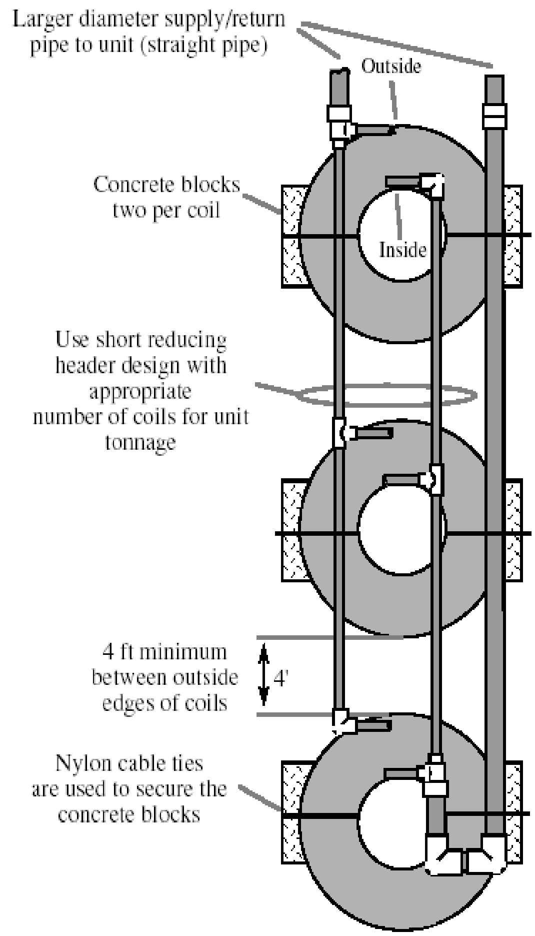
Pond/Lake Loop Installation

Pond Source - Open Loop Installation

Pond water is never recommended for direct use in the heat pump system due to severe fouling of the heat exchangers/ pumps from mineral and biological growth. Pumping also is always a problem whether the pump is located in the pond because of clogging, seasonal serviceability and power wiring or if located in the structure due to suction lift, filter clogging and pump priming.

Pond Source - Closed Loop Installation

The pond loop as illustrated in Figure 1 is one of the most economical loops that can be installed. The loop is typically a 300 foot coiled 1" CTS PB or 3/4" IPS PE pipe that is circuited in parallel and connected via the header which is usually 1 1/2" CTS or 1 1/4" IPS (high tonnage or long headers will require larger sizes). Maximum length of coils should be 300 ft. The pond loop requires a pond of a minimum 1/2 acre and 8-10 ft. deep. Actual area needed is probably around 3000 sq. ft. per ton, however, the size helps in determining drought proofness. The most important aspect of the pond is that it will remain a pond all year around. In other words, we need a consistent pond that has remained relatively unchanged even in extreme droughts. The drought summer of 1988 would be a good test because most of the country's ponds dropped at most 2-4 ft. and it is readily remembered by the homeowner. If a pond disappeared that summer, the pond loop system should not be considered.



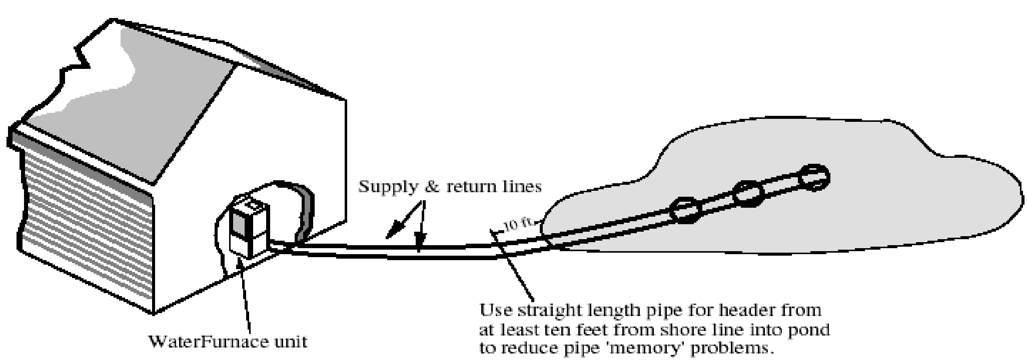


Figure 1

Under an ice cover in the winter, ponds can maintain approximately 39° F throughout. This is due to the density characteristics of water. Water has maximum density at 39° F. As water becomes colder the density increases, thus the colder water falls to the bottom. Then, when the water approaches the freezing point (<39° F) its density increases significantly, thus the coldest water will then rise (ice floats remember!). This creates a natural convention current of constantly rising colder water (<39°) and falling water (see Figure 2).

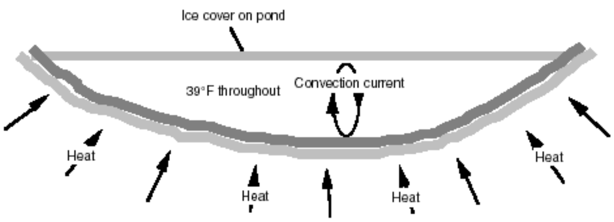


Figure 2

The heat transfer of pond loops is better when this natural convection can flow around and between the pipe coils. Therefore, it is best to allow the coils to float 9-18 inches from the bottom to prevent sediment from blocking this flow and reducing the heat transfer. (See Figure 3) The coils are in affect utilizing the bottom surface area of the pond as the loop, allowing the water to flow through to enhance the heat transfer.

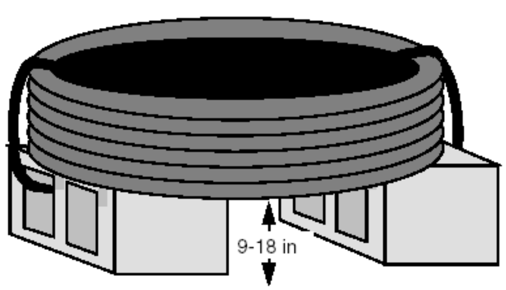


Figure 3

Private Ponds or Lakes

Permits for private ponds are generally not required, however, some states do not have regulations. For instance, Indiana requires a permit for all public bodies of water and any private bodies that have a watershed area of greater than 640 acres. All local regulations need to be reviewed before the design of the loop is completed.

Public Bodies of Water - Lakes And Ponds

Lakes and ponds are excellent sources, however, laws and regulations governing these bodies of water may limit their practicality. In certain instances the lake may be 'dragged' to find missing swimmers/boaters and boat anchors can also be a menace to a submerged closed loop. A reported instance is one in which the reservoir had been dropped to its winter level and a passing motor boat propeller sliced through the plastic pipe coil. Any installation in a public or livestock pond should also have the land to water header transition encased in a schedule 40 PVC or equivalent sleeve to prevent damage to the supply and return pipe (see Figure 4).

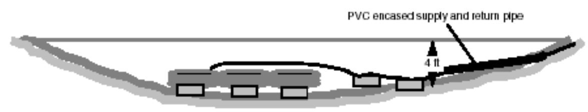


Figure 4

Recreational Bodies of Water

A schedule 40 PVC sleeve might be a good idea for protection of supply and return lines at the shoreline to protect the pipe from boats being dragged up on the beach. Stay clear of boat ramps, access piers, fishing and swimming areas to avoid problems (see Figure 4).

Livestock Ponds

Any installation in a livestock pond should have the land to water header transition encased in a schedule 40 PVC or equivalent sleeve to prevent damage to the supply and return pipe. Insure that the coils are safe from livestock trampling by a 4 ft. water depth especially during drought conditions. Allow an extra 3-5 ft. in depth for these ponds. Low water buoys can be used here to signal low water conditions (see Figure 4).

Location Buoys or Low Water Buoys

Location or low buoys can be used as necessary. A spray painted 4" PVC tubing 2-3 ft. long will provide a long life (see Figure 5).

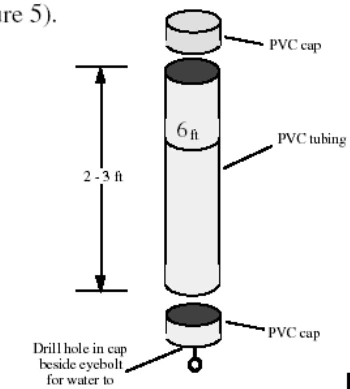


Figure 5

Loop Fabrication

The loop itself can be assembled and fused at the shop if desired. Inspect all of the coils for shipping damage. Set the coils in the desired configuration making sure the coils are all symmetric as shown in Figure 6 (i.e. the pipe ends protruding from the same area of the coil) so that the header can be aligned for fusion. Bind each coil tightly with a cable tie allowing the loose pipe ends enough movement for fusion.

Install the header as shown making sure that the header is not in a bind when fused-do plenty of 'dry runs'. Always tape the ends of the pipe to prevent foreign matter from being introduced into the loop during storage or transportation. Never tape a surface that will be used in the fusion process, if it has been taped, cut it off.

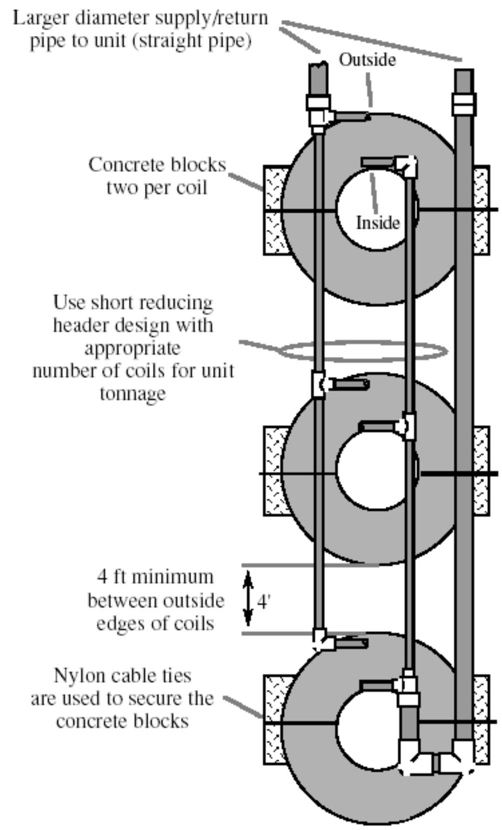


Figure 7

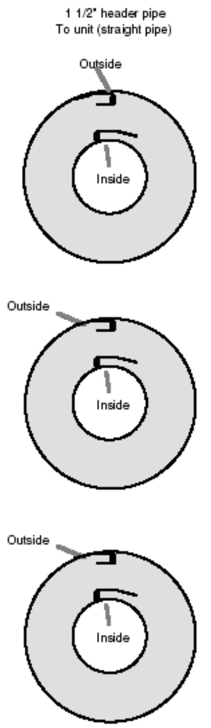


Figure 6

Do not install concrete blocks until the coil is at the edge of the pond. Pipe can be damaged from the extra weight and sharp edges of the blocks. Pressure test the coils after completion. This concludes the loop fabrication. It is now ready to be transported to the job site.

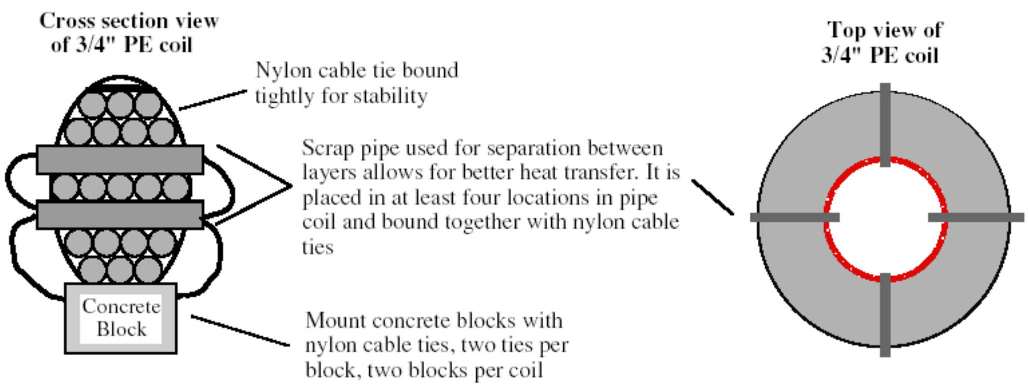


Figure 8

Supply/Return Trenching (house lower than pond)

On loops larger than 4-5 coils, break down into 3-5 coil sections and assemble and fuse together at pond edge. The site survey should already have indicated the location of the supply and return pipe trench. Trenching with a backhoe (at least 2 ft. bucket) should start at the building penetration and proceed out toward the pond to the transition trench (see Figure 9).

This transition point is where the building trench and the pond trench will meet and the backhoe changes direction. This transition should be located at the highest point between the house and the pond. Trenching completely to the pond will flood both trench and the building penetration. Pipe can now be unrolled in the trench and the remainder left coiled in the transition trench. Backfill should be completed between the penetration pit and the transition trench before starting the trench at the pond. At this time, building penetration should be started. See the building penetration manual for more information.

When digging the trench from the pond the backhoe should reach out into the pond as far as possible working its way back to the transition trench. At this point the backhoe will need to be repositioned to complete the connection of the two trenches.

The remainder of the supply and return pipe can now be unrolled within 10 ft. of the pond edge. 10-20 ft. straight pipe should then be fused onto the coil ends keeping the 'pond end' of the pipe up on shore. If pipe size transition is needed, do it here.

Complete the backfilling of all trenching. In unusual cases the trench may need a mechanically tamped clay 'dike' to prevent pond drainage through the newly disturbed trench backfill (as shown in Figure 10). Care should be taken when backfilling.

Supply/Return Trenching (house higher than pond)

House penetration is higher than pond. This installation can sometimes be simplified by eliminating the transition trench and simply digging a single full length trench.

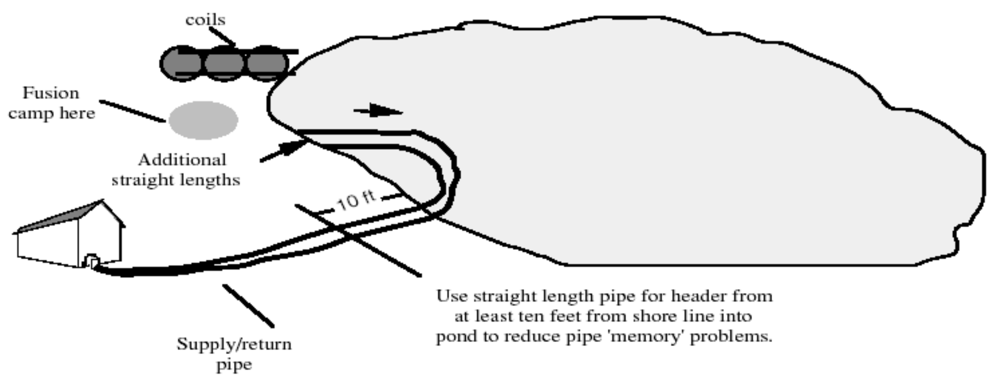


Figure 9

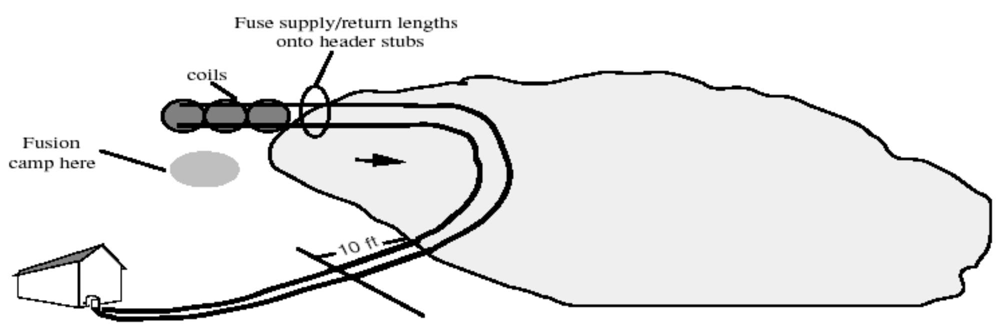


Figure 10

Completing the Supply/Return Pipes

A 'fusion camp' should be set-up near the loop coils toward the edge of the pond to continue fusing straight lengths of pipe on to the 'pond side' of the supply/return piping (see Figure 11).

When the desired length of the supply/return piping has been constructed, the pond side of the pipe can be fused to the header stubs on the pond coils completing the loop. Remember to allow for curing time (see Figure 7 and 12).

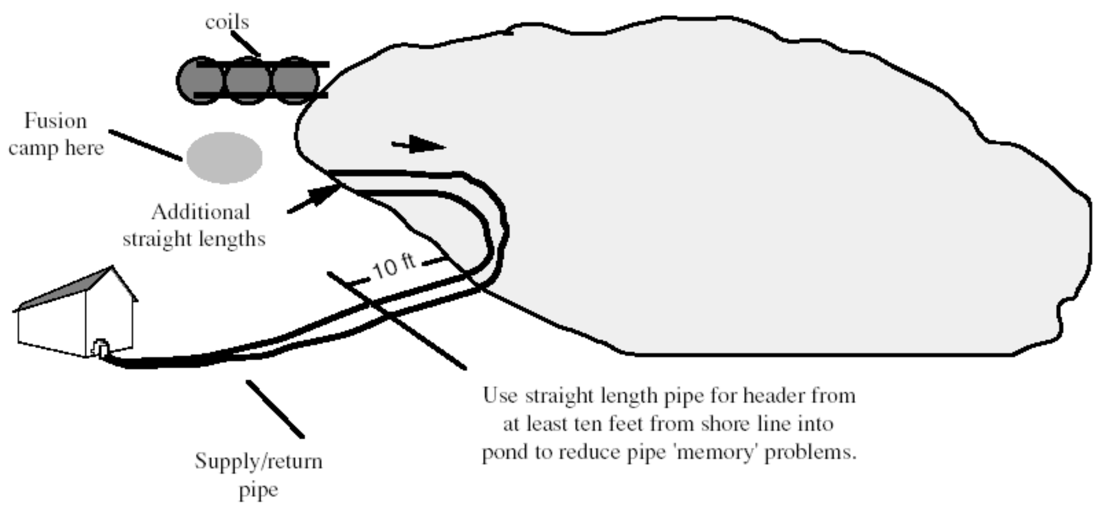


Figure 11

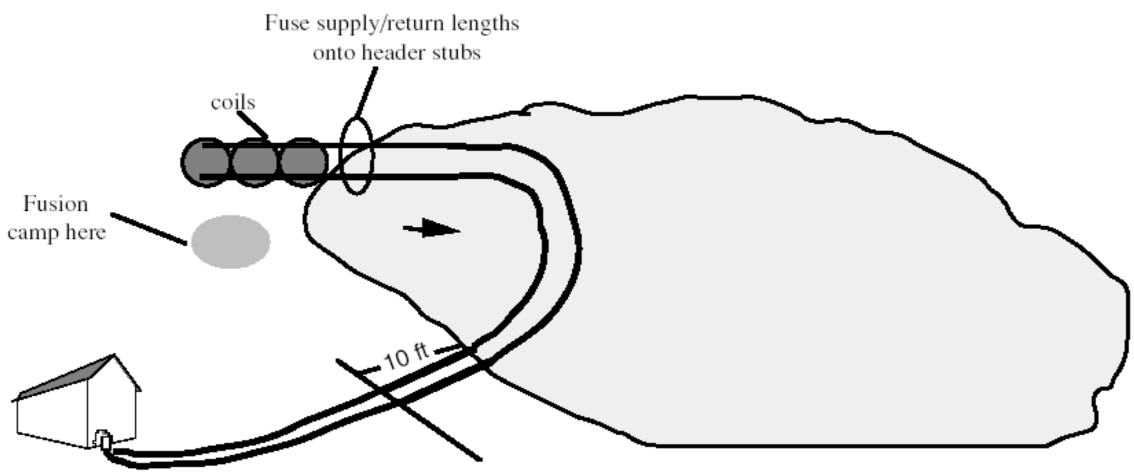


Figure 12

Floating the Coils out into the Pond

Maneuver the coils to the shoreline until the first coil is partially in the water. Attach the concrete blocks (as shown in Figure 8) using the cable ties. Refer to Table 1 for the proper selection of a counter weight concrete block to sink the coil. The total block weight of each coil should be between the air value and the loop fluid value. For instance, 300 ft. 1" PB SDR 13.5 pipe requires 96 lb. to sink before flushing and at least 6 lb. to sink after flushed with 20% methanol antifreeze solution. A weight in the 20-60 lb. range would be suggested. A weight greater than 96 lb. would prevent floating the loop out into position. Proper caution must be taken to ensure that the coiled pipe will never rub against the weight. Use plenty of slack. Now, shove the coil assembly out into the pond until the second coil is partially in the water. Repeat the procedure until all of the coils have concrete blocks attached. A row boat can be used to maneuver the coil assembly out into the desired position. In some cases a nylon rope could be used to pull the coils into position from shore line.

Next, more concrete blocks should be attached for every 15-20 ft. of supply/return piping using nylon cable ties to ensure the pipe will not float up. Start at the pond edge and move toward coils. Refer to Table 1 for counter weight values needed.

Finally, the binding cable ties can be snipped to allow some separation of the pipe within the coils for enhanced heat transfer. The loop is now ready to pressure test, flush and sink.

Buoyancy Tables

Pipe filled:	1" CTS PB SDR 13.5 300 ft coil	3/4" IPS PE SDR 11 300 ft coil
with air (before flushing)	96	77
with water	2.5	1.7
with 20% Methanol	5.5	4.1
with 30% Prop Glycol	-0.7	-0.8

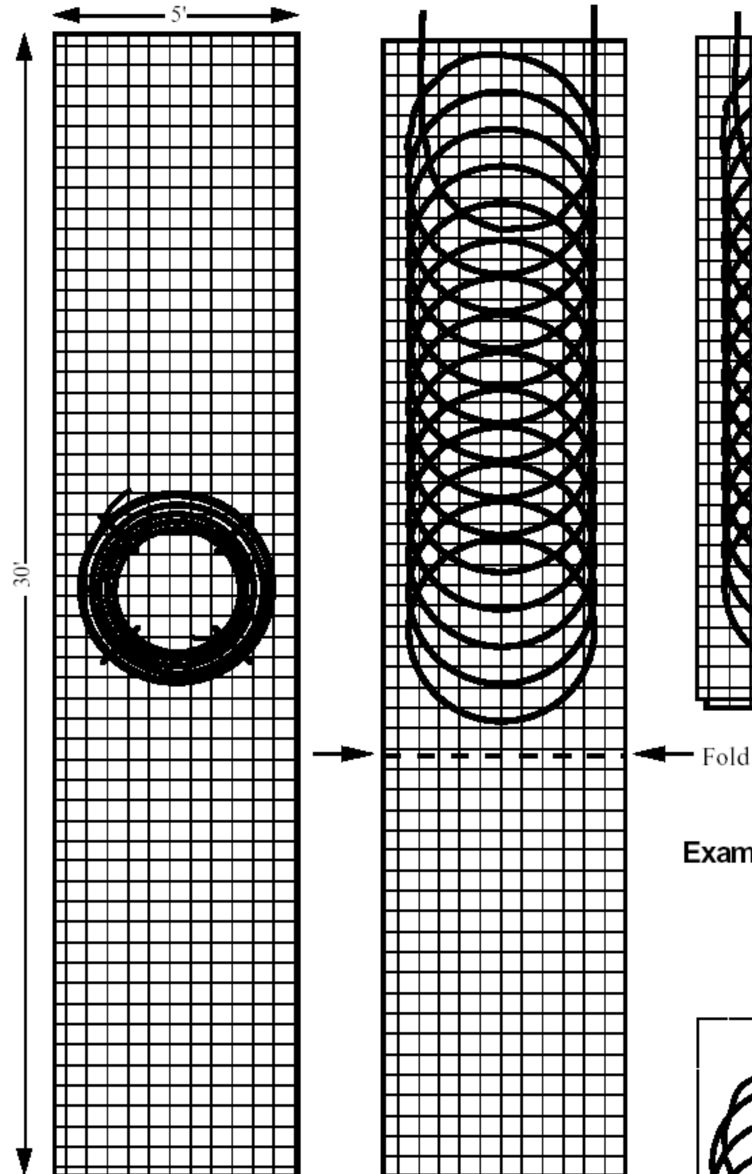
All weights in lbs.

Pipe filled:	1.5" PB SDR13.5	2" PB SDR13.5	1.25" PE SDR11	2" PE SDR11
with air	13.4	22.9	13.4	26.3
with water	0.35	0.59	0.35	0.54
with 20% Methanol	0.77	1.32	0.77	1.37
with 30% Prop Glycol	-0.09	-0.15	-0.09	-0.31

lbs per 20 foot length of pipe

	Avg Weight (lb)	Typical Low cost
Concrete Block 8 x 8 x 16 light	38	$0.73
Concrete Block 4 x 8 x 16 light	19	$0.48
Concrete Block 8 x 8 x 8 light	18	$0.56
Brick (3 hole)	4.5	$0.26

Table 1



Mat Design Recommended Installation

1. Spread out approximately 30’ X 4’ of plastic reinforcing mat or fencing. Place 300’ roll of 3/4” polyethylene pipe in center.

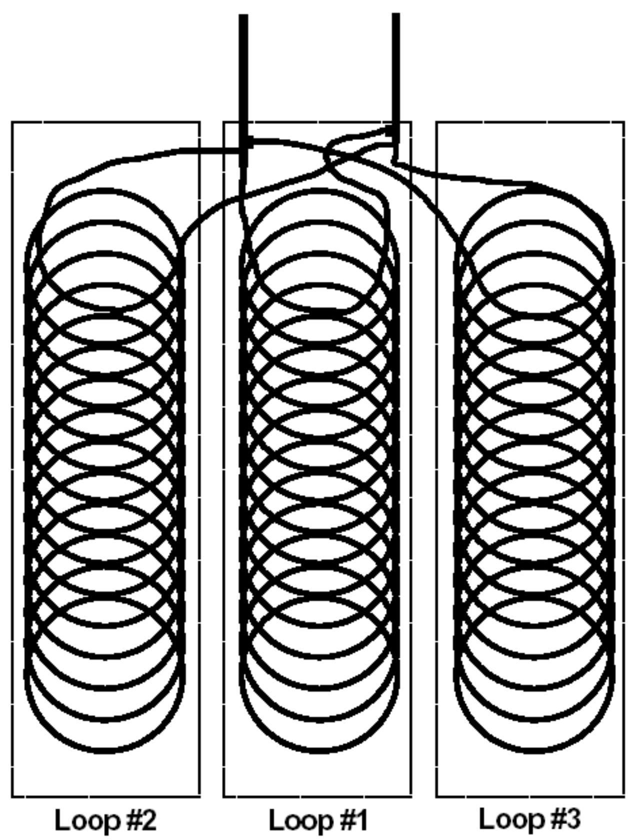
2. Cut straps on roll of pipe and spread it over half of the mat material. Bring both ends of the pipe to the end of the mat.

3. Fold the remaining mat material over the pipe. Tie the mat piping together with plastic tie-wraps leaving the two pipe ends accessible through the top of the mat.

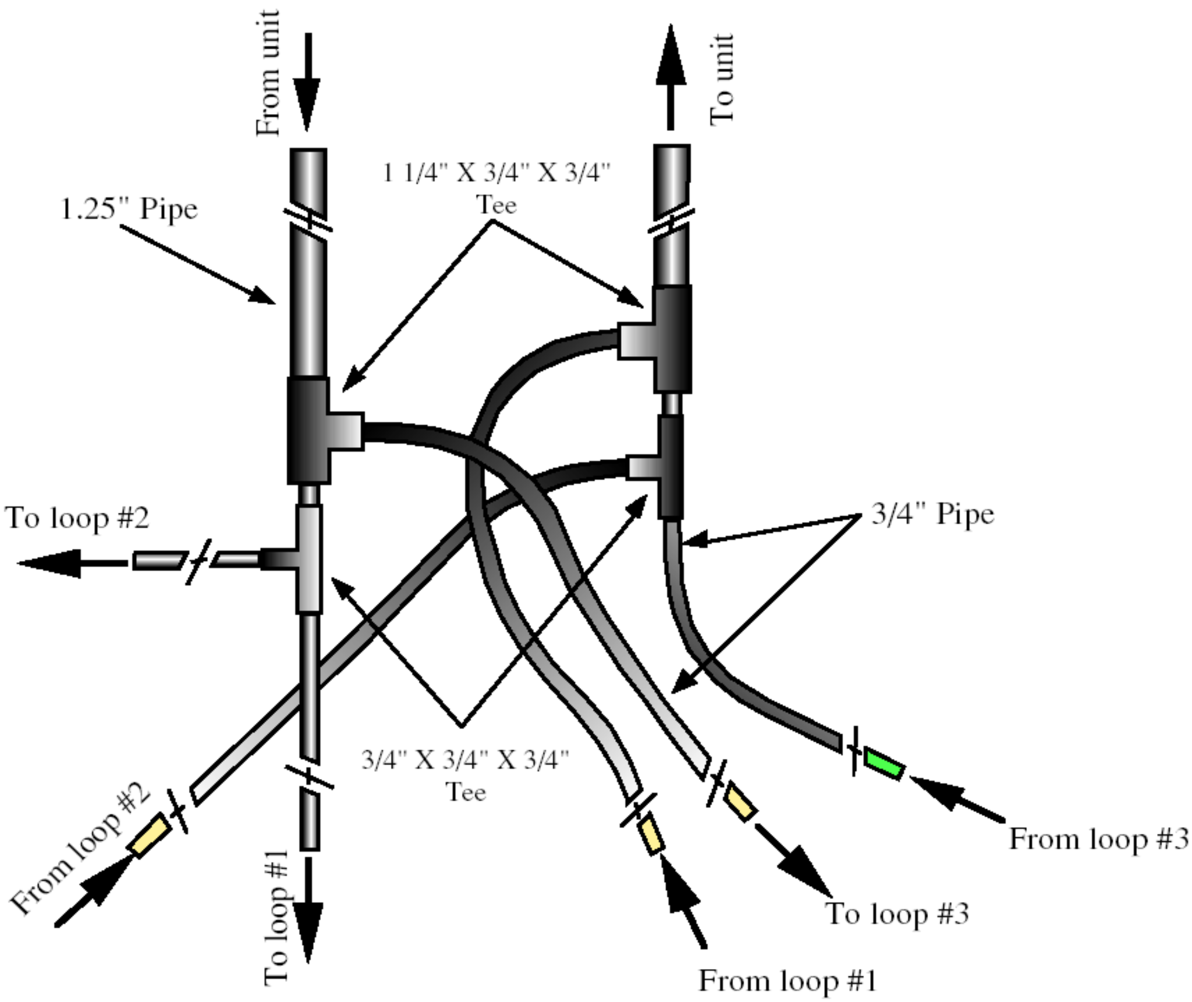
4. Build one mat system for each ton of equipment. Tie mats together, with a minimum of 5 feet between mats and reverse return headers and fuse all connections.

5. Float the mats out on inner-tubes and place sufficient weight on the mat system such as bags of ready mix cement or plastic drainage tile filled with concrete (approx. 130 lbs. per 300’ of 3/4”loop). Maneuver into position, sink and flush.

Example Loop Layout



Header Detail



Design Notes:

- WaterFurnace International, Inc. recommends the use of polyethylene 3408 pipe as the only suitable material for use as pond/lake loop heat exchangers.
- One 300 ft. - 3/4” parallel flowpath is recommended for each ton of equipment installed.
- Pond/lake loops should be submerged 6 to 8 ft. minimum.
- Loops and pumps should be designed such that under normal flow conditions, the flow rate in all parallel branches is sufficient to meet or exceed the minimum acceptable Reynolds # of 2500 with 20% methanol/ 80% water circulating (3 gpm/ton).
- Pond/lake loops should be anchored and/or weighted sufficiently to ensure that loops will not float should ice build up on coils.
- Pond or lake surface area should meet or exceed 3,000 sq. ft./ton.
- Fusion is the only acceptable method for joining underground or underwater PE pipe and fittings.
- Any header piping running below parking lots or other cleared areas should be adequately insulated to prevent abnormal frost penetration.