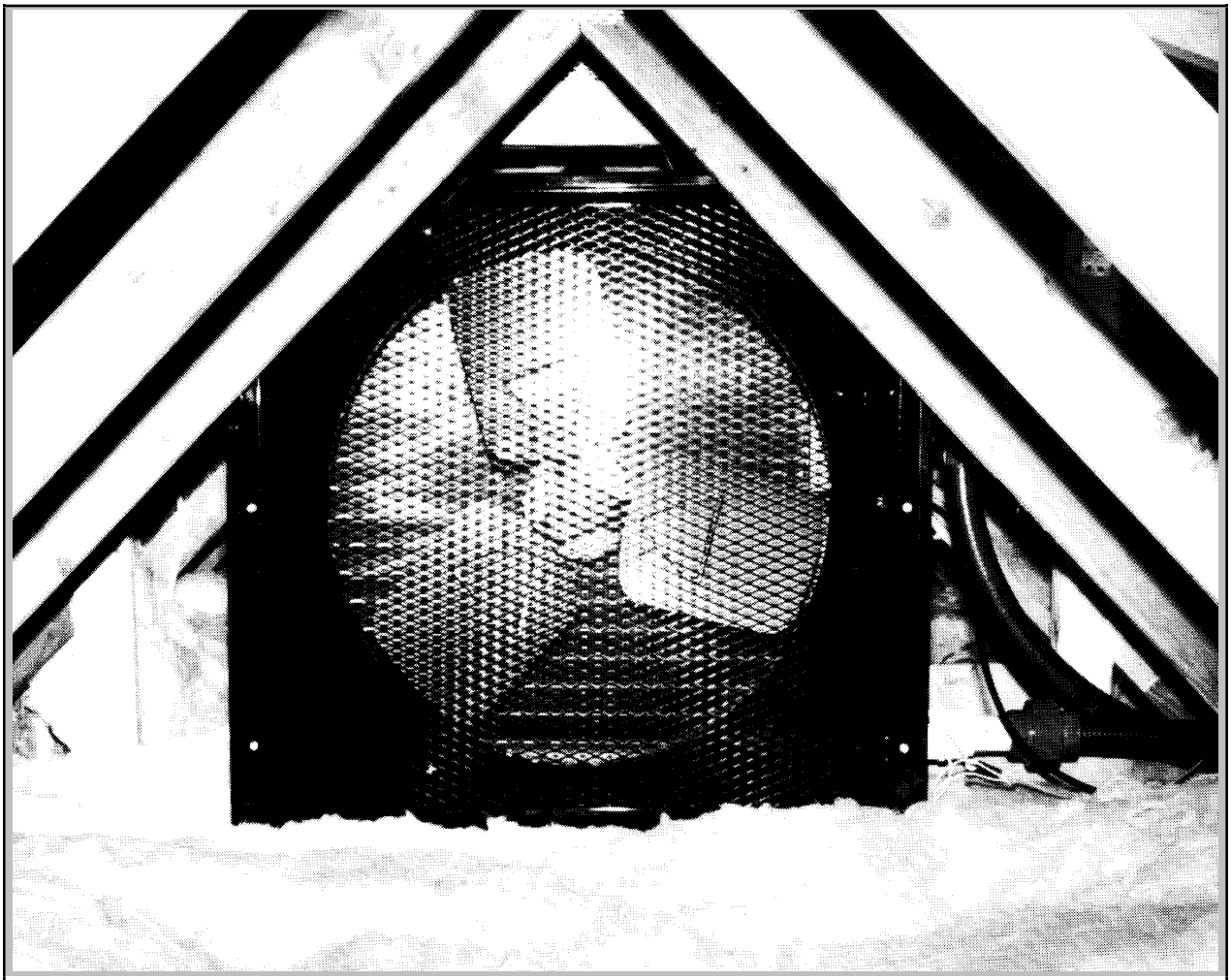
SolarAttic™
Pool Heater Manual



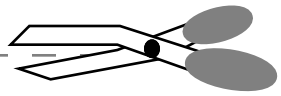
SOLAR Without PANELS

SolarAttic, Inc.
Elk River, Minnesota 55330

Date of last Revision: 12/10/96

Manual Updates

Version	Changes Made
6/15/93	Base date of manual. No changes in the period 6/15/93 - 1/3/94.
1/3/94	Updated Warranty information on Page S1-4. Changed all references of Attic Technology, Inc to the new company name of SolarAttic, Inc.
2/15/94	Converted document to M.S. Word 5.1 file from M.S. Word 4.0 and made minor format changes to this table. No other changes made.
5/9/94	Fixed some additional formatting problems that were discovered—a direct result of the file's conversion to MS Word 5.1. Several pages were affected with mis-tabulation, mis-pagination and other minor formatting issues. The technical and material content of the manual was not affected by the conversion process. Updated the service and weight caution paragraphs with minor changes to pages S1-9 &10. Added "location of temperature sensors" to page S1-11. Checked spelling and made some minor word corrections. Updated the table of contents.
2/27/95	Fixed additional pagination & formatting problems on several pages in four sections. Note: This is the second time and may be related to either the system 7.5 upgrade; fixed vs true-type scalable font conflicts; movements within the font folders; or, the page setup dialog settings. Minor updates or corrections to the manual were made on the following pages: S1-6, 10, 13; S3-5; S6-1. No substantive technical changes were made to the manual at this time. Checked spelling.
5/1/95	Updated Troubleshooting Guide to include Relay's Wing Nut.
3/28/96	Inserted PCS1 Photo & Specifications into pages 2 & 3 of section 1. Inserted BTU heat transfer graphs into page 7 of section 2. Inserted Equipment Pad plumbing photos into pages 19 & 20 of section 3. Inserted Attic Installation photos into pages 31 & 32 of section 3. Inserted PCS1 Auto+ System layout graphic on page 53 of section 3. Removed blank pages 54 & 55 of section 3. Added new page on bypass valve winterization caution to service section 4 (new page 5).
7/17/96	Added Plumbing Caution concerning the use of drain-waste fittings.
12/10/96	Added cover page inside document for www.solarattic.com pdf file Provided new web site address.



Valuable Coupon

The "SolarAttic™ Pool Heater Manual" is supplied free of charge to all purchasers of PCS1 Systems. If you purchased this manual separately, you can use this coupon to deduct the complete cost of your manual from any PCS1 System purchased. There is no time limit on this coupon. Record your manual purchase here.

Name: _____

*Address:*_____

*City, State, Zip:*_____

*Purchased From:*_____ *Date:*_____ *Amount Paid:* $ _____

SolarAttic, Inc.
Elk River, Minnesota 55330

NOTICE

This manual is a PCS1 reference guide. It is not designed to answer all of the technical questions that could arise. The manual illustrates one method of installing the PCS1. Technical issues that are common to all installations are discussed in length.

Each purchaser is solely responsible for the proper installation of the PCS1, which must comply with local, state and national building codes. Where those codes differ from the information contained herein, they supersede this information and should be used.

If any doubt exists about complying with building codes, the services of a competent and licensed building contractor, pool contractor, plumber or electrician should be enlisted.

SolarAttic, Inc. welcomes any feedback on this manual. If you experienced any difficulty in the installation of the PCS1, send photos and an explanation and we'll share the information and cover it in an updated version of this manual. If you found this manual to be especially helpful, in any way, we'd like to hear about that also. Send all comments or questions to:

SolarAttic, Inc.
15548 95th Circle NE
Elk River, MN 55330-7228

(763) 441-3440
(763) 441-7174 Fax

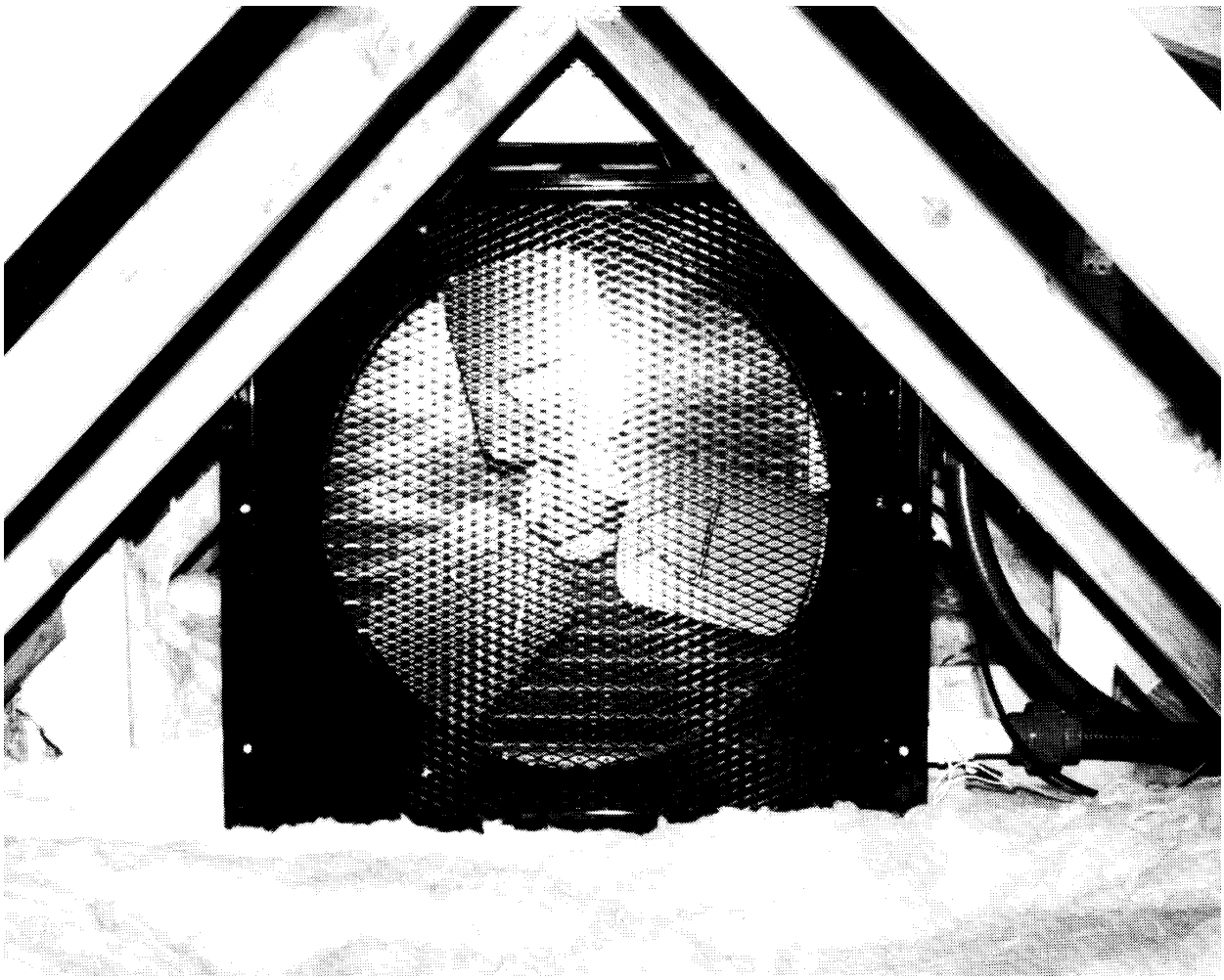
http://www.solarattic.com
Email: info@solarattic.com

Table of Contents

SECTION ONE

SYSTEM ARRIVAL

PCS1 Specifications



DESCRIPTION OF OPERATION: Solar radiation bombards the house's roof structure throughout the day. The roof functions as a "solar collector." Solar radiation reaches the attic through a process called "conduction." The attic functions as a storage and heat transfer area. The PCS1 is physically located inside the attic and then transfers this solar radiation from the attic air into the swimming pool's water through a process called "forced air convection."

FULL AUTOMATIC OPERATION: Is achieved with the optional LX220 control. When the attic is eight degrees hotter than the pool and the pool needs heat, the LX220 automatically routes water up to the PCS1 and turns it on. It can even synchronize the pool's pump by turning it on at the same time.

Temperature sensors sense the pool and attic temperatures. Maximum heat is then extracted automatically. The pool owner simply sets the desired thermostat setting on the LX220. Flowreversal™ can substantially reduce the pool's heat demand by allowing the heat to rise from the main drain. Flowreversal™ is a trademark of Mark Urban, Tustin, California. A pool blanket can be used when the pool is not in use thereby minimizing heat losses caused by evaporation (60%). Specifications are subject to change without notice.

Specifications

- Pool Sizes: Up to 1000 square feet or 35,000 gallons
- Up to 70,000 gallons with FlowReversal™ valves
- Nominal BTU Rating: 60,000 BTUs/hour @ D 32°F
  I.E. Pool water input 72°F & Attic's Peak @ 104°F
- BTU Transfer Range: 20-150,000 BTUs per hour
- Attic space required: 3 ft min height to peak; and,
  square ft of attic equal to or greater than pool sq ft
- Attic access: Fits through standard 24" o.c. trusses
- Minimum access opening recommended: 21"x 31"
- Can be disassembled for smaller access openings
- PCS1 Size: 33"W x 30"H x 20"D
- PCS1 Weight: 135 pounds
- Shipping Crate Size: 42"W x 38"H x 24"D
- Shipping/Crated Weight: 246-253 pounds
- Power: 220 vac 1.8 amps @ Full Load
- Operating Cost: $5-11 per month @ 9¢ per KW/hour
- U.L. Listed: Coil, Motor & other components
- Plumbing: 1 1/2" or 2" PVC typical
- Pressure Drop: 4-6 PSI typical
- Air Flow Rate: 2500 SCFM
- Water Flow Rate: Range 15-80 GPM
- Optimal Water Flow Rate: 45-55 GPM
- Modes: Manual Off & On
- Optional Automatic Operation: LX220 control

U. S. Patent 5,014,770

Limited Warranty

All PCS1 convection units are warranted to be free from defects in material and workmanship for a period of eighteen months from the date of shipment from the factory. This warranty covers all parts and labor to correct manufacturing defects, but does not cover incidental fin damage nor any corrosive damage to heat transfer coils caused by improperly maintained chemical Ph levels in pools. Ph levels outside of the 7.2 to 7.6 range void warranty. Use in salt water pools voids warranty.

Corrugated fins are used on the heat transfer coils for improved efficiency. They are waffled in appearance and not straight. Fin bending that has been combed with a fin tool does not affect performance and is not considered a manufacturing defect. Our obligation under this warranty is limited to the repair or replacement, at our factory, of any part or parts which, upon our examination, have proven to be defective. Correction of such defects by repair or replacement (at our option) and return freight via lowest common carrier, shall constitute fulfillment of SolarAttic, Inc.'s obligation to the purchaser.

This warranty does not apply to those products which, in our judgment, have been altered or repaired outside our factory, or subjected to misuse, negligence, accident, corrosive atmospheres, or operating beyond the limits of our design.

THIS WARRANTY CONSTITUTES THE BUYERS SOLE REMEDY. IT IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. WHERE CIRCUMSTANCES CAUSE REMEDY EXPRESSED HEREIN TO FAIL OF ITS ESSENTIAL PURPOSE, SOLARATTIC, INC'S LIABILITY SHALL NOT IN ANY EVENT EXCEED THE PURCHASE PRICE. IN NO EVENT, SHALL SOLARATTIC, INC BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, WHETHER THE THEORY BE BREACH OF THIS OR ANY OTHER WARRANTY, NEGLIGENCE, OR STRICTLY TORT. DISPUTES ARISING UNDER THIS AGREEMENT SHALL BE GOVERNED BY APPLICABLE MINNESOTA LAW.

PCS1 SERIAL NUMBER: _____

DATE SHIPPED FROM FACTORY: _____

SHIPPED TO: _____

_____

_____

INSTALLED: _____

_____

_____

DIALOG MANUAL

Thank you for your purchase! This manual is the PCS1 installation, technical support, and reference manual. It is not necessary that you read every page. Instead, you may wish to read only those sections that you are concerned about. The material provided in this manual is very detailed and is considered sufficient enough for the skilled or semi-skilled craftsman to install the PCS1 system.

This manual provides a "dialog" and discussion of the issues involved in the technical literature. The dialog covers areas that may not be readily apparent from the technical literature itself [drawings, diagrams, etc.].

This "dialog" or discussion type of manual can be contrasted to a "step by step" manual where all known installation factors are the same in every instance. In such a case, the installation manual could then take you from step A to step Z -- one step at a time. Due to the unlimited variations in swimming pools, their support systems, and the homes in which the PCS1 is installed -- a "step by step" manual is not feasible. This manual, therefore, explains all of the technical issues and provides the installer with a **general installation process** to follow.

Having explained the technical issues, the installer must then apply the general installation process to the specific pool and home involved. Do-it-yourselfers can install this product using this manual if they have the appropriate skills involved. These are primarily electrical and pvc plumbing skills. Again, since this is an "issues" and "dialog" manual, the do-it-yourselfer **must** also be able to apply the knowledge provided to the actual installation site.

CAUTIONS

The following pages are CAUTION notes designed to inform you of the existence of hazardous areas. They will help prevent personal injury and fatalities. They will also help prevent damage to equipment, swimming pool systems or to the house.

MAKE SURE YOU READ AND UNDERSTAND ALL OF THESE CAUTION NOTES!!!

CHILDREN CAUTION

SEVERAL SHARP EDGES ON THE PCS1 CAN CAUSE CUTS OR INJURIES. THIS IS NOT A PRODUCT THAT CHILDREN SHOULD BE ALLOWED TO TOUCH. THEIR NATURAL CURIOSITY CAN RESULT IN INJURY OR ACCIDENT. **KEEP ALL CHILDREN AWAY FROM THIS PRODUCT TO PREVENT INJURY OR ACCIDENTS**

ELECTRICAL CAUTION

DANGER: THIS PRODUCT USES 220 VAC AND CAN CAUSE A FATAL INJURY. THE MANUAL ASSUMES AN EXPERIENCED ELECTRICIAN IS BEING EMPLOYED. ALL ELECTRICAL WIRING MUST BE DONE IN ACCORDANCE WITH APPLICABLE CODES.

PLUMBING CAUTION

THIS PRODUCT REQUIRES PVC CEMENT WELDING AND THE MANUAL ASSUMES AN EXPERIENCED PLUMBER IS BEING EMPLOYED. DO NOT ACCEPT ANY LEAKING PVC JOINTS. DO NOT "LEARN" PVC CEMENT WELDING ON THE EXPENSIVE POOL VALVES PURCHASED. DAMAGE TO THE VALVES FROM POOR PVC WELDING IS NOT COVERED BY THE MANUFACTURERS WARRANTY. ASSEMBLE THE VALVES AND PIPES BEFORE WELDING TO MAKE SURE THEY FIT PROPERLY. THIS IS CALLED A PRACTICE RUN BEFORE ACTUAL PVC CEMENT WELDING OCCURS AND INSURES YOUR PARTS ARE READY FOR PERMANENT CEMENTING.

PLUMBING CAUTION

DO NOT USE DRAIN-WASTE (HOUSE SINK OR DRAIN) PVC FITTINGS (45° OR 90° ELBOWS, STRAIGHT SXS FITTINGS, ETC.) ON YOUR POOL'S SUPPORT SYSTEM RE-ASSEMBLY. **USE SCHEDULE 40 PVC FITTINGS**. THE DRAIN-WASTE PVC FITTINGS DO NOT HAVE THE SAME DEPTH OF PVC PIPE PENETRATION WHICH COULD RESULT IN THE POOL'S PVC PIPE POPPING AWAY FROM THE SHORTER DRAIN-WASTE PVC FITTING (ELBOW, ETC.).

FIN CAUTION

THE FINS ON THE PCS1 COIL ARE SHARP AND CAN CAUSE A RAZOR-LIKE CUT IF YOUR HAND OR ARM COME INTO CONTACT WITH THEM. TAKE APPROPRIATE CARE DURING INSTALLATION AND DO NOT COME INTO DIRECT CONTACT WITH THE FINS OF THE COIL. IF THE COIL FINS ARE ACCIDENTALLY DAMAGED, THEY CAN BE "COMBED" STRAIGHT WITH A FIN COMB [10 FINS PER INCH].

GRILLE CAUTION

THE PROTECTIVE GRILLE HAS SHARP EDGES WHICH CAN CUT YOUR FINGER OR HANDS. EXERCISE CAUTION WHEN HANDLING, REMOVING OR INSTALLING THIS GRILLE.

FAN CAUTION

DO NOT OPERATE THE PCS1 WITH THE FAN GUARD PROTECTIVE GRILLE REMOVED. THE PROTECTIVE GRILLE IS TO PREVENT HARM WHILE THE FAN IS OPERATING. UNPLUG THE CONVECTION UNIT [PCS1] DURING SERVICE AND ENSURE THAT THE FAN BLADE HAS STOPPED ROTATING. IF THE FAN BLADE HAS BEEN CHANGED, ENSURE THAT THE NEW BLADE IS TORQUED DOWN TO 120 INCH POUNDS AND THAT LOCTITE HAS BEEN APPLIED TO THE THREADS OF THE LOCKING SCREW.

MOTOR CAUTION

DO NOT OPERATE THE MOTOR FOR AN EXTENDED TIME WITHOUT THE FAN BLADE ATTACHED. THE MOTOR IS A "TOTALLY ENCLOSED AIR OVER" MOTOR [TEAO] AND THE AIR FLOW OVER THE MOTOR FROM THE FAN BLADE PROVIDES COOLING FOR THE MOTOR. OPERATING THE MOTOR WITHOUT THE FAN BLADE ATTACHED WILL LEAD TO THE MOTOR OVER HEATING AND A THERMAL CUTOFF OF THE MOTOR [INTERNALLY].

TEKS SCREW CAUTION

DO NOT REPLACE ANY SELF TAPPING #10-1/2 **TEKS** SCREW **USED ON THE PCS1 REAR COIL SIDE** WITH ANY SHEET METAL SCREW GREATER THAN ONE-HALF INCH (1/2") IN LENGTH. DOING SO CAN DAMAGE THE PCS1 WATER COIL BY PUNCTURING ONE OF THE COIL'S WATER PIPES OR MANIFOLDS.

WEIGHT CAUTION

THE PCS1 WEIGHS 240-253 LBS CRATED AND 135 LBS UNCRATED. IN ADDITION, THE UNIT IS BULKY. CAUTION SHOULD BE TAKEN WHEN LIFTING THE UNIT SO AS NOT TO TWIST FROM THE WAIST OR TO PLACE A BURDEN ON THE LOW BACK. NO ATTEMPT SHOULD BE MADE TO LIFT THE UNIT ALONE. TWO OR MORE MEN SHOULD BE PRESENT. ATTEMPTING TO LIFT OR HANDLE THE PCS1 ALONE CAN LEAD TO PHYSICAL INJURY.

POOL CHEMISTRY CAUTION

AN IMPROPERLY MAINTAINED POOL WILL TURN ACIDIC VERY FAST AND DAMAGE ALL OF THE POOL'S SUPPORT EQUIPMENT INCLUDING THIS HEATER. MAINTENANCE OF POOL WATER CHEMISTRY IS A SERIOUS RESPONSIBILITY OF OWNING A SWIMMING POOL. NOTE: IF YOUR POOL WATER IS CRYSTAL CLEAR, DRINKABLE AND DOES NOT SMELL OF CHLORINE -- YOU HAVE THE RIGHT POOL CHEMISTRY. CHECK WITH YOUR LOCAL CHEMICAL DEALER IF YOUR POOL DOES NOT HAVE THESE ATTRIBUTES!

BUILDING CODE CAUTION

INSTALL ALL EQUIPMENT IN ACCORDANCE WITH LOCAL, STATE AND NATIONAL CODES TO PREVENT INJURY, FATALITIES OR DAMAGE TO EQUIPMENT.

SERVICE CAUTION

UNPLUG THE PCS1 BEFORE ATTEMPTING ANY SERVICE! SERVICE SHOULD NOT BE ATTEMPTED BY AN INEXPERIENCED TECHNICIAN WITHOUT FIRST READING THIS ENTIRE MANUAL!

SERVICE CAUTION

DO NOT CREATE A SITUATION THAT WOULD ALLOW POOL WATER TO BE INADVERTENTLY ROUTED TO DISCONNECTED ATTIC PIPES. IF THE PCS1 IS DISCONNECTED FROM THE ATTIC PIPES, DISCONNECT THE PUMP AND REMOVE THE VALVE CONTROLS AND HANDLES DURING SERVICE. OR RECONNECT A BYPASS PIPE IN PLACE OF THE PCS1 DURING ITS REMOVAL.

FACTORY SHIPMENT

BOXES SHIPPED

The PCS1 convection unit is shipped in a custom designed crate. It is shown on the page after next. When ordered with the PCS1, the LX220 solar controller and valve(s) are packed inside the crate to the right of the PCS1. On occasion, the controller and valve(s) **MAY** be shipped separately in one or more additional boxes. All of these boxes would then be identified separately on the shipping manifest. If more than one box [including crate] is shipped, each will be identified by a number within a total number. For example: 1 of 2; 2 of 2; etc. In this way, you will know if you have received all of the boxes that are a part of your shipment. In the preceding example, **2** boxes should have been received.

LOCATION OF SENSORS

Both the water and attic temperature sensors are located inside the LX220 solar controller behind the front panel. See page S3-49 drawing. Using a phillips screwdriver, unlock the front panel door and open the hinged panel. Both sensors are located in the lower (high voltage) compartment near the "grounding bar." See page S3-51 for a drawing of the LX220's internal compartments.

SHORTAGE CLAIM

IF YOU HAVE NOT RECEIVED ALL OF THE BOXES IDENTIFIED BY THE TOTAL NUMBER -- WRITE THIS DIRECTLY ON THE MANIFEST AS A SHORTAGE!! IDENTIFY WHICH BOX OR EQUIPMENT WAS NOT RECEIVED. DO NOT ALLOW THIS SHORTAGE TO GO UNDOCUMENTED. YOU HAVE TO FILE A CLAIM WITH THE SHIPPER -- IMMEDIATELY -- [AT THE TIME OF RECEIPT] IF ALL OF THE BOXES DID NOT ARRIVE. UNDER THE FACTORIES SHIPPING TERMS OF FOB, YOU OWN TITLE TO THE EQUIPMENT WHEN THE FACTORY PLACES THE EQUIPMENT ON THE CARRIER. IN OTHER WORDS, WHEN THE EQUIPMENT LEAVES THE FACTORIES DOCK -- YOU OWN IT. A SHORTAGE MEANS YOUR PROPERTY HAS BEEN LOST BY THE CARRIER. THE CARRIER MUST EITHER FIND IT OR PAY FOR IT.

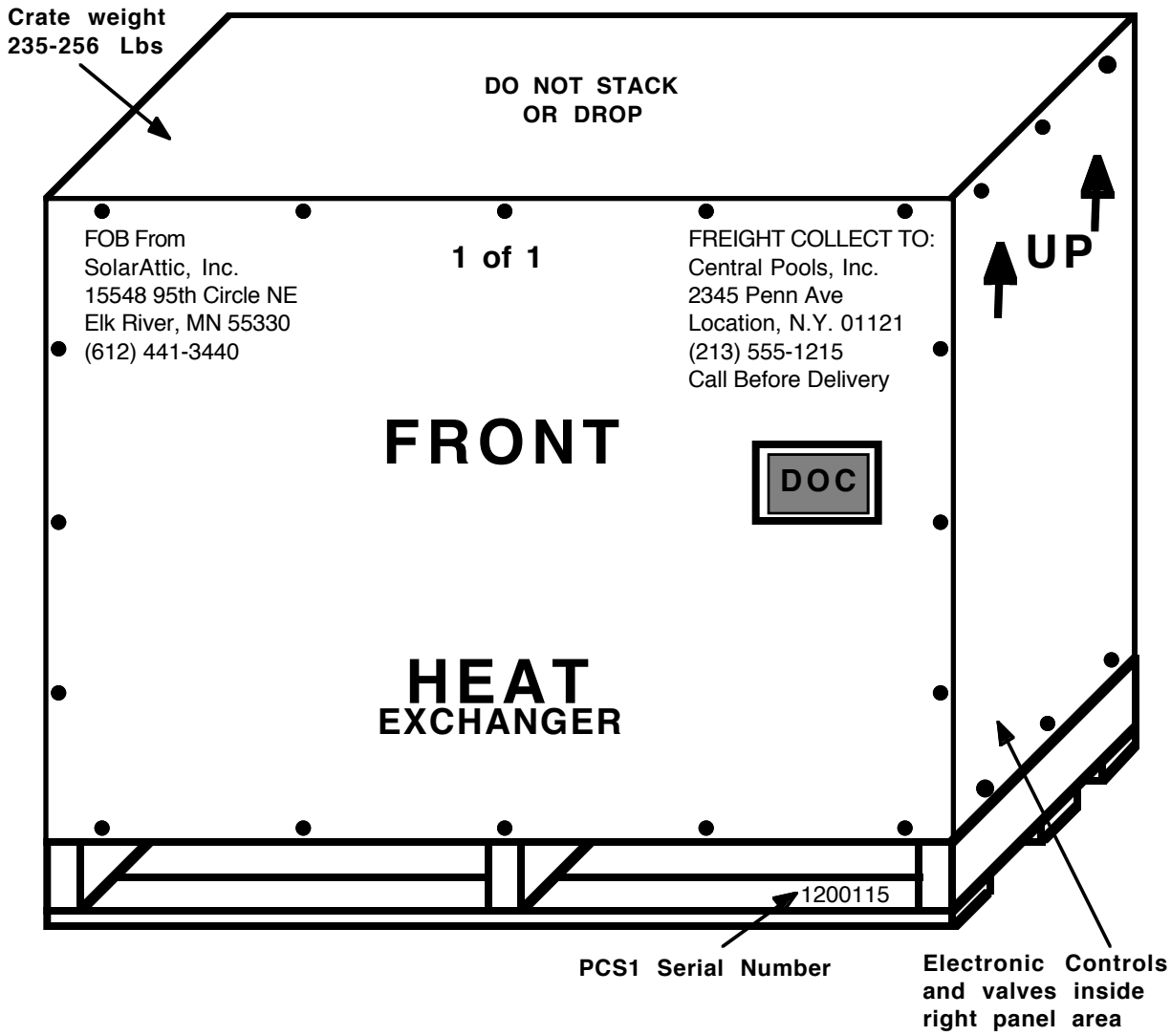
DAMAGED EQUIPMENT

THE EQUIPMENT LEFT THE FACTORY INTACT. IF IT IS RECEIVED IN A DAMAGED CONDITION, THE CARRIER MUST PAY FOR THE DAMAGE. FILE A CLAIM -- IMMEDIATELY -- IF THE EQUIPMENT IS RECEIVED IN A DAMAGED CONDITION. THIS INCLUDES INTERNAL DAMAGES!! USUALLY, IF THERE IS NO EXTERNAL DAMAGE -- THERE PROBABLY IS NO INTERNAL DAMAGE. HOWEVER, THIS IS NOT ALWAYS THE CASE. IF THE EQUIPMENT HAS BEEN DROPPED FROM A FORKLIFT, FOR EXAMPLE, INTERNAL DAMAGE COULD OCCUR WITHOUT EXTERNAL DAMAGE BEING APPARENT. IF YOU ACCEPT DELIVERY WITHOUT OPENING AND INSPECTING THE PARTS AND FIND DAMAGED GOODS INSIDE -- CALL THE CARRIER UP IMMEDIATELY AND FILE A DAMAGE CLAIM. THE CARRIER WILL WANT TO COME OUT AND INSPECT THE GOODS. DO NOT CONTINUE UNPACKING WHEN DAMAGE IS FOUND.

VISIBLE EXTERNAL DAMAGE

IF A CORNER OF A CRATE OR BOX IS CRUNCHED INWARD, THIS MEANS THAT THE BOX HAS BEEN DROPPED OR THROWN ONTO ITS CORNER. THE RESULT COULD BE INTERNAL DAMAGE TO THE PARTS DUE TO CARRIER MISHANDLING ALONG THE SHIPPING ROUTE. IF THERE ARE ANY SIGNS OF EXTERNAL DAMAGE TO THE BOXES, MAKE A NOTE OF THIS ON THE CARRIERS DELIVERY MANIFEST. IF POSSIBLE, INSPECT THE SHIPMENT INTERNALLY WHILE THE DELIVERY PERSON IS STILL PRESENT. THIS WILL HELP PREVENT ANY CLAIMS CONFLICT WITH THE CARRIER SHOULD DAMAGE BE FOUND.

PCS1 SHIPPING CRATE



DAMAGE INSPECTION

EXTERNAL INSPECTION

1. Inspect all sides of the shipping crate for any sign of damage. No external damage should be visible. Be sure to inspect the bottom of the shipping crate!

2. Make note of any visible external damage on the shipping manifest to document a potential claim against the carrier. If possible, when you find external damage, make an internal inspection of the goods in the presence of the delivery person. NOTE: Do not sign the receipt of the goods [manifest] until you are satisfied you have received the goods intact [undamaged] and/or have documented **ON** the manifest any claims you may have against the carrier.

3. File a claim with the carrier, immediately, if any internal damage to the equipment is found.

INTERNAL INSPECTION

1. Remove the front plywood panel of the crate.
2. Remove the front foam insert.
3. Carefully rip open the plastic bag covering the PCS1.
4. Inspect to see that the motor is still in place and attached to the motor arms.
5. Inspect to see that the motor arms are still in place and attached to the venturi.
6. Inspect to see that no damage to the coil fins has occurred from shipping. NOTE: internal damage caused by dropping the crate could sever one or more motor mounting brackets which would free the motor and could cause fin damage and damage to the fan blade, etc.
7. Verify the fan blade is free to rotate in the venturi and is not obstructed.
8. Remove the right panel to inspect the electronic control and valve(s).
9. Remove the rear panel to inspect the coil's pipe threads and fins if desired.

REUSE SHIPPING MATERIALS

The shipping materials can be reused in the installation of the PCS1. The plywood can be used as a base in which the PCS1 can rest on and the foam can be used under the PCS1 to dampen any vibration present from the PCS1. NOTE: a small amount of vibration is normal from the PCS1 convection unit. Use of one or more layers of foam under the PCS1 dampens this small vibration and prevents it from radiating into and along rigid structures. The plywood can be further used in the reframing of an attic access opening. Other uses of the crate materials become obvious depending upon site conditions.

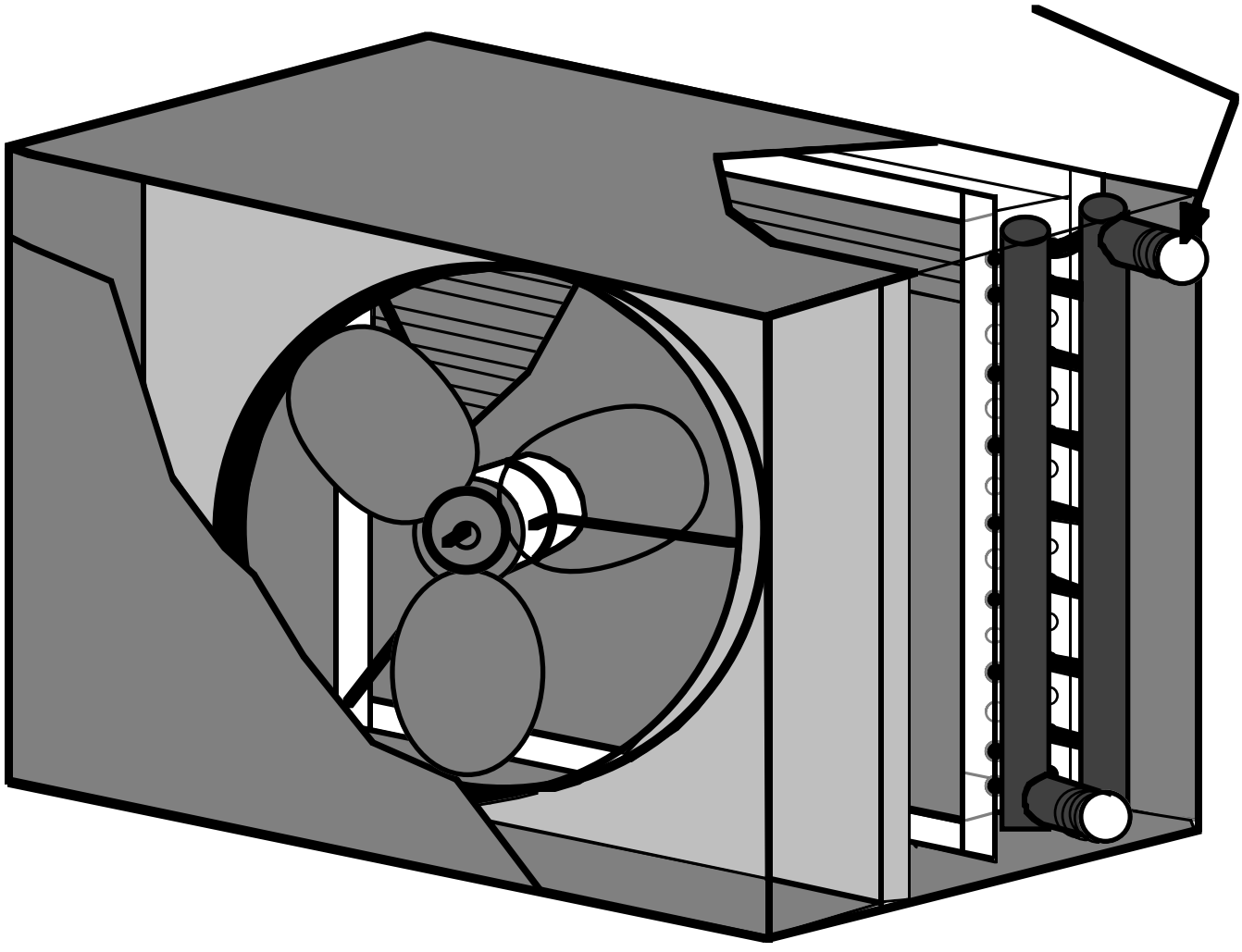
PCS1 SERIAL NUMBER

Each PCS1 is given a seven digit serial number which is inscribed onto the top inlet manifold pipe.

SEVEN DIGIT SERIAL NUMBER

EXAMPLE: 0380105

Scribed on top of coil Intake Manifold.



SECTION TWO

HEATING DATA

PCS1 SOLAR THEORY

1. Solar heat energy radiates onto roof

2. Roof is a massive solar collector

3. Roof absorbs solar heat energy

4. Roof conducts heat energy into attic

5. Attic stores/builds up heat energy

6. PCS1 removes heat from attic

7. PCS1 transfers heat to pool

8. Solar process is continuous

PCS1 SOLAR HEATING

Solar heating depends upon weather conditions. The more sunny it is, the more solar radiation and the more resultant heat that is available for your swimming pool. Conventional heaters are sized to achieve a substantial gain in pool temperature of 10-30° F in a 24 hour period. It is therefore typical to find conventional fossil fuel swimming pool heaters with ratings of 150,000 to 300,000 btus per hour.

Solar heaters do not attempt to raise the pool's temperature by that large a change in a single 24 hour period. A more likely scenario is that it will take two weeks for your solar heater to raise your pool temperature to the desired level. Once this is reach, the solar heater works daily to maintain the temperature by replacing the lost heat with new solar derived heat.

The difference in heating techniques can be thought of as pulse heating and constant heating. Solar heaters are constant heaters and are therefore rated lower. Typical ratings of solar heaters are from 35,000 to 60,000 btus per hour for residential swimming pools. Heat pumps for swimming pools are rated similar to solar heaters and are also designed to provide a continuous supply of heat to the pool.

The PCS1 behaves just like a solar panel system in that it will bring the pool up to temperature over a two week period and then work to keep it there. Obviously, if you have poor weather, the performance of the PCS1, like solar panel heaters, will be poorer than if you have good sunny weather. Other factors will influence the availability of pool heat and these are described later in the "Common Questions" section of the manual. This would include color of roof, etc.

EMPIRICAL TRACKING

The data supplied below is an example of the PCS1's actual performance near Jacksonville, Florida during 1989. It can be observed that the PCS1 raised the pool's temperature from 3 to 8° F in a single day. A more typical rise in the pool's temperature is 1 to 2° F per day. Thus, over the course of two weeks, the pool is raised to the desired swimming temperature. The pool in the example below used a pool blanket during periods of extended non use.

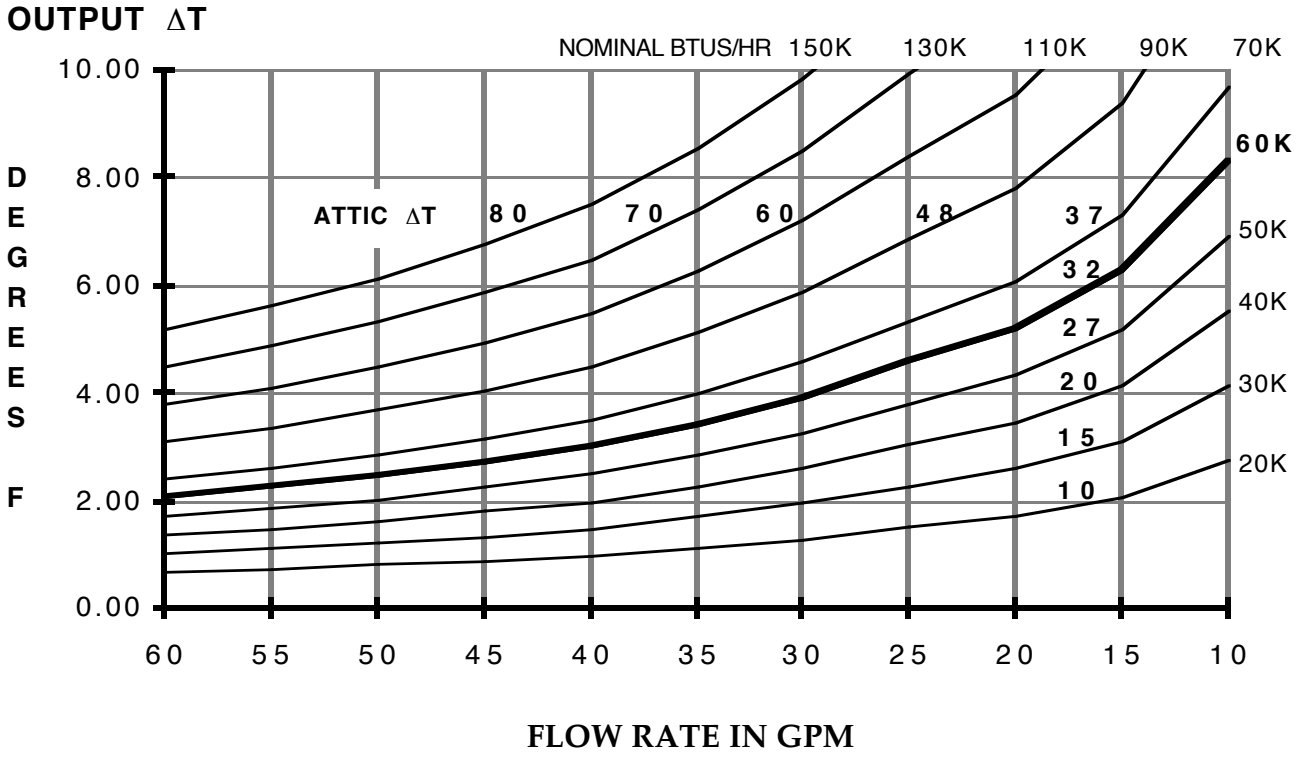
The format provided below is a good one to use for determining the overall performance of the PCS1 in your own installation. Take the temperature readings at the same time each morning [7-9 a.m.] and each afternoon [4-6 p.m.].

EMPIRICAL DATA

Date	Air Temp	Conditions	Pool °F a.m.	Pool °F p.m.	°F Gained
4/19	87	Sunny	82	87	5
4/20	80	Overcast	85	88	3
4/21	74	Cloudy	---	86	---
4/22	83	Sunny	83	88	5
4/23	85	Sunny	86	91	5
4/24	88	Sunny	87	92	5
4/25	90	Sunny	89	94	5
4/26	90	Sunny	90	98	8
4/27	90	Sunny	96	stopped heat	
5/2	84	Sunny	84	90	6
5/2	80	Sunny	86	91	5

What is the PCS1 capable of doing? The following curves show designed verified performance. The performance curves assume constant temperature differentials. In reality, the temperature differentials will vary somewhat throughout the course of the solar heating day.

PCS1 Operating Curves



These operating curves show the heat transfer range of the PCS1. By knowing the flow rate in gallons per minute, the attic's temperature and the pool's temperature -- both the BTU hourly rate of heat transfer and the output rise in degrees Fahrenheit from the PCS1 can be accurately predicted.

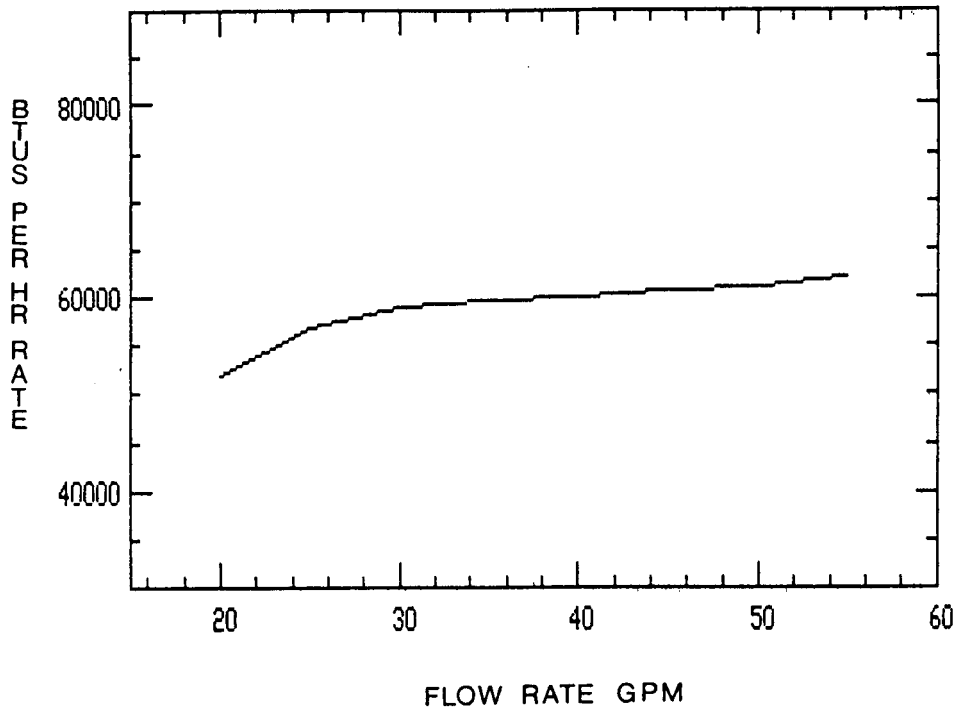
Example: If the flow rate is 30 gpm and the temperature differential between the attic and the swimming pool is 32° F, the output rise will be approximately 4° F [PCS1 output temperature minus input temperature]. This can be found by simply locating the flow rate on the horizontal scale and going up vertically on the graph until you find the curve with the correct temperature differential between the attic

and the pool. This is the attic temperature minus the swimming pool temperature. Then, simply draw a horizontal line to the left scale from the curve and read the output rise in °F. An example of a 32° F temperature differential is an attic at 110° F and a swimming pool at 78° F.

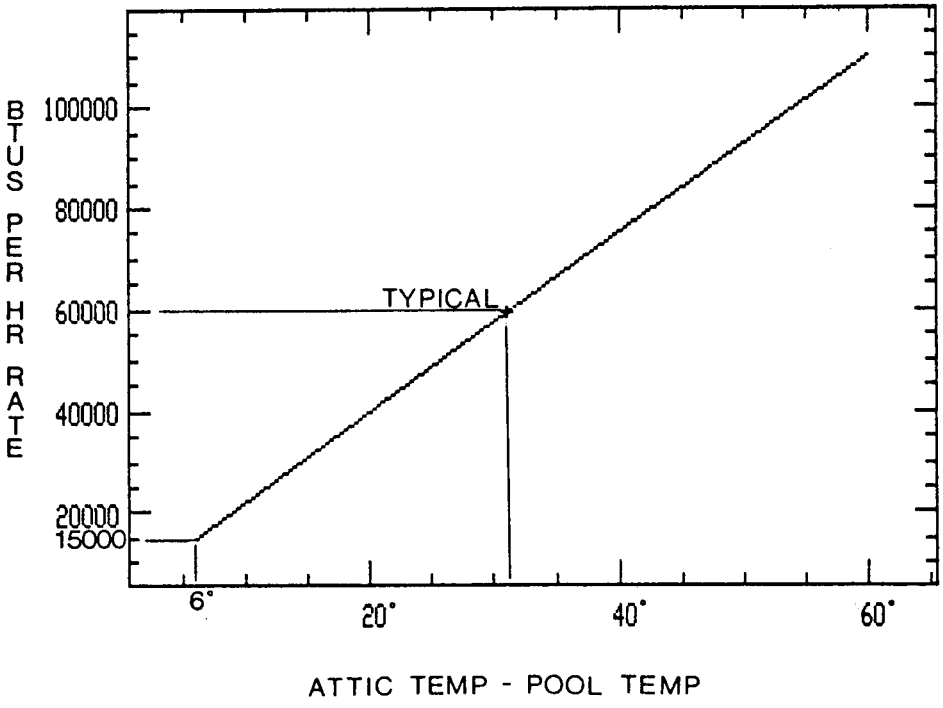
Observe that as flow rate decreases for a given and constant temperature differential that the output in ° F will increase. Conversely, as flow rate increases, output temperature in ° F will decrease. The amount of heat transfer, however, is the same in both instances as long as the temperature differential remains constant and is governed by the formula **BTUS = 500 x ΔT x GPM**. The constant 500 is derived from the weight of water at 8.34 pounds per gallon times the factor 60 used to convert the heat transfer to an hourly rate.

Observe also that as the temperature differential increases between the attic and the pool, that the rate of heat transfer also increases. The attic temperature should be measured inside the attic at or near its peak. Once operating, the PCS1 will stratify the attic with lower temperatures at the attic floor and higher temperatures at its peak. The PCS1 will simply take the solar radiation off the inside of the roof at the same time it emanates into the attic. The roof will function as a massive solar panel!

BTUS Vs GPM



BTUS Vs ΔT



POOL HEATERS

Many different types of swimming pool heaters are available. Most heaters currently on the market burn fossil fuels. While gas heaters can be purchased and installed at a lower price than the PCS1, they quickly make up the difference in cost in the form of "energy consumed". Gas heaters represent the majority of the heaters sold today and typically will cost $150.00 or more per month to operate. The PCS1, in contrast, burns no fossil fuels and only costs an estimated $10.00 per month to operate.

All solar systems use renewable energy and are very efficient when heating swimming pools. Depending upon location, a solar system may provide 100% of the energy to heat your pool or may require some form of backup heater. The PCS1 follows the same rules as conventional solar panel systems. So, what is the difference then? The difference is the panels. The PCS1 provides solar heating without having to use roof mounted panels. This is a major advancement in solar heating technology!

The following pages highlight some of the problems associated with solar panels, gas heaters, and heat pumps. Additional discussions of pool heaters are contained in the special reports "How To Calculate Pool Heating Costs", "How To Create An Energy Efficient Pool" and "How To Understand Pool Heat Pumps" which are available directly from SolarAttic, Inc.

BACKUP HEATER USE

A backup heater may be desired in certain areas to further extend the swimming season. Check with your local solar dealer to find out how long the swimming season is with a solar panel system. The PCS1 will have a similar length. Make sure you have an efficient pool; use the PCS1 solar heater; and, use a pool blanket judiciously. If, after using these techniques, your season is not as long as you would like -- then install a backup heater.

Solar Panel Problems

The following problems can occur with **solar panels**:

1 Massive roof installations
2 Roof rotting
3 Deterioration of panels
4 Plugged panel orifices
5 Vandal damage
6 Large surface areas
7 Orientation towards sun
8 Wind damage
9 Glazing of panels
10 Glass breakage
11 Glass cracking
12 Rubber breakage
13 Rubber cracking
14 Leaking panel joint
15 Poorly assembled joints
16 Glue problems
17 Vacuum problems
18 Water leveling problems
19 Pressure problems
20 Flow rate problems
21 Unsightly installations
22 Obtrusive installation
23 Restrictive covenants
24 Panel shifting
25 Roof facing wrong direction

Gas Heater Problems

The following problems can occur with **gas heaters:**

1 Fouling of the air quality
2 Contributing to the "Greenhouse Effect"
3 High monthly fuel costs
4 Shortages of fuel
5 Fuel leakage
6 Runaway operating costs
7 Restrictive energy use laws
8 Flow rate problems
9 Fire problems
10 Copper heat sinks
11 Pressure regulator problems
12 Flue gas problems
13 Flow bypass problems
14 Gas piping problems
15 Gas valve problems
16 Fuel storage problems
17 Flow setting adjustments
18 Flow meter problems
19 Pressure problems
20 Flow rate problems
21 Unsightly installations
22 Obtrusive installation
23 Internal High Voltage wiring
24 Pilot lights
25 Flame exposed heat exchanger

Heat Pump Problems

The following problems can occur with **heat pumps**

1 Fouling of the air quality
2 Contributing to the "Ozone problem"
3 Questionable fuel savings
4 Shortages of maintenance CFC chemicals
5 CFC chemical leakage
6 Compressor problems
7 Restrictive energy use laws
8 Flow rate problems
9 Large current requirements
10 High circuit exposure to pool water
11 Pressure regulator problems
12 Internal pressure problems
13 Flow bypass problems
14 Internal temperature problems
15 Recharging problems
16 High recharging costs
17 Excessive moving parts
18 Refrigerant disposal restrictions
19 Pressure problems
20 Flow rate problems
21 Short design life
22 Obtrusive installation
23 Internal High Voltage wiring
24 Limited C.O.P. of 4 to 6
25 Planned extinction of products using CFC 12 or CFC 22

VENTILATION

Attics get very hot. In some cases, attics get extremely hot. All of this occurs because of solar radiation. Homeowners have taken extraordinary steps to cool down their attics. These steps have included wind driven turbines, roof mounted power driven turbines, whole house ventilating fans mounted in the attic and numerous other devices. Creative designs and modifications of houses have produced cooler attics in certain instances.

Required passive ventilation needs [for moisture purposes] use the rule of thumb of 1 square foot for every 350 sq ft of attic space when a poor vapor barrier is present on the ceiling of the home. When a good vapor barrier is present, as in new home construction, the rule of thumb is 1 square foot for every 700 sq ft of attic space. Any ventilation over this amount is "additional" and is added for "cooling" purposes.

Altering a "cooled-down" attic is simple. Just turn off the wind ventilators, power ventilators and plug up some of the added ventilation holes. Ventilation can be reduced down to 1 square foot for every 350 sq ft of attic space without much concern.

Certain types of passive ventilation can actually improve the heat transfer characteristics of the PCS1. We know that the PCS1 works fine with twice the passive ventilation that a home was designed with 15 or more years ago. We know that newer homes are being built today with more passive ventilation. We also know that power ventilators and wind turbines take out too much heat. The ideal ventilation for the PCS1 has not been fully defined by research yet.

SECTION THREE

INSTALLATION

Before Installing Your System
Some simple dos and don'ts!

1. Heat rises even in a hot attic. Locate the PCS1 as high in the attic as is practical.

2. Airflow through the PCS1 is important. Do not obstruct air going in or out of the unit.

3. Recirculating air in the attic works well for heat transfer. Locate the PCS1 within the middle 1/3 of the attic. Do not locate near an end wall.

4. Heat is drawn into the coil and cooler air is discharged from the fan. If the PCS1 is located slightly off center along the attic ridge, make sure the coil side of the unit is facing the larger portion of the attic.

5. Suspending the PCS1 supporting platform using chains will minimize noise amplification caused by wood trusses. Therefore, do not rigid mount the PCS1 to the roof structure in areas where noise is a concern.

6. The attic sensor can be cooled by the air discharge of the PCS1. Locate the attic sensor at the peak of the attic and out of the airflow of the unit.

7. The pool water sensor can be influenced by the sun and rain. Shelter the pool water sensor as much as is possible. It can even be insulated if necessary with fiberglass or other materials.

8. The ground can “SINK” heat away from pipes going to and from the PCS1. INSULATE OR WRAP ALL UNDERGROUND PIPES SO DIRT (GROUND) DOES NOT CONTACT THE PIPES DIRECTLY.

9. Do not over tighten the wing nut on the relay for the Auto or Auto Plus systems. It can cause the relay to malfunction.

10. The mechanical stress caused by unsupported pipes can crack glued pvc joints. Support all pipes in and outside of the attic with straps or C-clamps that keep the weight of the pipes off of all joints and union connections.

INSTALLATION PROCESS

[BASIC]

1. Retrofit support system with new valves
2. Install the PCS1
3. Automate the PCS1

The installation discussions that follow will amplify this basic installation process and provide plumbing and electrical details. **NOTICE**: It may be necessary to modify the diagrams supplied depending upon local installation requirements including code restrictions. The installer is responsible for making these determinations. The most difficult part of the installation is the first step -- retrofitting the pool's support system.

Suggested Tool Lists

INSTALLATION TOOLS

Cable Hoist/Puller tool (used to raise PCS1 into attic)
Reciprocating Saw (used to enlarge a closet access to attic space)
Circular Saw
Hacksaw
Hammer
PVC pipe cutting tool (otherwise use hacksaw)
Screwdriver(s)
Ladder(s)
Flashlight
Other forms of lighting (for use in attic)
Wire brush (cleaning manifold pipe threads if needed)
Other tools as dictated by the installation

SERVICE TOOLS

Electric Screwdriver
Fin Comb Tool for straightening out bent fins
[Watsco Part No P-8 or equivalent for a 10 fin per inch coil]
Torque Wrench
[For re-torquing fan bolt to 150 in lbs if removed]
Loctite
[For re-loctiting fan bolt if removed]
Standard medium flat blade hand screwdriver [1/4″ blade width]
[For 10-24 x 1/2″ Float bracket screws on venturi]
[For 10-24 x 1/2″ Capacitor bracket screws on venturi]
5/16″ Socket or spin nut driver
[For cabinet sheet metal screws]
5/16″ Box & open end wrench
[For Fan blade bolt]
3/8″ Box & open end wrench
[For 10-24″ Nut on float bracket & capacitor bracket nuts]
1/2″ Box & open end wrench
[For Float removal from float bracket]
[For Motor band mounting bolt]
[For Motor arm to venturi mounting bolt nuts]
9/16″ Box & open end wrench
[For Motor band mounting bolt nut]

SERVICE NOTE: Replace any worn or loose 5/16″ Hex head #**10** x 1/2″ sheet metal screw with a 5/16″ Hex head #**12** x 1/2″ sheet metal screw. This is a common hardware store item. A #10 screw can become loose with repeated removal.

Suggested Materials

PVC CEMENT

- Weld On P-70-C (Primer)
- Weld On 705 (Rigid PVC Cement)
- Weld On 795 (Flexible PVC Cement)

CAUTION: Do not use old pvc pipe cement or primer as poor weld joints could occur. Do not use rigid pipe cement on flexible pvc pipe as poor weld joints could occur.

PVC

- 50 feet of **flexible** 1 1/2" or 2" pvc pipe (for use in the attic)
- 60 feet of 1 1/2" rigid pvc pipe (supplied in 8 or 10 foot lengths)
- 10 feet of 2" rigid pvc pipe (for ease of valve installations)
- (2) PVC Unions (to be used with the PCS1 inlet and outlet manifolds)
- Check Valve (for use on PCS1 return line at support system)
- PVC pipe 90° Elbows, 2"- 1 1/2" Reducing Bushings, Straight SXS Couplings, etc.
- Emery cloth (for roughing up pvc pipe surface area prior to priming & cementing)

NOTE: Flex pvc **does** come in 2 inch or 1 1/2 inch size. Actual length of pipe needs will depend on each individual installation. Also pvc pipe fittings such as reducing bushings, tees, 45° elbows, 90° elbows and straight couplings will be required. These fittings are supplied as either SXS which means slip [cement-type] fittings on each end or in combinations with nominal pipe threads at either or both ends [male or female pipe threads].

OTHER MATERIALS

- 220 vac 20 amp Outlet & Box: Leviton #5821 or equivalent [PCS1 simply plugs in]
- 22 gauge wire for attic thermistor [temperature sensor]
- Silicone Sealant (for use on PCS1 manifold pipe threads)
- misc electrical materials
- misc plumbing materials
- misc construction materials (hinges, etc.)

NOTE: *Actual materials to be used on a particular installation depend upon the installation site and the choices made between various material options. These choices are sometimes dictated by local codes. For example, copper pipe is required for use within the attic in some California communities.*

PCS1 PARTS LIST

PART#	DESCRIPTION OF PART
11001	Cabinet Top Panel
11002	Cabinet Base Pan
11003	Cabinet Right Panel [facing fan blade]
11004	Cabinet Left Panel
11005	Venturi
11006	Front Protective Grille
11007	Grille mounting brackets (2 on each grille)
11008	Heat transfer COIL assembly
11009	Motor
11010	Motor Mounting Collar
11011	Motor Mounting Arm (3 on each motor)
11012	Motor Starting Capacitor
11013	Capacitor mounting bracket
11014	Capacitor rubber shield
11015	Fan Blade
11016	Internal Leak Float - Low Level
11017	Float Bracket

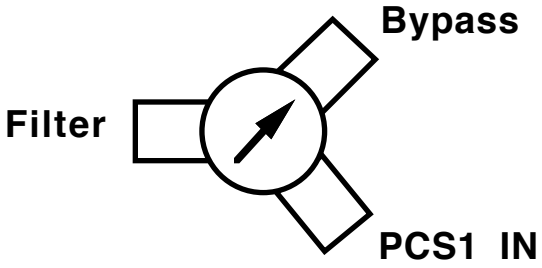
Miscellaneous Hardware

#12 x 1/2" Sheet Metal Screw with 5/16" slotted hex head
#10 x 1/2" TEKS self tapping screw with 5/16" hex head
5/16-18 x 1 1/2" Hex machine bolt
5/16-18 Square nut; 5/16 Split lock washer
10-24 x 1/2" Round head slotted machine screw; 10-24 Nuts; 10-24 Washers
5/16-18 x 1" Carriage bolts; 5/16-18 Hex nuts; 3/8 & 5/16 Washers

Description of Valves

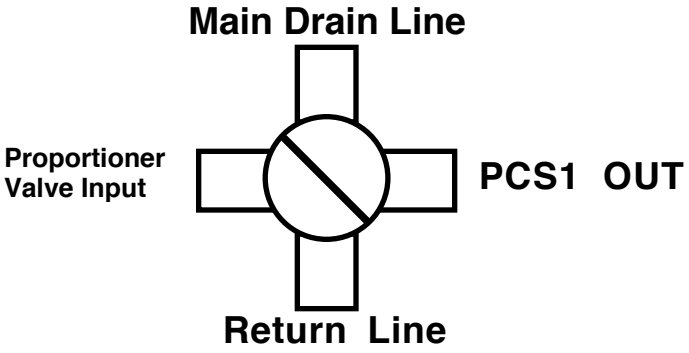
A. Solar Bypass Valve

Function: Allows the pool water to be routed up to the PCS1 for extracting the heat from the attic. Operated automatically from the Compool LX220/2Y controller. Can be manually operated but this is not recommended since the PCS1 can both heat and cool pools.



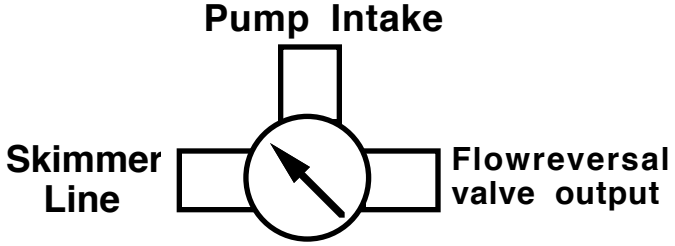
B. Flowreversal™ Valve

Function: Allows the pool water flow to be reversed so that the heated pool water rises from the pool's main drain. Operated manually and left in reverse flow unless cleaning or draining the pool. Flowreversal is a trademark of markUrban Products in Tustin, California. Recommended for inground pools that do not have the main drain connected directly to a skimmer.



C. Proportioner Valve

Function: Allows proper skimmer suction to be maintained during reverse flow. Operated manually and "set" once to obtain proper suction & water flow through the skimmers.



STEP ONE:

RETROFIT SUPPORT SYSTEM

Retrofitting the support system is the most difficult part of installing the PCS1. The reason for this is the generally rigid and permanent nature of the typical pvc type support system's plumbing. This usually means having to carve up the pvc pipe and not being able to salvage and reuse the fittings and in some cases the valves also. The good part about pvc type support systems is that pvc pipe, fittings and general purpose valves are relatively cheap and can be purchased in many hardware, plumbing and building stores. If you have a pvc support system that needs to be retrofitted, plan on redoing the entire plumbing layout.

CAUTION: If you are in an area that freezes, it is common to find a gate valve on all lines going to the swimming pool. These are the pool's main drain line, the pool's return line and the pool's skimmer line. In some instances, there may be more than just these three lines [such as two skimmer lines, etc.]. Do not remove these valves -- they will be needed to winterize your swimming pool. In some cases, they may have to be removed and later reinstalled.

Plan on connecting the new valves and PCS1 to the valves and pipes leading to the swimming pool. When it comes to the filter and pump, simply rearrange these as you reconstruct the support system's plumbing.

In the case where copper pipes and brass valves have been used, they can be reused. If copper or brass has been used, you will need to mate these to pvc pipe which is generally done using a metal to rubber "mission" coupling that adapts directly to the outside dimensions of both pipes involved. Example: 1 1/2 inch copper pipe has a different O.D. [outside diameter] than 1 1/2 inch PVC pipe. The appropriate union to couple these pipes will have a rubber insert that matches their different sizes.

The special valves described are 2" pvc and can be reduced down to 1 1/2" by using a "reducing bushing". Some pvc valves accept both 1 1/2" or 2" pvc fittings directly. **NOTE**: Be sure to read the valve manufacturers instructions. Also, it may be easier to use sections of rigid 2" pvc pipe for installing the specialty valves shipped with the PCS1. This would include using some 2" pvc fittings.

The PCS1 inlet and outlet lines go to the attic. Having the support system located in a convenient spot for easy attic access is a good strategy. Support systems located far away from the attic can be relocated closer by extending the pool's support piping. Extremely long pipe runs will require added horsepower from the pool's pump. If your pump is inadequate for the added lift to the attic, it will reduce the flow of water and result is poorer filtration and it may thermally cut itself off from over heating. **NOTE**: *Do not upgrade your pump because it feels hot! Your pump will feel "too hot" to touch by hand under normal operating conditions.*

If you are building a new pool, there is no expense associated with retrofitting the support system. Simply build the support system by following the diagrams included in this manual.

The first step in plumbing? Create a new plumbing layout!

NEW LAYOUT

1. Is the support system located as close to the attic as possible?
2. Can you extend the pool's pipes closer to the house/attic?
3. If the pump is over 50' to the attic, you may need to upgrade it by 1/2 hp.
4. How will you access the attic? Through the eaves? Garage?
5. Will the support system location allow easy attic access?
6. Is there a wall or other place to mount the LX220 by the pump and filter?
7. Is 110 or 220 vac power available from pump for the LX220 solar controller?
8. Can 220 vac power be run from the LX220 to the PCS1 in the attic?
9. Can the thermistor temperature sensor wire be run from LX220 to PCS1?

CAUTION: Locate all chemical dispensers down stream from the PCS1!

PLUMBING PROCESS

A. Disconnect all power to the pump at the power panel.

B. Drain the water out of the filter, pump and support system.

C. Disconnect the plumbing pipes from the filter, pump and pool lines.

D. Create new layout of the valves, filter, pump and other parts.

1. cut new pipe to connect the components together

2. make a mockup of the layout by inserting pipes into valves, etc.

CAUTION: Do not cement parts together at this stage!

3. complete the entire new layout to your satisfaction

a. Is everything laid out in an acceptable way?

b. Will everything function properly in the new layout?

c. Does the new layout provide for easy winterization?

d. Does the new layout provide for easy servicing?

e. Does the new layout provide for easy draining of the pool?

f. Does the new layout allow for removal of the pump? filter?

4. take a picture of your new layout for reference purposes.

5. make a drawing of your new layout for reference purposes.

E. Permanently cement the various pvc parts together.

F. Connect remaining parts together.

G. Connect a short section of pipe between the PCS1 inlet and outlet lines

1. this creates a temporary "bypass loop" at the support system.

H. Test the operation of the completed support system.

1. make sure there are no leaks.

2. check operation of bypass valve.

3. check operation of flowreversal valve.

4. set proportioner valve for correct skimmer action.

PLUMBING NOTES

NOTE: In theses notes, some comments refer specifically to flowreversal valves that allow the pool's water to rise from the bottom of the pool. Such a condition makes the pool more enjoyable to use since the water is the same temperature throughout the pool. If the flowreversal valves are not used, simply ignore these comments. See the plumbing diagrams that follow for further explanation.

1. The use of a **temporary bypass loop** at the support system simulates the attic based PCS1 and allows the support system to be completely tested prior to plumbing the PCS1 and bringing it on line. While this step is certainly optional, those who are inexperienced in PVC plumbing -- should give it serious consideration.

2. The **support system plumbing** is the most complicated part of the PCS1 installation. Once it has been determined that the support system is plumbed properly and functional -- the balance of the installation is relatively simple.

3. A **bypass testing loop** can be installed at the support system, within the attic, or at any point up to where the PCS1 is to be installed.

NOTE: the bypass loop, when installed within the attic, can take the form of a section of pipe with union fittings identical to those on the PCS1. An attic bypass loop is helpful when the entire installation can be completed and there is a delay in the PCS1 delivery.

4. **Rigid PVC pipe** is used at the support system location for most connections. Use of 2" pvc pipe can make the valve installations easier. It has better flow characteristics than 1 1/2" pvc. This helps on long pipe runs or large pools.

5. **Flexible PVC pipe** can be used within the attic to minimize joints and provide installation ease. This flexible pvc pipe should be a continuous length from both inlet and outlet through the eaves or other location where it is connected to the rigid pvc pipe with a straight SXS coupling [cemented].

6. The flexible pvc pipe end that connects to the PCS1 inlet and outlet should be equipped with a **PVC UNION** that allows for a quick disconnect. This union should be cemented onto the flex pvc outside of the attic environment. *There is absolutely no need to do any pvc cementing within the attic itself.*

CAUTION: PVC cementing should only be done in well ventilated areas!

7. The **pool water temperature sensor** should be located directly after the filter for best water temperature sensing. **NOTE**: *This sensor should be insulated after its installation to prevent weather conditions from unduly influencing the sensed temperature [of the pool] causing a false start or stop of the solar collection process.*

8. The **check valve** prevents water from entering the PCS1 via its outlet.

9. Any chemical dispenser is located downstream from the PCS1 and must not distribute chlorine or other chemicals directly into the PCS1.

10. The **skimmer suction line** may contain other valves to further split the suction into additional paths. A typical example is the "vacuum line" which is usually connected to the skimmer suction line using its own on/off gate valve.

11. Plumbing for a **pool vac** is left up to the installer. Such plumbing should not defeat the purpose of flowreversal, if used, by sucking 90% of the water through the vac. In such a case, pool heating would be heavily dependent upon the pool vac's location. The pool vac could simply take water one foot from the main drain and the system would return it out of the main drain in flowreversal causing a "vortex" of water current and resulting in a false temperature condition, premature shutdown of the solar collection process or erratic operation of the system.

12. An exploded view of the **flowreversal valve**, along with a more detailed description of its operation is contained in the special report "How To Create An Energy Efficient Pool" which is available directly from SolarAttic, Inc.

13. The **proportioner valve** is used in conjunction with the flowreversal™ valve and is usually set once for the proper skimmer line suction. A proportioner

valve is required so that proper skimmer action can be maintained when in "reverse flow". Without it, water would be blown out of the skimmers.

Suction follows water volume. The proportioner allows the majority of water to flow from the flowreversal valve [via the main drain or return lines] and just the right amount of water flow from the skimmer line. This creates proper suction on the skimmers and allows the skimmers to function "independent" of the main drain.

14. The **vacuum line** is usually connected to the skimmer suction line and with its own shutoff gate valve as discussed above.

15. Effective **flowreversal is observed** by feeling suction from the return line holes and skimmers. In addition, water flow should be observable out of the main drain.

16. The **proportioner valve** can be turned all the way to the right to allow all of the pump's intake suction to be directed to the skimmer line [or vacuum line] for cleaning purposes. Mark the normal position of the proportioner valve pointer! This allows an easy "reset" after vacuuming, backwashing or draining operations.

17. It is not usually feasible to simply plumb an inground pool in **reverse flow** since the pool may have to be drained to the bottom through its "main drain".

NOTE: **Aboveground pools** can be permanently plumbed for reverse flow by simply using a pipe running over the edge of the pool and returning the water from the PCS1 into the bottom of the pool. Aboveground pools do not need the flowreversal™ or proportioner valves since their plumbing is simplified compared to inground pools.

18. Operation of the **Bypass Valve** can be observed when the LX220 is switched on to manual and back to off. Rotation stops when the valve reaches its predetermined electrical stops. This is set internally by cams and micro switches.

19. **Automatic drain down** of the PCS1, in the off mode, can be obtained by installing a solar drain down kit. This is available from SolarAttic, Inc and consists

of a small 1/4" plastic tube connected from the inlet line to the outlet line of the PCS1 at the support system and above the check valve. Whether to install this is up to the installer. The PCS1 holds approximately 5 gallons of water.

If a **Polaris pool vacuum sweep** is used [booster pump installed], it is recommended that a drain down kit not be installed unless a second sweep delay relay is used within the LX220 to control the operation of the booster pump. This second relay delays the startup of the booster pump [4 minutes] until all of the air is out of the PCS1 eliminating any damage to the booster pump from air getting into it.

Without a drain down kit, the PCS1, inlet and outlet lines will remain filled with water [when the bypass valve is off]. This is accomplished via "suction" of the water. Installing a drain down kit releases this suction and allows the water in both lines and the PCS1 to drain down via the check valve in the return line.

20. When the PCS1 is **first powered up**, bubbles will be noticed from the main drain in reverse flow [return lines in normal flow]. This is the air within the system being forced out. It is a normal occurrence.

21. If an automatic **drain down kit** has been installed, air bubbles will be noticed each time the PCS1 is restarted.

22. **Leaving water inside the PCS1** and pipes via suction [no drain down kit] helps to keep flexible pvc pipe cooler. Flexible pvc pipe can sag at 150° F. With the PCS1 system, these temperatures do not exist for prolonged periods.

23. In some cities, copper pipe may be required [local code] within the attic.

24. In some cities, the pvc pipes going to and from the solar system are required to be painted flat black [local code].

25. Use of disconnect unions at the PCS1 are recommended for ease of service.

OPERATING MODES

NORMAL FLOW

1. Flowreversal valve is in "NORMAL FLOW"
2. Water is taken off the bottom of the pool and from the skimmers
3. Water is returned to the top of the pool via return lines
4. 2-3 foot area around the main drain appears clean all the time
5. Balance of floor debris has to be vacuumed up

REVERSE FLOW

1. Flowreversal valve is in "REVERSE FLOW"
2. Water is taken from the return lines and from the skimmers
3. Water is returned to the pool via the main drain
4. 2-3 foot area around the main drain appears clean all the time
5. Balance of floor debris has to be vacuumed up

VACUUMING POOL

1. Place Flowreversal valve in Normal Flow
2. Use proportioner valve to direct more suction to the vacuum line
3. Water is taken primarily from the vacuum line and the main drain
4. Water is returned via the pool's return lines.
5. Vacuum pool floor and clean towards main drain as usual.
6. Return Flowreversal valve to Reverse Flow when done.
7. Return proportioner valve to normal position for proper skimmer action.

BACKWASHING FILTER

1. Place Flowreversal valve in Normal Flow
2. Backwash filter

DRAINING POOL

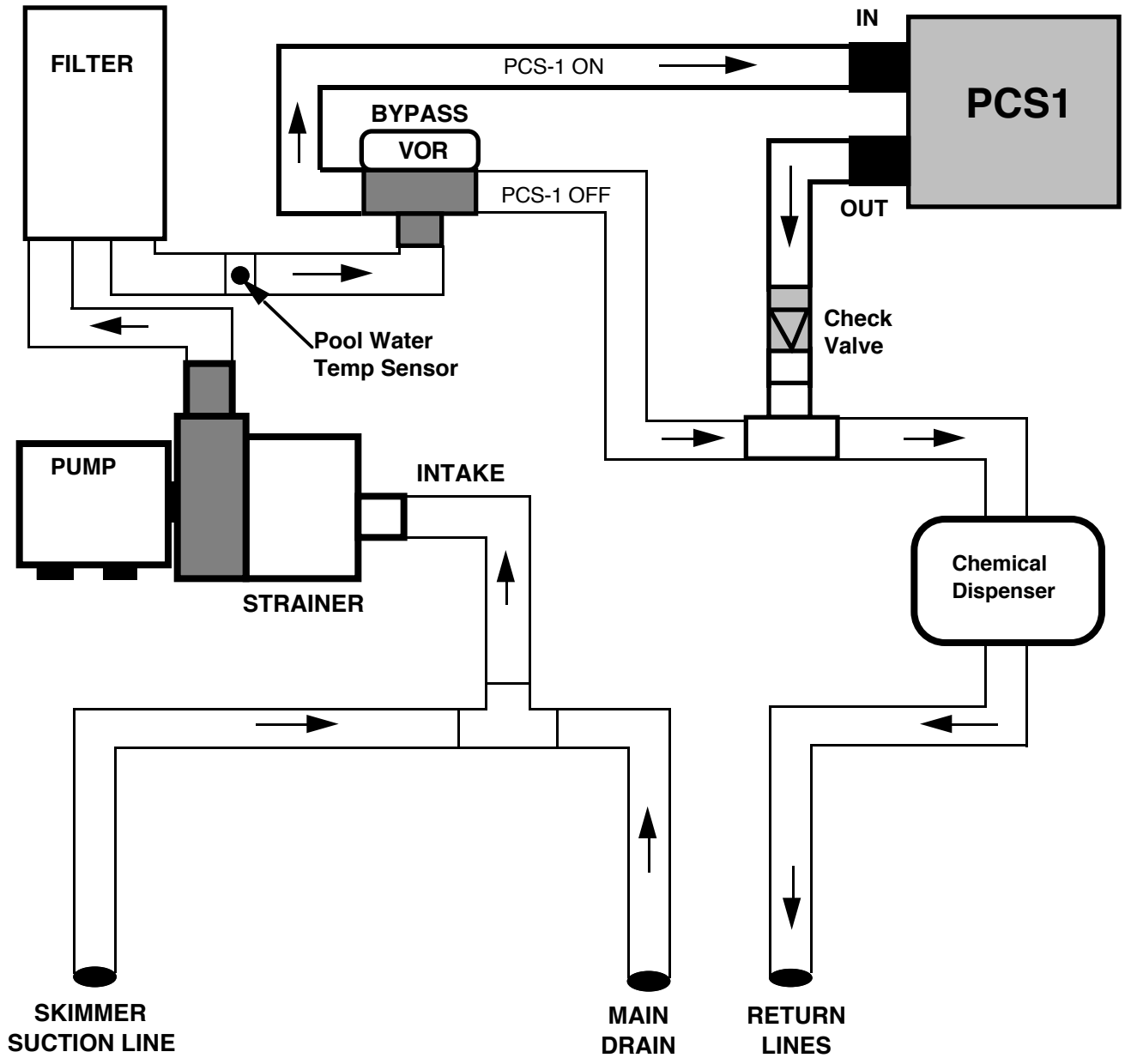
1. Place Flowreversal valve in Normal Flow
2. Drain pool

RECOMMENDED POSITION

1. Leave Flowreversal valve in "REVERSE FLOW" for optimum heating of the pool at all times unless vacuuming, backwashing filter or draining the pool.

BASIC PLUMBING DIAGRAM

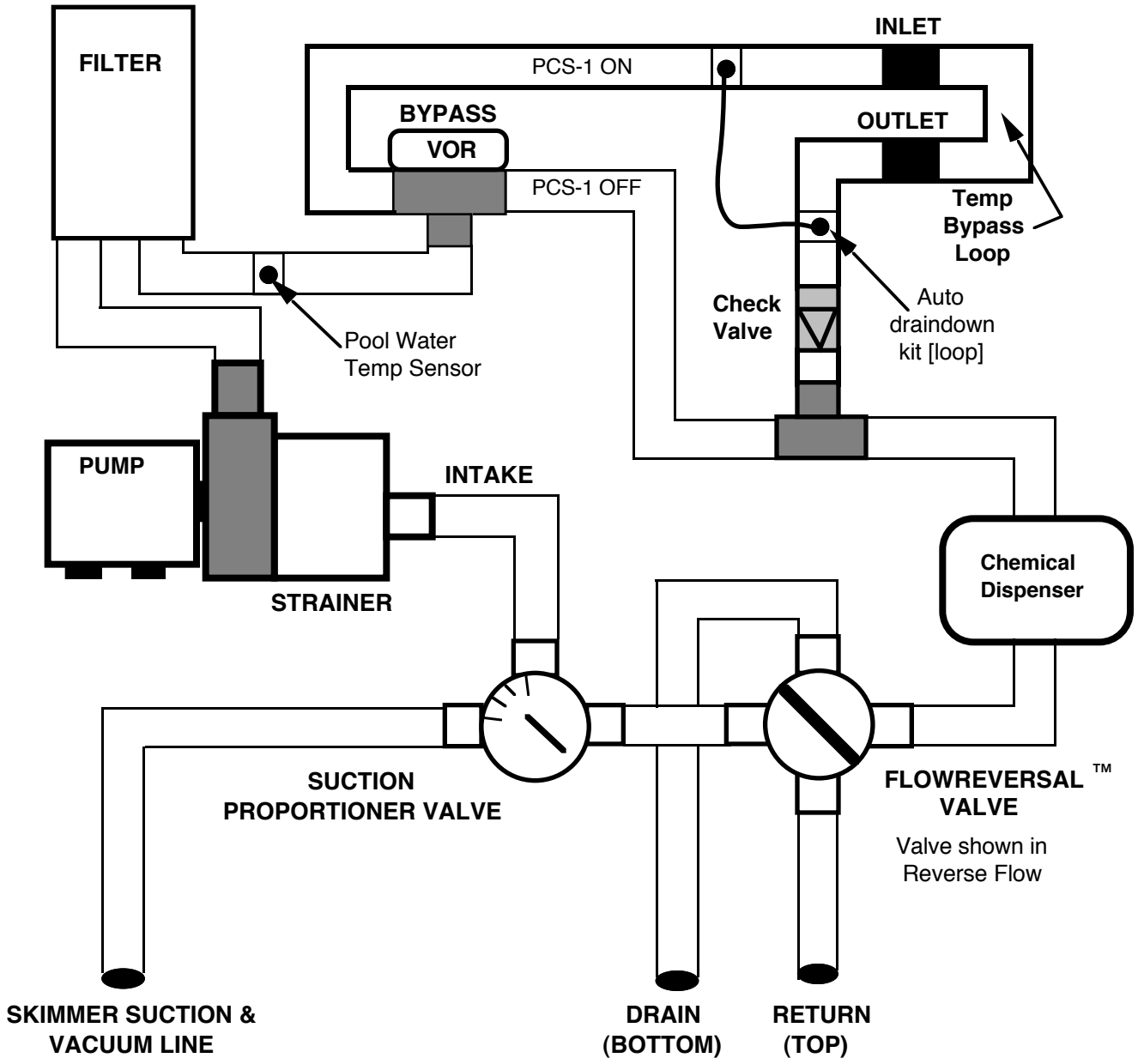
Without Flowreversal™ Valves



PLUMBING DIAGRAM

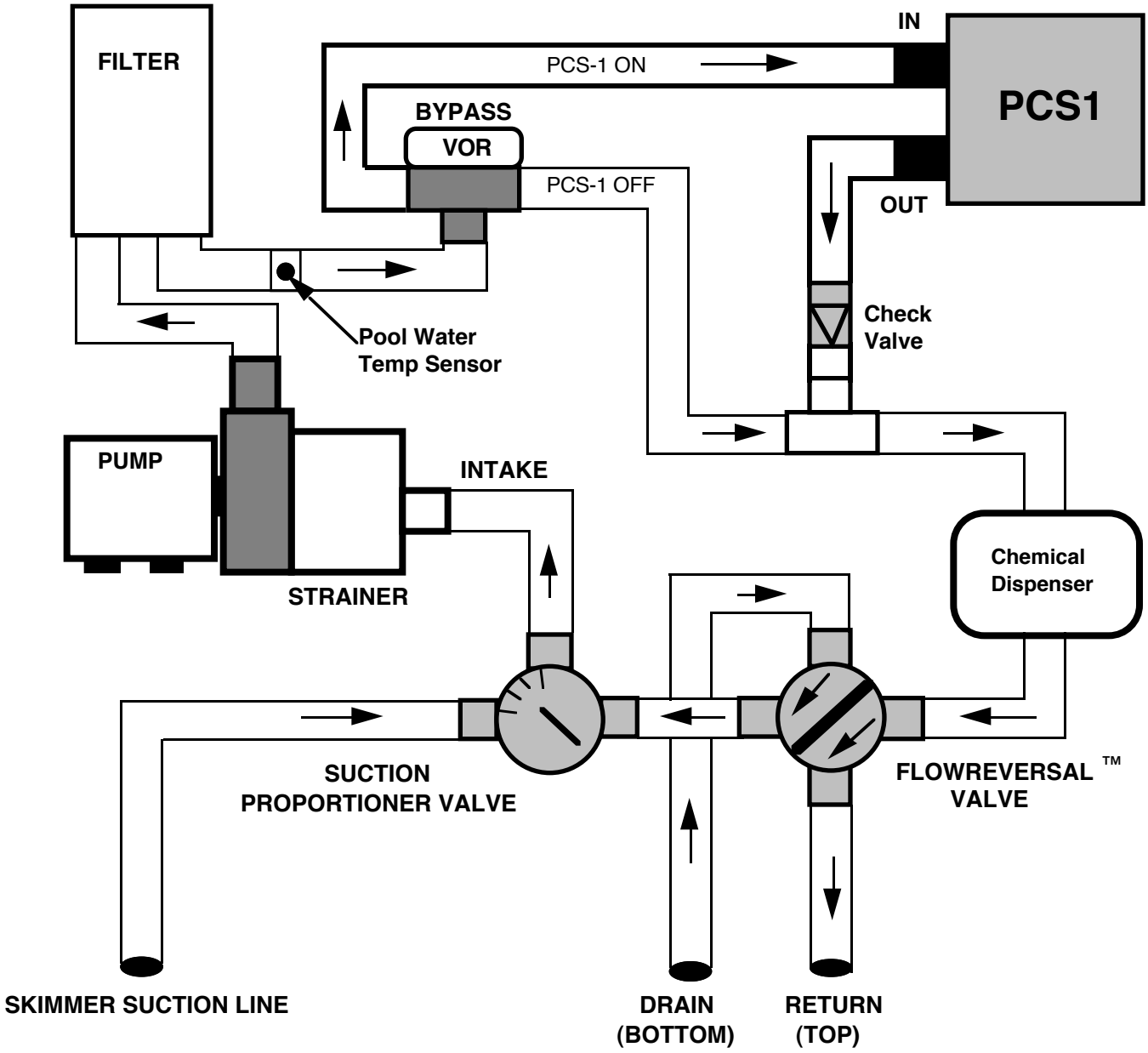
With Flowreversal™ Valves

And Temporary "BYPASS LOOP"



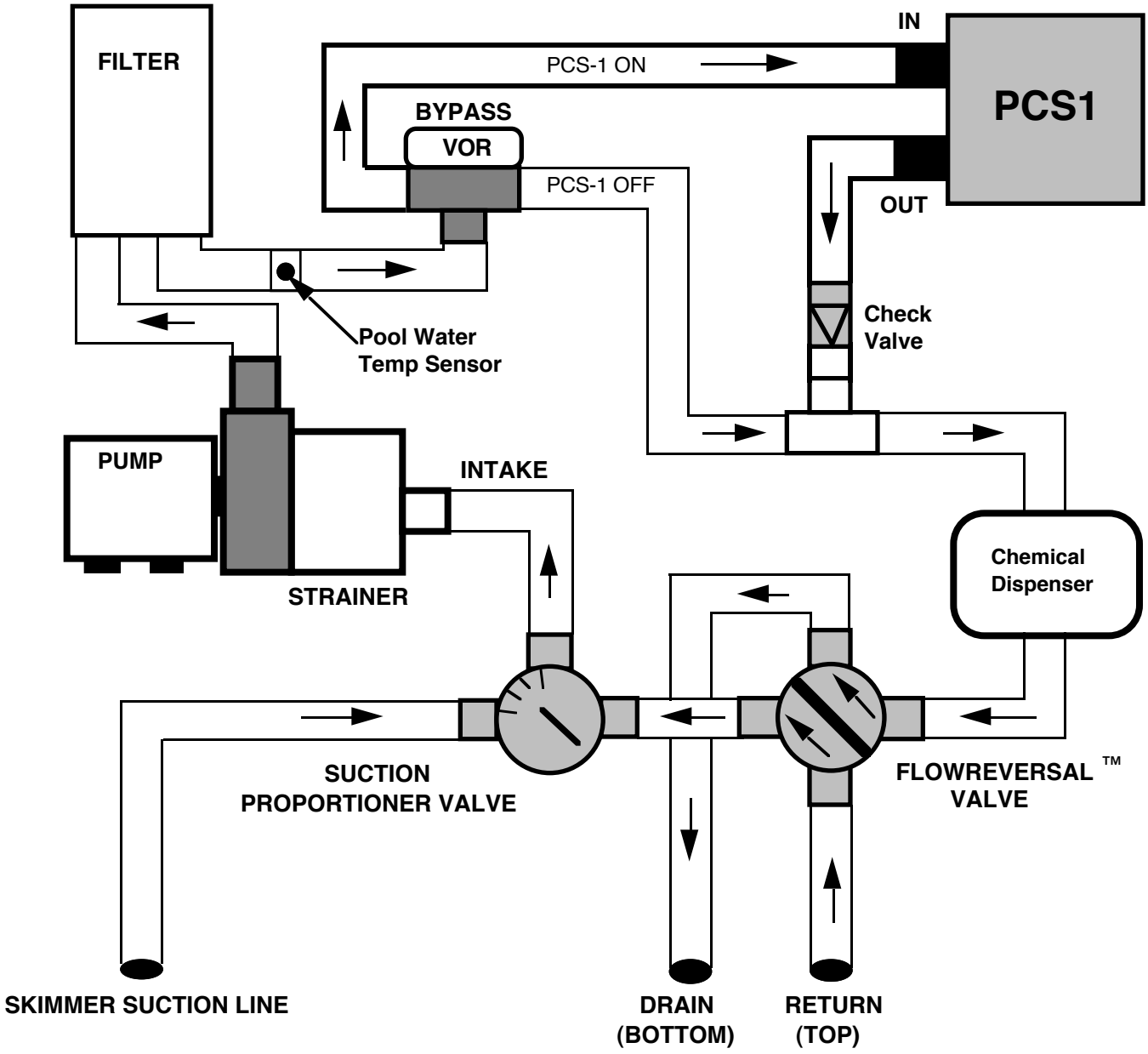
PLUMBING DIAGRAM

With Flowreversal™ Valves
Showing Normal Flow



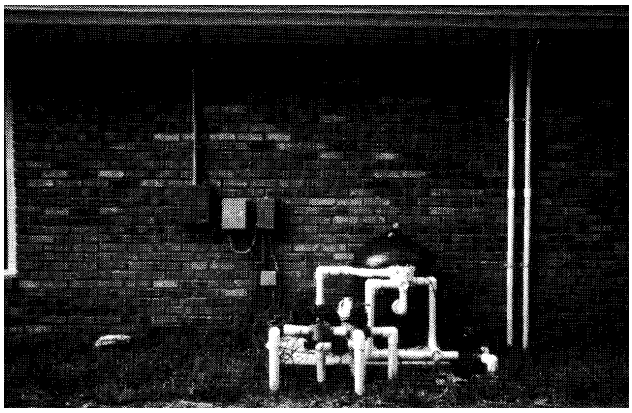
PLUMBING DIAGRAM

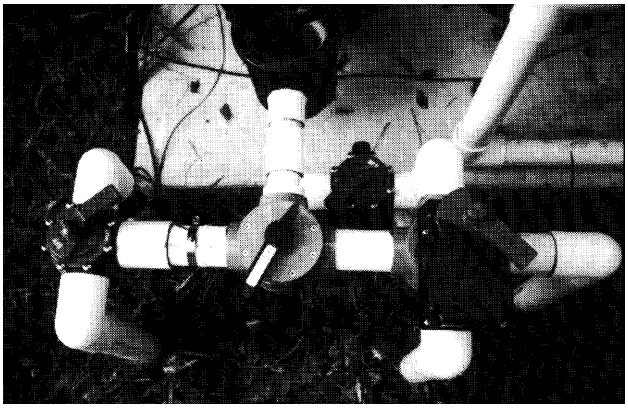
With Flowreversal™ Valves
Showing Reverse Flow

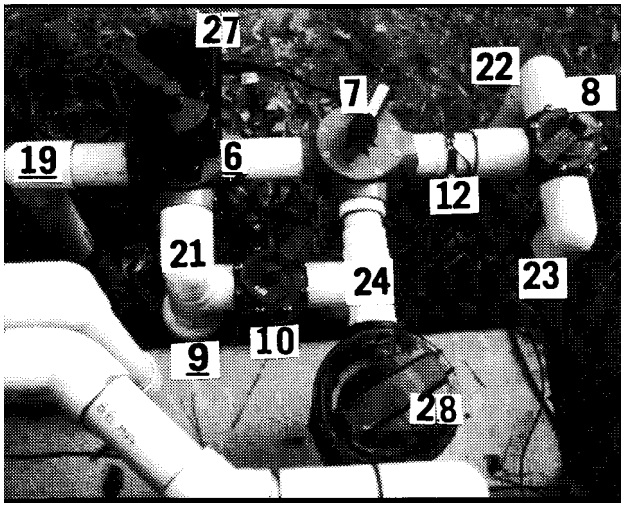


Equipment Pad Configuration

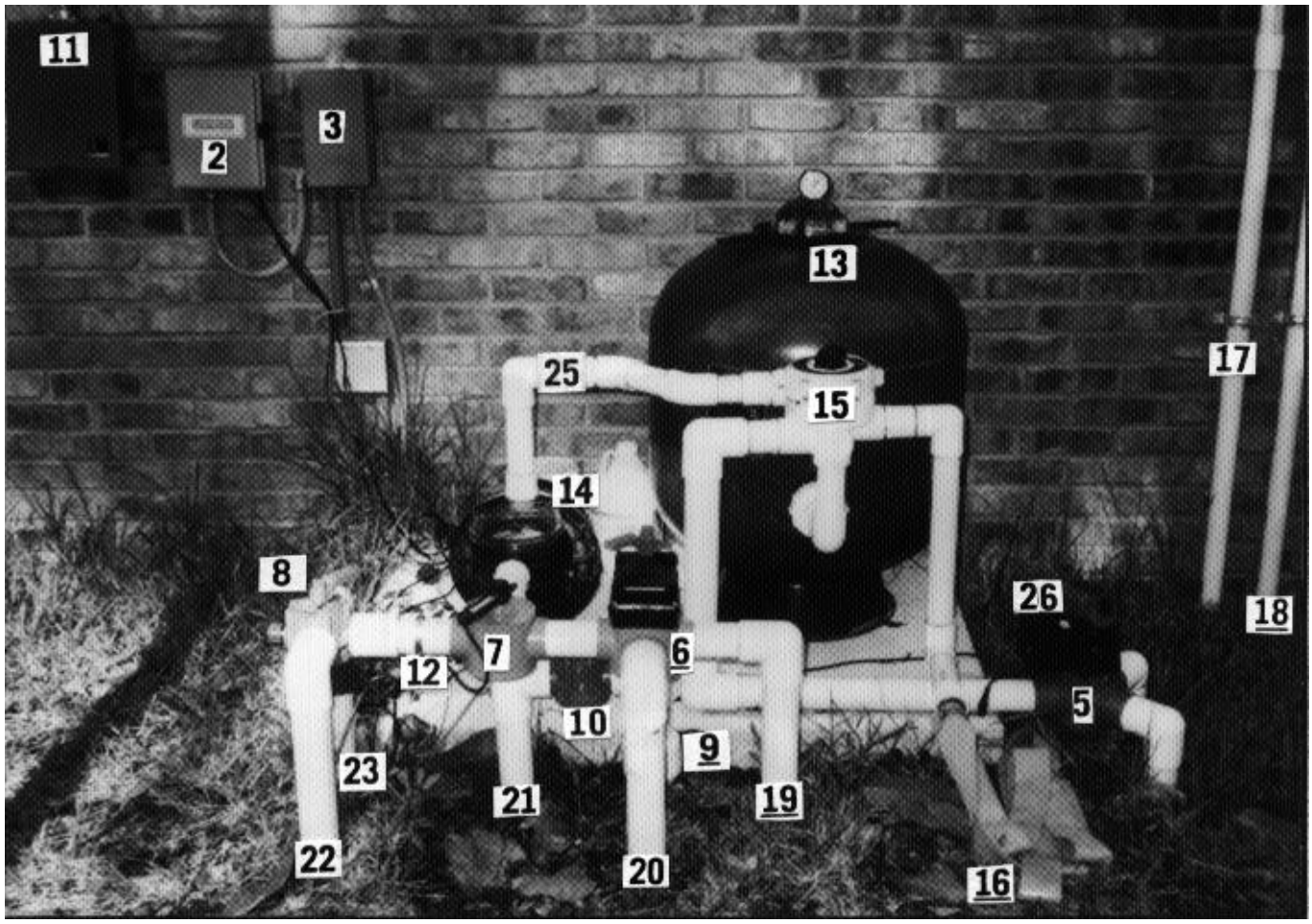
1989 Photos Courtesy Of
Max Fisher Pools, Orange Park, Florida







New Pool Installaton Includes PCS1

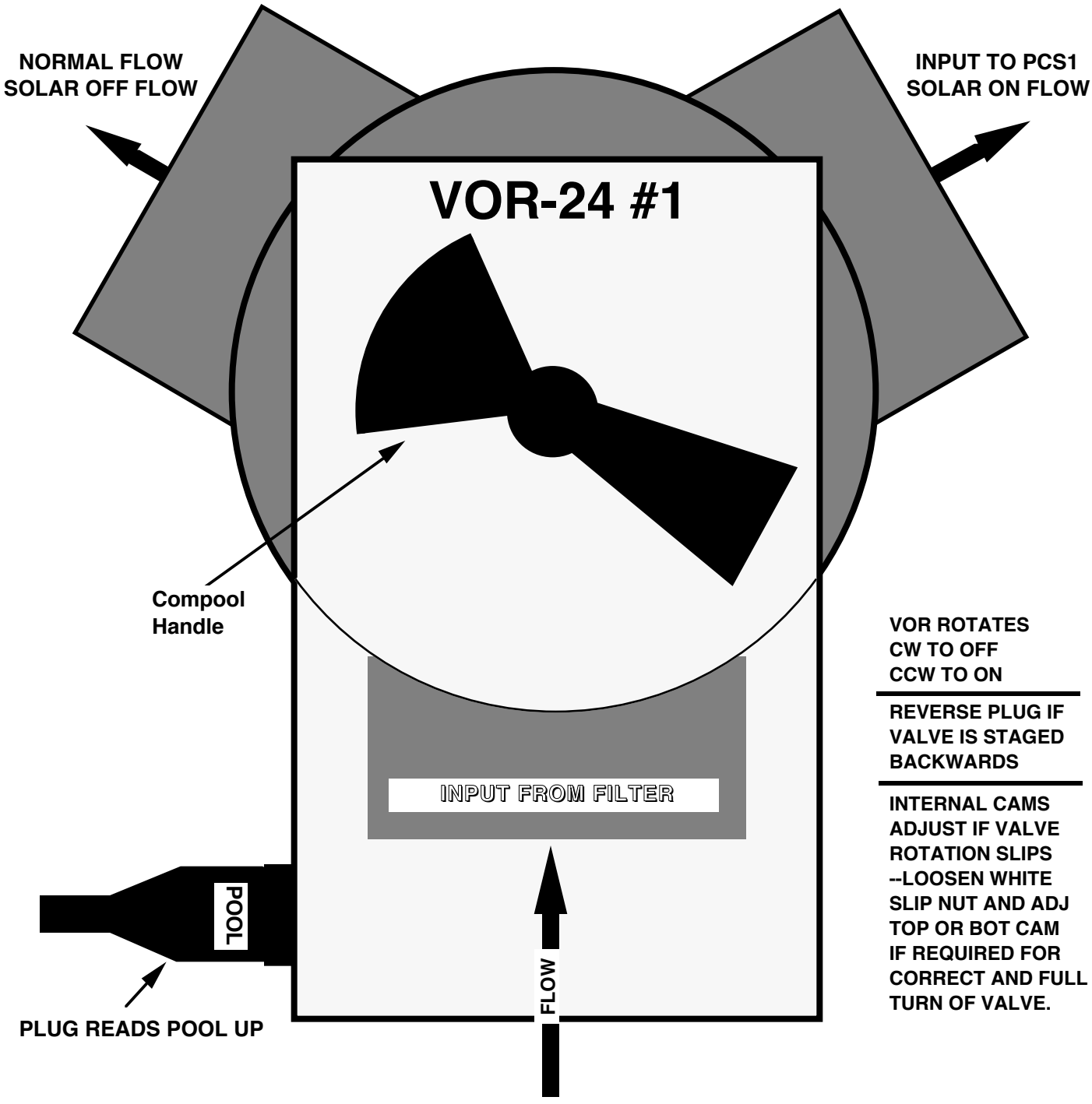


Plumbing Features

1 PCS1 Heat Exchanger (In Attic)
2 Automatic Temperature Controller
3 Timer for min runtime of pump
4 Automatic Pool Vacuum
5 Automatic Bypass Valve for PCS1
6 Automatic Flowreversal Valve
7 Proportioner Valve (Intake flow)
8 Proportioner Valve (Skimmer/Vac)
9 Check Valve (on main drain for vac)
10 Flow Balancing Valve (vac)
11 Power control panel
12 Water Temperature Sensor
13 Filter
14 Pump Motor
15 Filter Backwash Valve
16 Backwash Drain Line
17 PCS1 Inlet Line
18 PCS1 Outlet Line
19 Equipment Pad Return Line
20 Return Line To/From Pool
21 Main Drain Line To/From Pool
22 Skimmer Suction Line
23 Pool Vac Line
24 Pump Intake Line
25 Pump Discharge Line
26 Compool Valve Operator (Auto)
27 Mark Urban Valve Operator (Auto)
28 Strainer Basket

Bypass Valve

**TOP VIEW OF ASSEMBLED
COMPOOL VOR24 &
BYPASS VALVE FOR PCS1**



STEP TWO:

INSTALL THE PCS1

Compared to the support system issue, installing the PCS1 is the proverbial "piece of cake". Or, at least it can be! There are several different possibilities for approaching the installation of the PCS1. **Access to the air on the interior side of the roof is the key consideration.**

Solar derived heat is conducted into the attic space as previously discussed. **Drawing this heat off -- as it is conducted into the attic space -- is the objective.** This can include mounting the PCS1 inside the attic [recommended approach], outside of the attic at a gable location, or physically mounting the PCS1 within the roof itself. Any number of other variations are possible and will depend upon the home or structure where the PCS1 is being installed.

Whatever method is used, it is necessary to mount the PCS1 so that the air can be drawn off of the interior of the roof and through the PCS1 heat exchange coil. Any mounting other than horizontal and inside the attic may require a condensate drain provision. Also, any mounting other than horizontal will render the internal float for leak detection inoperative. In the normal case, a small amount of condensate can be expected and would simply collect and eventually evaporate in the bottom pan of the PCS1.

Installations should be in the main attic area with a square footage of ceiling area greater than the size of the pool surface area [length x width, etc.]. Any exterior installation of the PCS1 must ensure a good seal is present between the PCS1 coil and the attic area.

This discussion will focus on one typical installation method. This involves the 2 x 2' closet access to the attic found in many homes. See "Common Questions" at the back of this manual for an additional discussion of installation options.

ATTIC PROCESS

A. Locate current closet access [may be a hallway opening]

B. Open up access and inspect attic area.

1. Does the area adjacent to opening provide a central location?
2. How far to the place where you want to locate the PCS1?
3. Is there blown in insulation one foot deep?
    a. If so, place fiberglass batt insulation immediately around PCS1
4. How wide are the joists?
    a. PCS1 fits in between standard 24" on center trusses
    b. 16" on center trusses will require some reframing
5. If you expand this access opening, will the PCS1 fit into the attic?

NOTE: THE FLEXIBLE PVC PIPE MUST BE ROUTED TO THE PCS1. ENSURE YOU MAKE ALLOWANCE FOR THIS PIPE RUN, THE PVC UNIONS, AND ELECTRICAL WIRES TO THE PCS1.

C. **Strategy: Reframe access hole and place PCS1 adjacent to it inside the attic!**

D. Inspect for any attic electrical wiring which may be in the way.

1. Make arrangements to deal with any wiring found.

E. Using a reciprocating saw, enlarge the access hole to each joist [24" OC]

1. Enlarge hole to each joist and make access hole 34-48" in length.
2. This provides a 22.5" width [2.5" clearance beyond PCS1's 20" depth]

NOTE: Some homes have a larger attic access panel which is almost large enough. It is possible that it can be enlarged slightly to accommodate the PCS1. A rough opening of 21" x 31" will allow the PCS1 to go through - on its side - if sufficient height is inside the attic.

F. Install a hook at near the peak for use with a hoist/puller tool.

1. Use lag bolts to permanently install hook for raising PCS1

G. Create a base for the PCS1 to rest upon.

1. Reuse plywood from the shipping crate and lay over 2+ joists.
2. Place 1-2 pieces of 1″ certifoam on top of plywood for cushion
    a. Reduces any vibration transmission
3. PCS1 can simply rest on these materials

H. Prepare the PCS1 by installing unions on the inlet and outlet manifolds.

1. clean manifolds with wire brush
2. use silicone sealant around male pipe threads
3. install female pipe threaded part of union to inlet and outlet
4. **Let silicone sealant cure a full 24 hours prior to using PCS1.**

I. Prepare single lengths of flex pvc pipe for both inlet and outlet lines.

1. A single length [without joints] should run from the PCS1 to the support system location [outside eaves]
2. install the slip part of the union to the flex pvc lengths outside of the attic environment.
    a. prevents having to breathe cement fumes in a small area.
    b. **Allow the cement to cure a full 24 hours prior to using joint.**

CAUTION: *There is absolutely no need for PVC cement work inside the attic and doing so can be hazardous. Do all PVC cementing outside of the attic in areas with adequate ventilation!*

J. Ensure the pump is off and electrical power is disconnected.

1. drain support system
2. cut off bypass loop and prepare pvc pipes going to PCS1 for extension

K. Complete rigid pvc pipe run to eaves connecting to flex pvc at eaves

1. place straight SXS coupling outside of eaves, not inside

    a. **Minimize cemented joints in the attic** [union-flex only joint]

L. Run electrical wiring for PCS1 power from LX220 to outlet box in attic

1. follow wiring codes and instructions
2. PCS1 simply "plugs into outlet" [unplugs for any service work]

M. Run temperature sensor wire [22 gauge vinyl jacketed] to attic thermistor

1. install attic sensor near peak and out of PCS1 air flow stream
2. Connect temp sensor in series with white float wires from PCS1

    a. float is normally closed switch that opens if water is 3/8"+

NOTE: *Electrical wiring should now be completed.*

N. Close off all excessive ventilation and power ventilators.

1. board up any large ventilation holes previously created [power, etc.]
2. only passive ventilation holes should be present.

    a. rule of thumb, 1 sq ft for every 350 sq ft of attic is required.

O. Place straps around the PCS1 and raise it into the attic with a hoist/puller.

1. Two strong men can lift the 134 lb PCS1 into the attic.

CAUTION: *The PCS1 is bulky and the fins are razor like. Take due care when manually raising the PCS1 into the attic. If manually lifting, the bulk of the unit along with the sharp fins can pose a significant danger. Especially if the PCS1 is dropped or loss of control is experienced. This can result in a back or other injury. The larger the access opening, the easier the unit can be man-handled. Small openings with minimal clearances require a higher degree of control than manual lifting may afford.*

P. Place the PCS1 onto the attic platform and into the desired position.

1. airflow from the PCS1 should be open and not restricted
2. a plenum with flexible duct work can get around air obstructions

Q. Connect the flexible pvc pipe unions to the PCS1 manifolds.

1. Inlet pipe goes to the top of the coil.
2. Outlet pipe goes to the bottom of the coil.

CAUTION: *Do not over tighten or "muscle" pvc unions as they may crack. Do not attempt to use the system with a cracked union [redo it].*

NOTE: *All of the plumbing should now be completed!*

R. Finish reframing the access opening.

1. hinges may be used if desired and convenient to the access method
2. use rubber sealing tape around access edges to protect the vapor barrier [generally a winter moisture issue in freezing climates].
3. hinge opening so that door lowers down from ceiling: not into attic

S. Test outlet in attic to ensure power is proper and ground is intact.

1. Keep filter pump unplugged or turned off for these initial attic tests.

2. place LX220 in **ON** [manual override] to test power.
    a. observe operation of bypass valve
        1. will water be routed correctly when pump is energized?
3. plug PCS1 into outlet and observe that fan turns on.

NOTE: a properly wired solar controller will turn the PCS1 on when **ON** [manual override] is selected and off when the controller is turned **OFF**. In **AUTO**, the temperature sensor in the attic must be 8° F higher than the pool temperature sensor and it will depend upon the position of the temperature thermostat on the LX220.

T. Turn off the solar controller and observe that the bypass valve rotates off.

1. become familiar with the bypass valve's on & off positions.
    a. on means water is routed to the PCS1 which is on.
    b. off means water bypasses the PCS1 which is off.

NOTE: *"Off" on the valve handle indicates that the port pointed to is off.*

U. With the LX220 **OFF**, restore the filter pump power and prepare to test the PCS1 water flow as follows:

1. Someone should observe attic unit for any leaks during these tests.
2. Turn LX220 to **ON** [manual override] and observe attic for any leaks from the plumbing.
3. Shut down immediately by turning off pump or LX220 to **OFF** if any leak is present.
    a. Fix any leak detected.

CAUTION: ***Absolutely do not accept any small leaks in the plumbing!*** *Small leaks only get worse. If you have allowed the silicone sealant and pvc cement to cure a full 24 hours before using these joints in the attic, there should be no leaks or problems in the plumbing joints!*

V. Complete the remaining installation issues such as cleaning up, etc.

This is a **general attic process** to follow when a small access opening is expanded. You, as the installer, are responsible for the safe application and installation of the PCS1. Poor workmanship inside the attic can lead to a mess.

ATTIC NOTES

1. The PCS1 can be located over adjoining garages as a further leak protection measure.

2. When the PCS1 is located on one end of the attic, air flow can be extended by using large flexible duct work attached to the PCS1. This would require a metal plenum to be fashioned and attached to the PCS1. Flexible duct work would then be attached to the plenum.

> **CAUTION**: *Care should be taken not to substantially increase the static pressure the PCS1 is subjected to [increased resistance to airflow via small ducts, etc.]. This would have the effect of decreasing air flow CFM and diminishing heat transfer rates.*

3. A PCS1 plenum and flexible duct kit is expected to be available in 1993.

4. When installing the PCS1 in the attic, do not "build it in" so it cannot be removed. While the PCS1 is relatively maintenance free, service may be required and in rare instances the unit may have to be taken down from the attic.

5. An attic bypass loop can be fashioned for service purposes at the time of installation and placed into the attic as a contingency. Such a bypass loop would be a small piece of rigid pvc pipe with mating union sections for hooking directly up to the flexible pvc line in the attic [serving as an attic bypass loop] should service and disconnect of the PCS1 ever be required.

6. Vapor barriers are a concern in geographical areas subject to prolonged freezing temperature. Water, in the form of vapor, escapes into the attic and "freezes" onto the interior of the roof where it can build up. When temperatures warm up, this water can turn into a liquid state and fall into the attic insulation. Eventually, a build up from the condensed water vapor can damage the ceiling area by forming water stains. Good vapor barriers [usually plastic] help to prevent this from occurring.

CAUTION: *When reframing attic access, maintain the vapor barrier by using a rubber seal around the attic door where it mates to the ceiling area. In other words, you have no gaping holes where moisture inside of the house can easily vent to the attic area!*

7. Make sure the flexible pvc pipe and electrical wiring to the PCS1 do not come into contact with exposed nails and other sharp objects inside of the attic.

8. Lay down an extra piece of plywood from the shipping crate directly in front of or behind the PCS1 as a service platform. In this manner, someone who has to service the unit will not have to dangle their legs between attic joists.

9. While doing electrical work in the attic, consider wiring an outlet and light near the PCS1 location for convenience purposes.

10. After the plumbing has been connected to the PCS1, provide some support for the flexible pvc pipe. An easy way to accomplish this is to use "plumbers strapping" which is a flat metal coil with holes in the metal. Simply cut off a length of metal strap and wrap around the pvc pipe and nail the strap to a roof joist.

CAUTION: *Flexible pvc pipe that simply dangles in the attic without being supported can cause undo pressure on the union joints in the attic.*

11. In large attics such as those in hipp type construction, you may want to build a small platform from the ceiling for the PCS1 to sit on.

12. It will generally take two people to hoist and position the PCS1 into place.

13. It will generally take two people to work the flexible pvc pipe through the eaves. One in the attic and one at the eaves.

14. The check valve in the PCS1 outlet line should be located near the rest of the support system's plumbing and NOT in the attic.

15. Board up large vent holes that have been created from the inside of the attic with scrap plywood, etc. For example: If wind driven turbines have been installed in the roof, simply board up the interior hole and leave the roof alone. The turbine may still rotate, but it will not draw out air.

16. Disconnect the power to any installed power ventilator and board up the hole from the inside of the attic. This leaves the roof appearance as is but renders the ventilator inoperative. It also closes up what is an excess passive opening in the attic.

17. Ventilation should be reduced down to what the house was built with. Again, the rule of thumb is 1 sq foot for each 350 sq ft of attic area.

18. The actual cubic air space inside of the attic is not important. It is the roof's surface area and being able to draw the air off of the roof's interior through the PCS1 heat transfer coil that is. Air itself does not hold much heat.

19. If a radiant heat barrier has been installed onto the roof's interior, it must be removed for effective operation of the PCS1.

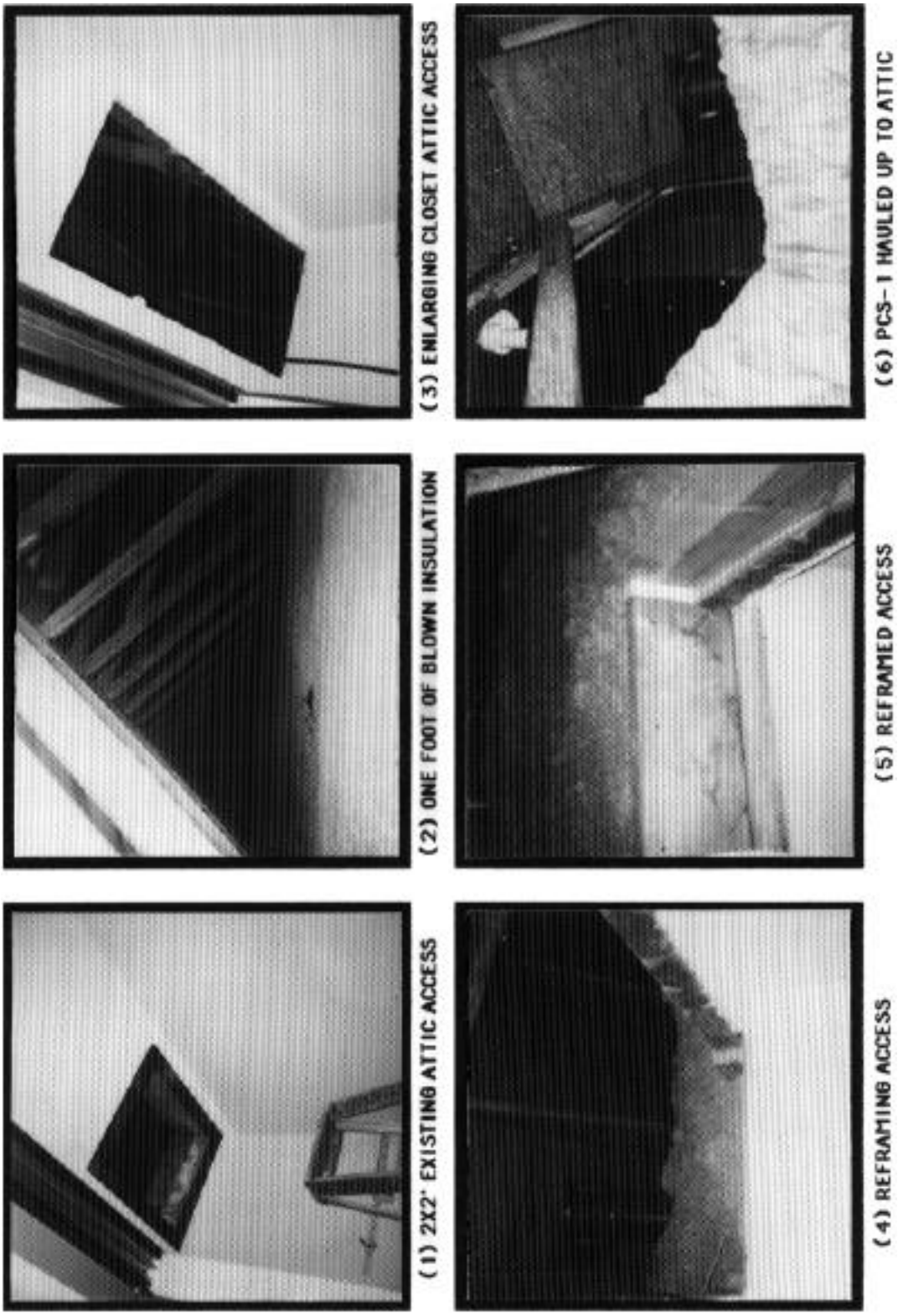
20. If a radiant heat barrier has been installed on the ceiling area, it can be left as is since it does not affect the operation of the PCS1. NOTE: radiant barriers work to keep the attic heat from radiating into the home. The PCS1 solves this problem by taking the heat and placing it into the swimming pool. The PCS1 removes the heat load from the ceiling of the house.

21. The PCS1 can function as an attic ventilation fan by unplugging the bypass valve and turning the LX220 to **ON** [manual override] and opening all outside attic vents. This can be useful in some instances.

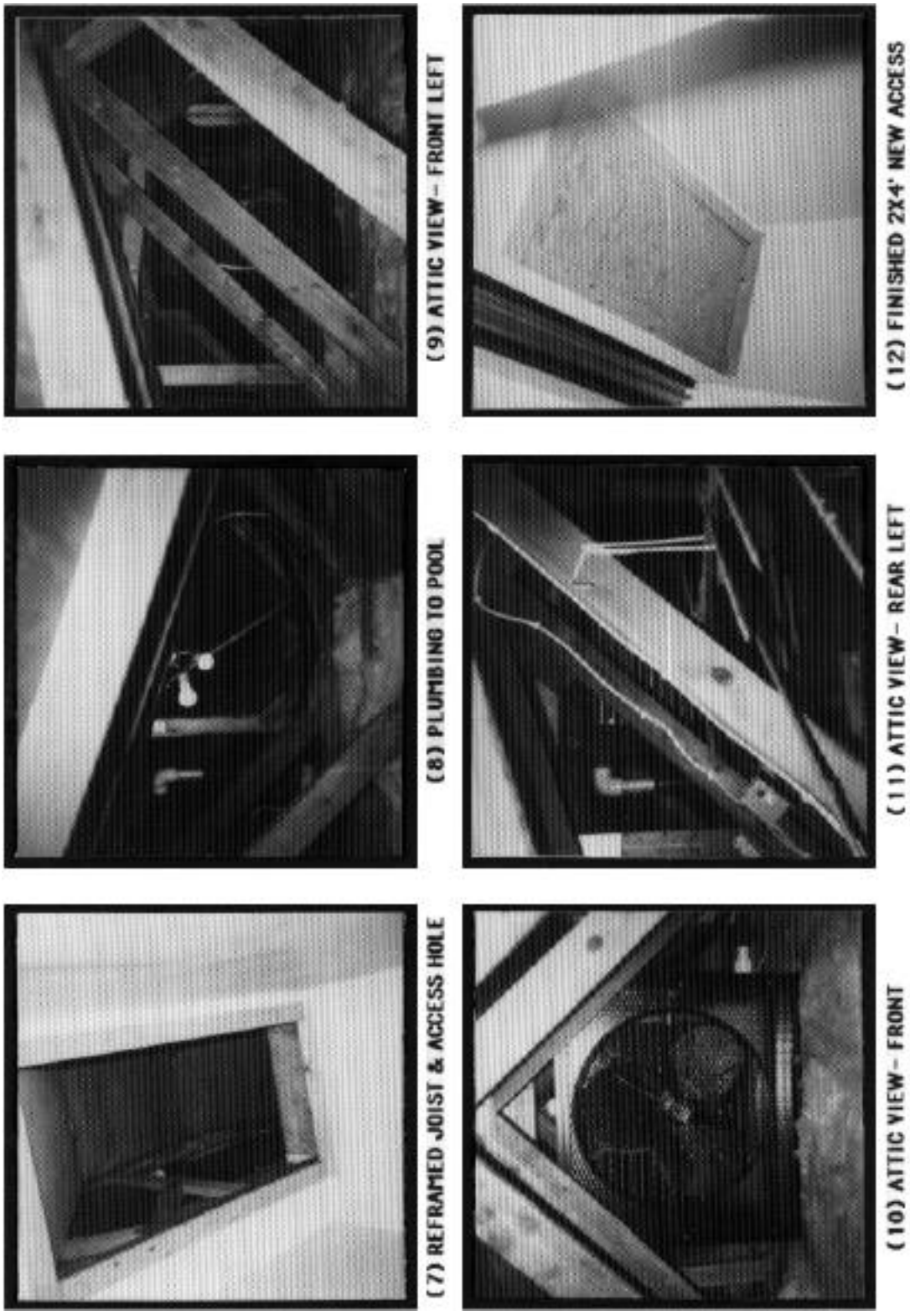
22. Make sure the attic temperature sensor is out of the air stream and is mounted near the peak of the roof.

23. See "Common Questions" for other attic notes at the back of this manual.

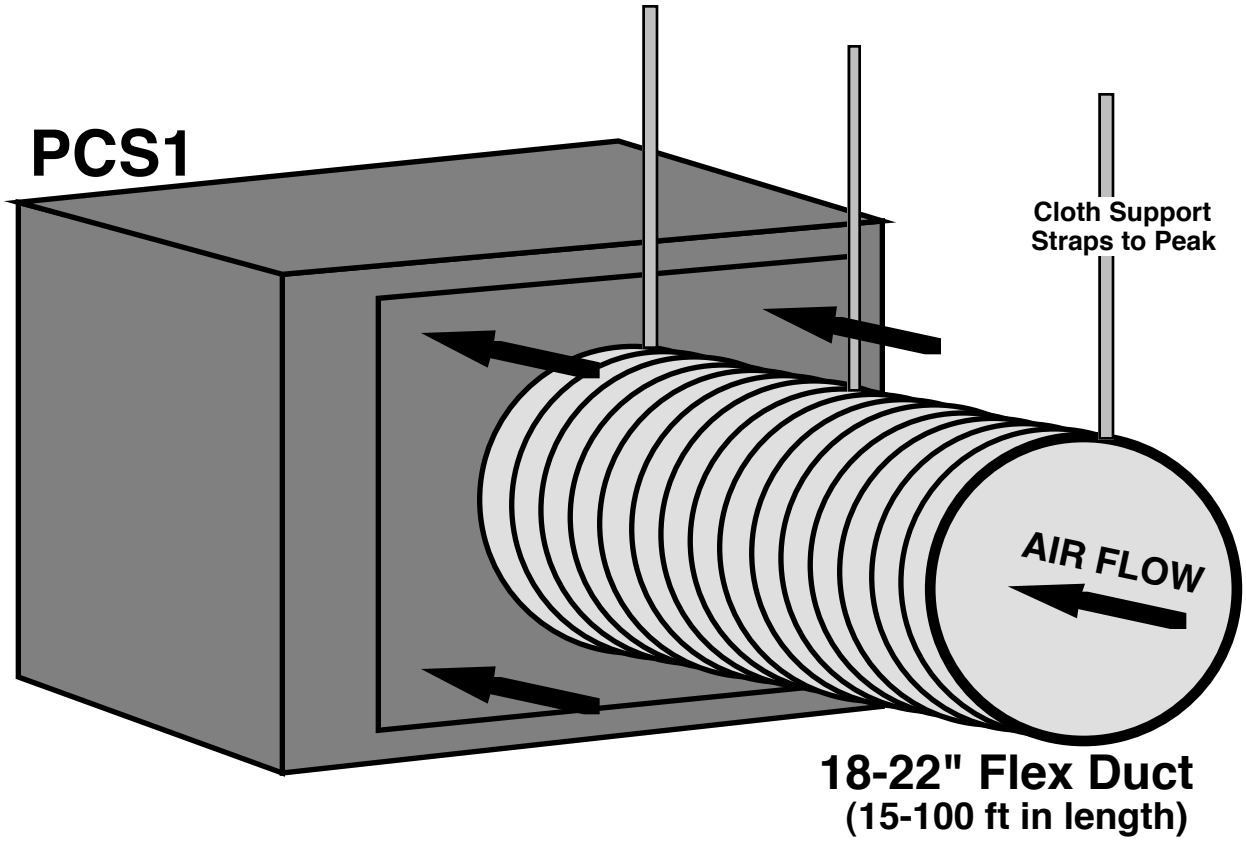
Attic Installation Photos



Attic Installation Photos



ENHANCING HEAT TRANSFER (A)



A simple method of enhancing heat transfer within the attic is to suspend from the attic's peak a length of large flexible duct. Place the flexible duct adjacent to the PCS1's heat transfer coil 1-2 inches from the fins. This allows "distant" air to be more easily drawn across the heat transfer coil. Centering the flex duct on the coil's surface also allows "local" air flow to be drawn across the coil at the same time.

This method is useful in attics where the PCS1 would have an obstructed air flow path. It promotes a larger circular air flow pattern thereby enhancing attic heat transfer. It is also useful in attics with cathedral like ceilings that use scissor joists. These ceilings have a two (2) foot attic air space above the cathedral like ceiling.

Large flex duct is available at building supply centers. Standard cloth support straps are available for suspending the large flexible duct from the attic's peak. Both the large flex duct and support strap are relatively inexpensive.

ELECTRICAL WIRING NOTES

1. Thermistor temperature sensors are supplied with the LX220. These [10K] sensors are nonpolarized and are denoted by the same color of leads [black]. This means the leads can be hooked up either way to the WTR or SOL terminals.

2. Use 22 gauge wire for connecting the attic thermistor to the LX220.

3. The attic temperature sensor is connected in series with the white internal float leads located on the right side of the PCS1 by the electrical clamp. The internal float is a normally closed switch which opens if the water in the base pan rises to 3/8". This could only occur under a leak of the coil or a malfunction of the motor and fan. Do not attempt to use this float for any other use. Contact ratings are only 15 ma and its intended use is strictly with the attic temperature sensor.

NOTE: If you raise this float by hand, the switch will open when the float is off the base pan by approximately 1/8". In actual water, 3/8" is required to raise the float to an open circuit. The float will not reset until lowered all the way.

4. When the internal float rises and opens the circuit to the attic temperature sensor, the LX220 interprets this as an extremely cold attic condition. It therefore turns off the bypass valve and power to the PCS1.

> **CAUTION**: *This internal protection for the PCS1 is only available during the time the LX220 is operating in "automatic". If the controller is placed into* ***ON*** *[manual override], it will ignore the attic temperature sensor and float.*

5. A second [optional] relay can be installed in the LX220 to automate a pool vacuum pump [i.e. Polaris, etc.]. This relay plugs into the **SWP** socket on the LX220.

6. On poor solar days, the pool's pump may not achieve a minimum amount of desired filtration time. If a certain minimum filtration time is desired, a pump timer should be installed as shown to bypass the LX220 during optimum solar time. The pump timer should be set to start at 12 noon and run for the length of minimum time desired.

Wired this way, the pump timer will not affect the operation of the PCS1 heat exchange system by being mis-synchronized in a solar context.

7. The LX220 relays provide two sets of contacts rated at 2 hp maximum. If additional contacts are desired, substitute a different 24 vdc relay that has the correct amount of contacts desired. OR, connect additional relay(s) in tandem [next item].

8. Additional 115 vac or 230 vac relays can be connected in **tandem** from the current power relay contacts **to achieve amplification of the power handling** capabilities of the LX220. Follow national and local electrical codes when modifying relay output circuits to achieve additional power handling capabilities.

9. Some timers provide for a manual override function eliminating the need for an additional electrical switch and/or circuit if a timer is used. Also, a timer set to operate both the pump and the PCS1 from 11 a.m. to 7 p.m. can achieve a SEMI-AUTOMATIC operation of the system without using the LX220. However, remember that the PCS1 can cool down a pool if the attic is cooler than the pool!

10. The Flowreversal™ valve can be automated. This requires an optional module and a second valve operator. The part numbers are MOD-VLV and FR-VOR respectively. Theoretically, an automated flowreversal valve would yield optimum cleaning **and** heating. However, experience questions this. SolarAttic, Inc. does not recommend the automation of the flowreversal valve.

11. The diagram that follows shows a suggested method and is not a substitute for national and local codes. Where codes apply, they supersede the attached wiring diagram. All wiring should be done by a qualified electrician and must comply with electrical codes.

12. Note that 220 vac power is typically available at the pool's pump already [in most cases]. This power can be tapped for the LX220 to use.

13. We recommend that the pool's pump be slaved to the LX220. This will cause the pump to operate only during the solar collection process which is typically 10 hours per day. If the pump is sized properly, this should provide adequate filtration. On poor solar days, a timer can augment this by providing a minimum amount of pump run time for filtration as previously described.

CAUTION: *Some pool pumps were sized smaller and set up to run 24 hours per day for proper filtration. If the pool water is getting cloudy and a timer is not used, manual operation of the pump may be required for proper filtration. Or, the pump may be upgraded to provide proper filtration without running 24 hours a day. See discussion on pump sizing in "Common Questions."*

14. Use a separate circuit breaker for the pool's support system which includes power to the LX220 and the PCS1 via the LX220.

15. The LX220 is UL listed.

16. Option: Use a manual bypass switch for the PCS1 power to manually turn the fan on without activating the solar controller. This is useful for ventilating the attic without heating the pool. An alternative method is to unplug the bypass valve's valve operator [VOR] so it doesn't route water to the PCS1 and then turning the LX220 to **ON** [manual override]. This also turns the fan on.

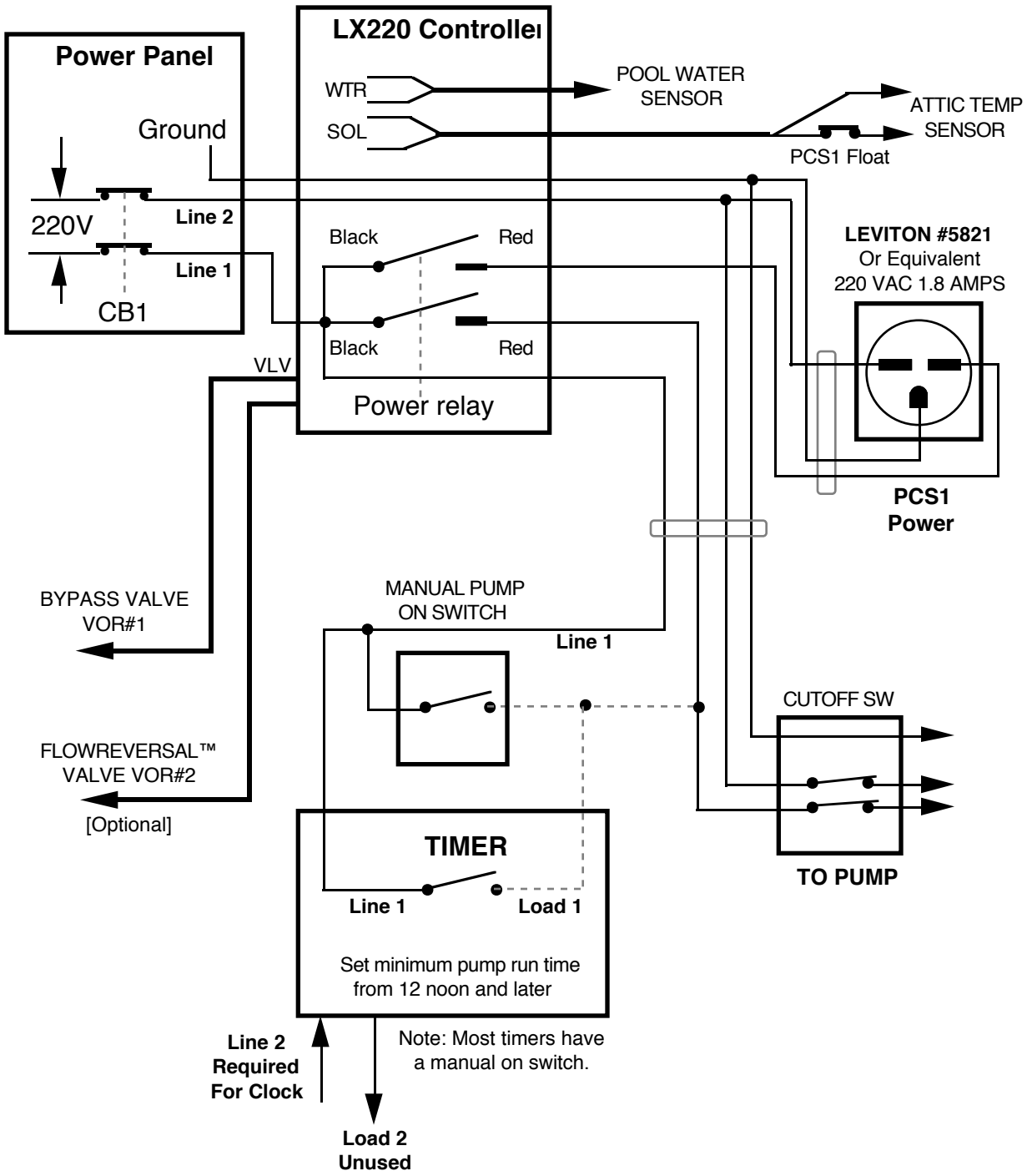
17. Use a pump manual bypass switch for manual pump operation.

18. **DO NOT DIRECT WIRE THE PCS1.** Use an outlet box in the attic so the unit can be unplugged for service needs. Use a double pole cutoff switch for attic power as an additional safety feature if desired.

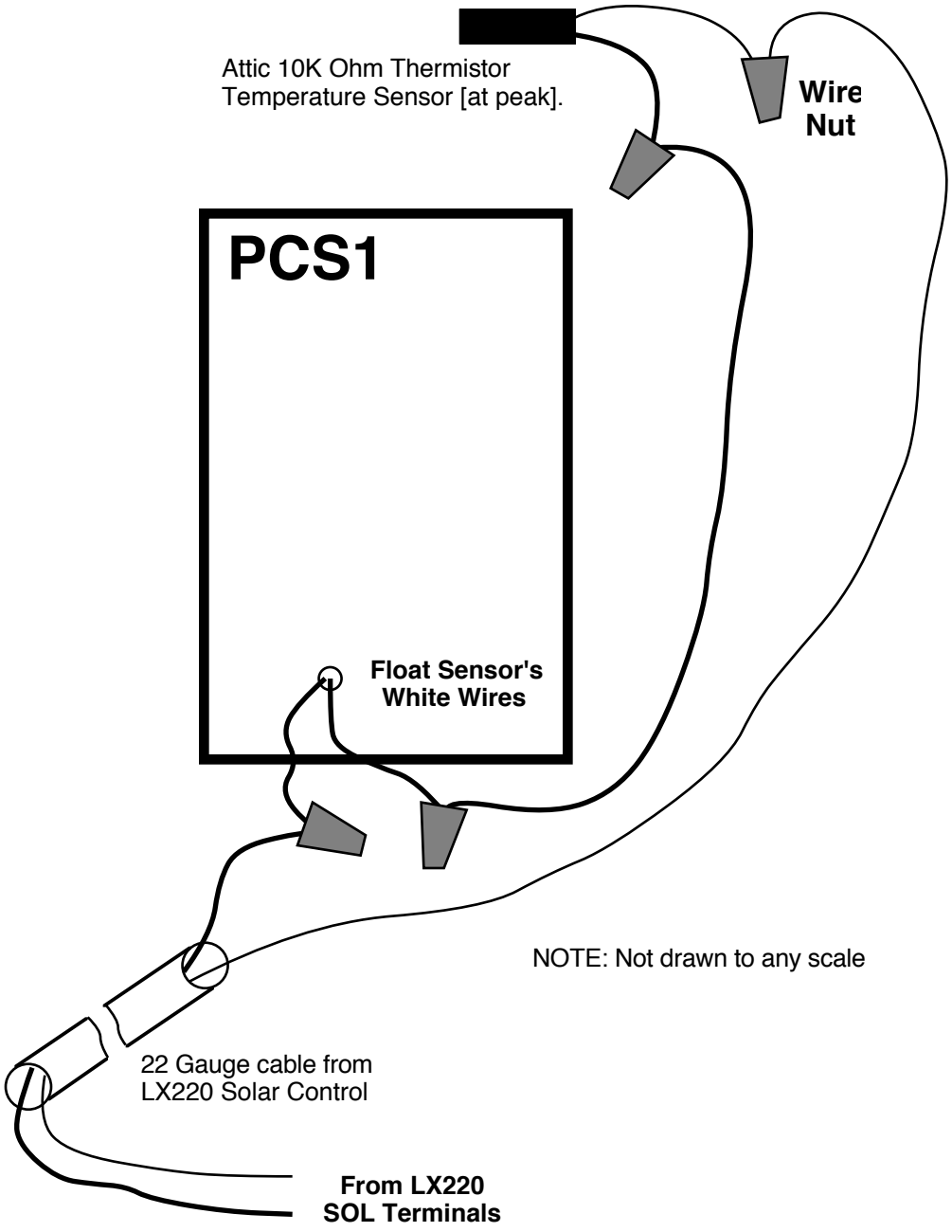
19. Some pumps may be wired to run off 110 vac. The pump is usually the source of power for the LX220 and PCS1. Check first to see if the pump is capable of running off of 220 vac. Most pumps can be simply "switched" at a rear panel to run off 110 or 220 vac. If the pump can run off of 220 vac, we recommend that the pump be switched and that the power be rewired at the circuit breaker panel from 110 to 220 vac. This simplifies the electrical wiring.

If the pump only runs off of 110 vac, this power can still be used to run the LX220. However, a separate electrical run will have to be made to the LX220 from the power panel for 220 vac PCS1 power. This 220 vac is then run from the LX220 [from the power relay] up to the PCS1. **The LX220 power relay controls the PCS1!**

ELECTRICAL WIRING DIAGRAM



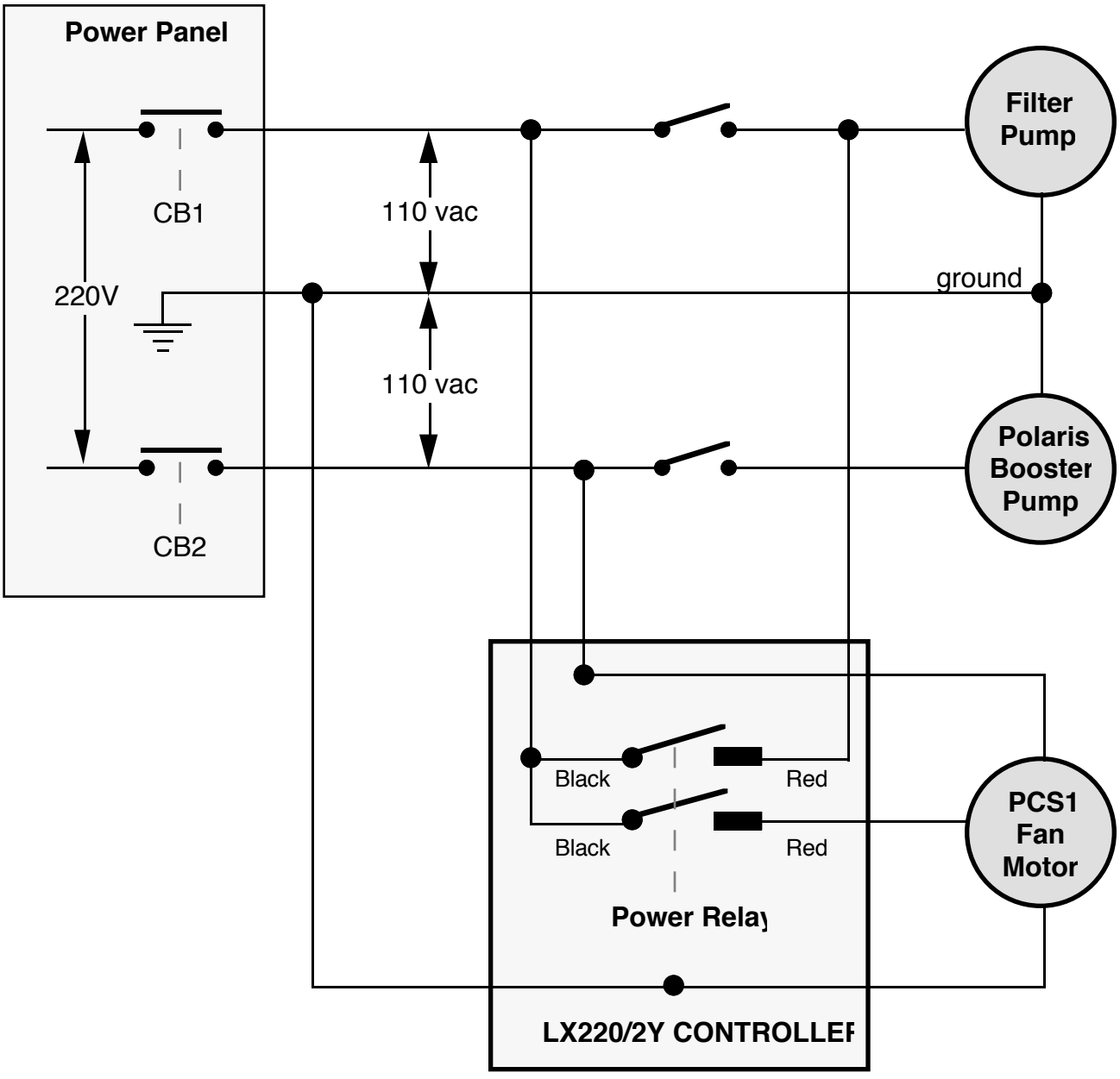
INTERNAL FLOAT WIRING



The attic based solar sensor [thermistor] must be wired "IN-SERIES" [in-line] with the leak detection float's white wires [AS SHOWN ABOVE]. The float is a closed circuit switch. If excess water should ever occur inside the PCS1, the float rises and the switch opens. In AUTO mode, the LX220 interprets this open circuit condition as a cold attic and shuts the bypass valve off. The LX220 "Solar Sensor Service Req'd" light will then turn ON indicating a need for service.

POLARIS POOL VAC

Alternate Wiring Diagram (A)



Description of Operation

Alternate Wiring Diagram (A)

POOL'S ORIGINAL WIRING

This pool was equipped with both a filtration pump and a polaris booster pump [for cleaning the pool via a polaris vacuum sweep]. Both pumps were wired directly from the power panel through different [and adjacent] circuit breakers. Each pump had its own "manual" on/off switch. Each pump was wired to operate off of 110 vac. Because of adjacent circuit breakers being used, 220 vac was present at the support system manual switch boxes.

WIRING THE LX220

Wiring the LX220 was accomplished directly above the manual on/off switches. 110 vac was taken from each manual switch for use in the LX220 as 220 vac for the PCS1. The LX220 itself could have been wired to operate from either 110 vac or 220 vac. The PCS1 **requires** 220 vac at 1.8 amperes.

PUMP OPERATION

The 110 vac from the filtration pump was fed back to the other side of the manual switch. This allowed automatic operation or manual operation of the filtration pump.

POLARIS VAC SWEEP OPERATION

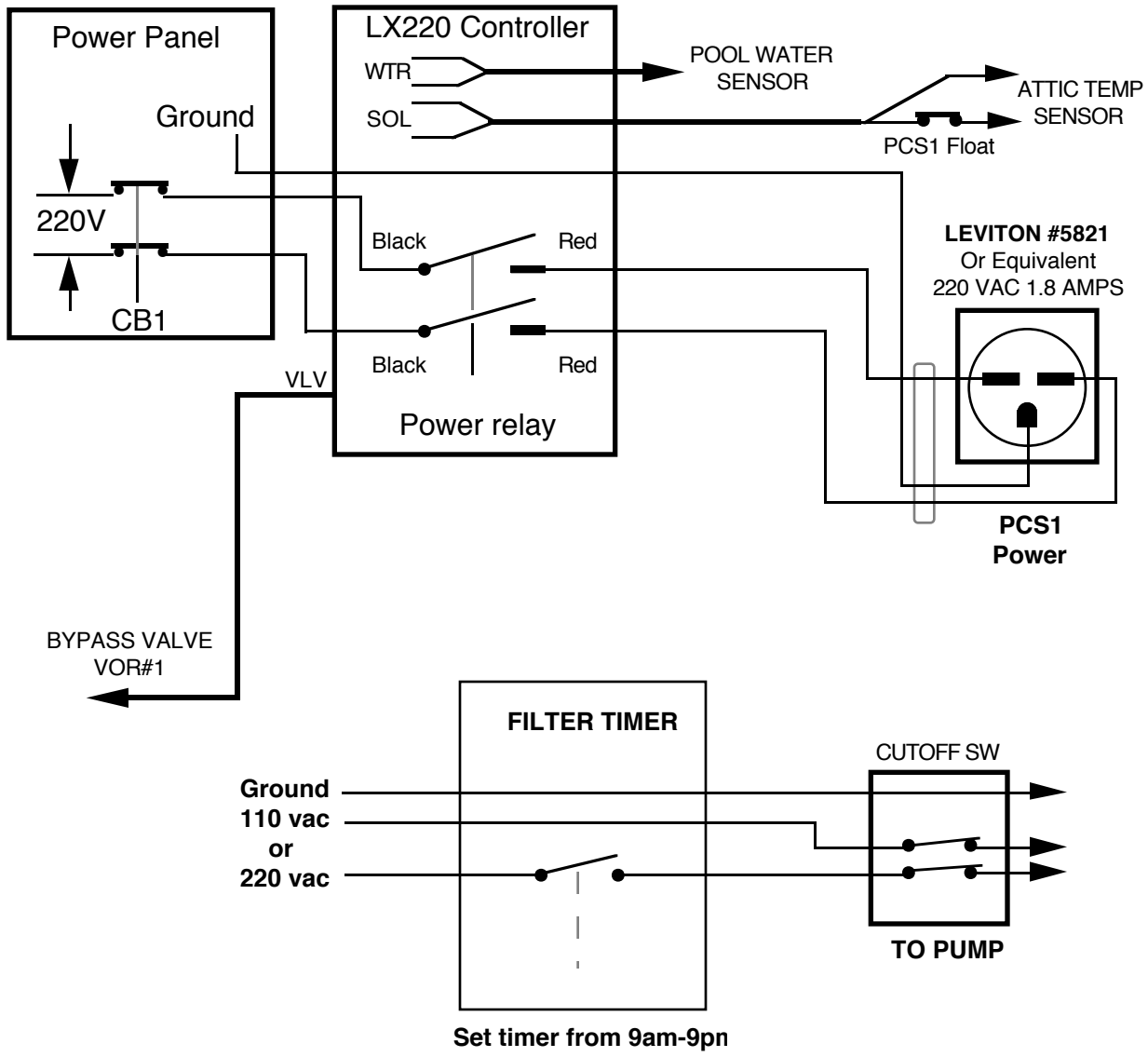
Operation of the polaris vac sweep is accomplished manually when both switches are on. During this cleaning operation, solar heat collection occurs automatically when the bypass valve turns on routing the pool's water through the PCS1. Automatic operation of the polaris vac sweep can be accomplished via a second internal sweep relay inside the LX220 [optional].

CAUTION NOTES:

The booster pump must not be operated when the filter pump is off and the PCS1 should not be equipped with a solar drain down kit unless a sweep delay relay is used in the LX220 to delay the startup of the booster pump! This prevents air bubbles from getting into the booster pump during PCS1 startup.

POOL PUMP ON TIMER

Alternative Wiring Diagram (B)



Description of Operation

Alternate Wiring Diagram (B)

POOL'S ORIGINAL WIRING

This pool was equipped with a 110 vac pump that was connected to a timer. The location of the pump, timer and PCS1 made wiring the pump to the LX220 controller a challenge. It was also the customer's desire to leave the pump wiring as it was. Leave it wired to 110 vac.

NOTE: Most pool pumps can be wired to operate off of either 110 vac or 220 vac by simply adjusting a jumper inside the rear panel of the pump. In such a case, the pump can be switched to 220 vac and rewired at the circuit breaker panel for 220 vac. This would enable 220 vac to be present at the pump's location making power convenient for wiring the LX220 and PCS1 [directly at the support system location]. It also minimizes wiring needs when dealing with a 110 vac pump.

WIRING THE LX220/PCS1

Wiring the PCS1 [alternate diagram B] uses both relay contacts in the LX220.

PUMP OPERATION

The pump operates off of the timer. In order for the solar collection process to occur, it is important for the pump to operate during the time that the PCS1 would operate. Setting the timer to operate from 9 a.m. until 9 p.m. should cover the width of time that the solar collection process occurs.

The timer width of 12 hours can be adjusted downward by observing either the PCS1 fan or the LX220's **SOLAR ON** light to determine when it turns on and off.

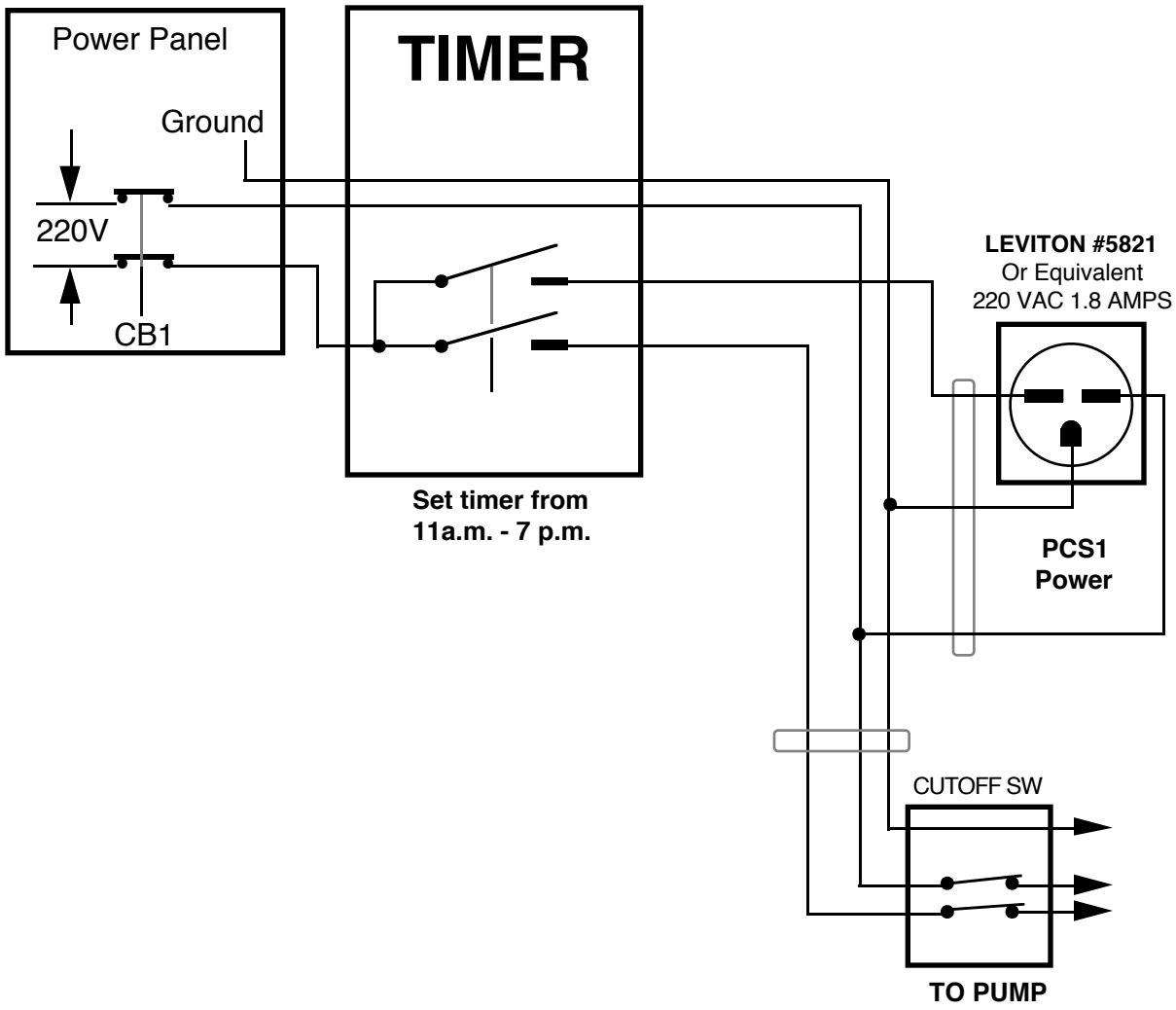
After observing solar on and off times, simply adjust the timer to operate during your local solar collection process time. This is estimated to be about 10 hours per day based on current experience.

CAUTION NOTE:

No solar collection occurs unless the pump is on while the PCS1 fan is on.

PUMP + PCS1 ON TIMER

Alternative Wiring Diagram (C)



Description of Operation

Alternate Wiring Diagram (C)

POOL'S ORIGINAL WIRING

This pool was equipped with a 220 vac pump that was connected to a timer. Both sets of timer contacts were wired to run the pump. The customer purchased a "MANUAL SYSTEM" and desired to use the timer to control both the pump and the PCS1.

WIRING THE PCS1

Wire 220 vac from the timer to the PCS1. Wiring the PCS1 in this alternate diagram C requires the use of one set of the timer's power contacts. The other set is used for the pool's pump.

NOTE: Some pool pumps are 110 vac. In such a case, 220 vac must be ran to the timer for use by the PCS1 [via the second set of power contacts].

SEMI-AUTOMATIC OPERATION

Both the pump and the PCS1 operate off of the same timer. The timer is set to operate from 11 a.m. until 7 p.m. on sunny days. This covers part of the time that the solar collection process occurs. In a fully automated system, the solar collection process could start earlier and run later if heat is available.

SECOND TIMER

Another approach to using timers for low cost semi-automatic operation is to simply use a different [second] timer for the PCS1. Make sure that both timers are synchronized or the solar collection process will be degraded.

CAUTION NOTE:

The PCS1 will cool down the pool if the attic is colder than the pool water!

STEP THREE:

AUTOMATING

The PCS1

With Compool's

LX220 Solar Controller

AUTOMATE THE PCS1

The PCS1 can have a manual on/off function if desired. Simply have a manual bypass valve and a manual power on switch. The problem with this is that the PCS1 is capable of cooling down a warm pool instead of heating it up. It will accomplish this if the attic is cooler than the pool water. Using a manual setup will always leave you guessing as to what is really happening.

Without an automatic method of controlling the PCS1, **optimum** heat collection from solar radiation will not be possible. In addition, the leak protection float inside the PCS1 only works in the automatic mode of the LX220 solar controller.

Many types of solar controllers exist. SolarAttic, Inc. specifies the Compool Corporation's LX220 Solar Controller because Compool has a proven history of reliable products. SolarAttic, Inc. has had several years of experience with Compool's superior products. SolarAttic, Inc. does not support other solar controllers.

Full automation is accomplished by the LX220 operating in **AUTO**. Follow Compool Corporation's installation instructions as shipped with the LX220.

LX220 INSTALLATION PROCESS

1. Physically mount the LX220 on a wall close to the support system. Note that the valve operator cable must connect to the valve operator located on top of the bypass valve. [The LX220 cable must reach the valve.]

2. Supply 220 vac power to the LX220 [or 110 vac].

3. Connect the LX220 internal leads for the correct voltage [220vac as shipped].

4. Wire the internal relay with 220 vac. This relay plugs into the **PMP** position on the printed circuit board.

NOTE: The **SWP** plug refers to another optional relay that is used when a polaris pool vac is used. This relay is used to delay the sweep's booster pump from operating during the initial 4 minutes of solar startup. It prevents air bubbles from entering and damaging the booster pump.

5. Connect the output of the relay to the PCS1 using one set of contacts.

NOTE: This assumes that the wiring of the pump's power will be slaved to the LX220 controller. *If not, use both relay contacts for the PCS1 power.*

6. Connect the output of the relay to the Pump using the second set of contacts.

7. Wire the auxiliary timer and other devices as may be necessary.

8. Connect the attic temperature sensor wires to the **SOL** terminals on the inside of the LX220. It does not make any difference which way the wires are connected.

NOTE: The LX220 is shipped with nonpolarized 10K thermistor sensors.

9. Connect the pool water temperature sensor wires to the **WTR** terminals on the inside of the LX220. It does not make any difference which way the wires are connected. See note above.

10. Connect the valve operator plug to the **VLV** socket.

11. Close up the front electrical panel of the LX220 and apply power.

12. Test the LX220 by switching from **OFF** to **ON** [manual override]. Observe the bypass valve operator turn on; pump turn on; and, PCS1 turn on.

13. Test the automatic mode by turning the thermostat up and down and observing startup and stop while the LX220 is in **AUTO**.

LX220 OPERATING INSTRUCTIONS

1. Set the thermostat to a relative position. We suggest you set it at maximum until the pool starts to get too warm. This will keep the solar heating process going at maximum.

2. As the pool gets warmer, you can start to lower the thermostat until you find the setting you like best.

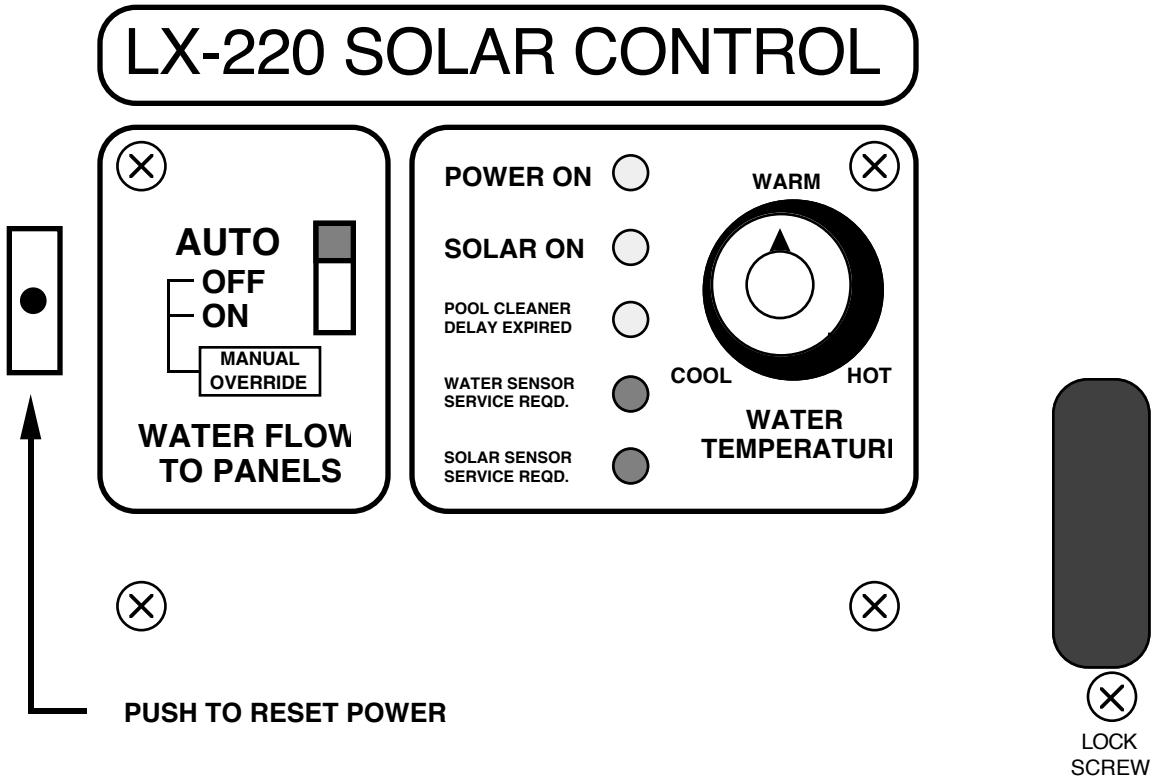
3. Place the **AUTO**/OFF/ON switch to **AUTO**.

FOR POOL CLEANING/DRAINING/BACKWASHING

Ensure the pump is on and the valves set as previously discussed.

FOR COOLING DOWN A HOT POOL

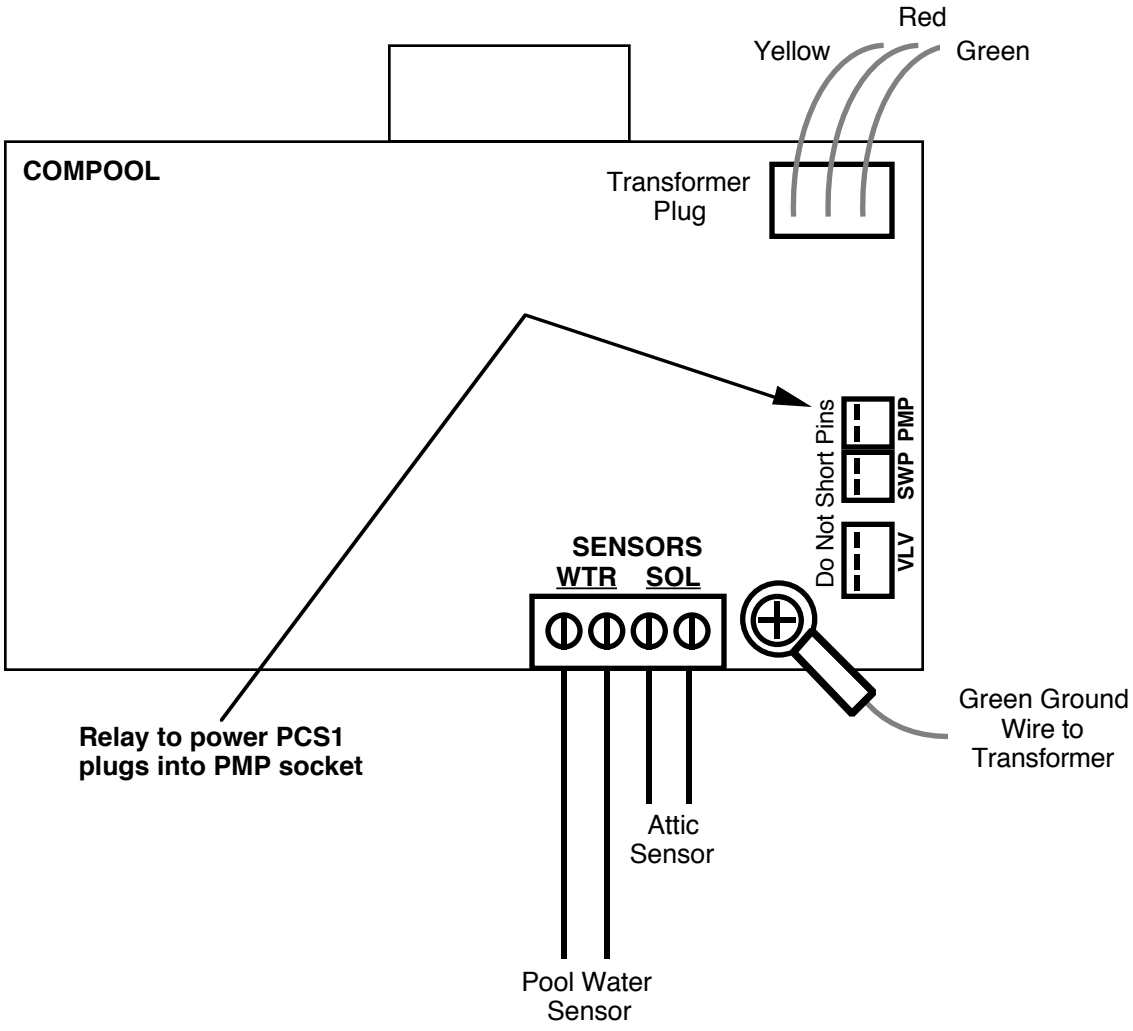
Turn the LX220 to **ON** [manual override] during evening hours when the sun has set. Manually monitor temperature drop. During the daylight hours ensure the LX220 is **OFF**.



FRONT PANEL LIGHTS

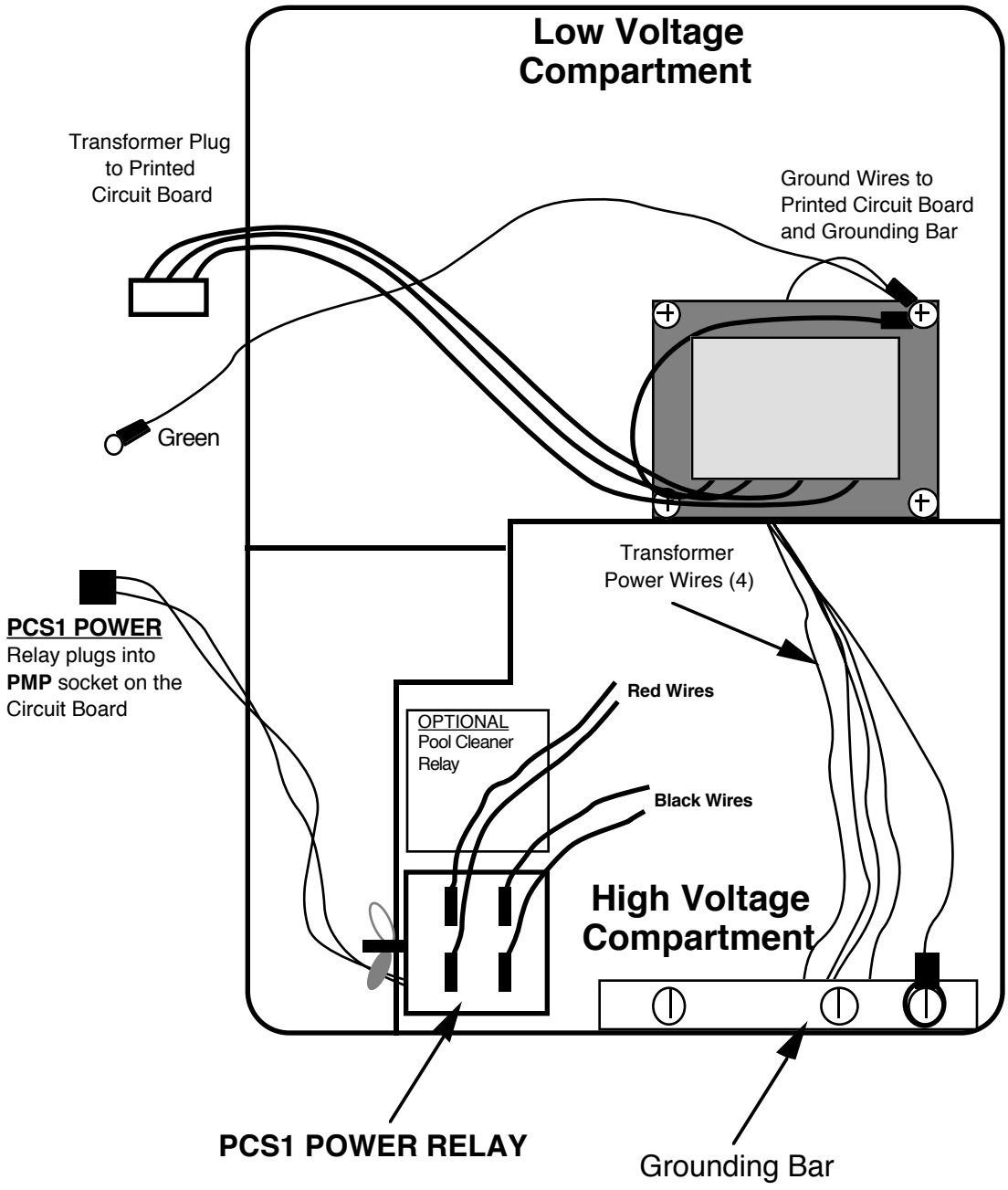
POWER ON	Indicates that electrical power is available to the LX220 solar controller and that power is available to operate both the internal relay(s) and the automated valve operators attached.
SOLAR ON	Indicates that the PCS1 is on. The bypass valve should now be routing water to the PCS1 and the fan should now have power.
POOL CLEANER DELAY EXPIRED	Indicates that power should now be available to any pool vacuum auxiliary pump that is wired to the optional second relay inside the LX220.
WATER SENSOR SERVICE REQUIRED	Indicates that the pool water temperature sensor is either open, shorted or that the electrical wire from the sensor to the LX220 has a defect. Could also be a loose screw at the WTR terminals on the LX220 electronics board.
SOLAR SENSOR SERVICE REQUIRED	Indicates that the attic temperature sensor is either open, shorted or that the electrical wire from the sensor to the LX220 has a defect. Could also be a loose screw at the SOL terminals on the LX220 electronics board. Also turns on if the internal float in the PCS1 activates to shut the system down because of a leak detection. Could also turn on if the leak detection float inside the PCS1 is defective [opened].

CIRCUIT BOARD CONNECTIONS



PMP Socket	Plug the **PCS1 Power Relay** installed at the bottom of the high voltage compartment into this socket. [See next page].
SWP Socket	Plug the optional sweep [pool cleaner] pump relay into this socket.
VLV Socket	Plug the bypass valve operator into this socket.
WTR Terminals	Connect the pool water temperature sensor wires here.
SOL Terminals	Connect the attic temperature sensor wires here.
Power Plug	The three wire keyed plug from the power transformer plugs into the upper right corner of the circuit board.
Green Ground Lug	Ensure that the green ground screw with lug is connected to the lower right corner of the circuit board.

COMPARTMENTS



CONTROLLER NOTES

1. Compool has a Limited Warranty on the LX220 and the product must be returned directly to them for service or repair during this warranty period. See warranty on back of Compool's instructions.

2. The power reset button protects the solar valve and control circuitry from electrical overload situations. It is an internal circuit breaker. Check for short circuit conditions if breaker consistently trips. Push to reset.

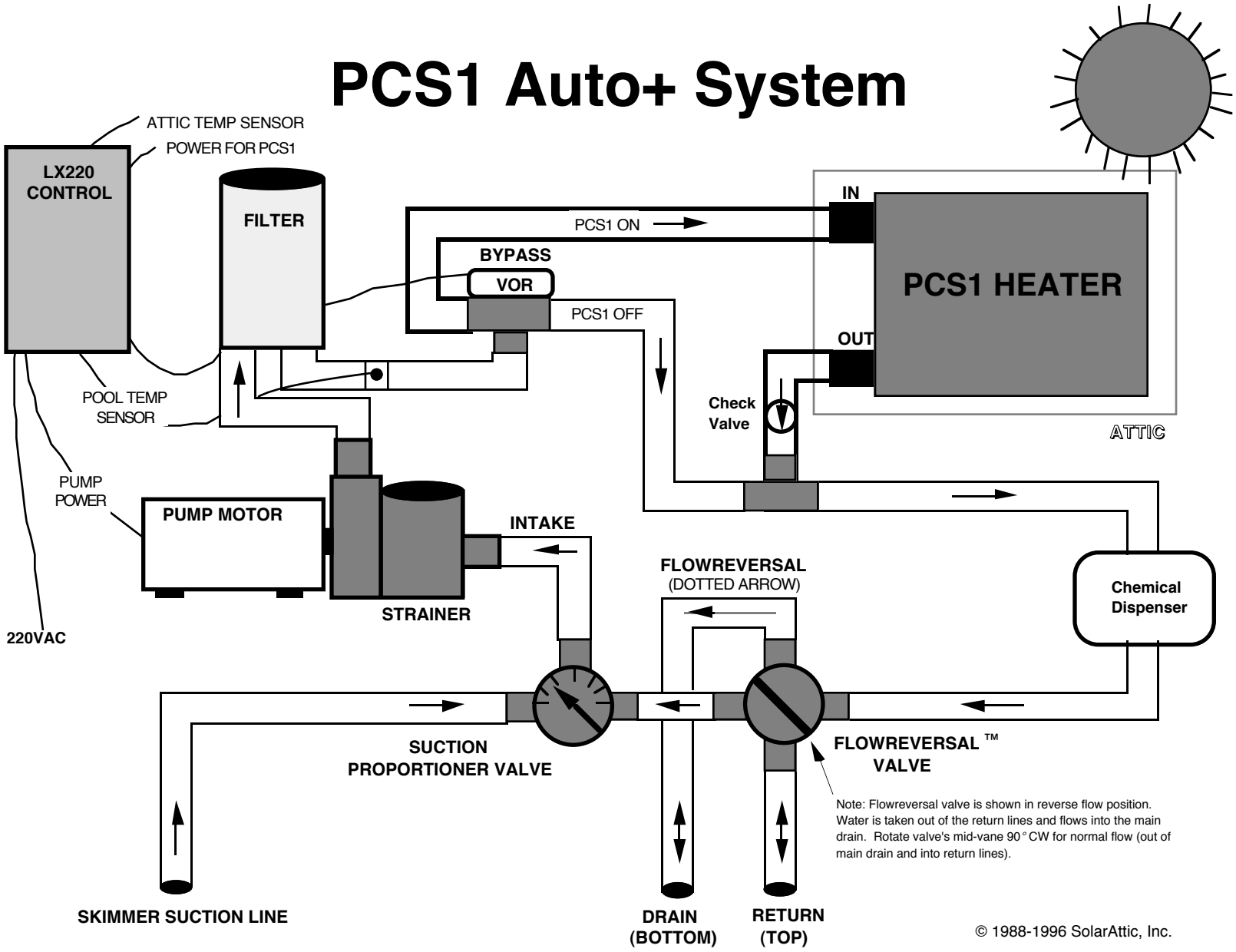
3. Always keep the cover to the LX220 closed to protect the electronic circuitry from moisture and weather exposure.

4. To install the **water sensor**, drill a 5/16" hole in the selected location and insert the sensor into the hole with "O" ring attached and facing pipe. Feed the sensor wires through hole in the clamp and gently tighten clamp around pipe. **Caution**: Over tightening of clamp can cause deformation of "O" ring seal. Run 22 gauge 2 conductor cable from the sensor to the low voltage compartment of the LX220. Strip back insulation 1/4" and connect to **WTR** screw terminals on printed circuit board. Use the UY crimp connectors supplied by Compool to provide waterproof connections between the sensor and the two conductor cable.

5. If the "water or solar sensor service reqd" lights are on—this could mean a defective sensor or loose wire(s) is/are present. An electrical ohmmeter should read resistance across the sensor's two leads. Typically 10K ohms at 68-70° F. As temperature increases, the resistance decreases. A very hot attic may cause the sensor to only read 6K ohms [6000 ohms across the sensor's two leads].

6. If the "solar sensor service reqd" light is on—this could also mean that the float inside the PCS1 has detected a condition of excess water in the base pan.

PCS1 Auto+ System



SECTION FOUR

SERVICE

SERVICE NOTES

The PCS1 is maintenance free and requires only occasional inspection to ensure everything is working properly. Here are some suggestions:

1. Inspect the PCS1 coil annually during spring startup or fall winterization for any accumulation of dust or debris from attic environment. Vacuum any accumulated dust off of the coil fins. This is not normally a problem.

2. Any time service is performed inside the PCS1, disconnect power first.

3. Any time the front grille or a side panel is off the PCS1, inspect to ensure proper operation of the float. This is indicated by the float being free to move. If the float switch was defective [open], the automatic mode of the LX220 would not work. Also, the "solar sensor service reqd" light on the LX220 control panel will be on. No debris or obstruction of the float should be present during this examination.

4. Do not lubricate the motor.

5. During startup, listen to the fan and motor. There should be mostly air flow noise associated with the fan. No bearing noise should be apparent. If so, the motor may need to be changed.

6. Some evidence of a small amount of condensate will be present in the form of a water stain in the interior of the PCS1 base pan. This is normal.

7. **CAUTION**: When working on the PCS1 where the inlet and/or outlet union(s) will be disconnected, ensure that (A) the bypass valve is in the "OFF" position bypassing the PCS1; (B) the controller is "OFF"; (C) the plug to the bypass valve operator is removed; and, (D) the manual handle for the bypass valve is removed. These precautions will prevent the pool water from accidentally being routed up to the attic during service. When reconnecting the plug to the VOR, ensure it shows "Pool" up the same as it was when it was removed [SPA up if the valve was reverse staged]. A reversed staged valve has inlet and outlets reversed.

SPRING STARTUP

1. Make a visual check of the plumbing for any deterioration or problems.

2. Visually inspect the fan blade for position on the motor. The fan should be 100% on the motor's shaft. The fan's hub should not protrude past the end of the motor's shaft.

3. Check the PVC unions on the PCS1 inlet and outlet. They should be tight. Do not over tighten as they could crack.

4. Perform other pool startup chores.

5. Restart system and inspect attic for any sign of plumbing leaks.

6. System is ready to use for the season.

WINTERIZATION

1. Winterize pool with air as you normally would. Make sure that power is off and the pump is disconnected.

2. Blow air through the PCS1 pipes until all water is removed.

3. Perform all other winterization chores.

4. Make sure all pipes by support system are drained completely or they will freeze and bust. Any suspect pipes having "trapped" water should have a hole drilled and a plug installed for winter draining.

5. Remove the PCS1's outlet union [at bottom of coil]. Tilt the opposite side up two inches and drain any coil water into a pan. Next, tilt the inlet/outlet side up two inches followed by a second tilt of the opposite side for draining any additional coil water into the pan. Repeat this process until no water drains from the PCS1.

6. Pour 1 quart to 1/2 gallon of RV [recreational vehicle] non toxic antifreeze into the bottom of the PCS1. Note: This dilutes any residual "trapped" water still remaining within the coil and insures no freeze damage. This is the same type of antifreeze used in the pool's pump and skimmers during the winterization process!

7. Reinstall the outlet union.

8. The PCS1 is winterized.

CAUTION

Failure to follow Step #6 above can lead to water coil damage! Even after Steps #1-5, the PCS1 water coil could still retain a small amount of residual water that is "trapped" within the bottom of the coil. The non-toxic "RV" antifreeze [available at local hardware stores] dilutes any residual water and prevents winter freeze damage.

WINTERIZATION

Bypass Valve Consideration

In the process of winterization, air is blown through all of the pipes to eliminate water inside of the pipes [and all valves]. The bypass valve should be exercised in both directions a few times to eliminate all of the water within the valve. This can be accomplished using the manual on/off function of the LX220 or by manually turning the valve in both positions. This should eliminate all water in the valve!

However, there have been two reported incidents of cracked bypass valves during spring start-up. The bypass valves were found to be cracked along the underside of the valve. This indicates that water was inside the valve during a freeze. This was probably the direct result of either: A) An improper winterization effort; or, B) A bypass valve that is installed in such a position to either "trap" or "collect-back" water into its base. After the pipes have been drained, a small amount of trapped water or moisture may still be present in some of the pipes or valves depending upon how the system is plumbed. If the bypass valve represents such a "trap" or a "collection point" for residual drain-back within the plumbing, it may cause damage to the valve. Water that freezes needs expansion space.

Two approaches can be used to eliminate this type of "plumbing" problem: 1) Install a small drain hole, valve or pitot tube near the bypass valve to drain off any water that could get trapped, drain-back or accumulate back into [or at] the bypass valve. An examination of the plumbing should reveal if any trapped water or drain-back of moisture would be accumulated inside of the bypass valve. OR, 2) Remove the valve operator, top screws and internal valve diverter. Inspect for water accumulation after winterization. There shouldn't be any. Non-toxic antifreeze can be poured into the valve if desired. >>#1 is a common approach used in plumbing.

CAUTION

The bypass valve should be installed in such a way that moisture or water does not get trapped into the valve or is allowed to drain-back or accumulate inside the valve's body after winterization. This can create damage to the valve during the winter freeze cycle. Also, improper winterization of the valve will lead to damage.

FREEZE WARNINGS

Not all swimming pools require the winterization process as described on the preceding page. For example, swimming pools located in Florida and elsewhere do not require this winterization process. These pools are not located in "hard-freeze" locations [like Minnesota].

However, in some areas that do not winterize the pool, there is still the possibility of a period of one or more days when temperatures below freezing are occurring [or being forecasted] by prevailing weather. OR, you may be simply late in getting around to winterizing your pool. What do you do in such an instance?

The standard operating procedure in such an instance is to **keep the pool's filtration pump running** during this brief period of freezing temperatures. This also pertains to the PCS1. You should keep water running through the PCS1 during this period of time.

Operating Procedure

1. Ensure that the pool's pump is manually ON.
2. Ensure that the bypass valve is manually ON.
3. Keep water flowing through the pool's pipes and the PCS1 until freezing temperatures are no longer present.

CAUTION

Failure to keep water running [flowing] in such an instance can result in damage to the pool's plumbing, support system and the PCS1.

UNATTENDED POOLS

Sometimes it may be necessary to leave your pool unattended for an extended period of time. For example: this could be a two week vacation or any other situation where the pool will be left alone and unattended. In such a situation, the pool's water chemistry is a serious concern for the pool owner.

CAUTION: Leaving pools unattended for an extended period of time can lead to poor pool water chemistry. This can then lead to an acidic pool condition which is capable of eating [etching] away the metal throughout your pool's support system equipment. This includes the PCS1.

One simple solution is to always have someone, who knows what they are doing, maintain your pool water chemistry during this period of time. A second solution is to use automatic chemical dispensing equipment while you are away. Equipment you trust and is capable of maintaining your pool's water chemistry while you are away.

WE RECOMMEND: That the PCS1 be turned off when the pool will be left unattended for extended periods of time. This can be accomplished by turning the LX220 controller to the "OFF" position. Additional security can be obtained by removing the bypass valve's "plug" and the bypass valve's manual "handle". Before restarting the PCS1, ensure that the pool's water chemistry has not degraded into an acidic condition.

Following these simple precautions will extend the life of your PCS1 solar swimming pool heating system.

TROUBLESHOOTING GUIDE

CAUTION: *Some tests require electrical skills because of the presence of high voltage.* ***The danger of a fatal or serious shock hazard may be present. These tests are indicated by boldface times italic font [characters like these].*** *If you do not possess the electrical skills required to perform these tests, obtain the services of a qualified electrician.*

SYMPTOM	CHECK
The LX220 POWER ON light does not light. Note: the SOLAR ON light is not ON when the LX220 is in the "Manual On" position.	1. Push RESET button on LX220 Front Panel. 2. Check for tripped breaker at the main power panel. 3. Ensure that timers are turned on. ***4. Check for loose power wire nut inside LX220.*** ***5. Check for 220 vac power inside the LX220 with voltmeter.***
PCS1 FAN does not turn on. Note: Solar On light is On. Sensor Service Required lights are Off.	1. Thermostat is set too low on LX220. Turn to maximum. 2. PCS1 is unplugged at attic outlet or power is missing. 3. Power is incorrectly wired at LX220. 4. LX220 relay is not activating; unplugged; or defective. 5. Internal motor thermal cutoff. Wait 15 minutes & retry. 6. Defective PCS1 power cord or plug. 7. Defective 5μf starting capacitor. 8. Defective Motor. 9. Defective Solar controller. ***10. Check for 220 vac at attic outlet with voltmeter.***
Valve Operator rotates in wrong direction. Note: "Solar On" turns water off to PCS1.	1. Valve operator plug is upside down. Check for "Pool" UP. 2. Valve was mis-staged as it was assembled. Reverse plug to "Spa" UP for correct operation.
Valve Operator does not rotate to proper stop position. Note: Valve stops before it should.	1. Internal limit switch needs adjusting. 2. Internal cam needs adjusting. 3. Internal mechanical stop needs adjusting.
Valve Operator only rotates in one direction. Note: I.E. Valve rotates to ON position but will not rotate to OFF. POWER ON and SOLAR ON lights are both on. Sensor Service Required lights are both off.	TEST: Reverse plug on VOR to "Spa" UP. Result A: Valve still does not rotate. 1. Defective limit switch mechanical stop inside of valve operator. 2. Defective internal limit switch inside of valve operator. 3. Defective limit switch circuit inside of valve operator. 4. Defective valve operator. Result B: Valve now rotates in other direction. This indicates that the valve operator is okay. 1. Defective solar controller.

Valve Operator rotates slowly. Note: Valve operator creeps and doesn't reach its end stops.	1. Transformer plug to LX220 printed circuit board is reversed causing 12 volts at valve operator instead of the required 24 volts. 2. Defective valve operator.
WATER SENSOR SERVICE LIGHT IS ON	1. Shorted pool water temperature sensor. 2. Open water sensor. 3. Cable problem from LX220 to water sensor. 4. Loose screw at LX220 WTR terminals.
SOLAR SENSOR SERVICE LIGHT IS ON	1. Attic temperature sensor is connected in parallel with PCS1's internal float wires. Connect temp sensor in series with white wires. 2. Loose screw at LX220 SOL terminals. 3. Cable problem from LX220 to attic temperature sensor. 4. PCS1 is mounted upside down causing open float condition. 5. Leak detection float inside PCS1 is detecting excess water. 6. Leak detection float inside PCS1 is defective. 7. Shorted attic temperature sensor. 8. Open attic sensor.
INSUFFICIENT HEATING Note: PCS1 does not appear to be heating the pool.	1. Poor solar weather [No Sunshine]. 2. Pump Timer(s) out of sync with solar energy collection time. 3. Water flow valves to PCS1 are shut off. 4. Bypass valve operator does not route water to PCS1. 5. Pool Cleaner water flow interfering with PCS1 water flow. 6. LX220 is not in "Automatic" mode. 7. LX220 Solar Controller does not supply power to PCS1. 8. PCS1 water flow and fan power are out of sync with each other. 9. Defective temperature sensor(s) or Open leak detection float. 10. Defective fan motor on PCS1.
SHORT SEASON Note: The swimming season is not as long as you would like but the PCS1 is heating the pool.	1. LX220 is not in "Automatic" mode. 2. Heat loss opportunity exceeds heat gain opportunity. I.E. The pool is uncovered and the nights are cold causing excessive heat loss which is not recovered during the solar day. Solution: Use a pool blanket or cover to eliminate the excessive heat convection losses which occur directly from the surface of the pool. This will allow the pool to retain the free solar heat and extend the swimming season. 3. Solar heating capacity and pool heat retaining capacity are no longer adequate for the current season's weather. Solution: Use a backup heater to further extend the swimming season until the pool has to be winterized [if required].
PCS1 TURNS ON AT NIGHT Note: No attic heat is available for the pool. The attic is cooler than the pool or the same temperature.	1. Pool water temperature sensor exposed to cooling winds, rain, etc. giving the LX220 a false indication of cold water temperatures [the attic falsely appears much warmer than the pool causing the PCS1 to cycle on]. Solution: Insulate the pipe around the water temperature sensor and cover with plastic to waterproof.
PCS1 OR FILTER PUMP DOES NOT TURN OFF Note: LX220 is on auto and switching the control to the manual off position has no effect. However, tapping the relay turns the system off.	1. Relay's wing nut is too tight. Loosen the relay's mounting wing nut so that the wing nut is just holding relay in place. Overtightening of the wing nut can close the gap between the relay's contacts. This can cause the relay to operate and appear like the system is turned on.

EXCESSIVE VIBRATION	1. Unbalanced fan blade. 2. Loose fan blade. 3. Loose motor mounting or cabinet hardware. 4. Lack of foam base for PCS1 to rest on. 5. Rigid mounting PCS1 to building structure. 6. Contamination on fan blade causing imbalance. 7. Motor bearings defective.
HIGH PRESSURE AT FILTER Note: Total pressure should be less than 25-30 lbs in the typical installation with a clean filter.	1. Backwash and clean filter. 2. Check position of valves within support system. Incorrectly positioned valves can restrict water flow and increase pressure with the system. 3. Contact pool servicer. Problem is not in PCS1 system.
POOR CIRCULATION Note: pool water gets cloudy.	1. Clean filter. 2. Check valve positions. 3. Check water flow rate from pump. 4. Check pump sizing. 5. Contact pool servicer. Problem is not in PCS1 system.
HIGH ELECTRIC BILL	1. Check to see how many hours the filter pump is running. 2. Check the condition and size of the filter pump. 3. Wire the filter pump to the LX220 power relay and use a minimum runtime timer to ensure that only a minimum filtration time is achieved. Place LX220 in AUTO. This combination maximizes solar collection and minimizes the energy required to accomplish it. 4. Problem is not the PCS1. It only draws 1.8 amps maximum and its energy use is easily determined within a range of $3.00 minimum to $20.00 Maximum per month depending upon local electricity rates. At 9¢ per kilowatt hour and 10 hours per day, the PCS1 will cost an estimated $11.00 per month to operate. 5. Have an energy audit performed.

FACTORY HELP

Still experiencing problems after the above tests? Call the factory at (612) 441-3440 for further assistance. Our FAX number is (612) 441-7174. We'll be glad to assist you!

SECTION FIVE

REFERENCE DATA

Note: Each part of this reference section is identified separately by its contents. For example: Common Questions are identified as pages "***Common Questions*** *Page 1 of 10", etc.*

COMMON QUESTIONS

The Company

1. Who is SolarAttic, Inc.?

SolarAttic, Inc. is a Minnesota Corporation engaged in the research, development, and manufacturing of products that use attics as energy vehicles. The company's first product heats swimming pools using attic heat derived from solar radiation.

2. How long has the company been in business?

Pool Heat Company, a proprietorship, existed from 1/1/84 to 8/10/86. On 8/11/86, the company incorporated itself as Attic Technology, Inc and on 7/15/93 changed its name to SolarAttic, Inc.

3. Does the company have any business references?

Bank reference is Richard Gongoll, President, First National Bank of Elk River, MN (612) 441-2200. Company is registered with the Securities Division of the State of Minnesota and makes Annual Business filings with the Office of Secretary of State. Corporate charter is MN number 5H-1049.

4. Does the company accept credit cards for purchases?

The company currently accepts VISA, MasterCard and American Express.

The PCS1

1. Is the PCS1 UL LISTED?

Electrical components are UL Approved. The Coil is UL listed under file SA 2322.

2. What is the life expectancy of the PCS1?

It has a 20 year design life under optimum conditions. The primary life factor is the pool's water chemistry. Pool water properly maintained should not smell of chlorine, should be crystal clear visually, and should be potable water [drinkable]. To the extent the pool's water is not like this, it will shorten the life of all of the pool's support equipment in addition to shortening the life expectancy of the PCS1. The PCS1 has extended life characteristics when compared to heat pumps or fossil fuel heaters.

3. Is the PCS1 easy to service?

Yes, the front grille and a side panel are removable for ease of service.

4. Is the PCS1 FUSED?

The PCS1 motor is thermally protected against overload with an automatic reset.

5. **What kind of electrical power is required?**

220 vac is required. Full load amperage is 1.8 amps. A separate, 15 amp circuit, with a double pole safety cutoff switch and outlet by the PCS1 is recommended. The PCS1 must be wired in accordance with local, state, & national electrical codes.

6. **Is there any condensation in the attic at high humidity levels?**

Under extreme test conditions, very little condensate was evidenced. Under normal conditions, the bottom pan may collect minor amounts and it then will evaporate. This same technique is used on modern frost free refrigerators. The PCS1 provides for this collection and evaporation when mounted upright. In areas where concern exists, the bottom pan can be tapped and drained off. Any condensate can also be collected as distilled water if bottled.

7. **What is the optimum heating system configuration?**

PCS1 which exchanges free solar heat inexpensively from the attic into the swimming pool, a flowreversal™ valve that ensures the pool is efficient in its heat needs and a pool blanket to minimize losses during extended periods of non use.

8. **The PCS1 looks like a radiator?**

The principles of operation are similar but the radiator was designed for cars. The PCS1 coil was custom designed specifically for the needs of pools.

Technical Issues

1. **How does SolarAttic measure the BTU ratings? Sensible only or with latent?**

All quoted BTU ratings are sensible heat figures only. Delta temperatures can be measured with temperature sensors & sensible heat calculated. BTU figures are significantly higher if latent heat figures were included. BTU figures are higher under high humidity conditions as humid air contains more heat. BTU figures were calculated and measured under conditions of 20-30 % RH.

2. **How hot do attics get?**

Attics have been measured at 160 degrees Fahrenheit.

3. **How do I get the PCS1 into the attic?**

A) In a walk-in attic, no problem, just carry it up. B) In an attic with a 2x2 foot access, enlarge the access to 2x4 feet. C) Cut into the end of the house at the peak to access the attic, then cover hole with a vent grille [found at lumber yards & building stores]. D) Cut a new access hole into attic from the inside; the unit fits between standard 24" OC [on center] trusses. E) Disassemble the unit and reassemble it in the attic [not recommended; but, can be done]. F) Cut a new access hole in the roof and mount the PCS1 on the roof with a rain cover & condensate drain provision.

Note: the PCS1 mounts in any direction, but any direction other than horizontal requires a condensate drain provision. Use your imagination and create a list of 10 different ways for each new installation. Then select the best way, keeping the plumbing considerations in mind. This is called possibility thinking!

4. How can I hide the plumbing?

You also have to use some imagination here. In new home construction, simply build the pvc pipes into the walls. In homes with a garage next to the house, access to the main attic can usually be achieved through the garage roof and pipes can be concealed. Pipes can also be hidden in larger 4" pipes or with a wood frame around the pipes for the short distance from the garage roof to the main attic area. Plastic rain gutters can conceal pipes running up the side of a house. Also, the pipes can be ran up to the attic in an out of the way or non obtrusive location where it is not necessary to hide them.

Experience indicates this will not be an issue in the majority of cases. Pool owners are already used to electrical pipes, rain gutters and other pipes running up the outside of their homes. Neatly installed pipes running vertically from the support system equipment area into the attic through the eaves should be acceptable. Actual installation conditions and consumer preferences will usually dictate what has to be done.

5. What kind of pipe should I use?

Rigid CPVC 2" is recommended for increased flow and resistance to solar deterioration. Also PVC pipe 1-1/2 or 2" can be used. If outdoors, and PVC pipe is exposed to the sun, it should be painted to prevent deterioration of the plastic. Flex PVC pipe manufacturers state that it sags at 150° F temperatures and should only be used cautiously inside an attic. If the pipe will not drain down automatically in the system, this lessens the flex pvc temperature due to the water inside the pipe. Plumbing must be installed in accordance with state and local codes and good trade practices.

Experience has shown that a continuous length of flex pvc to and from the PCS1 in the attic and extending outside of the eaves where it is connected to rigid pvc pipe is acceptable. Rigid pvc pipe is used from this point throughout the rest of the support system. With the PCS1 installed in the attic, extended periods of high temperatures do not exist. Therefore, the flex pvc pipe doesn't appear to suffer. Using flex pvc inside the attic also removes any pvc cement activity which can be done outside.

6. What about roofs without four feet of height at the peak?

Roofs can be modified to accommodate the PCS1. A) By mounting the PCS1 at the end of the house vs inside the attic. B) By mounting within the roof itself in a waterproof way and providing for condensate drain. NOTE: The objective is to allow the roof to function as a collector and to pull heat from the inside of the roof and attic area. Once again, this is an area to use some imagination and creativity. List 10 possibilities!

7. Will the system work in all attics?

NO: Attics should be the main house attic with a square foot area greater than that of the pool's. In addition, see attic selection criteria below to determine effectiveness of attic.

8. What are some attic selection criteria to consider?

Black roofs are better than white; non shaded roofs are better than shaded roofs; all power ventilators must be disconnected; roof area should be at least two times pool area. i.e. 600 sq ft pool= 1200 sq ft roof **OR** the ceiling area (sq ft of the house) should be at least equal to or greater than the pool's sq ft area; insulation level is not a critical factor; interior of roof should not be insulated or lined with heat resistant material.

9. **Will there always be enough heat from my attic for my pool?**

No: Just like other forms of Solar heaters, the results will depend upon weather conditions. But, unlike solar panels, orientation to the sun is not a critical factor and the roof itself presents a more "massive collector".

10. **What about leaks in the attic?**

This is a real concern and represents the number one sales objection that people may have. Many water products are installed in attics and on roofs around the world. There is nothing that unusual about the concept. These products operate at 60 psi or even greater pressures. Is there a 100% guarantee that no leak is possible? The answer is NO. For the same reason you can't guarantee that your kitchen sink won't leak! To properly answer this valid question requires a knowledge about the operating environment of the PCS1.

The PCS1 coil is tested under water with dry nitrogen at 350 PSI and operates under no significant amount of pressure because the swimming pool is an "open container". In operating tests, the PCS1 was shown to only add 2-6 PSI to the existing system's pressure. This typically means that the total system pressure the PCS1 is exposed to is 20 PSI or less. It is therefore, highly unlikely, that any leaks could occur in the PCS1 as a result of pressure. Again the PCS1 is factory tested at 350 PSI under water with dry nitrogen and operates at 20 PSI or less.

A second issue is the plumbing to and from the PCS1. Here again are the dynamics of the pool. PVC pipe is rated at 120 PSI and again the system only operates at a fraction of this. It is important that all plumbing be professionally installed and that no questionable plumbing joints be accepted.

An acidic pool condition could quickly eat away the coil causing a "hole". In addition, an improperly winterized system could result in a "hole" caused by freeze damage to the PCS1 coil. The latter case has already occurred and the result was a small leak in the attic estimated at 1-2 gallons per minute. The system was turned off quickly and only a minor ceiling stain resulted from this leak. Had this system been inspected prior to spring startup, no problem would have occurred since the "hole" caused by improper winterization would have been detected and repaired first. It is recommended that an annual inspection be made at spring startup to ensure all pipes and other system parts are functioning properly and that no deterioration or freeze damage has taken place within the attic.

Design protection has been added to the PCS1 in the form of an internal float within the base pan. In a normal instance, only a pint or two of water would collect and eventually evaporate. In the event of a leak in the coil that sprayed water into the PCS1, the float would rise and automatically turn off the PCS1 when the water level exceeds 3/8 inch. Cutoff is accomplished by opening the attic temperature sensor which causes the solar controller to turn the bypass valve off. Note: this protection is only afforded when in full automatic mode with the solar controller. Turning the unit on “manually” ignores this protection feature.

Added protection can be obtained by using a simple leak protection liner placed under the PCS1. This can be in the form of a small kids plastic swimming pool which is tapped into with a garden hose and drained off to the pool area. The company expects to have a custom leak liner available in the future for purchase.

The biggest threat to the PCS1 is a poorly maintained swimming pool that turns acidic. Your pool water should be crystal clear, not smell of chlorine and be potable [drinkable]. This is not hard to obtain from proper pool water maintenance. If you have questions -- contact your pool chemical dealer and get educated. In the event an acidic pool does causes damage to the PCS1, the small amount of leaking water would either cause the PCS1 to automatically shut itself off or be collected safely and

drained off [by liner]. Any serious accidents to the attic or ceiling area are usually covered by homeowners insurance policies. Policies do not usually cover replacement of equipment and repairs due to owner negligence!

Further protection can be achieved by mounting a sheet metal plenum on the coil end of the PCS1 and connecting the other end of the plenum to flexible duct. In this scenario, the PCS1 would be installed over the garage area and draw air from the main attic. To be effective, it must have a clear path to draw and return the hot attic air. This technique has been used and works very well. The company expects to have a custom plenum kit available in the future for purchase.

11. How do I plumb the PCS1 into the system?

The PCS1 is plumbed into the support system after the pump and filter. Any chemical dispenser must be downstream of the PCS1 and should have a chemical check valve installed.

12. What does flowreversal™ do?

Flowreversal™ reverses the flow of water in the pool. It takes water off of the top of the pool and returns it to the bottom of the pool for more effective heating. In tests, the pool's heating needs have been demonstrated to be significantly less (1/3 rd to 1/2 less).

No degradation of filtering or cleaning effectiveness occurs. In fact, the pool appears visually the same to the pool owner in either normal or reverse flow. Flowreversal™ is accomplished by the simple 90° turn of a single manual valve. A proportioner valve is used in conjunction with the flowreversal valve to effect proper skimmer action during reverse flow. See plumbing diagram.

Experience has shown that a swimming pool can simply be left in reverse flow unless the pool is being cleaned or drained. Flowreversal™ enables the pool to be efficient in its heat needs. This in turn allows the PCS1 to provide greater capacity and heating margins in adverse environments. The PCS1 has been found to work effectively without the flowreversal valves. However, the swimming pool is considerably more comfortable with the valves [especially large or deep pools]. Flowreversal™ is a trademark of Mark Urban of Tustin, California.

13. Can I use a heat pump in my attic?

No: Heat pumps are not designed to withstand the extreme attic temperatures. Operating a heat pump in an attic will lead to failure of the compressor system.

14. What is the difference between the PCS1 and Heat Pumps?

In a comparative energy study, heat pumps were found to use seven to twenty-eight times the electrical energy! With the average heat pump using 12.1 times the energy use of the PCS1. Heat pumps use Chlorofluorocarbon chemicals [CFC'S] in the compressor heat producing cycle. These chemicals pollute our environment by damaging the earth's protective ozone layer. The PCS1 uses no chemicals. The PCS1 also has extended life characteristics when compared to heat pumps.

15. How does the "Coefficient Of Performance" [C.O.P.] compare with heat pumps?

A typical heat pump C.O.P. is calculated as follows: 57,000 btus output/11,977 btus input= 4.75 x 100 = 475%. For comparison, the PCS1 is calculated as follows: 60,000 btus output/1351 btus input= 44 x

100= 4400% EFFICIENT. In other words, the PCS1 has ten times the efficiency of the typical heat pump and 44 times the efficiency of electric resistance heaters.

16. **How does the system really work?**

The roof functions as a "massive solar collector"---collecting solar heat. The attic functions as a heat storage and transfer device---storing and transferring solar heat. And, the PCS1 functions as an "exchanger" that exchanges the heat from the attic into the pool. This is a continuous solar process.

17. **What's the worse that can happen with a conventional heater's operating costs?**

The kids can turn it up to maximum and run up hundreds of dollars in energy bills while you are away!

18. **What's the worse that can happen with the PCS1 heater's operating costs?**

On a cloudy and cold day, you won't get much heat. You will never get a high energy bill!

19. **What are the optimum installation conditions?**

A non dusty environment; a non corrosive atmosphere; proper Ph chemical balance between 7.2 and 7.6; automatic chlorine dispensing to keep levels below 3 parts per million or the use of a nonchlorine alternative; a water flow rate of 45-55 GPM; black roof; sunny roof; sunny pool; manual Flowreversal™; use of a pool blanket during extended periods of non use; a non salt water pool; some shelter of the pool to minimize convection losses. Plus other factors that help minimize a pool's heat losses.

20. **Can the PCS1 heat spas?**

Yes! The PCS1 has been used to heat water up to 105° F. SolarAttic, Inc. expects to have a separate spa version on the market sometime in the future.

However, in the meantime, **another opportunity avails itself**. That is the sharing of the heat from the attic with both the pool and a spa. This is especially true during periods of time when the pool cannot use the heat available. During these times, the heat can be channeled 100% of the time into the spa. A recent study showed that up to 25% of new pool installations are being installed with a spa attached to it.

To share the heater requires the use of a Share-a-Heater™ valve. With a simple 90° turn of a single valve, the spa can be heated instead of the pool. The valve allows the sharing of a single heater and it can be automated. Share-a-Heater™ is a trademark of Mark Urban and Innovative Pool & Spa of Tustin, California.

21. **How does the color of the roof affect performance?**

The following factors give you an idea of how roof color affects heat. (See paragraph below)

Black	1.28
Dark Blue	1.21
Blue	1.14
Dark Brown	1.07
Brown	1.00
Red	.86
Green	.71
Dark Gray	.71
Gray	.57
White	.57
Smooth White	.36

If good conditions exist for the pool, then just about any color of roof may be acceptable with the PCS1, Flowreversal™ and the use of a blanket. This would be especially true on relatively small pools (450 sq ft) and large roof areas. Grey, white, and smooth white may be marginal on a large pool with an extremely small attic to draw from. The above factors can be interpreted as follows: The PCS1 will perform nominally, or 1.00, with a Brown roof.

Other colors will increase or decrease relative performance, however, a large roof with a poor color factor may out perform a smaller roof with a good color factor. Due to the solar radiation and BTU availability. Larger numbers are better performers.

22. **What are some environmental factors?**

Outside blanketed pool & Flowreversal™	2.00
Outside blanketed pool	1.00
Screen & blanketed pool	.80
Outside, blanketed & windy	.67
Outside without blanket	.42
Screen without blanket	.33
Outside, without blanket & windy	.29
Water table (multiply above factors by)	.80

The above environmental factors show that the PCS1 will perform twice as good with Flowreversal™ and a blanket. The larger the number, the better the conditions of performance with the PCS1. **The dealer or purchaser is responsible for determining whether the PCS1 is suited to a particular installation and operating environment.**

23**. Is there a simple test to determine if an attic will be good enough?**

Yes, generally. On a 70° F sunny day, find out what the temperature is inside the attic at its peak. Acceptable attics will be 100° F or higher. Take the test when the Sun is shining and between 1-4 pm in the day. Power ventilators must be turned off the day before.

Some natural air vents or wind driven turbines may have to be shut off also. This test assumes that Flowreversal™ and a blanket are used with the system and that the attic is equal to or greater

than the pool's surface size in square footage [Or, the roof itself is two times the size of the pool in sq ft area].

24. How do I know if my pool pump can handle the additional "head"?

a) determine the vertical distance from the pump to the PCS1 located in your attic; b) divide this vertical distance by 2.31 to calculate the added pressure to the pump; c) add this additional pressure to your existing pool's pressure which can be usually read directly off of a filter pressure gauge; d) ask your pool contractor if the pump installed will handle the total pressure [added lift].

An alternate approach is to use the existing pump and observe for any problems. If the pump is inadequate, poor filtration will occur resulting in a "cloudy" pool [Note: this would be the direct result of a dramatic reduction in the pool's water flow rate]. Also the pump may cutoff due to thermal overload. Repeated cutout of the pumps thermal breaker indicates the pump is too small. Upgrading by 1/2 horsepower should do the job.

You cannot simply feel the side of the pump's motor. The motor should normally be running "too hot" to touch. If the pump was sized for filtration using a timer [less than 24 hours], the pump is probably adequate in size to handle the lift to the PCS1. If the pump is running 24 hours a day [no timer], it may require upgrading. This latter case allows a pool contractor to install a smaller pump to accomplish the same filtration needs that a larger pump will accomplish in less time. Both approaches are used for a variety of technical reasons. In fact, it's still argued [in the industry] about which method results in the least amount of pump operating costs.

25. How can I lift the PCS1 into the attic?

One approach to the attic installation is the enlarged closet access [see question #3]. Assuming you have used this approach, install an eye bolt near the peak and use a one ton come along or other pulley type of device to lift the PCS1 up into the attic. Be sure to center the lift and use straps under the unit. See the installation section of the PCS1 Manual for additional details.

26. How is the PCS1 delivered?

The PCS1 is shipped in a wooden crate that weighs 235 lbs. This crate must be removed from a carrier's truck which can range from a small delivery truck to a semi trailer. When the carrier calls, tell them you'll need help removing the unit from the truck. Make sure they have a lift gate and a dolly. This will make it easier to remove the unit from the truck. If no way exists for removing the unit in its crated state, unpack the unit and inspect it. This will reduce the weight down to 134 lbs and can be handled by two people.

27. Can the PCS1 cool down a hot pool?

Yes: The PCS1 can be manually turned on during the evening hours to cool down an overheated pool. In this case, the heat exchanger will work in the reverse mode. The hot pool water will be routed up to the PCS1 while cooler attic air will be drawn across the heat exchanger. This manual operation ignores the temperature control sensors. To be effective, some ventilation must be present in the attic to allow the heated attic air to escape into the atmosphere.

Cooling down an overheated pool is a common need during the hot summer months in various parts of the country.

28. **Do the PCS1 coil and pipes contain any lead?**

NO. The PCS1 is assembled using a hard brazing material called SILFOX. Our systems are totally lead free.

29. **What are some benefits of owning the PCS1?**

- **Energy savings** that put money into your pocket. The PCS1 pays for itself!
- **Personal satisfaction** in reducing the "ozone problem" - Not using chlorofluorocarbons [CFC'S].
- **Personal satisfaction** in reducing the "greenhouse" problem by not using fossil fuels.
- **Personal satisfaction** in using renewable solar energy.
- The **aesthetic beauty** of enjoying solar energy benefits without "ugly & obtrusive" roof panels.
- The **comfort & luxury** of swimming in a warm pool.
- The **relief from budget busting energy bills** and "restrictive energy use laws".
- The **additional energy savings** from reduced or eliminated air conditioning costs.
- The **availability** of electricity to run the PCS1 as opposed to natural gas and other fuels.
- The **practicality** of using attic heat to solve your swimming pool heat needs.
- The fast **payback** period and knowing that the system will result in continued energy savings.
- Having a **solar** device that heats your pool without all the problems of solar panel devices.

DICTIONARY

OF

TERMS

Dictionary of Terms

Air to Liquid — A heat transfer term referring to the transfer of heat from air to liquid or vice versa.

Bypass Valve — A valve used to route water up to the PCS1 when heat is available in the attic.

BTU — British Thermal Unit. The quantity of heat required to raise one pound of water one degree Fahrenheit. A way to measure heat transfer.

BTU'S/HR — The hourly rate of BTU heat transfer. Calculated by the formula: BTU'S per hour = ΔT x 8.34 x 60 x GPM

ΔT — Symbol for temperature differential. Usually the output temperature minus the input temperature. This can be either air or liquid temperatures. It can also be the temperature difference between two heat containers. In our material, it refers to the temperature difference between the output and the input of the PCS1. This can be either the water temperature difference or the air temperature difference. It also can be the difference between the pool's water temperature and the attic temperature.

8.34 — The weight of a gallon of water. A factor used in BTU calculations.

60 — The minutes in an hour. A factor used in BTU calculations.

CFC — Chlorofluorocarbon chemicals found to damage the earth's protective ozone layer. Found in swimming pool heat pumps.

Circuit — Refers to the heat transfer pipes that carry or are surrounded by swimming pool water inside a heat exchanger.

Coil — Refers to the water coil used in the PCS1 which is used to transfer heat from the attic air into the swimming pool's water.

Comfort Zone — The temperature at which water is the most comfortable for swimming. That zone is from 80-84° F. Olympic and competitive pools maintain 78-80° F.

Convection — A heat transfer principle where heat moves from one substance to another by "convection". This usually means passive heat

transfer. An example would be an item physically sitting in a hot attic getting hot just from being there.

C.O.P. Coefficient of Performance. A term used primarily with heat pumps to rate their performance against that of an electric resistance heater. C.O.P. is calculated by the formula: C.O.P. = BTUS OUT ÷ BTUS IN

Efficiency Another term used with heat pumps to reflect how efficient heat pumps are to an electric resistance heater. For example: a heat pump with a C.O.P. of 4 would be called 400% efficient. Able to deliver four times the energy out than the amount used. Efficiency is calculated by the formula: Efficiency = C.O.P. x 100%.

Flowreversal™ Valve

A valve used to reverse flow of water in a swimming pool so that the pool will use heat efficiently. This means taking the water off the top of the pool from the return lines and returning the water into the main drain at the bottom of the pool. Flowreversal™ is a trademark of Innovative Pools & Spa.

Forced Air A heat transfer term referring to the use of an air moving device such as a fan in conjunction with another device such as a water coil.

Forced Air Convection

The use of forced air to accelerate the heat transfer that would normally occur passively by "convection".

Gallons/Cu Ft Gallons per cubit foot. There are 7.5 gallons in the volume of one cubit foot. Factor used in some pool heating calculations.

GPM Gallons per minute. The flow rate of water in the swimming pool's support system. A factor used in BTU calculations.

Heat Exchanger A product that takes heat from one area and transfers it to another area. The PCS1 transfers heat from the attic to the swimming pool.

Heat Pump A method used to heat swimming pool's by using a reverse refrigeration cycle. This method uses a compressor similar to the one in your refrigerator. The product takes heat out of the ambient air to heat swimming pools and is four times more efficient than using an electric resistance heater.

KW KW refers to Kilowatt and is a measurement of electricity equal to 1000 watts. One KW contains 3,412 BTUs of heat.

LX220/2Y A temperature controller manufactured by Compool Corp.

PCS1 Acronym for "pool convection system one". Refers to the complete heat exchange unit that is physically placed into the attic for heating swimming pools.

PRO3 Valve A bypass valve manufactured by Compool Corporation.

Proportioner Valve

A valve used in conjunction with a flowreversal valve so that proper operation of the swimming pool's skimmers can be obtained during reverse flow of water in the pool.

Share-A-Heater™ A special valve manufactured by Mark Urban Products of Tustin, California that allows a common heater to be shared by a pool and a spa. Share-A-Heater™ is a Mark Urban Products.

Support System Refers to the swimming pool equipment pad which usually is comprised of the pool's pump, filter and other equipment used to run the pool.

Temperature Controller

An electronic device used to automate the bypass valve so that water is automatically routed up to the PCS1 in the attic when heat is available.

Therm One Therm equals 100,000 BTUs.

TmMr A manual proportioner valve manufactured by Mark Urban Products of Tustin, California.

Volume of Pool Equal to the pools surface area times the average depth and is expressed in cubit feet. Factor used in some pool heating calculations.

XmMr A manual flowreversal valve manufactured by Mark Urban Products of Tustin, California.

SITE SURVEY

SITE SURVEY

Use the "SITE SURVEY" form to help define the length of pipe and other materials you will need for the installation of the PCS1.

You can also use the form when communicating with the factory. Send the completed form in along with photos of the pool's support system and attic access area along with your questions. Or, if you chose to phone, fill out the form first and be prepared to discuss the installation issues.

The factory will provide limited technical assistance by either phone or letter based upon the information supplied either verbally or in writing. These are **only** technical recommendations since the factory does not have full access to a complete site perspective and does not provide on-site assistance. Responsibility for correct installation and application of the product rests solely with the purchaser.

All questions are self explanatory. On page 4 of this section is a SKETCH pad which can be used to provide simple drawing details of your installation. You can also use the backside of the forms for additional comments and/or drawings. Some survey questions are marketing issues designed to help us provide better service. Please call or write if you have questions about this site survey form.

PHONE ASSISTANCE

For phone assistance, dial (763) 441-3440

SITE SURVEY

Name:_____
Address:_____
City, State, Zip:_____
Phone Number:_____

Describe the pool:_____
Inground/Aboveground? Vinyl/Concrete/Fiberglass? (circle answers)
Pool Surface _____sq ft Diameter of pool_____
Length_____ Width_____ Max Depth_____ Avg Depth_____
Pump HP _____ Is a pump timer used for filtration? Y/N
Timer set for _____ hours? Is the pump wired for 115vac/230vac?
Is a spa attached to the pool? Y/N
Gallons of water in pool? _____ Water flow rate in GPM? _____
Is the pool Sunny or Shaded? (_____% Sun)
Is the main drain plumbed directly to a skimmer? Y/N
Is a pool blanket used? Y/N How Often:_____
Automatic pool cleaner used? Y/N Pool Vac Booster Pump used? Y/N
Automatic chemical dispenser? Y/N

House Sq Ft:_____Length_____Width_____Height ground to eaves:_____Ft
Roof Sq Ft:_____Length_____Width_____ [For one side of roof only!]
Roofing Material_____ Layers? _____ Color? _____
Condition of Roof: (Exc-Good-Fair-Poor) Sunny or Shaded? (_____% Sun)
Distance pool to support system: (1 way)_____ feet
Support system to house: (1 way)_____ feet
House to attic access: (1 way)_____ feet
From attic access to PCS1: (1 way)_____ feet
Vertical distance from the pump to the PCS1 inlet _____feet (Head)
Additional pressure caused from the vertical run:_____PSI (Head/2.31)

Describe attic access method:_____
_____
Describe materials required for access:_____
_____
Describe attic insulation & depth:_____
Attic height at peak? _____ Feet Attic radiant barrier installed? Y/N
Working space? Y/N Is there an automatic roof power ventilator? Y/N
Wind turbines? Y/N Age of house _____ Age of roof _____

Desired Pool Temperature: ____° F Current Heater? Y/N Yrs Used:_____
Describe type of heater and results experienced_____
_____
Cost to operate heater $/Mo._____ Pool Installed by_____
_____
Age of pool _____ Age of pool heater _____ Cost of pool $_____

Sketch Form