

**INSTALLATION
OPERATION
MAINTENANCE
MANUAL
OPEN LOOP/
OPEN LOOP PV**



Alternate Energy Technologies, LLC.
PO Box 61326
Jacksonville, Florida 32236
904-781-8305

CONTENTS

Introduction	1
Basic Tools and Materials	1
Collector Location	2
Collector Orientation	2
Collector Dimensions	3
Mounting Hardware	4
Mounting Hardware Spacing	7
Pitch Pan	7
Array Mounting	8
Collector Piping	9
Collector Piping Detail	9
Sensor Mounting at Collector	10
Piping Through Roof	10
Storage Tank Placement	10
Sensor Mounting at Storage Tank	11
Open Loop Fluid Handling System	11
Open Loop Differential Temperature Controller	12
Open Loop Start-Up	13
Open Loop Maintenance	13
Open Loop PV System	14
Operational Checklist	15
Systems Parts List	16
Collector Yard Mount	16

INTRODUCTION

We at AET would like to extend our congratulations on your purchase of an Eagle Sun System. Years of research and development backed by critical engineering have brought you the finest solar products you can buy. Please take time to read this booklet thoroughly. Each step is outlined completely and clarified by diagrams where necessary. All questions which arise from this material should be answered before you attempt installation of the system. With a little thought and careful planning, your Eagle Sun System can be installed quickly and easily by yourself or by a qualified plumber with a minimum of disruption to your business or home.

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

“Conservation for today... Energy for tomorrow.”

BASIC TOOLS AND MATERIALS

Electric Drill	Wire Cutters
Drill Index (w/ ½” and ¾” Wood Bits)	Adjustable Wrenches 8”& 10
Hack Saw	Torch and Striker
Tubing Cutter	100 PSI Pressure Gage
Tin Snips	High Temperature Pipe Joint Compound
16’ Tape Measure	Wire Nuts or Connectors
24” Level	Miscellaneous Copper Pipe & Fittings
Flashlight	Solder Flux
Extension Cord	Emory Paper
Slip Joint Pliers	Silicon Caulk, Roof Tar and Putty Knife
Needle Nose Pliers	½” I.D. Copper Tubing & Installation
Pipe Wrenches, 10” & 14”	Angle Iron
Open End Wrenches, 9/16 & 7/16	Threaded Rod, Nuts, & Washers
Screw Driver 6” Flat Blade	Stainless Screw Clamps
Screw Driver 6” Philips	Thermal Adhesive
Wire Stripper or Knife	Aluminum Flashing Sheet

PRE-INSTALLATION CHECKLIST

Unlike other types of solar collectors, the AET solar collectors do not add a significant amount of weight to the roof. However, if the collectors are placed at a steeper pitch than the roof itself, the additional exposed flat surfaces could present extreme wind loading forces during sustained high winds. Check local codes for roof load requirements. The mounting hardware supplied with your solar system has been designed for specific wind loads, but only if adequate support structure is present with sufficiently strong structural members (such as engineered trusses). Most building permit offices may be able to help you with recommended roofing practices for your area.

Obtain all applicable permits. Structural members penetrated by the solar system components must meet local codes. The installer is to run the piping in such a way that the performance of any fire rated assembly is not reduced. This applies to the collector mounting as well as the installation of any other system components.

Inspect the roof. If it is in poor condition, it is advisable to replace all or part of the roof where the system will be attached.

Locate a roof area facing as close to due south as possible for the placement of the solar collectors. The plumbing runs must be planned in advance so that the shortest possible route between the storage tank and collector is made. Make sure you have no low points in the sloped horizontal pipe runs. This could trap water and in freezing weather cause the pipe to rupture.

Make sure you have all the necessary plumbing materials, tools, and accessories before beginning work.

CAUTION!

Solar collectors become very hot when in direct sunlight with no fluid being circulated through them. Extreme caution should be taken when standing near, or handling solar collectors in this state. Where possible, cover the collectors with a tarpaulin or other opaque covering until you are ready to energize the system. The circulating pump becomes very hot when running. Do not touch before allowing sufficient time to cool down.

Wear gloves when handling the solar collectors! They get extremely hot when left exposed to the sun. The bright orange plastic caps should be removed prior to placing the collectors on the roof otherwise they may get so hot that they melt in place. Also, never try to lift the collectors by the pipe nipples. These bend when hot and would damage the collector. You should have a tarp handy to keep the collectors covered during the entire installation process. This will prevent the collectors becoming too hot to handle as you make your final adjustments and connections.

Direct systems are designed to use ½" copper pipe for the collector/tank interconnect piping. Type M may be used except where otherwise specified by the Authority Having Jurisdiction. Use only lead-free solder. Use of 50/50 lead solder is expressly prohibited. Use of galvanized steel, CPVC, PVC, PEX or any other type of plastic pipe is prohibited.

Dielectric nipples must be used on all connections to the tank. These are used wherever copper and galvanized lines are connected together. This is a requirement of the Uniform Plumbing Code. Typically, galvanized pipe nipples are used for all connections into the tank, which has ferrous female standard pipe thread, ¾" nominal (¾" inside diameter). One side of a dielectric union fits a standard galvanized pipe nipple, and the other side is brass or bronze for soldering to a copper pipe.

With solar tanks, the cold input from the pressurized supply line to the house (either city water or well water) must be fed into the tank inlet. This is marked "Cold Inlet" and is located on top of the tank. There is a long plastic tube attached internally to this connection so that incoming cold water is directed immediately to the bottom of the tank, and therefore does not mix and cool down the hot water. A cold-

water shutoff valve must be installed above this connection so that water flow may be completely stopped in the event of a leak, repair, or maintenance.

The hot water output to the house from the tank should be connected to the port labeled "Hot Outlet" on the top of the tank. Again, a dielectric union must be used where a connection is made between galvanized and copper pipes. A mixing valve must be installed at this point to limit the temperature of water delivered to the home.

All hot water lines should be insulated with at least 1/2" thick heat resistant rubber tubing insulation such as Armstrong Armaflex.

In most instances, the solar collectors can be attached to the roof using the standard mounting hardware provided with the solar system. Certain types of roofing will require special attention for proper mounting. For example, a clay tile or cement tile roof. Complete roofing attachment methods of solar collectors for these various types of roofs are beyond the scope of this manual. The manual will describe and illustrate some of these approved mounting techniques. A competent contractor should be used to ensure that all roof penetrations and attachment points are not a source of rainwater leakage later on. Standard plumbing roof jacks or solar industry copper flashings may be used for plumbing penetrations in most cases.

The collectors should be canted slightly toward the inlet side to ensure they drain completely when maintenance is required on the system.

CAUTION!

Photovoltaic modules produce electricity even in minimal sunlight. Keep the PV module covered during the installation process and when performing system maintenance. The PV system toggle switch should be in the off position until you are ready to energize the system.

Electrical connections should only be made after the plumbing system is fully installed and ready to be charged. Insure that the controller or the PV system toggle switch is in the "OFF" position until you are ready to energize the pump. Remember to remove all collector/module coverings prior to energizing the system.

NOTE: All collectors are to be mounted vertically, sloped in order to be completely void of fluid when drained, and oriented in such manner as described below under COLLECTOR LOCATION.

COLLECTOR LOCATION

Proper location and orientation of the solar collectors is important for maximum system efficiency. The collectors should be unshaded for the middle six hours of the day in each month of the year and should be located as close to the storage tank as possible to minimize heat loss in the piping runs. The best orientation is achieved when the collectors are facing due south and tilted at an angle from the horizontal of latitude + 10°. Figure 1 below shows many alternatives for collector mounting. When roof mounting, placing the collectors as close as possible to the peak of the roof will make installation easier due to increased attic access

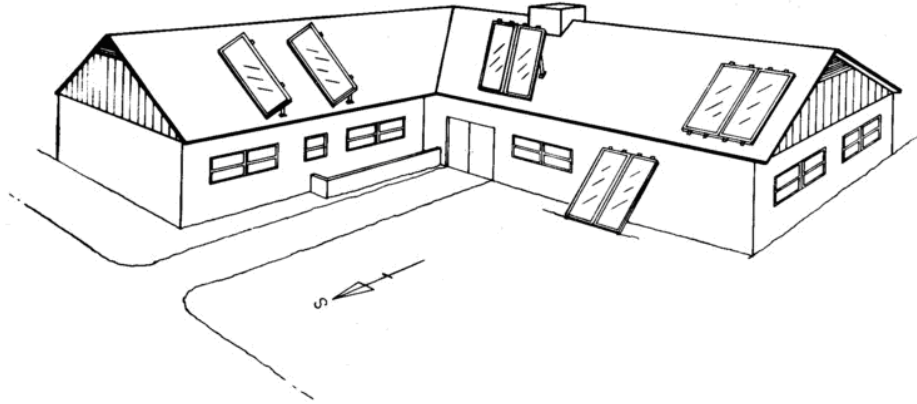


Figure 1

COLLECTOR ORIENTATION

Proper tilt angle for solar collectors is latitude plus 10° (see latitude map). This favors the winter sun because ambient temperatures are lower during the winter and collector efficiency suffers. This 10° additional tilt equalizes year round performance. Spacing can be determined from Table 1. When the collectors are mounted one behind the other, they are spaced apart so that in the morning and afternoon on December 21, when the sun is at its lowest altitude, the collectors will not shade each other and cause efficiency loss.

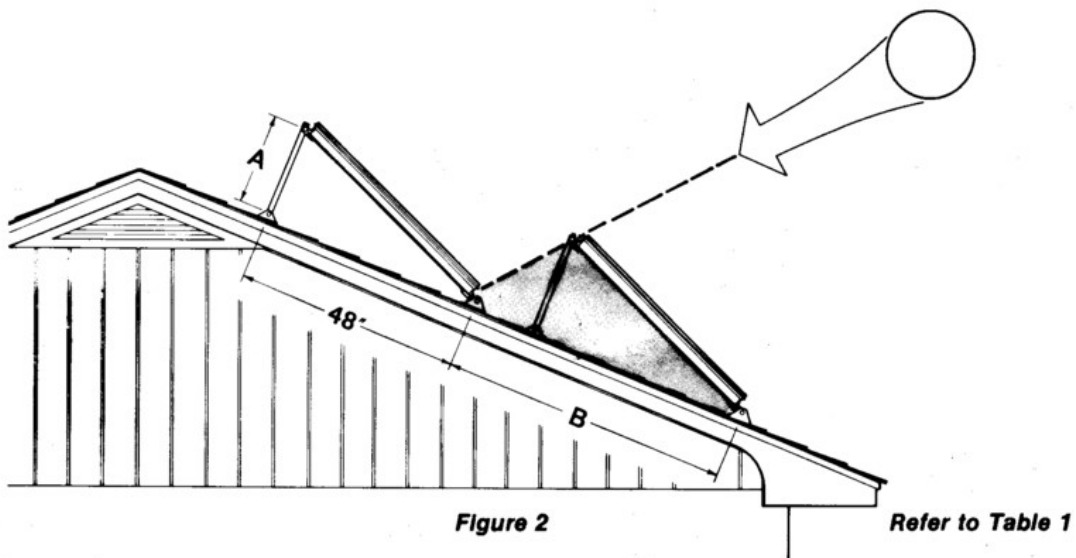


Figure 2

Refer to Table 1

LATITUDE		25° N		30° N		35° N		40° N		45° N		50° N	
COLLECTOR TILT		35°		40°		45°		50°		55°		60°	
		A	B	A	B	A	B	A	B	A	B	A	B
ROOF PITCH	FLAT	29	96	33	113	37	145	41	145	44	145	48	145
	5° 1/12	25	83	29	93	33	113	37	132	41	133	44	141
	9° 2/12	22	74	26	82	30	77	34	110	38	115	41	118
	14° 3/12	17	66	22	72	26	82	30	92	34	95	38	98
	18° 4/12	14	61	18	66	22	74	26	81	30	85	34	87
	23° 5/12	10	58	14	60	18	66	22	72	26	74	30	77
	27° 6/12	7	58	11	58	15	61	19	66	23	68	27	70
	30° 7/12	4	58	8	58	13	58	17	58	21	58	25	58
	34° 8/12	0	58	5	58	9	58	13	58	17	58	22	58
	37° 9/12	-2	58	3	58	7	58	11	58	15	58	19	58
	40° 10/12	-4	58	0	58	4	58	8	58	13	58	17	58
	43° 11/12	-7	58	-3	58	-2	58	6	58	10	58	14	58
45° 12/12	-8	58	-4	58	0	58	4	58	8	58	13	58	
	VERTICAL	-44		-41		-37		-33		-29		-25	

Table 1. All Lengths in inches

COLLECTOR DIMENSIONS

Collector	Gross Area (ft²)	Dimensions (in)	Transparent Area (ft²)	Weight (lb)
AE-21	20.8	35-3/16 x 85-3/16	19.2	74
AE-24	23.7	35-3/16 x 97-3/16	21.9	84
AE-26	25.3	47-3/16 x 77-3/16	23.6	90
AE-28	27.9	47-3/16 x 85-3/16	26.1	99
AE-32	31.8	47-3/16 x 97-3/16	29.9	113
AE-40	39.7	47-3/16 x 121-3/16	37.4	153
Tested: SRCC, FSEC, Metropolitan Dade County, Miami Test Lab, TUV (DIN 4757), RAPPERSWILL, ONORM M7714				

Table 2. Collector Dimensions for AE series

MOUNTING HARDWARE

Provided in the Eagle Sun package is specially designed mounting hardware to speed collector installation. This hardware consists of four LOCK-TIGHT hinge sets, four roof brackets, two rear struts, and bolts (Figures 3, 4, and 5).

- a) After locating the mounting points from Table 1, the mounting bracket holes should be drilled.
- b) A heavy coating of sealant should be applied to the bottom of the flashing plate, which should fit flat against the roof. It is necessary for the plate to slide under the above shingles to insure proper drainage of water.
- c) The bottom of the roof bracket and the area around the threaded rod should also be thoroughly coated with tar sealant. When the bracket is set in place, alignment with the collector hinges is necessary before final tightening of the nuts. This should be completed before the sealant has time to set.
- d) The threaded rod is fastened through a 2' x 6" wood or 2" x 2" x 1/4" steel angle bracket under the roof as shown.
- e) The rear struts should be cut and drilled to conform to Table 1. All bolts should be tightened securely. A stainless steel washer should be placed where the threaded rod passes through the aluminum bracket.

It is very important that the penetrations through the roof be well sealed. It should be carefully checked that all bolts are coated with tar and that no leaks are possible.

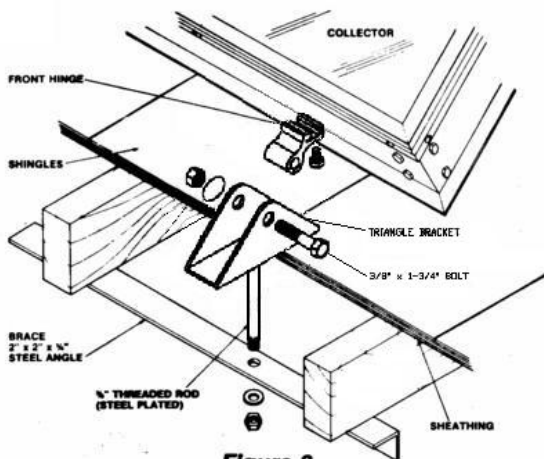


Figure 3

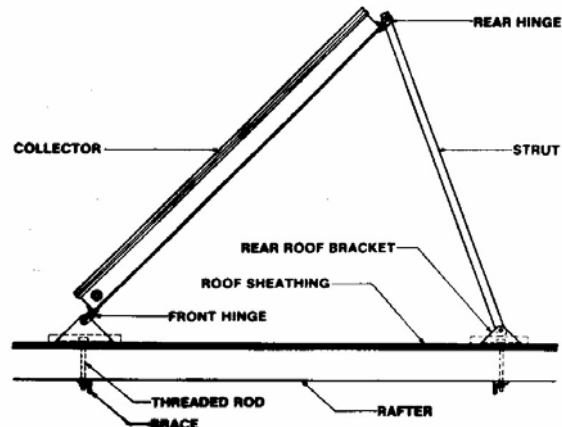


Figure 4

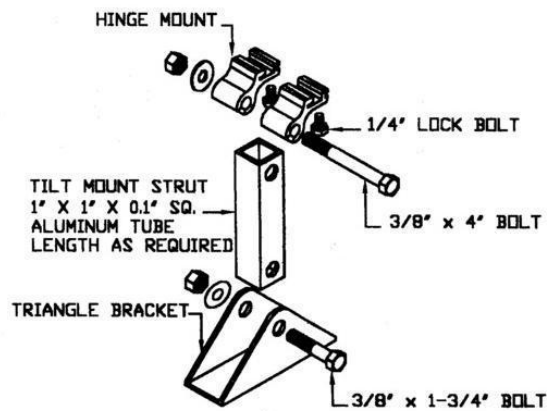


FIGURE 5

There are three acceptable ways to secure the collector mounting brackets to the roof.

1. Spanner Mounting
2. Lag Bolt Mounting
3. J-Bolt Mounting

SPANNER MOUNTING

In spanner mounting after the brackets are positioned on the chalk line, a 3/8" hole is drilled between the rafters. An aluminum flashing is positioned over the hole where the top of the flashing is extended up under the shingle above the 3/8" hole and extends down over it. Caulk is applied between the flashing and the roof. The bracket is then positioned over the 3/8" hole using sealant between the bracket and the flashing. A piece of 3/8" all-thread is then inserted through the hole. A washer and nut secures the all-thread to the bracket (be sure the seal underneath the washer and on top of the nut). The all-thread rod should extend about 4" below the roof rafters. Drill a 3/8" hole in a 2 x 4 and insert the all-thread rod through it. The 2 x 4 should span 2 rafters. With a washer and double bolt secure the all-thread to the 2 x 4. Tighten down until the bracket is tightly secured to the roof. Be careful not to over-tighten and bell out the roof underneath the bracket. (See Figure 6)

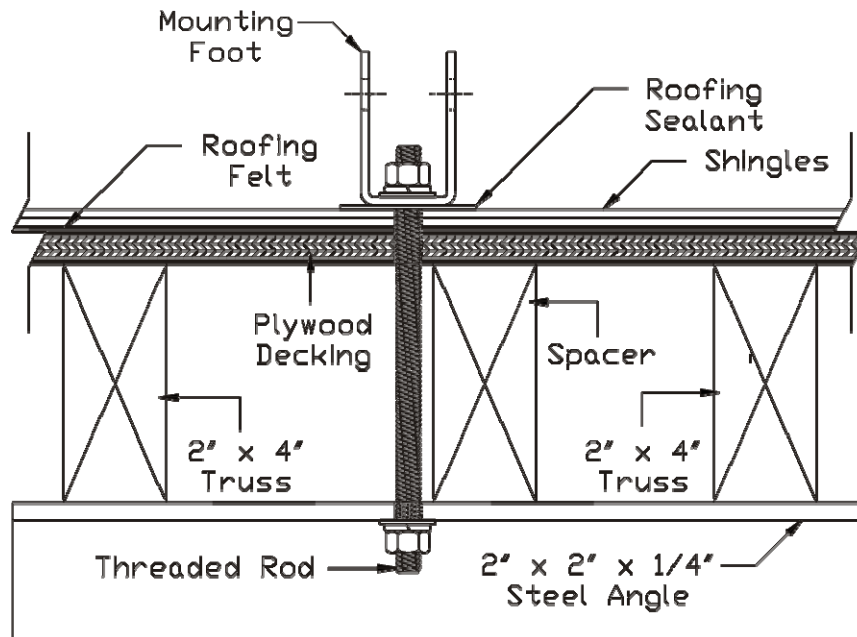


Figure 6. Spanner Mounting

LAG BOLT MOUNTING

In lag bolt mounting you must locate the center of the rafters along the top and bottom chalk lines. One method is to have one man on the roof and another in the attic. Using a hammer the man on the roof can tap the roof and determine where it is denser sounding. The roof man can drill a pilot hole while the attic man helps with distance corrections. Then the attic man can call of the distance to the next rafter while the roof man drills corresponding pilot holes. Flashing the brackets is done as previously described. Secure the brackets to the roof using a 1/4" x 3" stainless lag screw, a flat washer, and a lock washer (Figure 7).

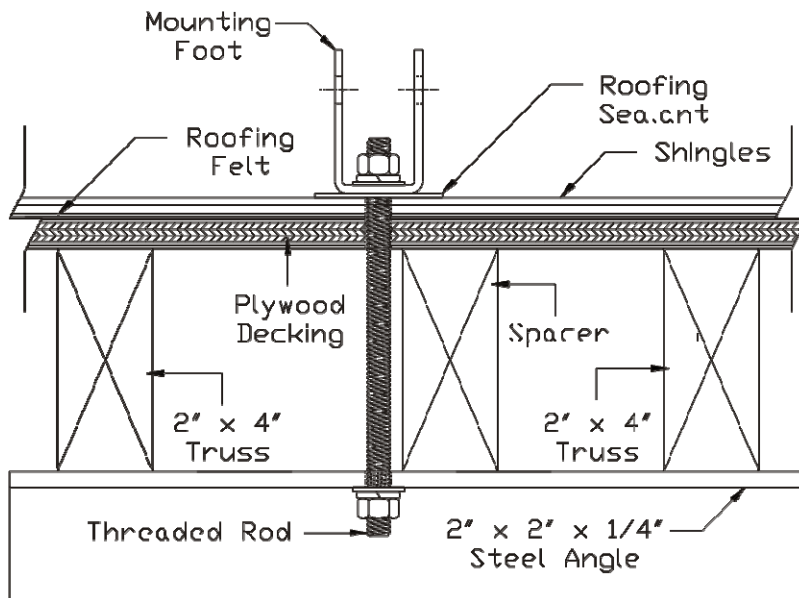


Figure 7. Lag Bolt Mounting

J-BOLT MOUNTING

J-bolt mounting is done very similar to lag screw mounting except instead of drilling into the center of a rafter, a hole must be drilled directly beside a rafter. The size of the hole must be slightly larger than the bolt diameter. This is more easily accomplished if the attic man would drill a pilot hole through the roof along side the chosen rafter. Fit the bolt through the mounting brackets and insert the bolt (J side first) through the hole in the roof. Work the J underneath the rafter. Pull the J-bolt snug against the rafter before tightening the nut. Use double nuts or lock-washers to securely fasten the mounting bracket to the J-bolt (Figure 8).

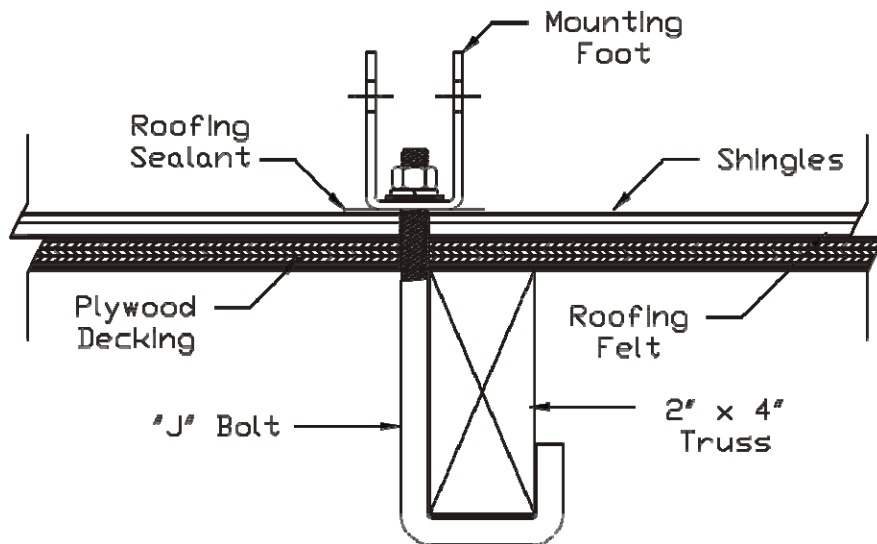


Figure 8. J-Bolt Mounting

MOUNTING HARDWARE SPACING

AE-Series			Center Line to Center Line (in.)		
Model	Size (ft)	Outside Box Dim. (in.)	AE-MH	AE-FM	AE-RM
AE-21	3 x 7	35.1875 x 85.1875	88.4375	88.9375	86.9375
AE-24	3 x 8	35.1875 x 97.1875	100.4375	100.9375	98.9375
AE-26	4 x 6.5	47.1875 x 77.1875	80.4375	80.9375	78.9375
AE-28	4 x 7	47.1875 x 85.1875	88.4375	88.9375	86.9375
AE-32	4 x 8	47.1875 x 97.1875	100.4375	100.9375	98.9375
AE-40	4 x 10	47.1875 x 121.1875	124.4375	124.9375	122.9375
MSC-Series			Center Line to Center Line (in.)		
Model	Size (ft)	Outside Box Dim. (in.)	MSC-MH	MSC-FRM	MSC-FM
MSC-21	3 x 7	35.8750 x 86.1250	90.5	87.375	37.125
MSC-24	3 x 8	35.8750 x 98.1250	102.5	99.375	37.125
MSC-26	4 x 6.5	47.8750 x 78.1250	82.5	79.375	49.125
MSC-28	4 x 7	47.8750 x 86.1250	90.5	87.375	49.125
MSC-32	4 x 8	47.8750 x 98.1250	102.5	99.375	49.125
MSC-40	4 x 10	47.8750 x 122.1250	126.5	123.375	49.125

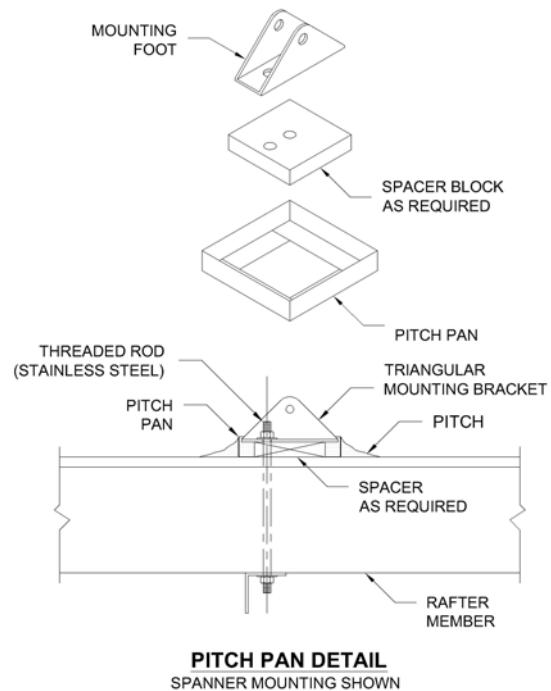
Table 3. Distance between centerlines of top and bottom mounts for all AE and MSC series

PITCH PAN

The pitch pan is necessary any time standing water is encountered (Figure 9). The purpose is to provide an adequate seal around any penetration in the roof.

The pitch pan is placed in the proper position and flat on the roof. Its flange is sealed with roofing felt and hot tar. The holes are sealed on the inside with roofing tar to a sufficient level to insure a permanent seal.

NOTE: All penetrations in structural members or fire rated assemblies are to be made in accordance with local codes using acceptable roofing practices.

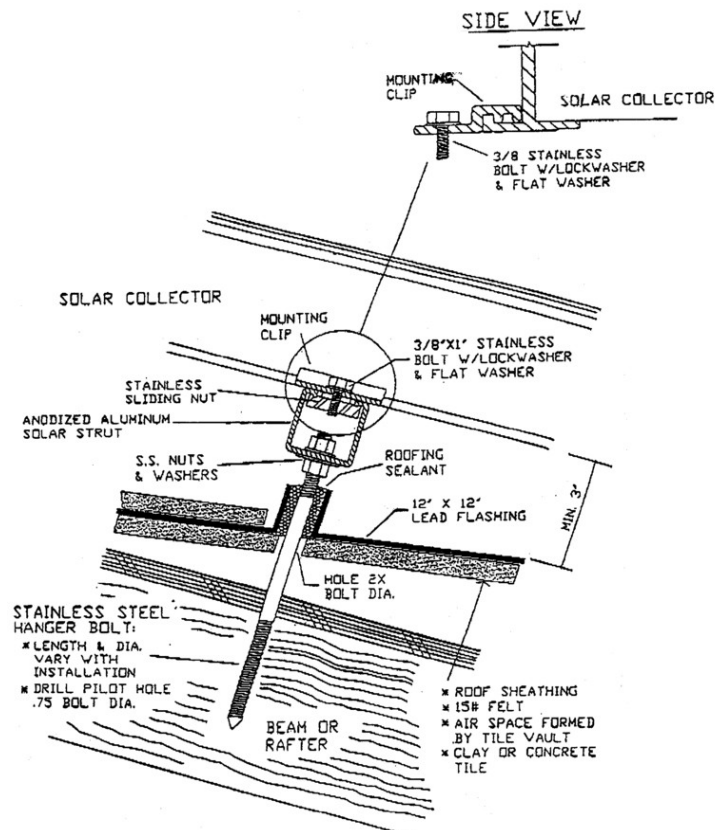


ARRAY MOUNTING ON TILE ROOFS

Tile roofs are a little more difficult to mount solar collectors on but following this procedure will render a leak free installation. The solar panels are mounted on two rails located at the top and bottom of the solar collectors. The collectors are secured to the rails using the AE rack mount hardware (AE-RM). The 1-5/8" Aluminum unistrut rails are anchored to the roof by using six or ten inch stainless steel 3/8" hanger bolts. These bolts are lag screw on the bottom and 3/8 NPT thread on the top. A ten foot length of unistrut should be anchored at three points, the middle and both ends.

Procedure:

1. Cut 12" x 12" square pieces of lead flashing.
2. Locate the roof rafters beneath the tile where the hanger bolts will be attached. Drill a 3/8" hole through the tile.
3. Slide the 12" x 12" lead flashing under the tile located above the 3/8" hole, then drill through the lead flashing into the hole.
4. Screw lag portion of the 3/8" hanger bolt into the rafter.
5. Cut strips of the lead flashing about 1-1/2" long and wide enough that when you fold it into a tube is slightly larger in diameter as the hanger bolt.
6. Using an acid core solder, weld the seam of the tube together.
7. Slip this tube over the top of the hanger bolt protruding from the roof, and then solder it to the 12" x 12" lead flashing.
8. Thread down a stainless 3/8" nut to the bottom of the thread and seal the top of lead tube to the nut with a polybutylene caulk.
9. Slip a 3/8" stainless washer on top of the nut.
10. Place the 1-5/8" aluminum unistrut rail on the hanger bolt and secure with another 3/8" stainless washer and nut.
11. The rail is now secured, weather tight to the tile roof. Next, mount the AET solar collector to the rail using the AE rack mounts (AE-RM). See Figure 10.



COLLECTOR PIPING

The piping of the system should be considered before a final decision is made on how the collectors are mounted. Piping should be made of copper tube of the type meeting local codes, insulated with Armaflex or similar, and painted or wrapped with aluminum tape where exposed to ultraviolet radiation.

Care should be taken in the spacing of collectors as attachment of piping is easiest with properly aligned collectors. The collectors and piping to the storage tank should be slightly sloped downward (3" in 8 feet) to allow draining in case of freezing conditions. Piping should be adequately supported for correct pitch and supports shall be designed to avoid compressing or damaging the insulation material. Soldered connections should be made with 95/5 solder.

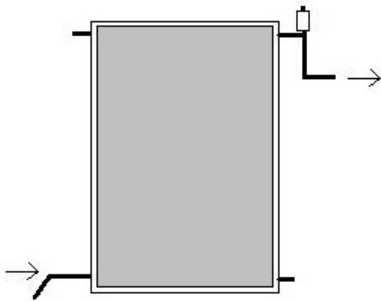


Figure 11

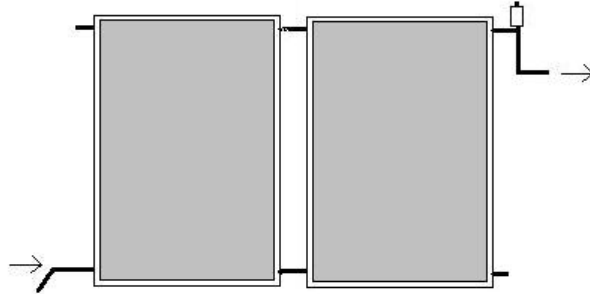


Figure 12

COLLECTOR PIPING DETAIL

The outlets of the collector are 1" copper pipe nipples (Figure 13). They should be piped as shown with provisions for an automatic air vent. This will prevent air lock and subsequent loss of system efficiency. The copper union makes attachment of piping to collector easy. Teflon tape or high temperature, high quality pipe sealant should be used when making threaded connections.

The collector inlets should be piped similarly but without the automatic air vent.

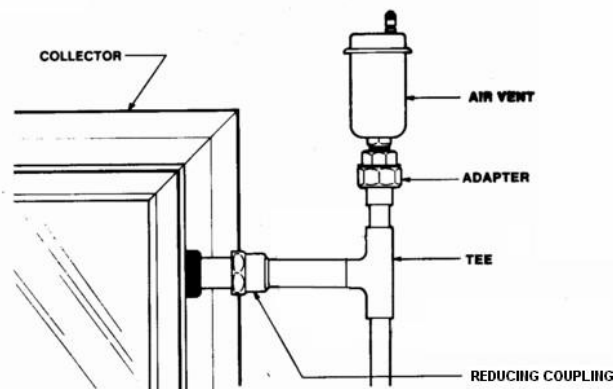


Figure 13

SENSOR MOUNTING AT COLLECTOR

The controller heat sensor is mounted to the nipple outlet of the collector (Figures 14). A stainless steel screw clamp should be used. The entire nipple should be wrapped thoroughly with insulating tape so that the sensor is isolated from the outside air.

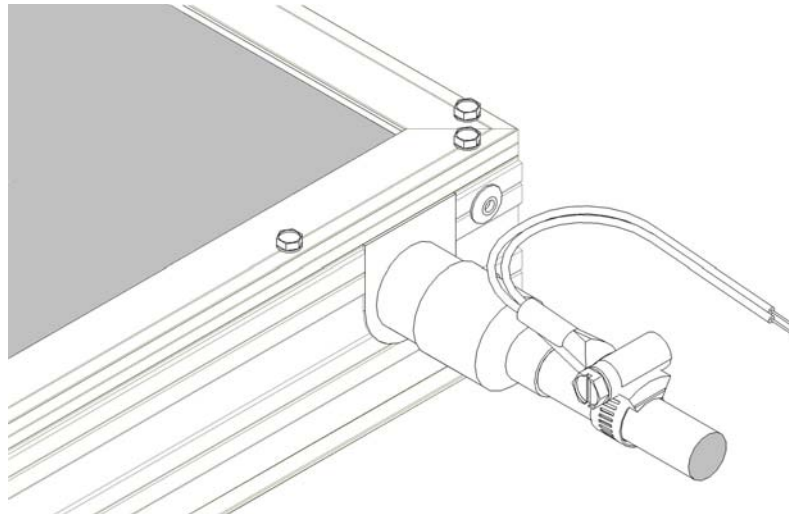


Figure 14

PIPING THROUGH THE ROOF

Piping through the roof should be weatherproofed as shown in Figure 15. One inch holes are drilled through the roof on the same plane as the supply and return header nipples. Do not drill the hole above the supply header of the collector. This will prevent the collector from draining. Placing the hole below the supply header is acceptable, but it is more aesthetic if it is located on the same plane. A copper flashing is placed around the hole with its base cemented to the roof and its upper edges slid under the adjoining shingle. The copper tube supply and return line is then pushed up through the hole in the flashing. A “coolie cap” is then slid over the copper tube till it meets the flashing. After piping to the collectors is completed, the “coolie cap” is soldered to the copper tube. Polybutylene adhesive is then placed on the top and bottom of the flashing, providing a weatherproof seal. The sensor wire should also be run through the return flashing.

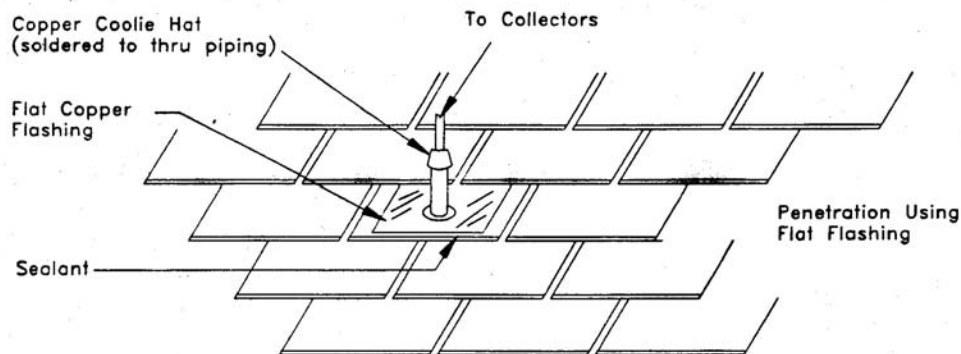


Figure 15

STORAGE TANK PLACEMENT

To minimize expense and heat loss, the tank should be placed near the collectors and central to points of greatest water demand. It should be located in as warm a spot as possible. It should be located with adequate ventilation, with a minimum of 6-8 inches of clearance and with ready access to controls and serviceable parts.

Provision should be made to prevent water damage in case of leakage. A catch pan with a minimum of 3/4" drain line at least 2" in height may be installed and pitched for proper drainage where the tank is installed in or above the living space. Electrical service of 240V should be available for the element and 110V for the pump and controller.

SENSOR MOUNTING AT STORAGE TANK

On the closed loop Rheem tanks the heat sensor mounting is located behind the round cover located at the bottom front of the 80 gallon storage tank.

Procedure:

1. The round cover located on the bottom front of the tank should be removed and the fiber glass insulation pushed aside so that the wall of the tank is accessible.
2. Remove the 1/2" brass plug from the tank.
3. After sealing the 1/2" lug sensor with teflon tape or pipe tape, screw it into the 1/2" threaded hole.
4. Attach 18/2 sensor wire to the wires of the sensor. It does not matter which sensor wire is attached to the thermostat wire.
5. Run the thermostat wire up the tank to the controller and attach it to the terminals marked tank or water.
6. Replace the insulation and cover.

OPEN LOOP FLUID HANDLING SYSTEM

An Eagle Sun open loop solar water heater operates by circulating water from the storage tank to the solar collectors when the collectors are at a higher temperature than the tank. This function is controlled by a differential temperature controller with heat sensors. When the collectors are warmer than the water inside the tank, the controller switches on the pump. (Figure 16).

A recirculation feature of the controller provides freeze protection. When the sensor at the collector indicates freezing temperatures, the pump is switched on and warm water is circulated through the collectors until warmed. The pump is then automatically switched off. This cycle repeats periodically until freezing conditions no longer exist. When a hard freeze is imminent or a power failure occurs, the system should be drained by closing the two ball valves that isolate the collector loop and opening the two drain valves that allow the collectors to drain.

The system also includes a freeze protection valve at the collector outlet pipe. This valve is designed to open at a set temperature 35-45°F and allow fluid to pass across the collectors to prevent freezing of the collector manifold. When operating properly the valve will drip water until a suitable temperature is reached at the valve.

Automatic air vents in the top of the system prevent air locks. Care should be taken that no air can be trapped in piping to and from the collectors. Water returns to the tank from the collectors via a drop tuber that extends halfway down the interior of the tank. This allows the returning water to stratify properly.

A check valve in the return line from the collectors prevents thermosiphon losses during the night. Temperature and pressure relief valves protect the system from damage.

A backup electric element is provided in the top of the tank to supply hot water during inclement weather. Power required is 240 volts.

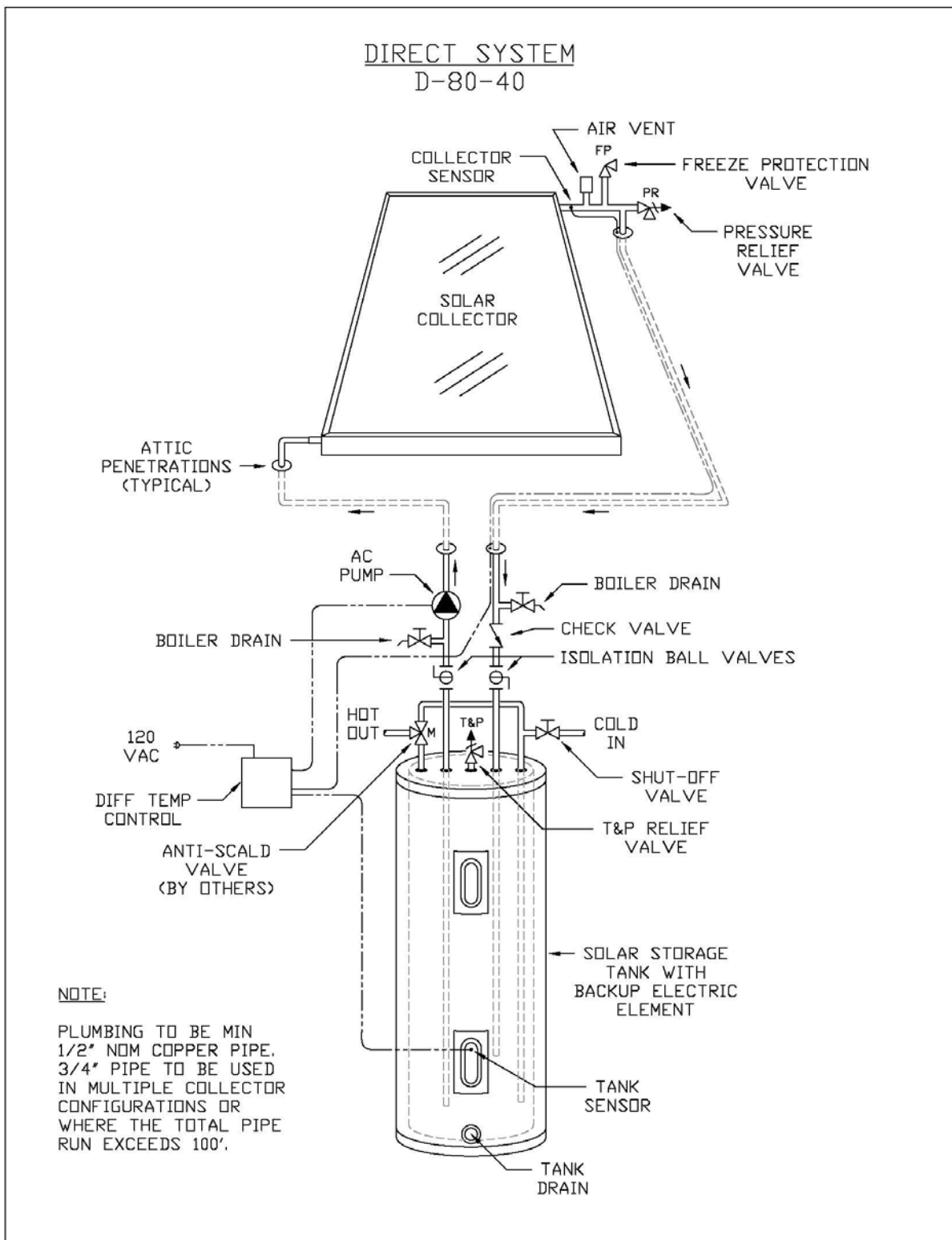


Figure 16

OPEN LOOP DIFFERENTIAL TEMPERATURE CONTROLLER

NOTE: When instructions are provided in the controller package, follow those and disregard the following.

The open loop differential temperature controller controls the pump to achieve maximum system efficiency. When one of the two heat sensors provided with the unit raises nominally 10° F above the other sensor, a power control relay is energized. Then, when the first sensor drops to within 5° F of the second sensor, the control relay contacts are opened. As long as the “turn-on differential of 10° F is exceeded, the control relay remains open. (The 5° F value is designated as the “turn-off differential.”) The first sensor is called the COLLECTOR sensor, since when properly installed monitors the temperature of the water in the solar collector. The second sensor is called the STORAGE sensor.

Mount the controller in any position or location that is convenient and sheltered from the elements. Aesthetics and economy of running power leads should dictate the location, since there is no restriction on the length of leads to the sensors. Connections to the circuit terminal strip inside the controller enclosure should be made according to Figure 17.

ALL CONNECTIONS SHOULD BE MADE WITH ACCORDANCE WITH LOCAL ELECTRICAL CODES. SPECIFICATIONS:

OPERATING VOLTAGE:	120 vac, 60 Hertz
CONTROL RELAY CONTACT RATING:	One third HP inductive load
TURN-ON DIFFERENTIAL:	10° F (+1° F) for Storage Sensor at 135° F
TURN-OFF DIFFERENTIAL:	4° F (+1° F) for Storage Sensor at 135° F
SENSOR MATCHING ACCURACY:	1° F or less at 135° F
MAXIMUM SENSOR TEMPERATURE:	300° F

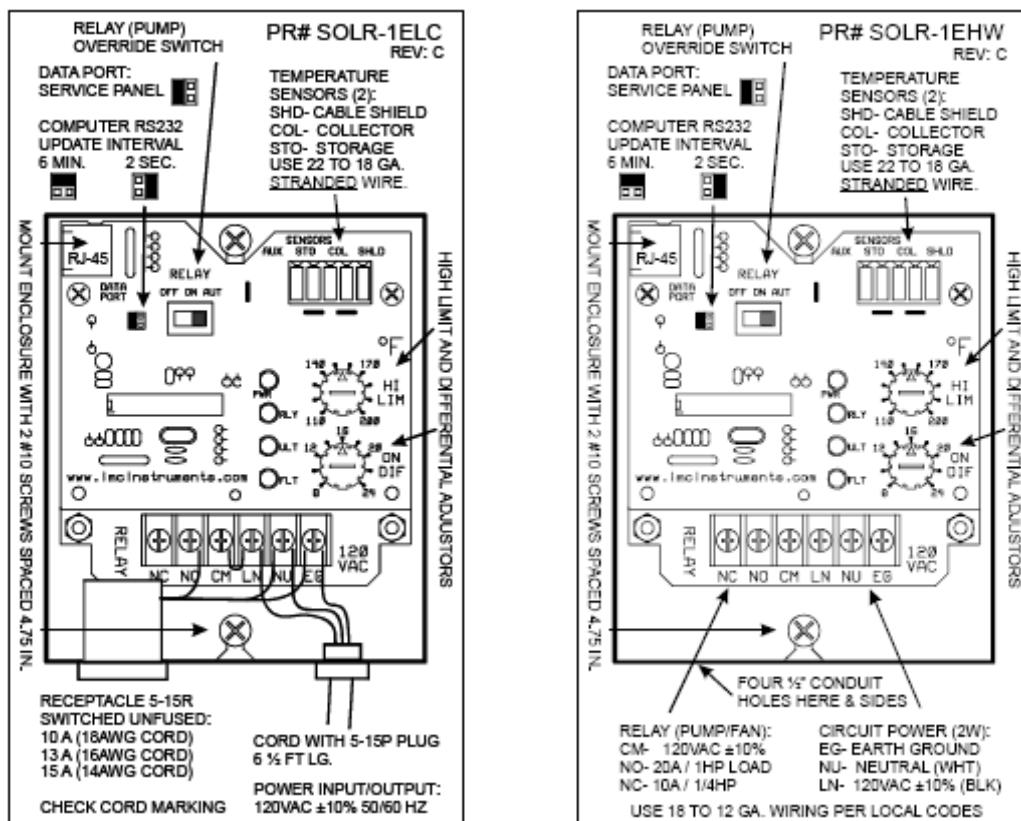


Figure 17

OPEN LOOP START-UP

After visual inspection of the complete system, it is ready for filling and pressure testing. All drain valves should be closed, all other valves opened. The air vent caps should be loosened two turns to allow air to escape the system. The cold water inlet valve should then be opened slowly and system checked for leaks as it fills. When the system is completely full, indicated by water escaping from the air vent when the valve is depressed it should be pressure checked with normal pressure for 30 minutes.

Once the system has been pressure tested and repaired if required, the control system can be energized. On an A/C controlled system, plug the controller into a 115/120 VAC outlet. Set the "ON DIF" dial to 10 and the "HI LIM" to 135. Move the "RELAY" (pump) override switch to the "AUT" (automatic) position. On a PV controlled system, switch the toggle to the "ON" position. If the sun is shining and the storage tank is cool, the pump should come on and water should flow through the collector. The first water through the collectors will be very hot but should stabilize in about 15 minutes. The return lines from the collectors should be hotter than the inlet lines and the collector glass should be slightly warmer than ambient temperature.

If the differential temperature control offers a freeze protection mode, testing of the sensor can be made at night when the pump is not normally working. A piece of ice set on the collector sensor should be sufficient to turn the pump on. The pump should turn off as soon as the sensor has a few seconds to warm back up when the ice is removed. Caution should be exercised when working on the roof at night.

OPEN LOOP MAINTENANCE

Maintenance of an open loop system is straightforward. The tank should be partially drained every 6 months to allow minerals to be removed preventing scale build up (this is recommended for all water heaters). The wye strainer should be cleaned at least once a year or more often if harsh water conditions exist. The power should be switched off, the piping drained, and the screen removed and cleaned.

The collector glass should be kept clean for best system performance. Rainwater will usually suffice but a garden hose can be used during dry weather. The air vent caps should be loosened two turns for proper operation and best system performance.

OPEN LOOP PV SYSTEM

The single photovoltaic module, attached to the top of the solar collector (Figure 18) operates a brushless 12 VAC or 24 VAC pump at a speed relative to the amount of available sun. When clouds pass over, the pumping operation slows to allow the water to remain in the collector longer for continued heating. When the sun goes down in the evening the pumping action will stop.

The solar system is installed as per the open loop installation manual. The photovoltaic module will replace the differential control and sensors. Be sure to mount the panels on the same plane as the solar collector. A toggle switch is to be installed, as per the "Direct PV System" diagram, to serve as a service disconnect should the solar system require maintenance or for purposes otherwise directed in this manual.

When wiring the photovoltaic module to the circulating pump use 16 gage stranded double exterior PVC jacketed wire for lengths up to 85 feet for 10 and 25 watt modules. Use 14 gauge for over 85 feet for a module over 1.4 amps. When wiring the module to the pump, remember that the black wire is always ground and the red wire is the hot wire. Do not reverse the polarity.

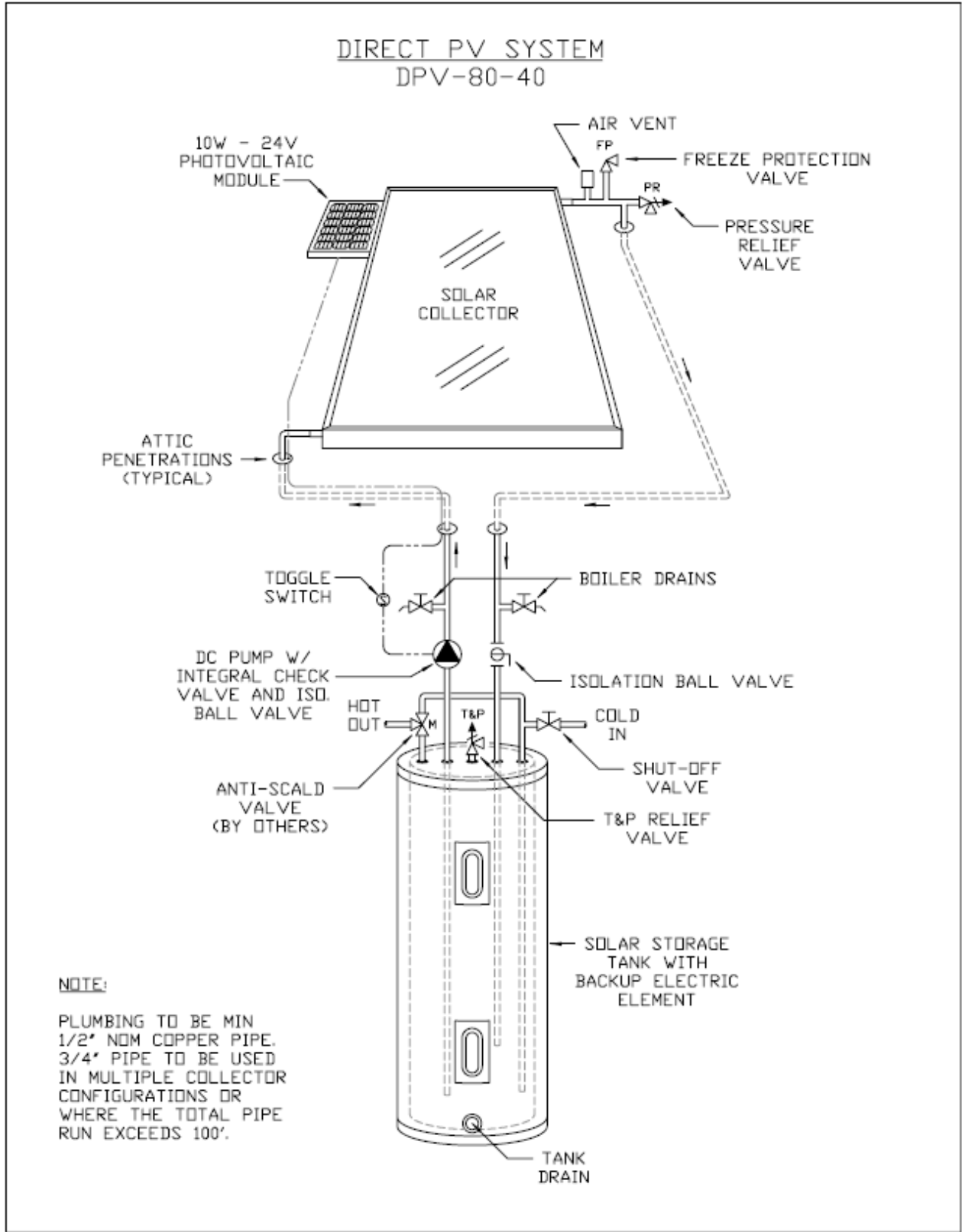


Figure 18

OPERATIONAL CHECKLIST

Before the system is turned on, the piping and electrical systems should be evaluated to see if they match the supplied drawings. If you are satisfied that the system is installed correctly, it should be filled and powered according to the preceding instructions. When the system is in the operational mode, care should be taken to check all piping for leaks and to make sure sufficient insulation has been used to provide maximum system efficiency. All modes of operation should be checked by the installer to assure proper functioning under all conditions.

Although operational checks may include physical contact (by touch) with the collector return pipe and the pump housing (for heat and or vibration), the addition of thermometers in the feed and return pipes or a flow meter in the feed line would provide a visual indication of operation. These items are not part of the supplied system and would be available through your solar contractor/installer.

VACATION PROCEDURES

If no hot water is to be used for some time, the system should be de-energized and drained. Follow instruction below; "*Leaks in the solar loop*" to shut the system down. To re-energize the system, refer to the OPEN LOOP START-UP section of this manual.

TROUBLESHOOTING GUIDE

Problems with systems usually fall under two categories: system leaks or lack of sufficient solar heated water.

LEAKS

If leaks exist, the system should be shut down for repairs.

Leaks at the tank:

1. Turn off the circuit breaker to the water storage tank and unplug the power to the controller (A/C controlled) or switch the toggle switch to the off position (PV controlled).
2. Close the cold water shut-off valve and close the isolation ball valves to the collector(s).
3. Connect one end of a garden hose to the tank drain valve placing the opposite end of the hose at a location suitable for draining.
4. Open the tank drain valve and the hot water valve of any fixture with the premises served by the water heater.
5. Allow the tank to drain and make the necessary repair.
6. Recharge the system as described in the Open Loop Start-Up section of this manual.

Leaks in the solar loop:

1. Unplug the power to the controller (A/C controlled) or switch the toggle switch to the off position (PV controlled).
2. Close the isolation ball valves to the collector(s).
3. Connect one end of a garden hose to the collector feed boiler drain valve and a washing machine hose to the collector return boiler drain. Place the opposite end of the garden hose in a location suitable for draining and the opposite end of the washing machine hose in a 5 gallon bucket.
4. Open the collector feed drain valve and then slowly open the collector return drain valve. The majority of fluid in this part of the system should drain through the collector feed drain valve.
5. Allow the solar loop to drain and make the necessary repair.
6. Recharge the system as described in the Open Loop Start-Up section of this manual.

There is a possibility that what appears to be leaks may be condensation on the pipes. Also water escaping for the T&P relief valve may be an indication of proper function as they are designed to vent off excess temperature and pressure.

INSUFFICIENT HOT WATER

If insufficient hot water is available a system malfunction may not be indicated. A low amount of solar radiation or heavy water demand can be the cause.

If no excessive demands are put on the system and ample solar radiation is available, the system should operate properly. The pump should run each sunny day until a full supply of hot water is stored. If the pump does not run, there is a problem on the electrical end of the system. Either the pump, controller, or sensors are malfunctioning. The controller can be bypassed by running a power cable directly to the pump and checking its function separate from the control system. Make sure that the problem is not a blown fuse or a tripped breaker. If the pump runs normally when powered externally, the control circuit is the problem area. Eagle Sun controllers use thermistor sensors to determine modes of operation. A controller tester is available from AET for checking differential function. Check sensor wiring. If no faulty wiring can be discovered, replace sensors.

If the pump is running all the time, even when the collectors are cool, then the storage sensor or collector sensor may be open. It is also possible that the sensor wire itself is at fault. To check this, test the continuity with an ohm meter. Be sure to disconnect the sensor when performing this test. Test the wire with both ends open, then retest often twisting the 2 sensor wires together at one end. The system can be set on a timer or switched on manually until the controller is properly functioning.

CONDENSATION ON COLLECTORS

If condensation occurs inside the collectors, ¼" vent holes should be drilled in the lower side of the collector. Three holes should be drilled, one at each end of the bottom of the collector and one in the center. These holes should be drilled 1" from the base of the collector

This should clear up any condensation within three days.

OTHER PROBLEMS

A noisy pump is an indication of worn bearings obstruction or loss of prime. As a rule of thumb about 8 to 12 degrees should be expected as a normal gain across a collector in bright sun at proper flow rate.

SYSTEM PART NUMBERS

This manual covers the installation of the following FSEC approved system model numbers:

D-80-40, D-120-64, DPV-80-40 and DPV-120-64

SYSTEM PARTS LISTING (A/C Controlled)

<u>COMPONENT</u>	<u>MANUFACTURER</u>	<u>MODEL</u>
Solar Collector(s)	Alternate Energy Technologies, LLC	AE-32 (-64 systems) <i>or</i>
	Alternate Energy Technologies, LLC	AE-40 (-40 systems)
Water Storage Tank	American Water Heater	SE62-80H-045S <i>or</i>
	Richmond (Rheem) Water Heaters	81VR80-TC-1
Circulation Pump	TACO, Inc.	003-BC4 <i>or</i>
	Grundfos Pump	UP15-10B5
Differential Control	Goldline Controls	GL-30 (LCO) <i>or</i>
	IMC Instruments	Eagle 1 <i>or</i> Eagle 2

SYSTEM PARTS LISTING (PV Controlled)

COMPONENT	MANUFACTURER	MODEL
Solar Collector(s)	Alternate Energy Technologies, LLC	AE-32 (-64 systems) or AE-40 (-40 systems)
Water Storage Tank	American Water Heater	SE62-80H-045S or 81VR80-TC-1
Circulation Pump	Laing Thermotech	D5Solar/090B
Differential Control (PV)	SunWise Technologies	OEM-10 or PV-10
	Yingli Solar	

COLLECTOR YARD MOUNT

When no sunny roof area is available or for “show” systems, the collectors can be mounted on the ground as shown in Figure 19. The piping and control wiring to the tank should be insulated and buried. It is important that the length of these piping runs be minimized.

Notes:

- Front edge of collector should be 18” above ground
- Use washers on all bolted wood connections
- All pieces must be measured and cut to orient collector at latitude + 10° – consult trigonometric reference.
- Piping to collector may be buried.

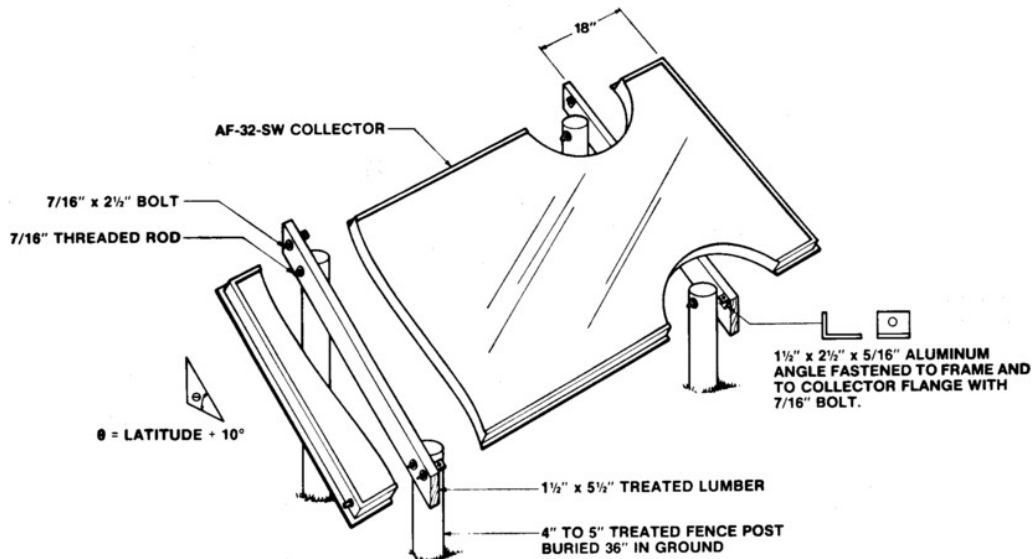


Figure 19

NOTE: All collectors are to be mounted vertically, sloped in order to be completely void of fluid when drained, and oriented in such manner as described under COLLECTOR LOCATION.