comments as you read. Two of the most important parts of the manual are the **Safety Notes** (1.3) and the **Functional Requirements** (1.4).

1.2 Preview of the Installation Process

After reading this section, the next step is to unpack all the pieces of the Copper Cricket. Check them against the packing list on the boxes, and become familiar with each piece.

As you read Section 2, you will need to make some decisions regarding the installation of your Copper Cricket. If this is your first installation you will probably need the **Installation Kit**. Decide where to locate the solar collector on the roof, where to run the pipes for the solar loop, where to place the solar storage tank and how to run the pipes between the solar storage tank and auxiliary tank. We recommend a two-tank system for most homes. A one-tank system is suitable only for one or two people who are very modest hot water users, and is not approved by SRCC. Connections to a wood stove are also not approved by SRCC.

Section 2 tells you how to put the Solar Pad heat exchanger and solar storage tank in place, connect them, and connect the solar storage tank to the house water system. Section 3 takes you onto the roof to install the solar collector(s) and connect it to the Solar Pad. You'll flush the solar loop in Section 4 and test it for leaks. The big moment arrives in Section 5 when the Cricket comes alive under the sun. Section 6 is a guide to sleuth any problems you may have down the road. Finally, Section 7 tells what to do if you have to re-roof your house.

1.3 SAFETY and Important Notes.

- DANGER!- Before you handle any electrical wires or connections, shut off the electricity at the breaker box. Test with a volt-meter or test light to be certain the power is off.
- WARNING! - Hot water can cause serious burns to people and pets, or kill garden plants and lawns. Take precautions when you drain hot water.
- WARNING! - Use only lead free solder for all connections in the domestic water system.
- WARNING! - Install the temperature-pressure (T-P) relief valve in conformance with local code, so it can pass up to 20 gallons per minute of very hot water without posing a hazard.
- WARNING! - The methanol used in the solar liquid is lethal if enough is drunk. Refer to the Material Safety Data Sheet in the appendix and on the can of Methanol. The pure methanol in the can is flammable at temperatures over 58°F. The methanol-water solution in the mixing bag is combustible at temperatures over 145°F. Once sealed in the solar loop it is safe.
- Note: Do not use flex connectors with brass nut ends in the solar loop. Flex connectors with solder ends are provided for the solar loop.
- Note: When you place *threaded plugs* in the *solar loop*, use only the *red silicone sealant* provided with the Copper Cricket. Use enough to fill the threads, but don't use too much or the excess will end up in the system. Ordinary water pipe sealants will not vacuum-seal the solar loop.
- Note: The red silicone sealant is not approved for domestic water pipes. When you thread pipes or fittings in the domestic water loop, use *Teflon tape* or an *approved water pipe sealant.*
- Note: When you tighten threaded copper or brass fittings, *use two wrenches,* one on either side of the threads, so that you don't twist the copper pipe or damage the equipment.
- Note: Ports and pipes are color coded with strips of colored tape around fittings or colored paint on surfaces near the connection. The coding is consistent throughout the system:

Red .....HOT solar liquid
Blue ..... COLD solar liquid
Yellow ..... HOT domestic water
Green ..... COLD domestic water

1.4 Functional Requirements.

1. Place the collector in a location which receives at least 3 to 4 hours of mid-day sun year-round. Pointing within 30° of true south (northern hemisphere) is best; you can expect significantly lower solar gain if the collector points more than 60° from true south. Recommended elevation (tilt) is between 20° and 40° for the continental US.

2. The solar collector must be elevated to no less than 14° (3 in 12 pitch) and no more than 60° (21 in 12 pitch). The vertical distance from the top of the collector to the Solar Pad must not exceed 36 feet, and the pipe run must not exceed 60 feet each way. Single collector systems must be plumbed with 3/4" copper. Double Cricket systems having a vertical distance greater than 20 feet must be plumbed with 1" copper.

____3. The hood (top edge) of the Copper Cricket collector must be perfectly level. The two collectors of a Double Cricket system must be perfectly level with one another. The Solar Pad heat exchanger must be perfectly level.

____4. All pipes must be installed to grade upward from the Solar Pad to the collector so that air can rise to the collector. Minimum grade is 1/4" per foot of run. Follow the rule "Shortest run, greatest grade." Pass through walls at 45°, not flat. Use "swivel joints" (45° elbow + 45° street elbow) for more flexibility.

____5. Keeping the air out of the solar loop is crucial to the operation of the Copper Cricket, and that depends on good plumbing. For soldering instructions, read "The Fine Art of Soldering" in the Appendix.

____6. Your solar storage tank may be any electric water heater which meets the following requirements:

.....A. It must be approved for pressurized domestic water.

.....B. It must hold at least 50 gallons for one collector, 80 gallons for two collectors.

.....C. It must be rated at R-20 for 50 gallons, R-16 for 80 gallons. Add a blanket of insulation if necessary.

.....D. It must have anti-convection traps on both the cold inlet and the hot outlet.

.....E. It must be at least 18" in diameter (shell 20") to receive the curved thermosiphon dip tube.

.....F. It must have 1" threaded electric element ports, or a 1" threaded adapter for the lower port.

____7. Freeze protection: The collector and pipes to the Solar Pad are immune to freeze damage at any temperature. However, the Solar Pad, its connection to the storage tank, and the connections between storage and the rest of the water system may be damaged by freezing if exposed to temperatures below 25°F (-40°C) for 18 hours or more. These parts must be installed where they are protected from hard freeze. Insulate pipes with at least 3/4" wall insulation.

____8. Your Copper Cricket will continue to heat the storage tank while you are away. If you live in the desert or Sunbelt and you leave for 3 days or more, protect the storage tank from overheating by either (1) covering the collector when you leave, or (2) installing a 190°F overheat protection (OHP) valve available from Sage Advance Corporation.

2.0 INSTALLATION AT THE SOLAR STORAGE TANK

2.1 Install the Solar Pad and the solar storage tank

Be sure the location you've chosen for the Solar Pad and storage tank will not get below 32°F.

A. **If you have an existing electric water heater, turn off the power before you do anything else.** Failure to do so could injure you, and draining the tank without turning off the power will destroy the heater elements.

B. Put the **rigid insulation board** on the floor where the solar storage tank will stand, and place the Solar Pad on it. When you stand in the most open work space, the side of the Solar Pad having two solar pipes (coded red and blue) should face 45° to your left, and the side having the two water pipes (coded yellow and green) should face you directly. Be sure the Solar Pad is perfectly level: use shims beneath the *rigid insulation board* if necessary.

C. If your *solar storage tank* is second-hand, flush the sediment out and check it for scale build-up before you install it. Replace galvanized nipples with heat-trap nipples.

D. Install the temperature-pressure (T-P) relief valve in the port provided. The temperature-pressure relief port is usually on top of the tank, but it is sometimes about 6" down the side. Plumb the T-P valve in conformance with local code. Installation of the optional overheat protection valve is done now if you choose to have that option.

E. Install the **small thermometer** (1" face with a 6" stem) on the solar storage tank. Drill a 3/16" hole through the tank's shell at a point 6" below the top of the tank and 4" right or left of the upper element shield. Be careful to drill only the shell and not the tank. Slide the small thermometer's stem in at an angle, about 45° or 50° from straight in, until you feel it touch the tank; be careful not to bend the stem. If necessary, re-insert again so that it is fully inserted when it comes in contact with the tank. Now pull it out once more, inject silicone into the hole, and re-insert the thermometer. When the silicone sets, it holds the thermometer in place.

2.2 Connect the Solar Pad to the Thermosiphon Port.

A. **BE SURE THE ELECTRICITY IS OFF!** Disconnect the wires for the lower electric element from the thermostat relay near the upper element. Disconnect the wires from the lower electric element and remove the wires.

B. Look at FIGURES 6 to 8. Remove the lower element using the element wrench provided in the installation kit. If your solar storage tank has *bolted-flange elements,* get a *flange-to-1" thread adapter* for the lower element port. The adapter is available in most plumbing stores — not in the kit.

C. If the solar storage tank is short, cut the curved plastic **thermosiphon dip tube** so that it comes no closer than 2" from the upper element. Insert the thermosiphon dip tube into the lower element port, pointing the inserted end upward in the solar storage tank, and lean the upper end against the back of the solar storage tank. Adjust the tube's position so that the part sticking out of the port is level, then mark it 3" out from the port and cut it off with a hack saw. TAKE CARE NOT TO LOSE THE DIP TUBE IN THE TANK — IT'S VERY HARD TO GET IT OUT !

D. Look at FIGURE 7. Apply pipe sealant to the threads of the **brass dip tube adapter** and slide it over the exposed dip tube. Thread the brass dip tube adapter with the thermosiphon dip tube inside into the solar storage tank port; tighten it until the rubber washer forms a tight seal with the tank port, but don't overtighten it.

E. If you decide to cut a hole in the water heater cover to install the dip tube adapter through take care to make the edges of the hole smooth and install the cover now.

F. Thread the **yellow thermowell** into the brass dip tube adapter, finishing so that the thermometer will face up for easy reading, and the end is pointing to the right and slightly down (1/4" per foot or more).

G. Using two wrenches, thread the side port of a **3-way valve** onto the *yellow port of the Solar Pad* ending with the valve handle up, and the valve tilted slightly up to the right to prevent air traps (see FIGURE 8).

H. Thread the **hose adapter** onto the left end port of the 3-way valve and the **3/4" X 2" brass nipple** onto the right end port. Be sure you have assembled the parts as in FIGURE 8 or you won't be able to flush the Solar Pad.

I. Use a **18" nut by nut flex connector** to connect the *yellow thermowell* on the solar storage tank to the *brass nipple* on the 3-way valve. Be careful not to kink the flex. Make sure that the flex always slopes upward from the Solar Pad to the yellow thermowell so that it will not trap air in the line.

2.3 Connect the Solar Pad to the Solar storage tank's Drain Port.

A. Refer to FIGURES 9 and 10. Remove the **boiler drain** from the **solar storage tank drain port,** the lowest port of the solar storage tank. Thread a **3/4" X 4" brass nipple** into the *drain port*. Thread a brass **street elbow** onto the *nipple.* Tighten with the *street-elbow* pointed toward the left and down slightly.

B. Using two wrenches, thread the side port of a **3-way valve** onto the *green port of the Solar Pad* ending with the valve handle up, and the valve tilted slightly up to the right to prevent air traps (see FIGURE 10).

_____C. Thread the **hose adapter** onto the right end port of the 3-way valve and the **3/4" X 2" brass nipple** onto the left end port. Be sure you have assembled the parts as in FIGURE 10 or you won't be able to flush the Solar Pad.

_____D. Use a **18" nut by nut flex connector** to connect the *street elbow* on the solar storage tank to the *brass nipple* on the 3-way valve. Be careful not to kink the flex. Make sure that the flex always slopes so that it will not trap air in the line (see FIGURE10).

_____E. Push the 18" nut by nut flex connector into position so that you can have access to the hose adapters in the future.

FIGURE 6. Parts laid out for the hot water hook-up between the solar storage tank and the heat exchanger.

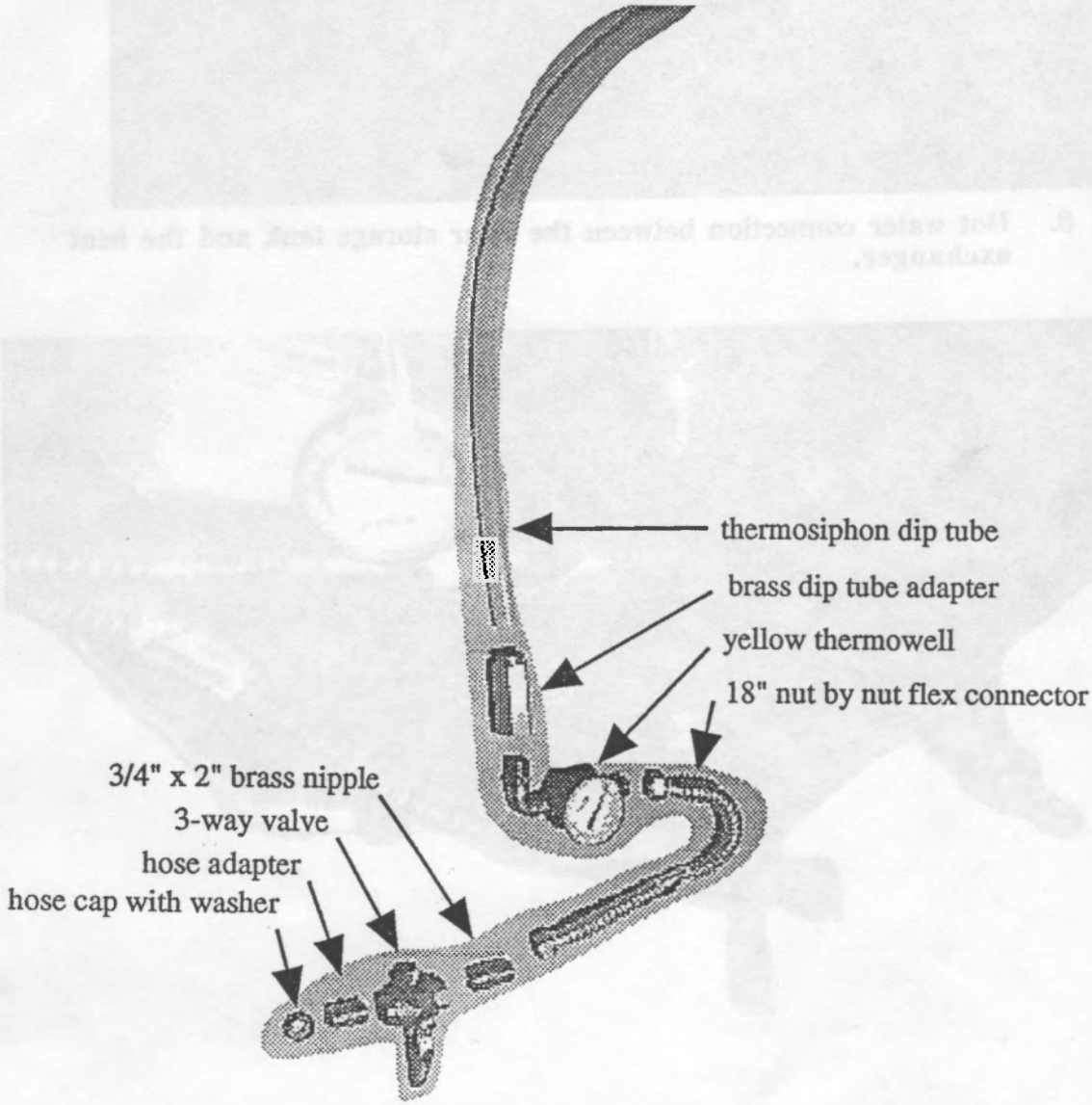


FIGURE 7. Installing the thermosiphon dip tube into the lower element port.

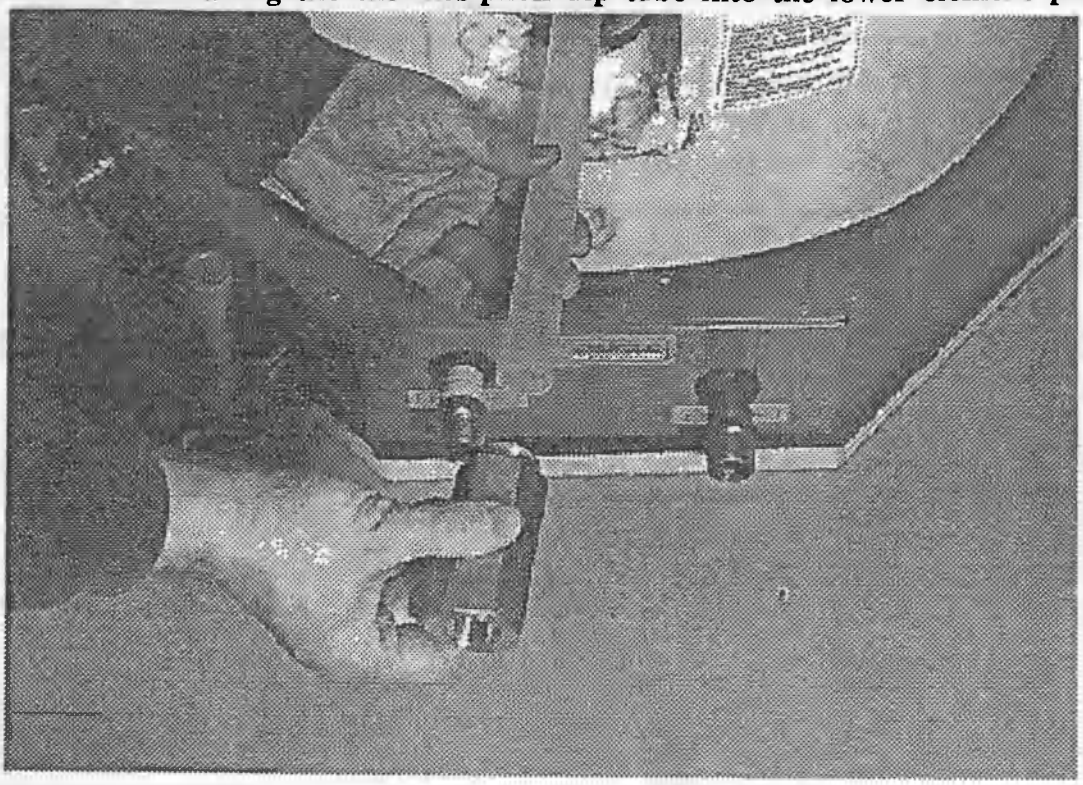


FIGURE 8. Hot water connection between the solar storage tank and the heat exchanger.

FIGURE 9. **Parts laid out for the cold water hook-up between the solar storage tank and the heat exchanger.**

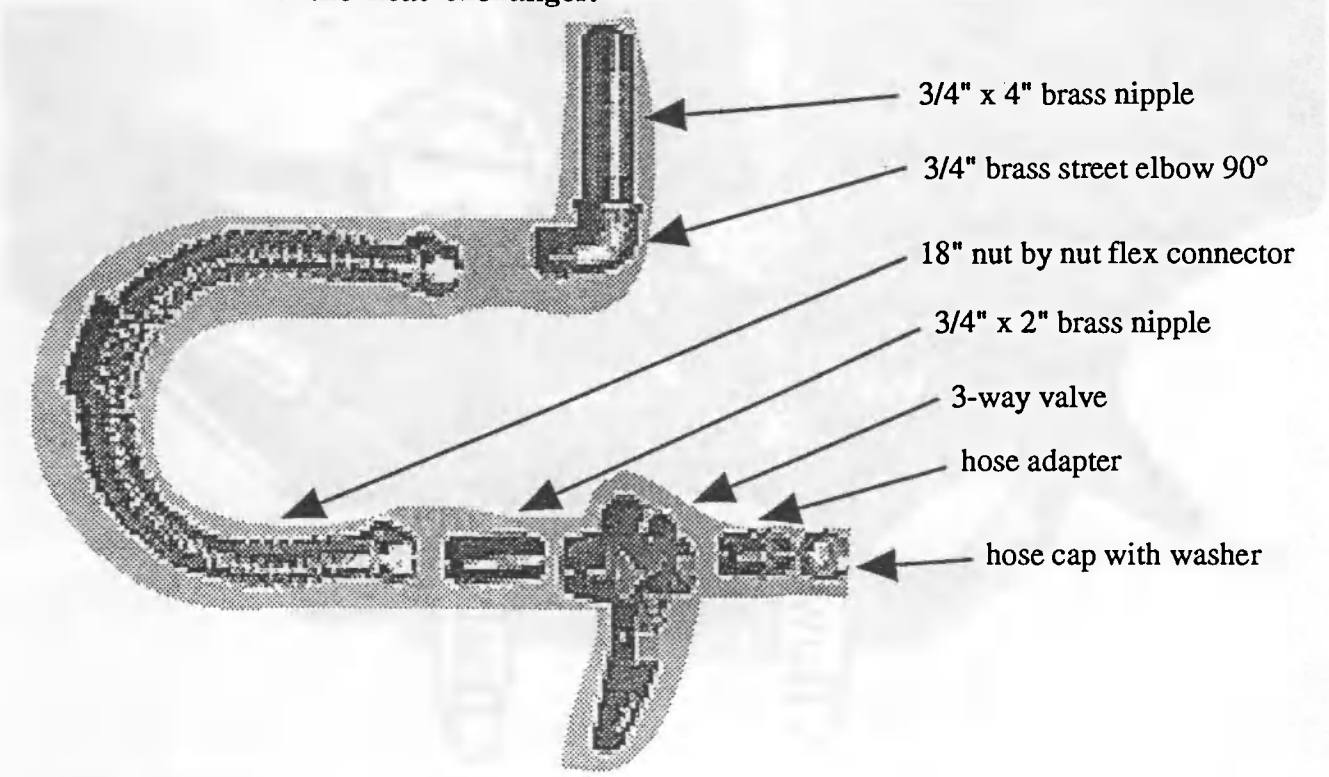


FIGURE 10. **Connection of the cold water between the solar storage tank and the heat exchanger.**

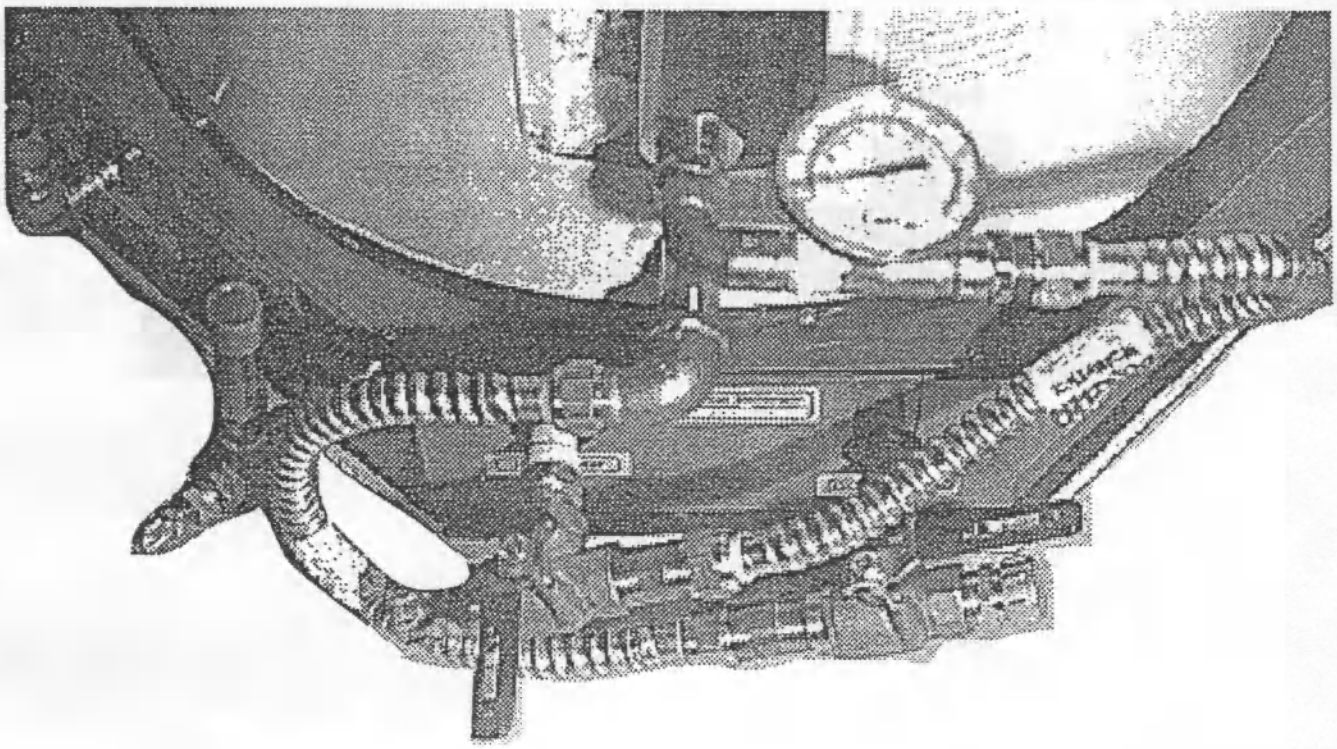


FIGURE 11. Heat exchanger 3-way valves showing flow and flush positions.

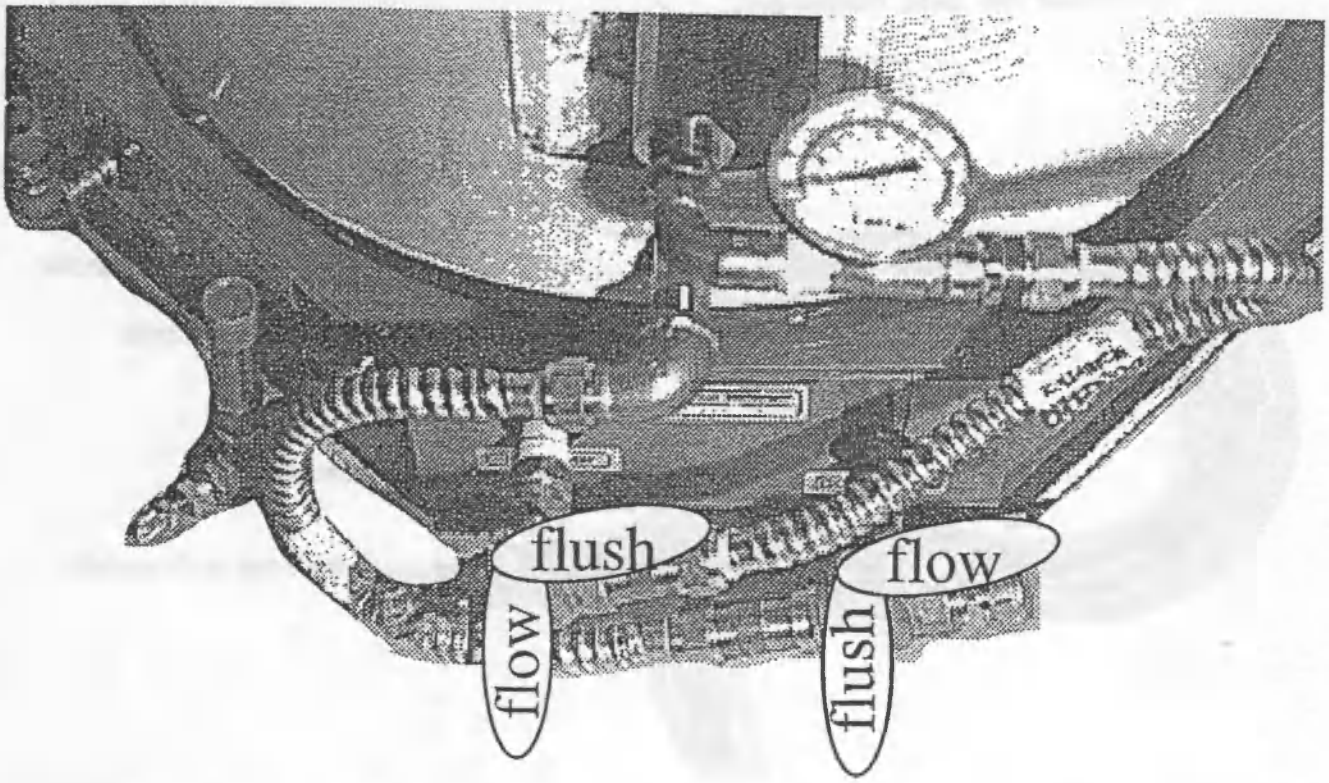
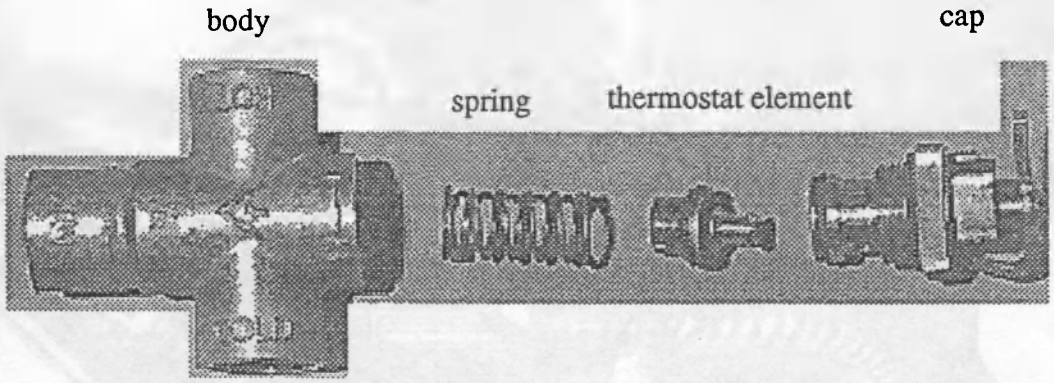


FIGURE 12. Parts of the mixing valve.
Install the spring first, then insert the thermostat element with its small end away from the spring. Finally thread in the cap and dial assembly.



2.4 Connect the SOLAR STORAGE TANK to the House Water System.

• **Note: Use lead-free solder for all domestic water soldered connections.**

_____A. Many energy-conserving water tanks already have anti-convection nipples in the cold inlet and hot outlet ports. If either of your tanks don't have them, purchase them at your plumbing store and install them.

_____B. Follow the schematic diagram in FIGURE 13 (or FIGURE 14 if you are installing the optional by-pass valve or the optional isolation valves) to connect the hot and cold water lines to the solar storage tank and auxiliary tank. Be sure there is a **cold water inlet valve** (valve #1).

_____C. Place the **mixing valve** (valve #4) 6" below the side of the tank, or use a 18" nut-by-nut flex connector looped upward at least 6" above the mixing valve to make a heat trap. Pull the thermostat element and spring out before you solder the mixing valve or the element will be damaged by the heat. FIGURE 12 shows how to re-assemble it properly. Set the mixing temperature in the range 120 to 140°F (49 to 60°C).

_____D. You may want to install an optional **by-pass valve**, available from Sage Advance, on the auxiliary tank. This option allows you to by-pass the auxiliary tank during the sunniest months, shut off the electricity or gas, and rely completely upon solar energy. The by-pass consists of a 3-way solder valve installed as shown in FIGURE 14.

_____E. Isolation of the solar storage tank makes use of a **brass nipple** supplied with the system. Wire the nipple to the cold water line so the owner can find it easily if it's needed. Instructions for using the nipple are in Emergency Shutdown Procedures. The label which shows how to use the nipple by-pass must be attached (pasted) to the storage tank or wall, wherever it is most visible. FIGURE 14 shows how to install three gate valves, an alternative (but more expensive) scheme for tank isolation *if required.*

_____F. Look at FIGURE 15 to see how to assemble the **T-P valve** and **overheat protection (OHP) valve.** The 3/4" x 1/2" brass bushing between the brass tee and the OHP valve is necessary to keep its sensing element out of the way of the T-P valve's sensing element. Use a T-P valve with a long sensing element so it will reach into the storage tank. Do not solder near the valve because the excess heat will destroy the valve. Do not exceed a maximum torque of 25 foot pounds when installing the OHP valve.

2.5 Fill with Water, Pressure Test, and Flush.

_____A. Fill the tank(s): Turn both 3-way valves to their FLOW positions (see FIGURE 11). Open a hot water faucet on a sink or tub in the house. Open the *cold water inlet valve* to fill the tank(s) and Solar Pad. When no more air comes out of the hot water faucet, the tanks are full. Close the hot water faucet to pressurize the system.

_____B. Pressure test for leaks: Inspect the water connections around the tank and Solar Pad for leaks. You may be able to stop leaks from flex nuts simply by tightening the nut. For solder leaks, drain the pipes, the tank(s) if necessary, and repair the leaky fitting.

_____C. Flush the heat exchanger: Attach a garden hose to the upper 3-way valve (valve #2 on the heat exchanger's *yellow port*.). Place the other end of the hose in a clean bucket so you can inspect what comes out. Switch the upper 3-way valve to its FLUSH position, hold onto the hose, and flush until the water comes out clear. Then switch the valve back to FLOW. Remove the hose, and put the cap back on the hose adapter. Repeat this flush procedure for the lower valve (valve #3 on the heat exchanger's *green port*).

FIGURE 13. Basic two-tank water hook-up.

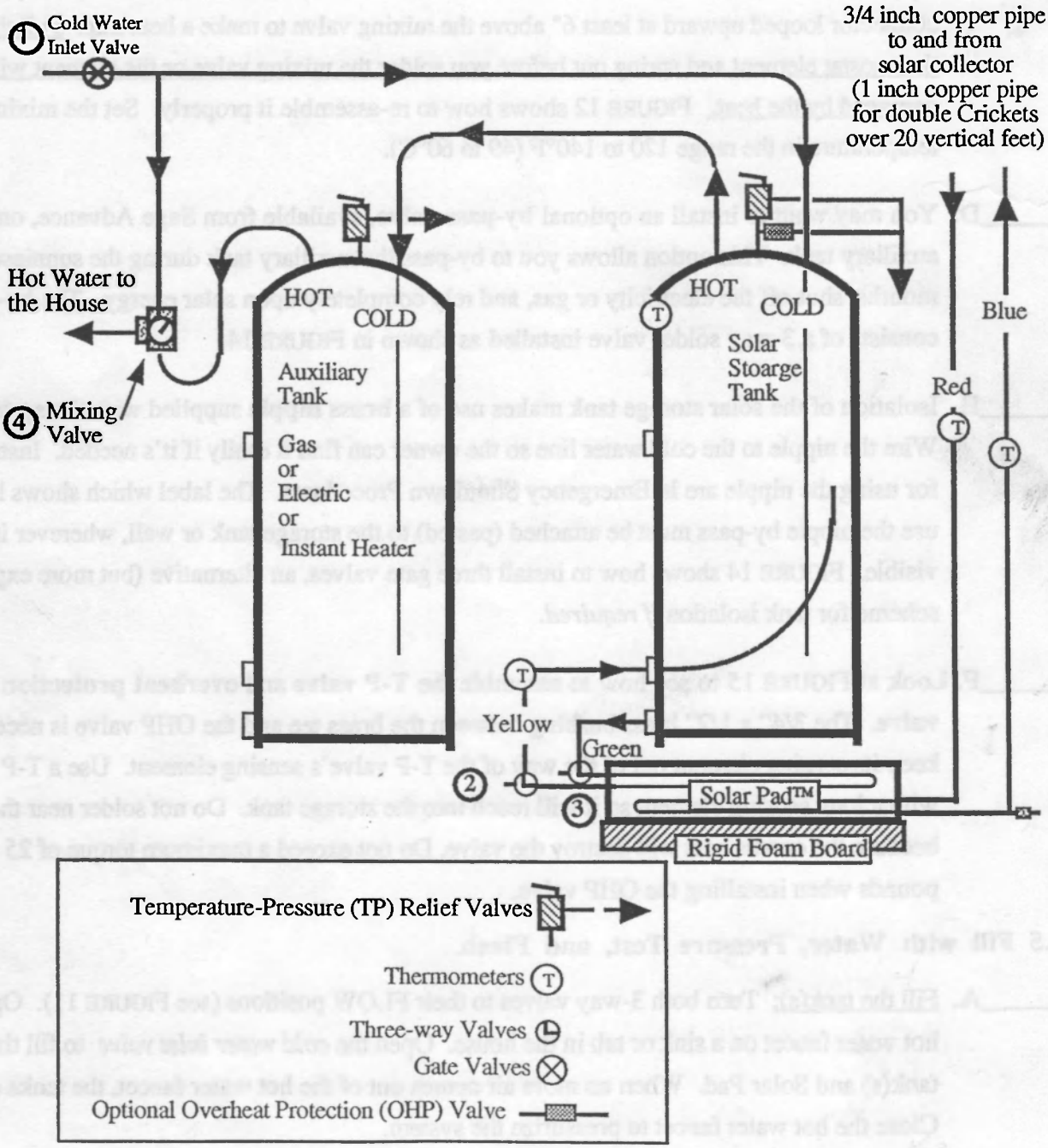


FIGURE 14. Water hook-up with optional by-pass and isolation valves.

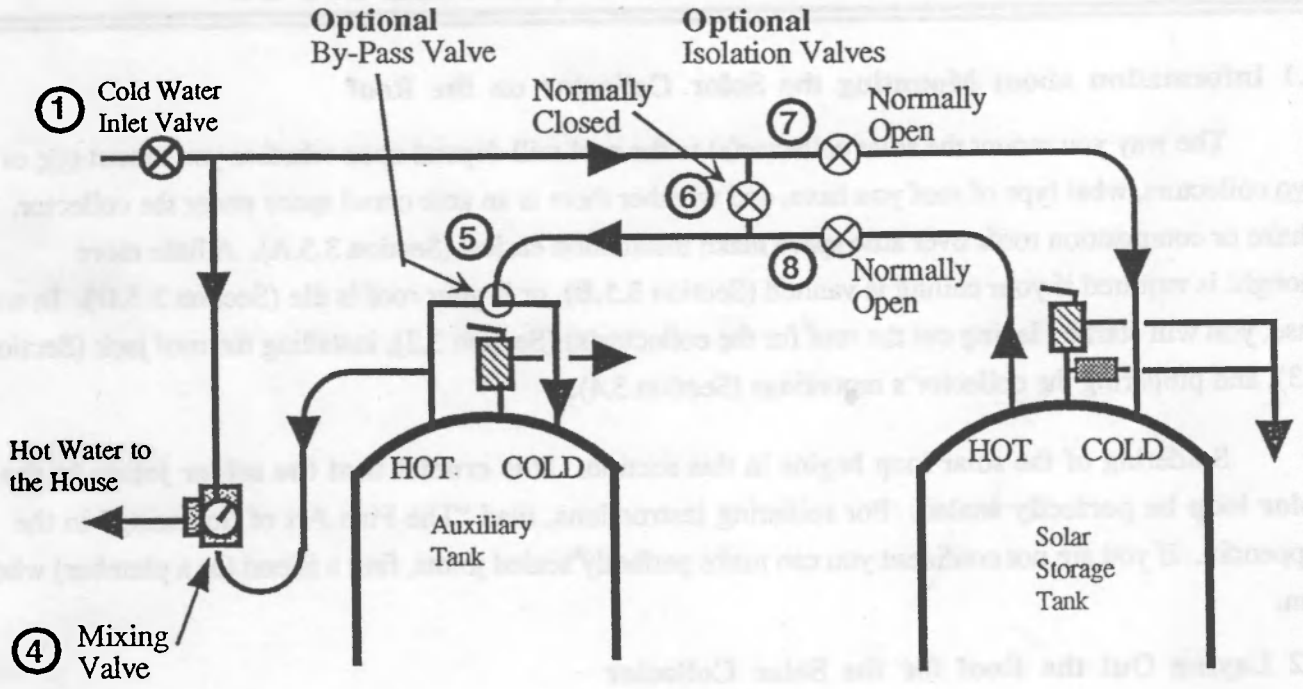
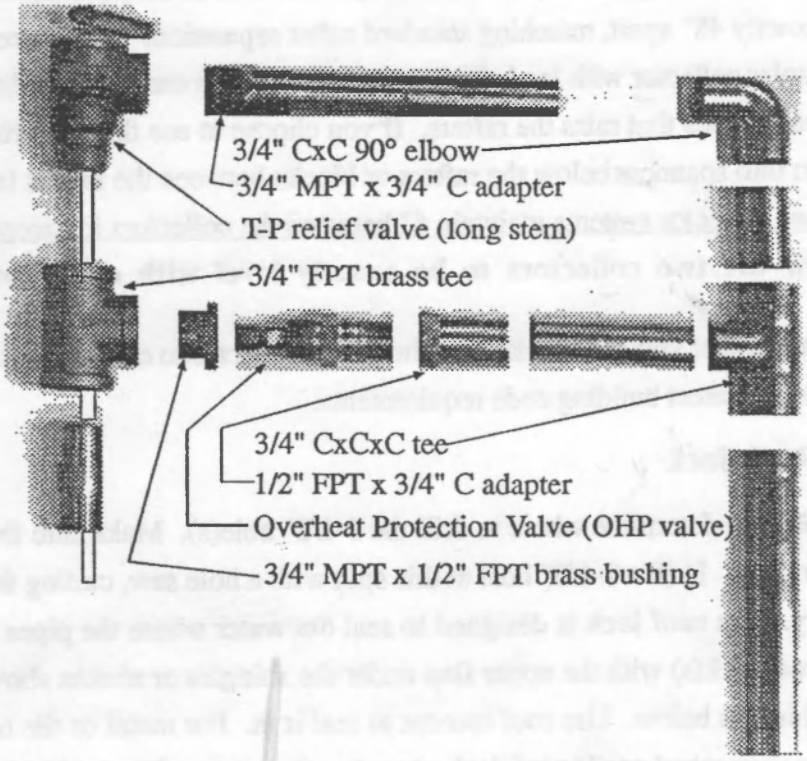


FIGURE 15. Assembly of the T-P valve and Overheat Protection (OHP) valve.



3.0 INSTALLATION ON THE ROOF

3.1 Information about Mounting the Solar Collector on the Roof

The way you mount the solar collector(s) to the roof will depend upon whether you mount one or two collectors, what type of roof you have, and whether there is an attic crawl space under the collector. Shake or composition roofs over attic space make installation easiest (Section 3.5.A). A little more thought is required if your ceiling is vaulted (Section 3.5.B), or if your roof is tile (Section 3.5.D). In any case, you will start by laying out the roof for the collector(s) (Section 3.2), installing the roof jack (Section 3.3), and preparing the collector's mountings (Section 3.4).

Soldering of the solar loop begins in this section. **It is crucial that the solder joints in the solar loop be perfectly sealed.** For soldering instructions, read "The Fine Art of Soldering" in the Appendix. If you are not confident you can make perfectly sealed joints, find a friend (or a plumber) who can.

3.2 Laying Out the Roof for the Solar Collector

_____A. Look at FIGURES 16 to 19. You will be making a total of five roof penetrations for each collector. One is a 2-1/2" diameter hole for the pipes to pass through, and four are 1/4" diameter for the lag bolts or 3/8" for the threaded rods to secure the **mounting brackets.** When the four mounting brackets are attached to the sides of the solar collector, the mounting holes are exactly 48" apart, matching standard rafter separation. This makes it easy to either mount the solar collector with lag bolts into the rafters (take care not to split them!) or to mount it with threaded rods that miss the rafters. If you choose to use threaded rods, you will need to secure them into spanners below the rafters or blocks between the rafters (see FIGURES 18 and 19). For two collector systems maintain 6" between the collectors for access. **The layout must allow the two collectors to be exactly level with one another.**

_____B. We recommend that you check with your building inspector to ensure that the way you secure the collector will meet building code requirements.

3.3 Installing the Roof Jack

_____A. See FIGURE 16 to determine where to drill the 2-1/2" hole(s). Make sure the roof penetration misses the rafters. Drill a 2-1/2" hole at this spot with a hole saw, cutting the roofing material as necessary. The **roof jack** is designed to seal out water where the pipes penetrate the roof. Install the roof jack(s) with the upper flap under the shingles or shakes above, and over the shakes or shingles below. Use roof cement to seal it in. For metal or tile roofs use your good judgment or your metal or tile roof dealer to select the appropriate roof jack for your roof style.

3.4 Preparing the Solar Collector(s) for Mounting on the Roof.

_____A. Weight distribution, especially important in snow country, is best if the mounting brackets are attached to the sides of the collector about 32" down from the top and 32" up from the bottom. Look at FIGURE 16. If your roof is shake, adjust the position of the mounting brackets an inch or two higher or lower, so that the brackets will rest in the middle of a shake and not on its edge.

_____B. Attach the brackets to the collector with the #12 x 1" stainless steel self-drilling screws supplied.

3.5 Mounting the Collector on the Roof.

_____A. FOR SHINGLE OR SHAKE ROOF CONSTRUCTION WITH CRAWL SPACE UNDER THE ROOF, tilt the solar collector on its side (onto wood blocks for protection) with the **red and blue stub pipes** facing out, and solder the **24" C by C flex connectors** to the *red and blue stub pipes*. (Use the flex connectors with the female solder fittings, not the flex connectors with brass nuts.) Depending on the roof angle and the difficulty of handling the solar collector, you may choose to lift it onto the roof before soldering the flex connectors on. Slip the **foam donut,** a round, black piece of foam with two holes, over the flexes. Apply roof cement to the collector side and press it against the collector, then apply roof cement to the roof side of the foam donut. Insert the flexes through the roof jack, and lower the solar collector to the roof; take care not to pop the rubber grommet off the roof jack. Check the foam donut to be sure it has sealed to the roof jack and the collector. Proceed to 3.5.C.

_____B. IF YOUR CEILING IS VAULTED AND YOU HAVE TO PRE-PLUMB IT, solder the 24" C by C *flex connectors* to the pipe runs inside the roof during pre-plumbing and curve them upward through the roof jack. To mount the solar collector after roofing is complete, pull the flexes upward through the roof jack about 6" and slide the **foam donut** down over the flexes. Solder the flexes to the red and blue stubs on the solar collector. Apply roof cement to both sides of the foam donut, and lower the solar collector to the roof. Be sure the flexes still slope continuously upward and have not crimped after the solar collector is in place. Proceed to 3.5.C.

_____C. FOR BOTH VAULTED CEILINGS AND STANDARD CRAWL SPACE ATTICS: Make sure the collector hood is level and the pipes are centered in the roof jack. Use the mounting bracket nearest the flexes as a guide and drill a 3/8" (1/4" for lag bolt) hole through the roof. Insert the first threaded rod (or lag bolt) through the mounting bracket, apply plenty of sealant under the mounting bracket, and tighten only partially. Check the level of the collector hood again. Adjust to level by shimming under the mounting brackets, or by moving the bottom of the collector right or left an inch or two. Drill holes through the roof at the remaining three mounting brackets. Bed the brackets in roof cement, and insert the rods or lag screws. Check the level once more, and snug down all four mounting brackets. Apply roof cement to the shaft of the threaded rod or lag bolt to seal the roof penetration. For a two collector system, repeat this process for the second collector. The second collector must be at exactly (±1/8") the same level as the first.

_____D. **TILE ROOFS** REQUIRE A DIFFERENT APPROACH. Tile roof over a vaulted ceiling requires special preparations — no more difficult but it needs planning for the roof attachment. Use your good judgment and the advice of your tile dealer to plan your installation. If you don't find a way, call us; we'll share our experience from a variety of different tile roof installations.

_____E. **COVER THE COLLECTOR(S).** Cover the solar collector(s), if you haven't already, with cardboard, insulation board, or an opaque tarpaulin; tie it down. Don't use a "blue tarp"; it won't block enough light.

FIGURE 16. Copper Cricket plan view and roof layout.

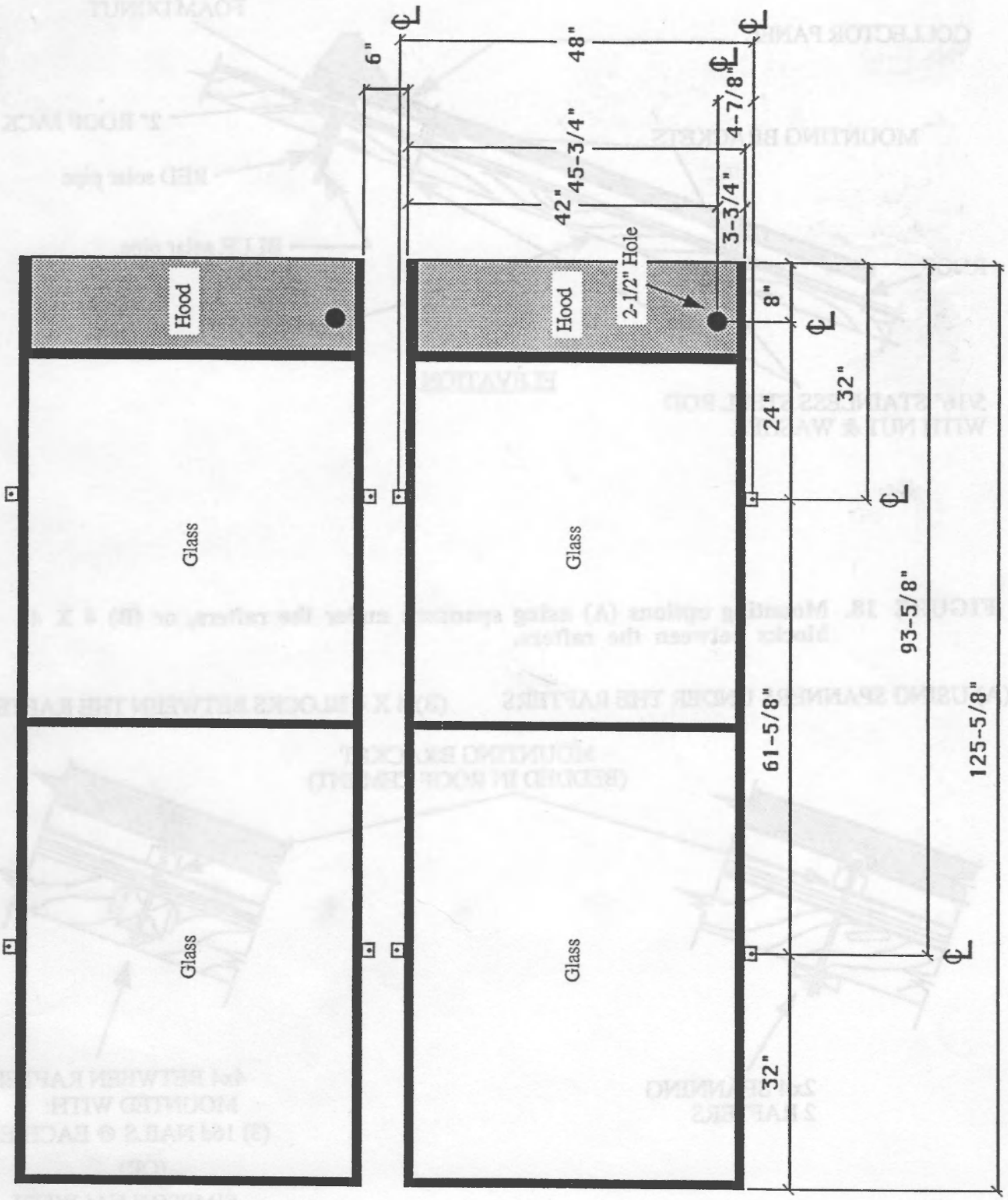


FIGURE 17. Copper Cricket east elevation and roof layout.

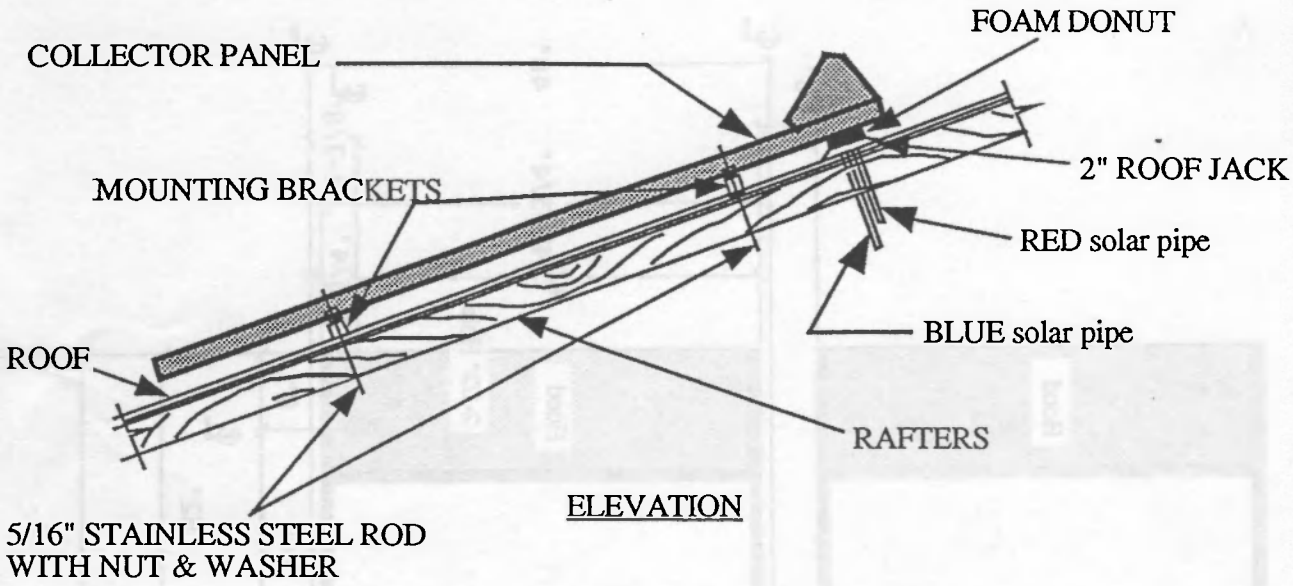


FIGURE 18. Mounting options (A) using spanners under the rafters, or (B) 4 X 4 blocks between the rafters.

(A) USING SPANNERS UNDER THE RAFTERS

(B) 4 X 4 BLOCKS BETWEEN THE RAFTERS

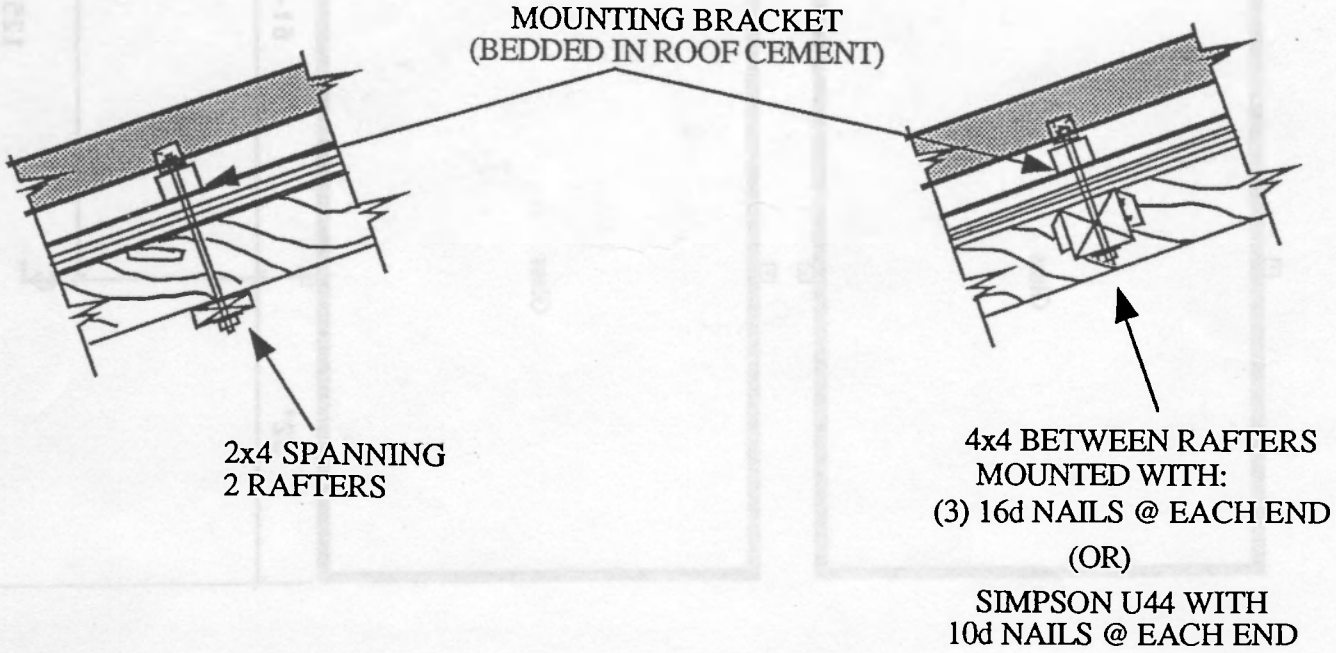
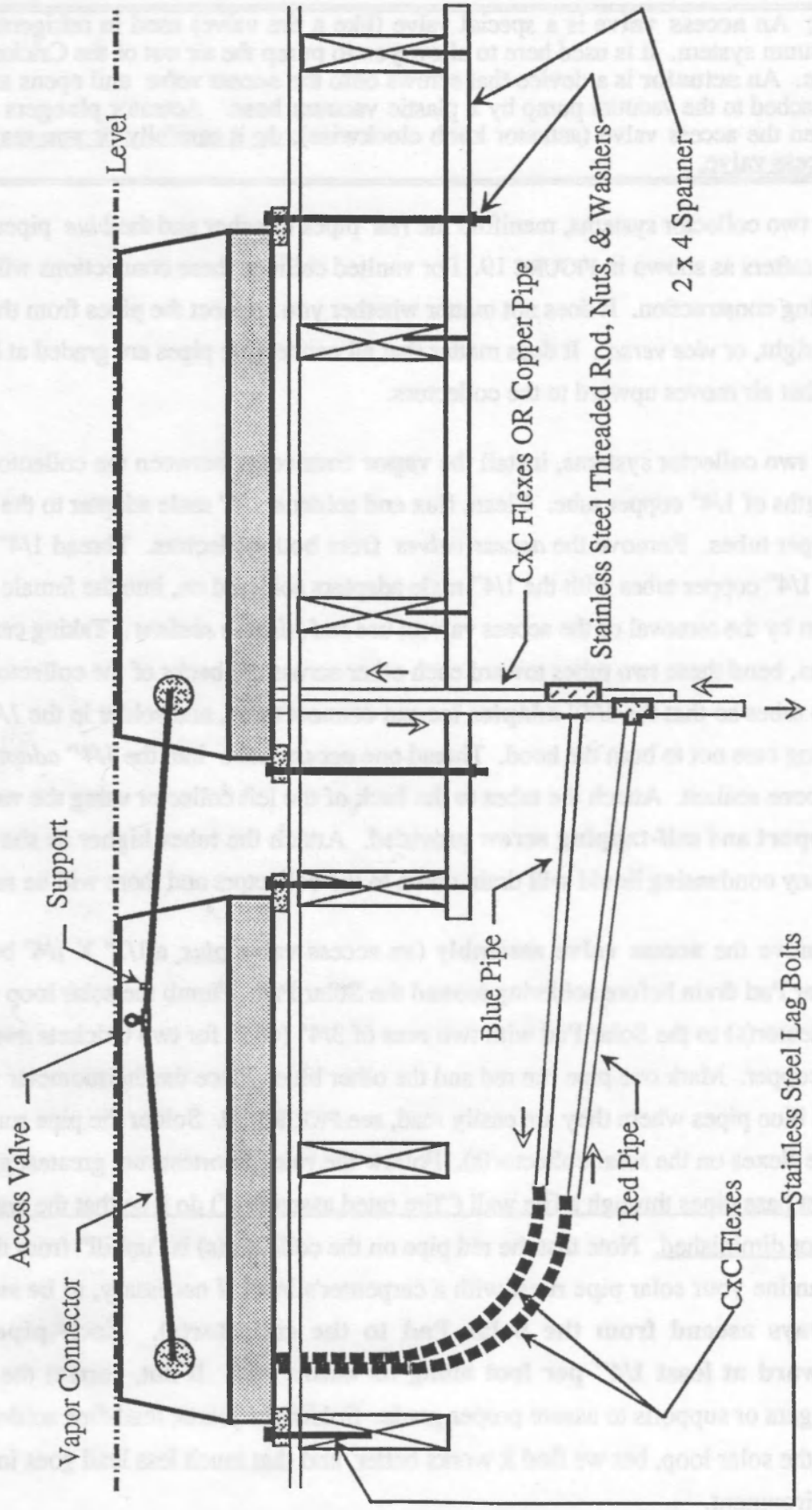


FIGURE 19. Connecting <u>two</u> Copper Crickets Red and Blue Pipes and Vapor Connector



3.6 Connecting the Solar Collector(s) to the Solar Pad.

Special names: An **access valve** is a special valve (like a tire valve) used in refrigeration equipment to "access" a vacuum system. It is used here to allow you to pump the air out of the Cricket system and then seal the system. An **actuator** is a device that screws onto the *access valve* and opens and closes it. The *actuator* is attached to the vacuum pump by a plastic vacuum hose. Actuator plungers may be too long. When you open the access valve (actuator knob clockwise), do it carefully or you may break the valve stem in the access valve.

_____A. For two collector systems, manifold the *red* pipes together and the *blue* pipes together beneath the rafters as shown in FIGURE 19. For vaulted ceilings these connections will have to be made during construction. It does not matter whether you connect the pipes from the left collector to the right, or *vice versa* . It does matter that all connecting pipes are graded at least 1/4" per foot so that air moves upward to the collectors.

_____B. For two collector systems, install the **vapor connector** between the collectors. Uncoil two lengths of 1/4" copper tube. Clean, flux and solder a 1/4" male adapter to the end of each 1/4" copper tubes. Remove the *access valves* from both collectors. Thread 1/4" **vapor tubes,** the 1/4" copper tubes with the 1/4" male adapters soldered on, into the female adapters left open by the removal of the access valves; use *red silicone sealant* . Taking care not to crimp them, bend these two tubes toward each other across the backs of the collector hoods. Cut the two tubes so that the **1/4" adapter tee** can connect them, and solder in the *1/4" adapter tee* taking care not to burn the hood. Thread one *access valve* into the *1/4" adapter tee* with red silicone sealant. Attach the tubes to the back of the left collector using the **vapor tube support** and **self-tapping screw** provided. Attach the tubes higher as shown in FIGURE 19 so any condensing liquid will drain down to the collectors and there will be no liquid traps.

_____C. Remove the **access valve assembly** (an access valve *plus* a 1/2" X 1/4" bushing) from the Solar Pad drain before soldering around the Solar Pad. Plumb the solar loop from the solar collector(s) to the Solar Pad with two runs of 3/4" (or 1" for two Crickets over 20' high) type-M copper. Mark one pipe run red and the other blue. Place the thermometer wells on the red and blue pipes where they are easily read, see FIGURE 20. Solder the pipe runs to the red and blue flexes on the solar collector(s). Follow the rule "Shortest run, greatest grade." If you must pass pipes through a fire wall ("fire rated assembly") do it so that the wall's fire resistance is not diminished. Note that the red pipe on the collector(s) is "uphill" from the blue pipe. Examine your solar pipe runs, with a carpenter's level if necessary, to **be sure both runs always ascend from the Solar Pad to the collector(s). Each pipe should slope upward at least 1/4" per foot along its entire run.** If not, correct the slope. Use hangers or supports to assure proper grade. Solder the joints; lead-free solder isn't required for the solar loop, but we find it works better, and that much less lead goes into our environment.

_____D. Remove the **plastic inserts** from the stem of the **thermometer,** and gently tap them into the three **thermowells** (red, blue, and yellow). If the plastic inserts get loose, tape them in with a 2" strip of aluminum tape.

FIGURE 20. Place the thermometer wells on the red and blue pipes where they are easily read.

4.0 FLUSH AND PRESSURE TEST THE SOLAR LOOP

4.1 Flushing Out the Solar Loop

_____A. Remove the **1/2" brass plug** from the solar collector's **drain port** (see FIGURE 21) and thread in a *boiler drain* found in the *Installation Kit.* Two boiler drains, one for each collector, are needed for a Double Cricket. If hot water running down the roof poses a hazard, connect a garden hose to the boiler drain, and direct the hose into the gutter or a drain.

_____B. Replace the *access valve assembly* in the Solar Pad's *drain port* with a 1/2" boiler drain. Connect the boiler drain to a water source, preferably hot water, using a washing machine hose or a garden hose. If you use a garden hose, you will need the **hose coupling** supplied in the Installation Kit.

_____C. Cover the solar collector(s), if you haven't already, with cardboard, insulation board, or an opaque tarpaulin; tie it down. Don't use a "blue tarp"; it won't block enough light.

_____D. Open both boiler drains. Turn on the water source, and flush water through the system for five minutes, or until no more black flakes appear in a little water caught in your hand.

4.2 Pressurize to Test for Leaks

_____A. Close the boiler drain on the solar collector(s) drain port to pressurize the solar loop. Inspect all joints for leaks. If a leak is found, drain the solar loop, repair it, and repeat the pressure test. NOTE: The Copper Cricket solar collector(s) and Solar Pad were pressure tested in the factory and proved leak free. If a leak appears in either, call your representative, dealer, or us.

_____B. Turn off the water source; leave the hose connected. Open the boiler drains to relieve the pressure.

_____C. For a single collector system, remove the **brass cap** from the access valve (see FIGURE 21). For two collector systems the single access valve for both collectors is on the *vapor connector* (see FIGURE 19.).

_____D. Thread the **actuator** (hose attached, vacuum pump detached) onto the access valve without using red silicone sealant. Gently turn the knob on the *actuator* clockwise, but only until you hear the air flowing in. This will open the *access valve*, allowing air to enter the solar loop so the flush water can drain out. WARNING: Flush water from the solar collector may be scalding hot.

4.3 Prepare for Start-up.

_____A. Disconnect hoses, drain excess flush water into a bucket. Remove the boiler drains.

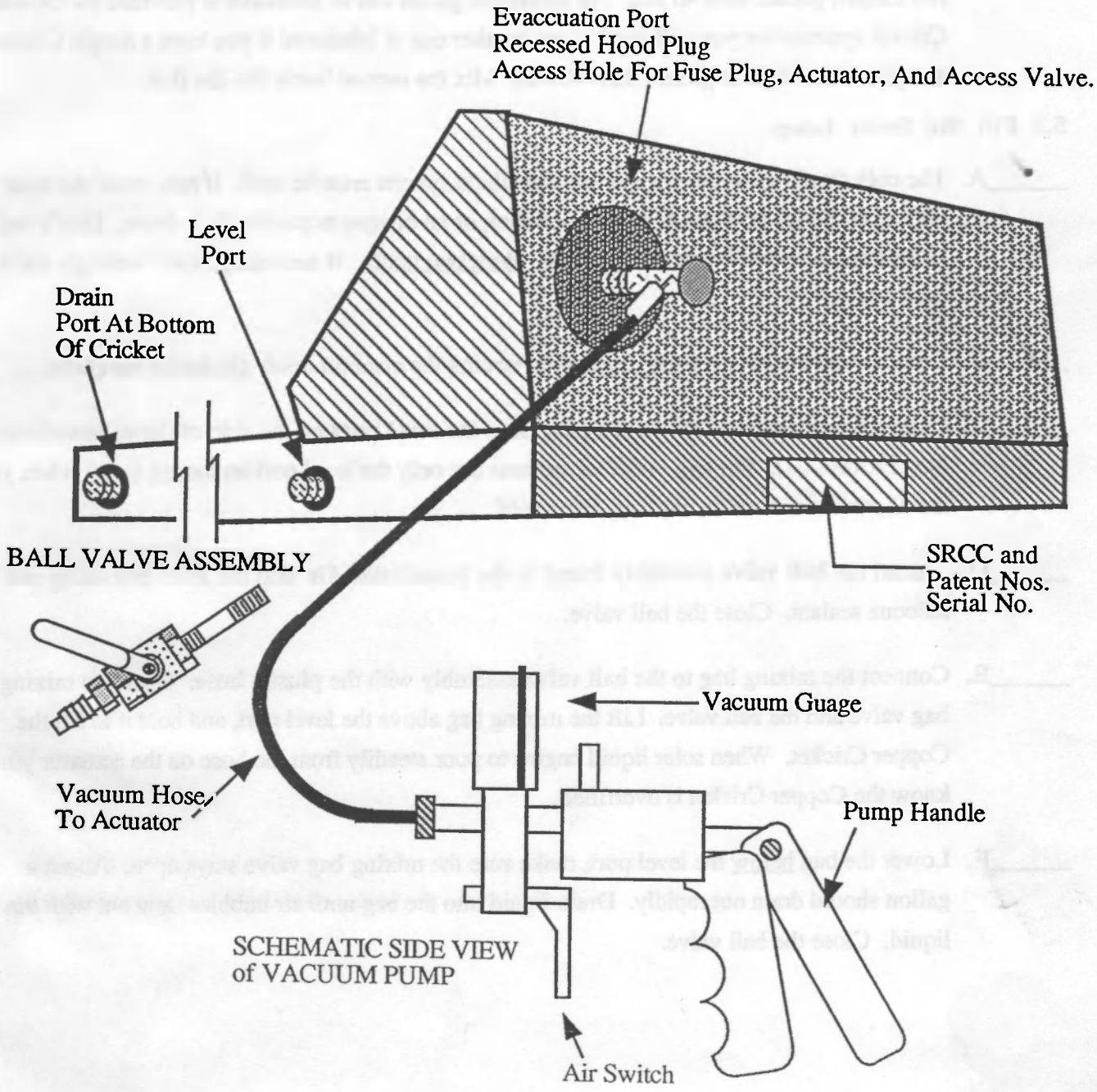
_____B. Seal the *access valve assembly* into the Solar Pad drain with red silicone sealant.

_____C. Seal the *1/2" brass plug* into the solar collector's drain port with red silicone sealant.

_____D. Insert the thermometer into the thermowell on the Solar Pad's red side.

_____E. Shift both 3-way valves to their FLOW positions.

FIGURE 21. Detail of Copper Cricket ports and schematic drawing of the filling equipment.



5.0 FILL AND START THE COPPER CRICKET.

5.1 Prepare the Solar Liquid.

✓ A. Review the Methanol Material Safety Data Sheet in the Appendix and the Material Safety Data Sheet on the can of Methanol.

✓ B. Pour all the Methanol from the one gallon can into the **plastic mixing bag**. Take special care to keep it out of your eyes and off your skin, and to avoid breathing its vapors. Pour in four gallons of distilled water. Put the mixing bag cap on and close the valve. Shake the bag a few times to assure complete mixing. Two bags full are needed for Double Cricket systems and run lengths greater than 40 feet. An additional gallon can of Methanol is provided for Double Cricket systems but you will need to get another can of Methanol if you have a Single Cricket and your run length is greater than 40 feet. Mix the second batch like the first.

5.2 Fill the Solar Loop.

✓ A. The collector(s) must be covered and the whole system must be cool. If not, cover the solar collector(s) with cardboard, insulation board, or an opaque tarpaulin; tie it down. Don't use a "blue tarp"; it won't block enough light. Wait two hours. If necessary, wait overnight for it to cool down.

✓ B. Confirm that the *access valve* is open by turning the *actuator knob* clockwise *carefully*.

_____ C. Carefully remove the **1/4" brass plug** from the **level port** on the side of the solar collector (see FIGURE 21). For two collector systems use only the level port on the left (east) when you are above the collectors, looking down roof.

_____ D. Thread the **ball valve assembly** found in the *Installation Kit* into the level port using red silicone sealant. Close the ball valve.

_____ E. Connect the mixing bag to the ball valve assembly with the **plastic hose**. Open the mixing bag valve and the ball valve. Lift the mixing bag above the level port, and hold it to fill the Copper Cricket. When solar liquid begins to pour steadily from the hose on the actuator you know the Copper Cricket is overfilled.

_____ F. Lower the bag below the level port, make sure the mixing bag valve stays open. About a gallon should drain out rapidly. Drain liquid into the bag until air bubbles flow out with the liquid. Close the ball valve.

5.3 Sun-Start the Copper Cricket.

_____A. The collector(s) must be covered and cool. See 5.2.A above.

_____B. Attach the vacuum pump to the actuator hose. Pump a couple of strokes to evacuate the vacuum hose. Open the access valve by turning the actuator knob clockwise *carefully*.

_____C. Evacuate air from the solar loop down to a vacuum of about 25 inches of mercury (the outside scale); it will take about 150 to 200 strokes for one Copper Cricket and about 300 to 400 strokes for a Double Copper Cricket.

_____D. Close the access valve by turning the actuator knob counterclockwise all the way out.

_____E. While holding the mixing bag above the level port, open the mixing bag valve and the ball valve to let liquid suck in. Hold the bag up until the liquid stops sucking into the collector. When liquid stops sucking in you know the Copper Cricket is overfilled.

_____F. Lower the mixing bag below the level port.

_____G. Pull the vacuum pump off of the actuator hose.

_____H. Turn the actuator clockwise to open the access valve and let air in. Open the ball valve. Make sure the mixing bag valve is open.

_____I. Drain liquid back into the bag until air bubbles appear with the liquid. This operation adjusts the liquid to its proper level.

_____J. Remove the ball valve assembly and thread in the 1/4" brass plug with red silicone sealant.

_____K. Attach the vacuum pump to the actuator hose and evacuate the system as in C. and D. above.

_____L. Uncover the collector.

_____M. After 30 minutes of sunshine, do the following:

.....i. If the red temperature is above 160°F then cover the collector(s) for 15 minutes.

.....ii. Pump a couple of strokes to evacuate the vacuum hose, note the vacuum reading.

.....iii. Open the access valve by turning the actuator knob clockwise.

.....iv. Note the vacuum reading.

.....v. Pump 40 strokes and note the vacuum reading again. If all the air is gone the two readings will be the same. If not, pump 40-50 strokes. Close the access valve by turning the actuator knob counterclockwise.

.....vi. Repeat these steps (i-iv) until the vacuum readings stay the same. A hotter system has a lower vacuum, cooler system higher vacuum (see the vacuum vs. temperature graph in the appendix.)

.....vii. Repeat this process (i-v) again after an hour of sunshine.

_____N. After an hour of sunshine and the repeat evacuations the difference between the temperatures on the red and blue thermowells should be between 30 and 50 °F. Check the temperature difference as follows:

.....i. With the thermometer in the red thermowell, write down the red temperature.

.....ii. Move the thermometer to the blue thermowell.

.....iii. Wait about one minute for the thermometer to settle.

.....iv. Write down the blue temperature.

.....v. Subtract the blue temperature from the red temperature.

If the difference is less than 50 °F you have successfully sun-started the Copper Cricket! **Go to "5.4 Finishing Up"**

If the difference is more than 50 °F. let the system operate the rest of the day, and "top it up" the next morning while it is cool and covered. This procedure gives air trapped in the pipes and heat exchanger time to migrate to the top, removing potential traps. Topping up when the system is cool replaces liquid that settled down as air migrated upward. You can not top it up while it is hot. You will remove too much liquid. **To top up, cover the collector at sunset. Next morning repeat "5.3 SUN-START THE COPPER CRICKET".**

5.4 Finishing Up

_____A. When the Copper Cricket is working properly, move the thermometer to the yellow thermowell near the bottom of the solar storage tank to monitor the hot water going into the solar storage tank.

_____B. Remove the actuator from the access valve. Wet test the access valve with a little saliva to be sure no air is being sucked in. If air is sucked in the valve stem is defective. Cover the collector until you can replace the valve stem. You can get a replacement valve stem from your representative, dealer, or Sage Advance Corporation. Re-evacuate the system as in 5.3.

.....i. Apply a small amount of red silicone sealant smoothly onto the outside threads of the access valve, taking care not to get any inside the access valve or on the valve stem. Screw the cap onto the access valve.

.....ii. If the collector pitch is steeper than 12 in 12 (45°), seal around the access valve with red silicone sealant to prevent rainwater from leaking into the collector.

5.5 Insulate Pipes and Solar storage tank

_____A. Insulate the solar loop, the solar and water pipes around the solar storage tank and the connection between the solar and auxiliary tanks including the cold water pipe. This is for freeze protection as well as conservation. Use the 18 feet of pipe insulation provided. Purchase insulation (at least R-2.6 for inside, R-4 for outside) for the rest of the solar pipe run that will stand up to 220°F.

_____B. If the solar storage tank's insulation is less than R-20, cover it and the sides of the Solar Pad with a commercial tank wrap which brings the total rating to R-20 or better. Be sure electric element covers are left exposed — check plumbing code.

_____C. For energy conservation, set the thermostats on electric elements or gas flame to 120°F. Set the temperature on the thermal mixing valve to the same temperature. Remove the handles from the two 3-way valves, attach them to the yellow valve with a piece of wire — and...

_____D. .....ENJOY THE SOLAR HOT WATER!

5.6 "NITE-START™" Note

The "SUN-START" procedure outlined above in Section 5 is designed especially for owner-installers and requires only an "Installation Kit." For dealers or solar installers who are not able to return to a site two or three times to "top up" the Copper Cricket, the NITE-START™ procedure and equipment may assist in getting the Cricket started on installation day, or at most with one return trip. Plans for assembling your NITE-START equipment are available at no cost from Sage Advance Corporation.

6.0 TESTING FOR PROPER PERFORMANCE

6.1 About Testing for Proper Performance

The best single sign that the Copper Cricket is working well is a YELLOW thermometer reading between 90°F and 120°F around noon on any sunny or lightly overcast day. It may read 140°F or more under bright, hot conditions. Check the YELLOW temperature occasionally around noon (11 a.m. to 2 p.m.) on sunny days just to confirm that the Copper Cricket is "alive and well." Also you can check the thermometer on the solar storage tank at the end of any day to confirm that you have collected solar energy. This thermometer will normally read over 100°F after a sunny summer day, over 120°F if no one has used hot water.

If there is any doubt that the Copper Cricket is functioning, choose a sunny day between 11 a.m. and 2 p.m. and place the thermometer alternately in the RED, BLUE, and YELLOW thermometer wells of the Solar Pad, wait a minute after each, and record the temperature and time. Then follow the "If—Then—Cause—Cure" flow that follows. Be patient: read and think carefully. Trouble shooting is more like fly fishing than duck shooting.

"Professor" Newt's Sure-fire Start-up Equation:

	"3 LEVELS" (Collector Solar Pad Liquid)
Plus	"1 UN-LEVEL" (Pipes)
Minus	"AIR" (No leaks, good vacuum)
Equals	"SAFE, PLENTIFUL HOT WATER, and no N-Plants!"

6.2 If the Red and Blue are both high (above 160°F), and Yellow is low (below 100°F)

A. Cause: Low or no flow of domestic water through the Solar Pad.

Due to: 3-way Valve(s) in the FLUSH position.

Cure: Switch 3-way valve(s) to FLOW position. Look at the "L" mark on the stem; it should point the same way as the arrows on the handle. If not, you may have the handle on the stem wrong.

Due to: Air trap in the flex connectors

Cure: Bend flex connectors so that they grade upward from the Solar Pad to the solar storage tank. If they can't be bent without crimping, replace them.

Due to: Air trapped in the Solar Pad.

Cure: Level the Solar Pad, with shims if necessary.

Due to: Scale buildup, fouling, or other obstruction.

Cure: Flush out the Solar Pad through both 3-way valves, as described in Section 2.5.C.

Due to: Tank water level below the dip tube.

Cure: Open the T-P valve and fill the tank to the top.

6.3 If the difference, Red-minus-Blue, is greater than 50°F, but less than 90°F.

A. Cause: Low flow rate in the solar loop.

Due to: Air in the solar loop.

Cure: Evacuate the solar loop as in Section 5.3.M.

Due to: Solar liquid level too low or too high.

Cure: Top up the solar loop as in Section 5.3.

Due to: Air trapped in the pipes.

Cure: Find pipes that are not graded 1/4" per foot. Flex them into grade if possible. Otherwise, drain the solar loop, correct the grade, refill and restart as in Section 5.

6.4 If Blue is higher than Red -

A. Cause: Red and Blue labels have gotten reversed on the insulation during installation.

Cure: No cure needed. Red pipe is on the left side when you face the Solar Pad, Blue on the right. Change the colored tape.

B. Cause: Red and Blue pipes are reversed.

Cure: Drain about two gallons from the solar loop so that the level is below the flexes in the attic. Break the lower flex solder joints, reverse the pipes, clean and resolder. Refill and restart as in Section 5.

6.5 If Red, Blue, and Yellow are all low (60-100°F) OR If Red-minus-Blue is greater than 90°F, OR if the fuse plug is melted -

A. Cause: VERY low flow rate in the solar loop.

Due to: Air trapped in the Solar Pad.

Cure: Level the Solar Pad, with shims if necessary. Make sure blue and red pipes emerge upward from the Solar Pad.

Due to: Air trapped in the pipes.

Cure: Find pipes that are not graded 1/4" per foot. Flex them into grade if possible and support them with hangers. Otherwise, drain the solar loop, correct the grade, refill and restart as in Section 5.

Due to: Leak in the solar loop.

Cure: Drain the solar loop. Pressurize with a compressor or bike pump and search for the leak. A spray bottle of soapy water helps find the leak. Refill and restart as in Section 5.

6.6 Replacing the Fuse Plug.

Replace the fuse plug if it shows any sign of melting or "weeping". To replace the fuse plug, remove the recessed hood plug and unscrew the melted fuse plug. Put *red silicone sealant* in the threads of the new plug and thread it into 1/8" fuse plug port. Tighten snug, but take care not to break the plug or strip the threads.

7.0 RE-ROOFING

At some time in the future you may need to re-roof. If you don't have an attic under the collector, call Customer Service at Sage Advance (503) 485-1947 for instructions. Otherwise, use the following procedure:

_____A. Drain the solar liquid from the solar loop by way of the access valve on the Solar Pad and the drain port in the bottom of the collector(s). Discard the old liquid properly by flushing it down the toilet with at least an equal amount of water— see the Material Safety Data Sheet in the appendix.

_____B. Cut the red and blue copper pipes below the flexes which connect to the collector(s), with enough room to solder it back together with a copper coupling. Straighten the flexes.

_____C. Unbolt the feet and lift the collector away from the roof. Remove the rods or bolts and roof jack.

_____D. When roofers are done, re-drill the bolt holes and re-cut the roof jack hole from below if possible. Replace the roof jack.

_____E. Place the collector(s) back on the roof, insert the rods or bolts, squirt roofing compound under the brackets, level the collector(s), and tighten down.

_____F. Use 3/4" copper couplings to rejoin the pipes under the roof. Solder well!

_____G. **Get fresh solar liquid.** Fill and start as in Section 5.

APPENDIX A - METHANOL MATERIAL SAFETY DATA SHEET

Legal Note about the Methanol Safety Data Sheet

Important: The information and data in the **Methanol Safety Data Sheet** have been compiled from sources believed to be reliable and are believed to be accurate. It is offered for your consideration, investigation and verification. Buyer assumes all risk of use, storage and handling of the product in compliance with applicable federal, state and local laws and regulations. Sage Advance Corporation makes no warranty of any kind, express or implied, concerning the accuracy or completeness of the information and data herein. Sage Advance Corporation will not be liable for claims relating to any party's use of or reliance on information and data contained herein regardless of whether it is claimed that the information and data are inaccurate, incomplete or otherwise misleading.

UNION CARBIDE CHEMICALS AND PLASTICS COMPANY INC.
Solvents & Coatings Materials Division

MATERIAL SAFETY DATA SHEET

EFFECTIVE DATE: 01/14/92

Union Carbide urges each customer or recipient of this MSDS to study it carefully to become aware of and understand the hazards associated with the product. The reader should consider consulting reference works or individuals who are experts in ventilation, toxicology, and fire prevention, as necessary or appropriate to use and understand the data contained in this MSDS.

To promote safe handling, each customer or recipient should: (1) notify its employees, agents, contractors and others whom it knows or believes will use this material of the information in this MSDS and any other information regarding hazards or safety; (2) furnish this same information to each of its customers for the product; and (3) request its customers to notify their employees, customers, and other users of the product of this information.

I. IDENTIFICATION

PRODUCT NAME: METHANOL SOLVENT

CHEMICAL NAME: Methyl Alcohol

CHEMICAL FAMILY: Alcohols

FORMULA: CH_3OH MOLECULAR WEIGHT: 32.04

SYNONYMS: Wood alcohol; carbinol

CAS # and 67-56-1
CAS NAME: Methanol

II. PHYSICAL DATA

BOILING POINT, 760 mm Hg: 64.7 C (148.5 F)

FREEZING POINT: -97.68 C (-143.82 F)

SPECIFIC GRAVITY(H_2O = 1): 0.7922 @ 20/20 C

VAPOR PRESSURE AT 20°C: 96 mm Hg

VAPOR DENSITY (air = 1): 1.1

SOLUBILITY IN WATER by wt: 100% @ 20 C

EVAPORATION RATE (Butyl Acetate = 1): 5.8

APPEARANCE AND ODOR: Water-white liquid; characteristic odor

PERCENT VOLATILES (BY VOLUME): 100

EMERGENCY PHONE NUMBER: 1-800-UCC-HELP (Number available at all times) or 304-744-3487

UNION CARBIDE CHEMICALS AND PLASTICS COMPANY INC.
Solvents & Coatings Materials Division
39 Old Ridgebury Road, Danbury, CT. 06817-0001

PRODUCT NAME: METHANOL SOLVENT

III. INGREDIENTS

MATERIAL	%	EXPOSURE LIMITS	HAZARD
Methanol (CAS# 67-56-1)	100	See Section V	Toxic, flammable

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 52 F (11 C) Tag Closed Cup; 58 F (14 C) Tag Open Cup

FLAMMABLE LIMITS IN AIR, % by volume: LOWER: 6.0 UPPER: 36.0

EXTINGUISHING MEDIA: Apply alcohol-type or all-purpose-type foams by manufacturer's recommended techniques for large fires. Use CO2 or dry chemical media for small fires.

SPECIAL FIRE FIGHTING PROCEDURES: Use water spray to disperse vapors; reignition is possible. Use water spray to cool fire-exposed containers and structures. Approach methanol fire with caution; methanol burns with an almost invisible flame in daylight. Use self-contained breathing apparatus and protective clothing.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors form from this product and may travel or be moved by air currents and ignited by pilot lights, other flames, sparks, heaters, electrical equipment, static discharges or other ignition sources at locations distant from product handling point.

Vapors may settle in low or confined areas, or travel a long distance to an ignition source and flash back explosively.

This material may produce a floating fire hazard.

V. HEALTH HAZARD DATA

EXPOSURE LIMIT(S): Methanol, 200 ppm-skin TWA OSHA & ACGIH
250 ppm-skin STEL OSHA & ACGIH
Values from OSHA 29 CFR 1910.1000 Table Z-1-A and ACGIH 1991-92

EFFECTS OF ACUTE OVEREXPOSURE:

SWALLOWING: Nausea, abdominal pain, vomiting, headache, dizziness, shortness of breath, weakness, fatigue, leg cramps, restlessness, confusion, drunken behavior, visual disturbances, drowsiness, coma, and death. There may be a delay of several hours between swallowing methanol and the onset of signs and symptoms. The effects observed are in part due to acidosis and partially to cerebral edema. Visual effects include blurred vision, diplopia, changes in color perception, restriction of visual fields, complete blindness. Ingestion of moderate quantities of methanol also produce metabolic acidosis. Onset of symptoms may be delayed up to 48 hours. 60-200 ml is a fatal dose for most adults. Ingestion of as little as 10 ml has caused blindness. With massive overdoses, liver, kidney and heart muscle injury have been described.

SKIN ABSORPTION: Prolonged or widespread exposure of skin may result in the absorption of harmful amounts of methanol.

INHALATION: May cause dizziness, drowsiness, disturbances of vision, and tingling, numbness, and shooting pains in the hands and forearms.

SKIN CONTACT: Prolonged contact with the skin may cause reddening and defatting of the skin.

EYE CONTACT: Liquid may cause mild redness and swelling of the conjunctiva, with transient

superficial injury of the cornea.

EFFECTS OF REPEATED OVEREXPOSURE:

Long-term repeated overexposure to methanol vapor concentrations of 3000 ppm or greater may allow a cumulative effect to occur with resulting nausea, vomiting, headache, ringing in the ears, insomnia, trembling, unsteady gait, vertigo, clouded and double vision. Liver and/or kidney injury may occur. Prolonged overexposure at levels of 800-1000 ppm may result in severe eye damage in some persons.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:

Due to its defatting properties, methanol may aggravate an existing skin condition, e.g., eczema. Due to its liver and kidney-injuring potential, may exacerbate existing liver and/or kidney diseases.

ADDITIONAL TOXICITY INFORMATION

None currently known.

EMERGENCY AND FIRST AID PROCEDURES:

SWALLOWING: If patient is fully conscious, give two glasses of water. Induce vomiting. Obtain medical attention without delay. If medical advice is delayed, give three to four ounces of hard liquor, such as whiskey.

SKIN: Remove contaminated clothing and flush skin with water.

INHALATION: Remove to fresh air. Give artificial respiration if not breathing. Oxygen may be given by qualified personnel if breathing is difficult. Obtain medical attention.

EYES: Immediately flush eyes thoroughly with water and continue washing for several minutes. Obtain medical attention.

NOTES TO PHYSICIAN: The combination of visual disturbances, metabolic acidosis, and formic acid in the urine is evidence of methanol poisoning. The therapuetic intravenous administration of ethanol (10 ml per hour) allows it to be preferentially oxidized and reduces production of methanol metabolites. Acidosis must be treated by means of intravenous sodium bicarbonate, and methanol elimination may be increased by hemodialysis, as indicated. Treatment should be based on blood methanol levels and acid-base balance. Folates may be administered to enhance the metabolism of formaldehyde. 4-Methylpyrazole has been suggested as an antidote: because of its alcohol dehydrogenase inhibiting effects, it reduces the production of formate and the development of metabolic acidosis. However, the value of this antidote remains to be proven in humans.

VI. REACTIVITY DATA

STABILITY: Stable

CONDITIONS TO AVOID: None

INCOMPATIBILITY (materials to avoid):

Alkali metals, concentrated nitric and sulfuric acids, aldehydes, acyl chlorides. The reaction of methanol with nitric acid is considered hazardous not only because it is exothermic, but also because it produces methyl nitrate. Methyl nitrate reportedly can explode violently if shocked mechanically or heated.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS:

Burning can produce carbon monoxide and/or carbon dioxide.

Carbon monoxide is highly toxic if inhaled; carbon dioxide in sufficient concentrations can act as an asphyxiant.

HAZARDOUS POLYMERIZATION: Will Not Occur

CONDITIONS TO AVOID: None

VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Extinguish and do not turn on any ignition source until area is determined to be free from explosion or fire hazards. Wear suitable protective equipment. Small spills should be flushed with large quantities of water. Larger spills should be collected for disposal.

WASTE DISPOSAL METHOD: Incinerate in a furnace where permitted under appropriate Federal, State and local regulations. At very low concentrations in water, this product is readily biodegradable in a biological wastewater treatment plant.

VIII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:
Self-contained breathing apparatus in high vapor concentrations.

VENTILATION: This product should be confined within vapor-tight equipment, in which case general (mechanical) room ventilation should be satisfactory. Special, local ventilation may be needed at points where vapors are expected to escape to the workplace air.

PROTECTIVE GLOVES: Butyl or nitrile rubber

EYE PROTECTION: Monogoggles

OTHER PROTECTIVE EQUIPMENT:
Chemical apron, eye bath and safety shower.

IX. SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
DANGER! Flammable.
Harmful or fatal if swallowed.
May cause eye damage and blindness if swallowed.
Harmful if absorbed through skin.
Harmful if inhaled.
May cause dizziness and drowsiness.
May cause heart muscle damage.
May cause liver and kidney damage.

Do not swallow.
Keep away from heat, sparks, and flame.
Avoid breathing vapor.
Do not get on skin, on clothing.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

FOR INDUSTRY USE ONLY

OTHER PRECAUTIONS: PROCESS HAZARD: Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperature and pressure, or sudden

ingress of air into vacuum equipment, may result in ignitions without the presence of obvious ignition sources. Published "autoignition" or "ignition" temperature values cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions.

Any use of this product in elevated-temperature processes should be thoroughly evaluated to establish and maintain safe operating conditions. Further information is available in a technical bulletin entitled "Ignition Hazards of Organic Chemical Vapors."

TRANSFER HAZARD: Vapors of this product may be ignited by static sparks. Use proper bonding and grounding during liquid transfer as described in National Fire Protection Association document NFPA 77.

X. REGULATORY INFORMATION

STATUS ON SUBSTANCE LISTS:

The concentrations shown are maximum or ceiling levels (weight %) to be used for calculations for regulations. Trade Secrets are indicated by "TS".

FEDERAL EPA

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center of release of quantities of Hazardous Substances equal to or greater than the reportable quantities (RQs) in 40 CFR 302.4.

Components present in this product at a level which could require reporting under the statute are:

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Methanol	67-56-1	100

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III

requires emergency planning based on Threshold Planning Quantities (TPQs) and release reporting based on Reportable Quantities (RQs) in 40 CFR 355 (used for SARA 302, 304, 311 and 312).

Components present in this product at a level which could require reporting under the statute are:

None

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III

requires submission of annual reports of release of toxic chemicals that appear in 40 CFR 372 (for SARA 313). This information must be included in all MSDSs that are copied and distributed for this material.

Components present in this product at a level which could require reporting under the statute are:

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Methanol	67-56-1	100

STATE RIGHT-TO-KNOW

CALIFORNIA Proposition 65

This product does not contain materials which the State of California has found to cause cancer, birth defects, or other reproductive harm.

MASSACHUSETTS Right-To-Know, Substance List (MSL) Hazardous Substances and Extraordinarily Hazardous Substances on the MSL must be identified when present in products.

Components present in this product at a level which could require reporting under the statute are:

HAZARDOUS SUBSTANCES (=> 1%)

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Methanol	67-56-1	100

PENNSYLVANIA Right-To-Know, Hazardous Substance List Hazardous Substances and Special Hazardous Substances on the List must be identified when present in products.

Components present in this product at a level which could require reporting under the statute are:

HAZARDOUS SUBSTANCES (=> 1%)

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Methanol	67-56-1	100

Toxic Substances Control Act(TSCA) STATUS:

The ingredients of this product are on the TSCA inventory.

CALIFORNIA SCAQMD RULE 443.1 VOC'S:

VOC 791 g/l; Vapor pressure 96 mm Hg @ 20 C

OTHER REGULATORY INFORMATION:

NEW YORK STATE BULK STORAGE REGULATIONS (GNYSRR Parts 595-599)

This product is covered by GNYSRR for Bulk Storage and Release Reporting and Response. Technical guidance and recommended practices are as follows:

MATERIALS OF CONSTRUCTION

Suitable materials of construction are: Steel, stainless steel, baked phenolic lined steel, galvanized steel, copper, and copper alloy.

Materials not to be used: Aluminum. Plastics are not recommended for flammable liquids.

STORAGE SYSTEM DESIGN

Design should comply with applicable industry, Federal, and local codes for a Class IB Flammable liquid with regards to mechanical, electrical, safety and health components. Should also comply with NYS/DEC Chemical Bulk Storage proposed regulations Parts 589.3 to 589.6 (for existing tanks) or Parts 599.2 and 599.7 (for new or substantially modified tanks).

CONDITIONS FOR STORAGE

Store at normal ambient temperatures.

INSPECTION AND MAINTENANCE

A testing/inspection program which ensures structural integrity and proper system operation should be established. Inspection and maintenance procedures and testing of equipment should comply with NYS/DEC proposed regulations Parts 598.7 to 598.10.

TRANSFER AND UNLOADING

These operations should comply with NYS/DEC proposed regulations, Part 598.5.

NOTE ----

The opinions expressed are those of qualified experts within Union Carbide. We believe that the information contained is current as of the date of the Material Safety Data Sheet. Since the use of this information and of these opinions and the conditions of the use of the product are not within the control of Union Carbide, it is the user's obligation to determine the conditions of safe use of the product.

REVISED SECTIONS: Section IX: PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE.

PC: 45206

F NUMBER: C0328F

APPENDIX B - PROJECTED LIFETIME OF PARTS

The Copper Cricket system is made of parts designed for long life in any environment found in the temperate zones of the world. It uses the patented "Geyser-Pumping" process expressly to give it a long, trouble-free life. This long life is achieved by (1) the use of methanol-water solution as heat transfer liquid, which provides absolute protection from freeze damage to the solar loop, and which will not corrode the copper pipes, solder, braze, or silicone sealant; (2) the complete absence of any mechanical, electrical, or electronic parts, which could fail or degrade performance; and (3) the use of high quality tempered glass, EPDM glazing seals, extruded bronze-anodized aluminum enclosure parts, and a gel-coated fiberglass bonnet.

If the Copper Cricket system is properly installed and the Solar Pad heat exchanger is flushed and/or descaled periodically in accordance with the maintenance instructions in this manual, then the collector, pipes, and heat exchanger should last for the life of the house. The tempered glass is resistant to breakage, but will shatter safely into small pea-sized chunks if struck by a fast hard ball, rock, or heavy tree branch. The EPDM glazing seals may appear to degrade after 10 to 15 years in the sun, but the parts of the seals under the aluminum glazing strips should still be intact and performing the sealing function. However, photochemical smog may degrade the entire seal, which should be examined after about 5 years and replaced if necessary. Salt-laden air in some coastal areas may etch the bronze-anodized aluminum enclosure, but will not impair its function. Similarly, caustic or acidic air pollution can damage the external surfaces without affecting performance. The gel coat on the fiberglass bonnet is similar to that used on fiberglass boats, and, along with the fiberglass, is expected to have a life of at least 20 years. The gel-coat may become dull and lose some color, but this should not shorten its life.

The solar storage tank is an industry-standard tank. Warranties for most such tanks are 5 years, and average lifetimes are about 10 years. The code-required "T-P valve" should last the life of the tank, but will fail if frequently required to relieve high temperature or pressure. The overheat protection valve installed for high temperature protection in hot, high sun climates is claimed by the manufacturer to operate 10,000 times without failure, which should easily give it a lifetime of 50-100 years.

If the water pipes are installed properly with hangers and good (lead-free) solder joints, they should last for the life of the house. The 3-way valves and shutoff valves used in the water system should also last for the life of the house, but may require minor repair such as the tightening of the packing nut or replacement of packing around the stem. Flex connectors are prone to crimping if bumped or stepped on. Their rubber seals may fail if water temperatures exceed 210°F, or after prolonged exposure to 130°F water.

APPENDIX C - PARTS LIST AND AVAILABILITY

(√ is available, — is not available)

Part	Plumbing Supply	Hardware Store	Sage Advance
283°F Fusible Plug	—	—	√
3-way Valves	√	—	√
Access Valve	—	—	√
Access Valve Stem	—	—	√
EPDM Glazing Seal	—	—	√
Fiberglass Bonnet	—	—	√
Flex Connectors	√	√	√
Glass	—	—	√
Installation Kit	—	—	√
Letro Thermometers	—	—	√
Methanol	—	—	√
Mixing Valve	√	—	√
Overheat Protection Valve (OHP)	—	—	√
Shut-off Valves	√	√	√
Solar Pad™ Heat Exchanger	—	—	√
Solar Storage Tank	√	√	√
T-P Relief Valve	√	√	√

SOLAR RATING & CERTIFICATION CORPORATION

AWARD OF SOLAR WATER HEATING SYSTEM CERTIFICATION

The solar water heating system listed below has been evaluated by the Solar Rating & Certification Corporation (SRCC) in accordance with SRCC Document OG-300, *Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems.* and has been certified by the SRCC as meeting the minimum standards for design, installation, operation and maintenance, performance, reliability and safety as specified in SRCC Standard OG-300. Thermal performance ratings are based on the successful durability and performance testing of a sample unit where said tests have been conducted by an independent laboratory accredited by the SRCC and the balance of the system has been modeled using TRNSYS, a computer simulation code developed by the University of Wisconsin.

System Certification # 300-92-005-A

Date Certified October 1, 1992 Expiration Date December 31, 1997

SYSTEM TYPE: Self-Pumping System

SUPPLIER: Sage Advance Corporation
P.O. Box 23136
Eugene, OR 97402
(503) 485-1947

BRAND: Copper Cricket MODEL: IB

DESCRIPTION: Indirect double tank, external heat exchanger, One IB collector (40.2 ft²), 50 gal. solar storage tank, SRCC electric auxiliary tank heater.

THERMAL PERFORMANCE RATING:

Category C	20.0	up to but less than	25.0	MJ per day
	18.9	up to but less than	23.6	kBtu per day

RATING PARAMETERS	TERM	(SI Units)		(Inch-Pound Units)	
Conventional Water Heater Energy Consumption	Q_{CONV}	49.4	MJ/d	46,850	Btu/day
System Set Temperature	T_{SET}	55	C	131	°F
Ambient Temperature	T_{AMB}	22	C	71.6	°F
Standard Test Load	Q_{DL}	42.3	MJ/d	40,119	Btu/day
Solar Irradiance	I_t	44,780	Wh/m²	1,500	Btu/ft²day

This award of certification is subject to all terms and conditions of the Program Agreement and the documents incorporated therein by reference. It must be renewed annually. Any change in solar water heating system design, materials, specifications, parts, or construction must be reported to SRCC for evaluation of continued certification.

Technical Director

777 North Capitol Street, N.E. ■ Suite 805 ■ Washington, D.C. 20002 ■ (202) 408-0306

SOLAR RATING & CERTIFICATION CORPORATION

AWARD OF SOLAR WATER HEATING SYSTEM CERTIFICATION

The solar water heating system listed below has been evaluated by the Solar Rating & Certification Corporation (SRCC) in accordance with SRCC Document OG-300, *Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems.* and has been certified by the SRCC as meeting the minimum standards for design, installation, operation and maintenance, performance, reliability and safety as specified in SRCC Standard OG-300. Thermal performance ratings are based on the successful durability and performance testing of a sample unit where said tests have been conducted by an independent laboratory accredited by the SRCC and the balance of the system has been modeled using TRNSYS, a computer simulation code developed by the University of Wisconsin.

System Certification # 300-92-005-B

Date Certified October 1, 1992 Expiration Date December 31, 1997

SYSTEM TYPE: Self-Pumping System

SUPPLIER: Sage Advance Corporation
P.O. Box 23136
Eugene, OR 97402
(503) 485-1947

BRAND: Copper Cricket MODEL: 2B

DESCRIPTION: Indirect double tank, external heat exchanger, Two 1B collectors (40.2 ft^2 each), 80 gal. solar storage tank, SRCC electric auxiliary tank heater.

THERMAL PERFORMANCE RATING:

Category F 35.0 or more MJ per day
33.1 or more kBtu per day

RATING PARAMETERS	TERM	(SI Units)	(Inch-Pound Units)
Conventional Water Heater Energy Consumption	Q_{CONV}	49.4 MJ/d	46,850 Btu/day
System Set Temperature	T_{SET}	55 C	131 °F
Ambient Temperature	T_{AMB}	22 C	71.6 °F
Standard Test Load	Q_{DL}	42.3 MJ/d	40,119 Btu/day
Solar Irradiance	I_t	44,780 Wh/m^2	1,500 Btu/ft^2day

This award of certification is subject to all terms and conditions of the Program Agreement and the documents incorporated therein by reference. It must be renewed annually. Any change in solar water heating system design, materials, specifications, parts, or construction must be reported to SRCC for evaluation of continued certification.

Technical Director

777 North Capitol Street, N.E. ■ Suite 805 ■ Washington, D.C. 20002 ■ (202) 408-0306

APPENDIX E - 10 YEAR LIMITED WARRANTY

SAGE ADVANCE CORPORATION
10-YEAR LIMITED WARRANTY
COPPER CRICKET ™

The following Limited Warranty is made on the COPPER CRICKET geyser pumped solar collector (hereinafter COPPER CRICKET) by SAGE ADVANCE CORPORATION (hereinafter SAGE).

LIMITED WARRANTY

SAGE warrants that the COPPER CRICKET is free from defects in material and workmanship under normal use and service, and will perform in accordance with SAGE's specifications for the product for a period of ten (10) years from the purchase date. This Limited Warranty is extended to the first owner and any other subsequent owners, PROVIDED, that the COPPER CRICKET is not removed from its original installation site.

EXCLUSIONS

This Limited Warranty shall not apply to the following events, defects or conditions:

1. Defects or conditions occurring as a result of misuse, abuse, negligence, accident, or alteration of the COPPER CRICKET or as the result of failure to properly follow the installation instructions.

2. Normal fading and minor surface deterioration due to exposure to the elements.

3. Freezing of the potable water conduits.

REMEDY

In the event of a defect or failure to perform, SAGE, or its authorized representative, will repair or replace the defective unit within thirty (30) days of notification of such defect.

TO MAKE A CLAIM UNDER THIS WARRANTY

To make a claim under this Limited Warranty, please contact the Customer Service Department of SAGE in writing or by telephone.

DISCLAIMER

Except as provided for herein, there are no other express warranties made by SAGE. SAGE does not authorize any other party to assume any obligation or liability on behalf of SAGE, make any representations on behalf of SAGE, or to modify the terms or limitations of this Warranty in any manner.

IMPLIED WARRANTY

ANY IMPLIED WARRANTY OF MERCHANT ABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS LIMITED TO TEN (10) YEARS FROM THE PURCHASE DATE. Some states do not allow a limitation on how long an implied warranty lasts so the above limitation may not apply to you.

CONSEQUENTIAL AND INCIDENTAL DAMAGES

IN NO EVENT SHALL SAGE BE LIABLE FOR SPECIAL, INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES ARISING FROM BREACH OF WARRANTY, BREACH OF CONTRACT, NEGLIGENCE OR OTHER LEGAL THEORY EVEN IF SAGE OR OUR REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH **DAMAGES.**

Some states do not allow the exclusion or limitation of consequential or incidental damages so the above limitation or exclusion may not apply.

OTHER RIGHTS

This Warranty gives the owner specific legal rights. The owner may also have other rights that may vary from state to state.

APPENDIX F - RECOMMENDED TOOLS LIST

_____Drill

_____Drill Bit: 3/8" diameter X 18" long (Long enough to go through the roof to the support blocks)

_____*Element Wrench

_____Extension Cord

_____Garden Hoses

_____Hammer

_____Hole Saw: 2-1/2"

_____Knife

_____Ladders

_____Level

_____Pliers

_____Rope

_____Saw

_____Screwdrivers

_____Socket Set

_____Torch

_____Tubing Cutter

_____*Vacuum Pump

_____Wrenches: Box end, open end, combination, or crescent

*Note: Element Wrench and Vacuum Pump are supplied with the Installation Kit.

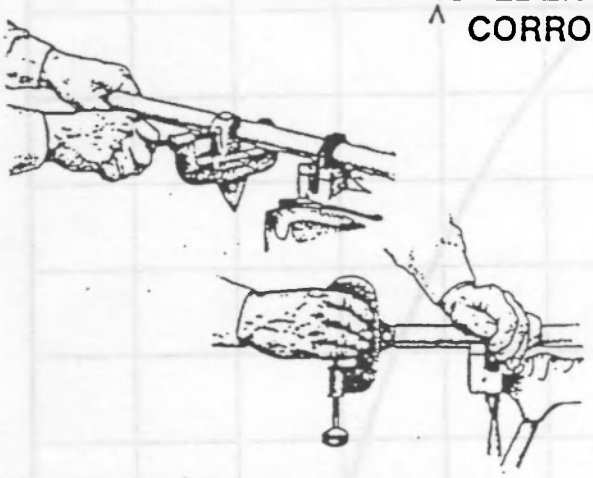
APPENDIX G - SOLDERING INSTRUCTIONS

NIBCO The Fine Art of Soldering

When adjoining surfaces of copper and copper alloys meet under proper conditions of cleanliness and temperature, solder will make a perfect adhesion. The strength of joint is equal to or even greater than the strength of tube alone. Surface tension seals the joint. Capillary attraction draws solder into-around-through-and-all-about the joint. It's easy to learn to make a perfect solder joint when you use NIBCO Fittings.

OR OTHER LEAD-FREE

WITH 95-5 SOLDER AND INTERMEDIATELY CORROSIVE FLUX

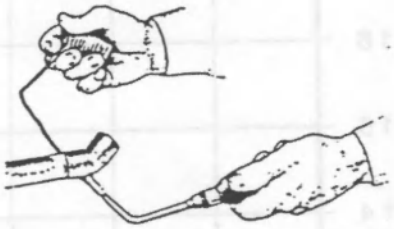


1. Cut tube end square; ream, burr and size.

2. Use sand cloth or steel wire brush to clean tube and cup to a bright metal finish.

3. Apply solder flux to outside of tube and inside of cup of fitting carefully so that surfaces to be joined are completely covered. Use flux sparingly.

4. Apply flame to the fitting to heat tube and solder cup of fitting until solder melts when placed at joint of tube and fitting.



5. Remove flame and feed solder into the joint at one or two points until a ring of solder appears at the end of the fitting. THE CORRECT AMOUNT OF SOLDER IS APPROXIMATELY EQUAL TO THE DIAMETER OF THE FITTING ... ½" solder for ½" fitting, etc.

6. Remove excess solder with a small brush or wiping cloth while plastic.

PROTECT YOUR PERSONAL ENVIRONMENT!
USE LEAD-FREE SOLDER ON
ALL POTABLE-WATER CONNECTIONS.

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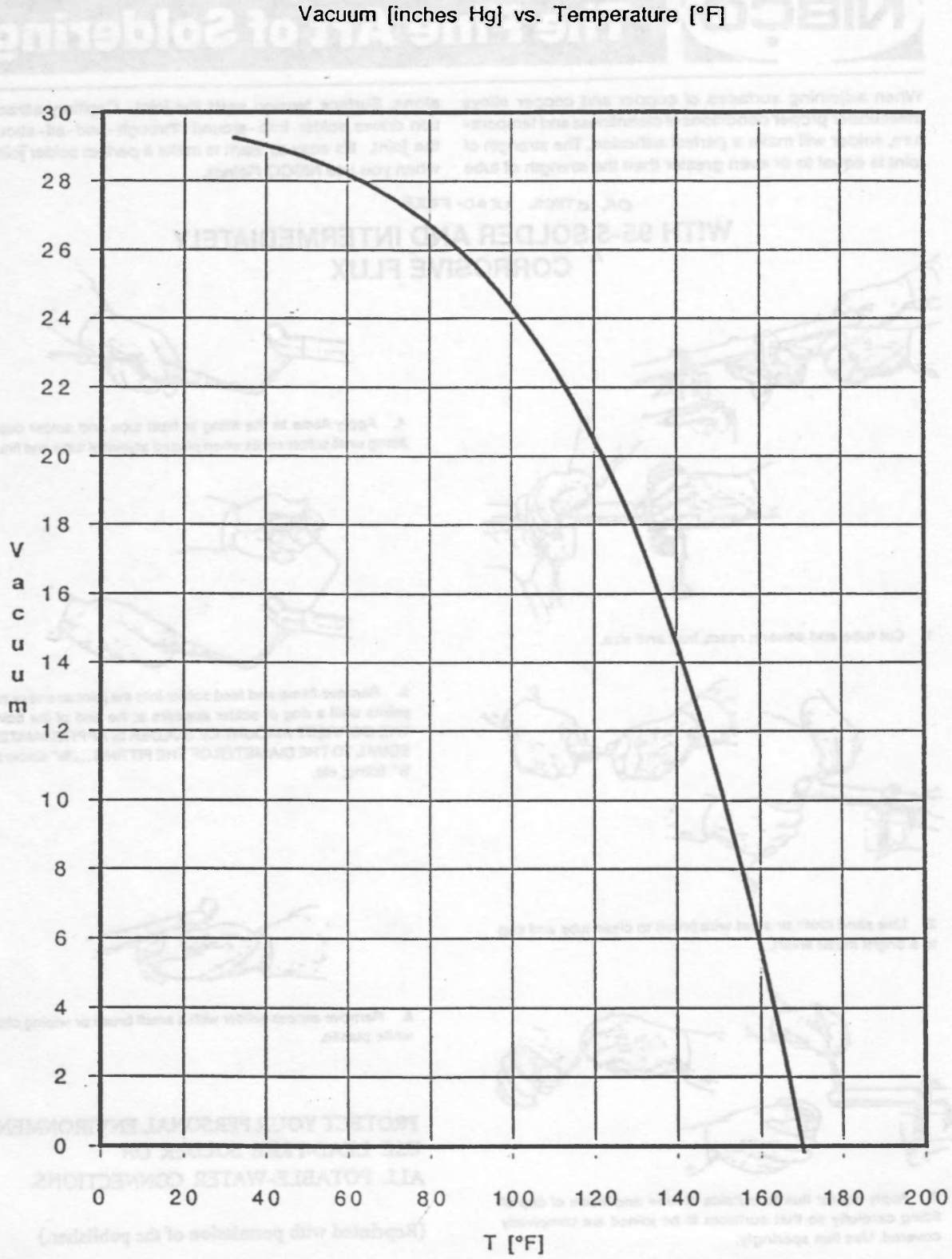
The above illustrations are taken from "The Theory and Technique of Soldering and Brazing of Piping Systems," a copyrighted book by H.A. Sosnin
For information on obtaining the text for use in classroom instruction, write to NIBCO INC., Elkhart, Indiana

APPENDIX H - VACUUM VS. TEMPERATURE GRAPH



Copper Cricket™
OPERATION and MAINTENANCE

EMERGENCY

If there's a **leak in the solar storage tank or Solar Pad heat exchanger,** isolate the storage tank: (1) Shut off water at valve #1. (2) Disconnect both flexes from the solar storage tank. (3) Couple the flexes together; use two wrenches. (4) Open valve #1.

If there is a **leak in the auxiliary tank or water pipes,** shut off the water at valve #1. If you're still flooding, call a plumber. Then call your installer or Sage Advance Corporation.

OPERATION

To confirm that your "Copper Cricket" is working, check the following:

1. The thermometer on the YELLOW pipe between the heat exchanger and the storage tank (near valve #2) should read above 100°F on any sunny day between 11am and 3pm.
2. The small thermometer near the top of the storage tank should read above 100°F at the end of a sunny day unless 30 or more gallons of hot water have been used in the afternoon.

MAINTENANCE

To keep your "Copper Cricket" chirping:

1. Rinse off glass when it becomes dusty. Do this in the evenings to avoid stress on the glass.
2. Flush the storage tank and heat exchanger periodically. Under normal conditions once a year will do fine. Follow the instructions in the Solar Pad and Tank Maintenance section of the manual.

SERVICE

For further service, call your installer or Sage Advance Corporation. We always welcome your call or letter.