SPACE HEATING PRODUCT GUIDE

SEISCO®

Home Comfort System

"The Perfect Solution for Residential and Commercial Space Heating"

MICRO BOILERS

Welcome to Microtherm's electric Micro-Boiler™ space heating family. I'm David Seitz, the Chief Executive Officer of Microtherm, Inc. Our award winning electric Micro-Boiler product line incorporates superior technology that has earned five U.S. and many more foreign patents.

Microtherm, Inc. introduced the industry's first "whole house" tankless electric water heater in 1986 at the ASHRAE show in conjunction with DuPont. Several years ago, Microtherm applied the same award winning technology found in the "whole house" water heater to a very compact low temperature Micro-Boiler that is revolutionizing electric hydronic radiant space heating. With thousands of Micro-Boilers already in operation in the coldest climates in the U.S., Microtherm has already proven the technology and gained a substantial customer base.

Homeowners everywhere are discovering the benefits of radiant space heating, more comfortable living conditions, and lower energy bills, up to 25% lower! Micro-Boilers are unique and incorporate many features unmatched by the competition. I invite you to investigate the advantages of Microtherm's Micro-Boiler product line.

This Space Heating Product Guide is designed to help you understand the basic principles of applying Micro-Boilers to hydronic radiant space heating systems. Whether the system is a floor based radiant heating application using PEX tubing, wall radiator, finned tube baseboard, or a heating coil in the air duct combined with the cooling system air handler, Micro-Boiler can be applied as the heat source.

A ten-year limited warranty is included along with all the patented features of our Micro-Boiler line. With its compact design and low cost, Micro-Boiler is easy to sell and install.

Most importantly, you have my personal commitment that Microtherm, Inc. will provide unmatched customer service with outstanding literature, internet, email, fax, and telephone support for all application, sizing, service, and warranty issues. I speak for the entire Microtherm team when I say that "we appreciate your business!"

–David Seitz, CEO

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Micro-Boiler™

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Everyone Loves A Compact, Efficient, Low Cost Solution For Comfortably Heating Their Home!

COMPACT

Micro-Boiler models are manufactured in two basic sizes, a four-chamber unit (15 ¾" x 15 ¾" x 6 ¼") and a two-chamber unit (15 ¾" x 10 ¼" x 6 ¼"). The same advanced microprocessor technology and construction are used in all models. In fact, many of the parts are interchangeable.

EFFICIENT

Rated at over 99% efficient, ***Micro-Boilers can help consumers save money on the cost of heating their home.***

LOW COST

The cost of the heat source for any radiant heating system is based on three different equipment factors: purchase price, the installation cost, and the annual operating cost of. Additionally, in new construction, consumers also pay for the space used by the equipment.

Due to their compact design and the rising cost of precious space...why waste it? **Micro-Boilers can be mounted on the wall, are much smaller than conventional high temperature boilers, and give customers the extra space they deserve!**

HYDRONIC HEATING

Two basic forms of low temperature hydronic space heating are used in today's space heating market: radiant, and forced air with a hydronic coil.

Radiant Space Heating: Radiant space heating takes several different forms: wall, ceiling, floor, and baseboard. Wall and ceiling applications are similar to floor applications because they utilize the same basic components. Radiant floor space heating is accomplished by circulating a heating fluid through long loops of tube located in the floor. As the heated liquid circulates through the loops, it conducts heat from the liquid, through the tube into the floor. Then, the floor either radiates heat into the room or transfers the heat to objects sitting on the floor that in turn radiate the heat into the room.

It's no secret that radiant floor space heating is up to **25% more efficient** than forced air space heating. Radiant floor heating adds heat directly to the "occupied zone" in the home. The occupied zone is the area of the home from floor level to 6 1/2 feet high, the area where people actually live.

Radiant floor heat is the only form of heat that results in the temperature at floor level actually exceeding the temperature at ceiling level. In addition, radiant space heating does not remove humidity from the air. Dry air causes irritation to the occupants of the building. Radiant floor space heating spreads the heat more evenly across

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the entire structure better than other forms of hydronic heating. It also eliminates cool drafts associated with forced air heating from furnaces and heat pumps. Other benefits include elimination of the furnace and the blower required to move hot air through the duct work. Radiant floor heat performs very well when used in combination with energy management control schemes such as off-peak power regulation. Due to the high mass of heated flooring and other objects touching the floor, the space heating system can be shut down for relatively long periods of time without the homeowner experiencing discomfort. This can be accomplished via remote control by the local power company for load management reasons. Load management programs allow power companies to sell “off-peak” power at much lower rates than normal.

Baseboard Radiators: Radiant heat using baseboard radiators is also a common practice in some markets. This method works similar to radiant floor heating. A hot fluid is circulated through baseboard radiators. Heat in the fluid is conducted through the radiator’s surface and radiated into the room. Baseboard radiators that utilize finned tube heat exchangers can be very efficient. However, in colder climates, the total required length of low-temperature baseboard radiators to sufficienty heat the stucture can be difficult to accommodate. Additionally, baseboard radiation may tend to concentrate the heat near the radiators rather than spread it evenly across the entire space. Obstacles such as furniture and curtains also interfere with baseboard heating.

Forced Air Hydronic Heating: Also called hydro-heat, in southern climates, forced air hydronic heating has gained some acceptance as a low cost method of providing space heating using the air conditioning system without the drawbacks of electric resistance heaters in the air conditioning duct. The same air handler used for the air conditioning system can also handle the hydronic heating system with the addition of a hydronic heating coil. Air from inside the home is circulated across a coil in the ductwork and back into the home. Simultaneously, hot water is circulated through the coil. As air circulates across the hot coil, heat is transferred to the air stream which re-enters the home.

MICRO-BOILER IS SUPERIOR

PowerShare™: **Micro-Boiler is the only low temperature hydronic heater with PowerShare, a patented power-sharing distribution method for activating the heating elements.** PowerShare control technology utilizes computer algorithms and electronic triacs to pulse power on and off to all heating elements resulting in uniform temperature modulation between 1-100% of the element’s range. This allows the Micro-Boiler to use only the power required to provide the exact amount of heat required by the heating system. **Most of the time, the Micro-Boiler’s amperage draw will be far below its maximum capacity.** PowerShare along with constantly flowing water across the heating elements ensure that the heating elements operate at the lowest possible sheath temperature. Low sheath temperature prevents mineral buildup on the heating elements, prolonging element life.

Eliminates Flicker: When properly installed, PowerShare technology prevents disturbances (flicker) in lighting circuits. This is very important since the proper temperature control of the Micro-Boiler depends on modulating or instantaneously varying the power to high-wattage heating elements. Without patented PowerShare technology, lights may flicker in the same modulating manner as if someone were turning the air conditioner or electric heating off and on very rapidly.

Ease of Service and Self-diagnostics: **Micro-Boiler’s microprocessor control is programmed with patented control technology that provides self-diagnostics.** If a service issue occurs, the control emits a visual or optional audible code. The user can interpret the code from a code sheet or have a service technician do it remotely over the phone using the audible beeps emitted by the

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control's speaker. In addition, if necessary, convenient cleanout plates below the heating chambers allow the user to remove any build-up of sand, or grit, inside the heating chambers. Modular construction and standard off-the-shelf heating elements help make the Micro-Boiler quick, easy, and inexpensive to service.

SH-18, 22, & 28 models have four-chambers and are designed for low temperature hydronic space heating applications requiring up to 145F° heating fluid temperature. SH-5, 7, 9, 11, & 14 are two-chamber models. All Micro-Boilers can utilize potable water or glycol solution as the heating fluid.

There are no moving parts or flow restricting devices used in Micro-Boilers. Micro-Boilers use electronic temperature sensors, called thermistors, for unique patented flow/no flow activation and detection. In standby mode, the heater maintains a very subtle temperature gradient. Flow is detected when a change occurs in the gradient. The advanced microprocessor control turns power on through a set of relays and ensures the power is off when flow stops.

Construction: Heating chambers are modular for ease of repair and molded of light weight thermoplastic materials. The chamber is specifically engineered for durability in harsh water heating environments and capable of withstanding extreme temperature swings and pressure changes. Heating elements, sensors and detection devices, that come in contact with the heating fluid are made of stainless steel, brass, or copper to resist corrosion. **Standard 1 ½ inch, screw-type heating elements are utilized which are interchangeable with heating elements available from virtually any plumbing distributor.**

Safety: Micro-Boilers have a complete array of dependable safety features to prevent harm to the user and the heater, including redundant high temperature limit switches on independent circuitry. Control is 100% based on temperature control, no flow switches required. Dual heating fluid level sensors are used to prevent dry firing of the heating elements. Chambers are designed with a patented air venting system that continuously vents gasses that release from the water during the heating process. For safety, a leak detector included in four-chamber models, but not on combination space/water heating models, is mounted on the casing and sounds an alarm while automatically shuting off the power to the heating elements in case a leak occurs. The control board

is protected against electrical surges. Additional surge protection is achieved by open relays during periods of standby, providing no available electrical path to the heating elements.

Power Rating: Four-chamber models contain four electric heating elements whose combined wattage is the total power rating of the heater. For instance, standard SH-28 models contain four 7000 watt elements for a total of 28,000 watts, or 28 kilowatts (kW). Two-chamber models, SH-14, contain only two 7000 watt elements for a total power rating of 14,000 watts, or 14 kilowatts (kW). Refer to the Micro-Boiler product specification sheets for KW ratings by model.

Heat Input/Output: The total heat input of Micro-Boilers models is simply the total kilowatt power rating of the combined heating elements converted to BTUs using 3,413 BTU per kW. For instance, SH-28 models have a total power rating of 28 kW or a 95,564 BTUs of heat input.   **Heat output is the same as heat input because the heating elements are totally immersed in the heating fluid. 99+% of the heat produced by the heating elements transfers to the heating fluid.**

Voltage Ratings: Micro-Boilers are manufactured with common 240 volt (AC) heating elements designed for optimum operation on a standard residential 240 volt (AC) electric service, but will operate at 208 volt (AC), a typical commercial voltage, with standard 240 VAC heating elements. However, the power rating and the heat output are reduced by 25%. For models designed for 208 VAC operation, consult with your local Microtherm sales representative

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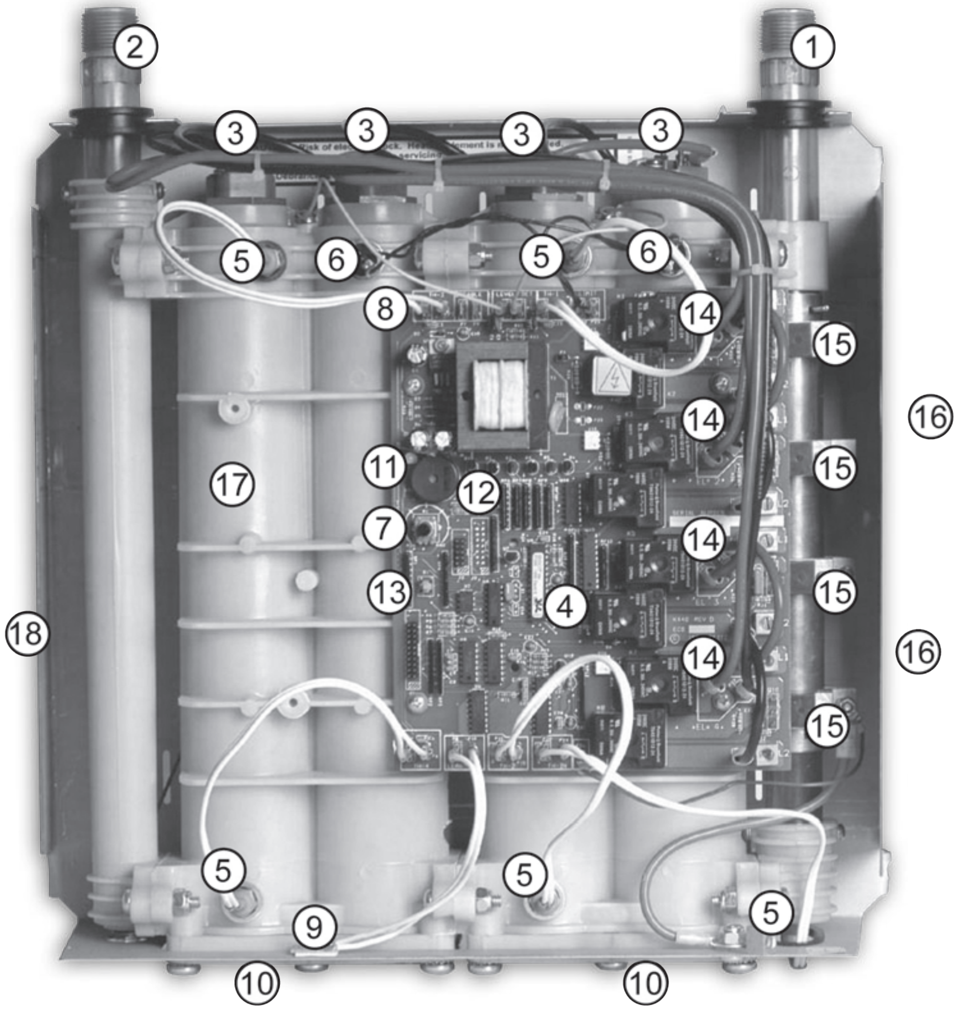

Four Chamber Design-Inside View

1	Cold Water Inlet	10	Cleanout Plates
2	Hot Water Outlet	11	LED Indicator Light
3	Heating Elements	12	Speaker
4	Microprocessor	13	Service Button
5	Thermistor Temperature Sensors	14	Power Lugs
6	Safety Cutoff Switches	15	Triacs
7	Temperature Control Knob	16	3/4" Conduit Connections
8	Off Peak Control Connection	17	Non-Ferrous Water Passages
9	Water Leak Detector	18	Heavy Gauge Steel Mounting Panel

Note: Leak detector applies to four chamber models only, not two chamber models. Combination space/water heating models do not include a leak detector.

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Maximum Amperage Rating: Each Micro-Boiler model has a maximum electrical current rating (or amp rating) equivalent to the sum of the heating element ratings. For example, a four-chamber model, SH-28, operating at 240 VAC has four heating elements, each with a maximum rating of 29 amps. The maximum current rating or total current rating of the SH-28 is therefore 116 amps. However, the actual current measured during operation can be much less than the maximum rating of the heater.

Electrical Capacity: Whether considering retrofit or new construction, the initial consideration for use of a Micro-Boiler is the advanced patented electrical design. The Micro-Boiler represents only a part of the overall electrical requirements. When a reference is made to electric service, it means the rating of the building's primary electric service. Typically, in an existing building, the electrical service rating can be determined by looking at the number stamped or written on the main breaker (i.e. 125, 150, 200 amperes or more). Some buildings will have two electrical panels that combine to provide the total service.

Today, most new homes have a 200 amp electric service. However, homes that utilize gas for space heating, water heating, and cooking may have 100, 125, or 150 amp electric service. In many cases, an all-electric home of 2750 square feet or less with a 200 amp whole house electric service will have the electrical capacity for one SH-28 (95,564 BTU) model, sufficient to provide 25 BTUs

per square foot of heat. However a qualified electrician must calculate the electrical loads in the home or building with the load of the selected Micro-Boiler model(s). Load calculations should be done according to the National Electric Code (NEC), 220-82 and 220-83, Optional Calculation. Refer to the electrical requirements section on pages 29-37 in this publication.

Heating Fluid Temperature: The design temperature of the heating fluid along with the temperature drop across the heating system are important in a properly functioning hydronic heating system. Micro-Boilers are adjustable between 90-145°F. Temperature settings up to 160°F are possible if specified when the Micro-Boiler is ordered.

Flow Rate and Temperature Rise: The flow rate for each model is given on the product specification sheet. A**long with the temperature rise, the flow rate must also be determined in order to choose the appropriate Micro-Boiler piping arrangement. The flow rate is determined by the combined flow rates of all heating loops flowing through the Micro-Boiler. Flow rate and pressure drop are both used to determine the correct pumping method, primary or primary/secondary.**

Pressure Drop: Pressure drop through the Micro-Boiler is the amount of pressure lost as the heating fluid flows through the unit. Micro-Boilers have a very low pressure drop as shown in the chart on page 9. Low pressure drop helps make pump selection easier by allowing a larger selection of available pump models.

Photography on this page courtesy of Watts Radiant.

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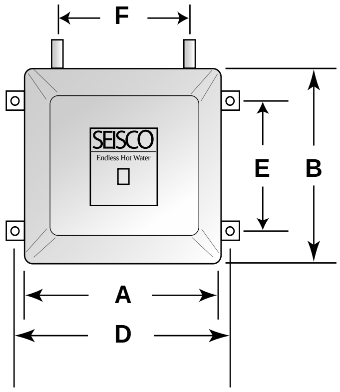
DIMENSIONS, TECHNICAL SPECIFICATIONS, AND PERFORMANCE



*Depth: Not Shown On Drawing
**Optional: 1, 75 Amp. Breaker
***Optional: 2, 75 Amp. Breakers
E=13" on all models.

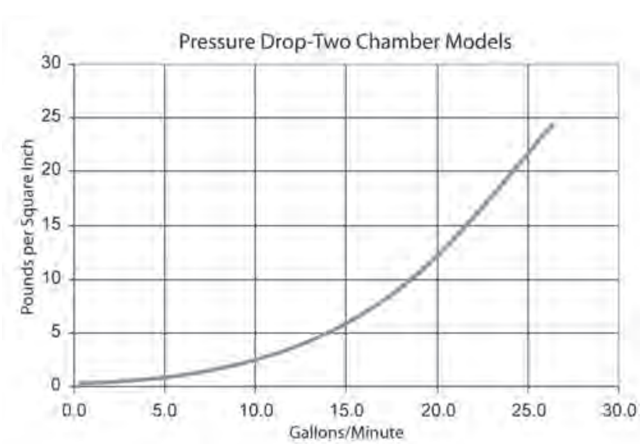
Model	SH-5	SH-7	SH-9	SH-11	SH-14	SH-18	SH-22	SH-28
KW Input	5	7	9	11	14	18	22	28
BTU Input	17,065	23,891	30,717	37,543	47,782	61,434	75,086	95,564
A	10 1/4"	10 1/4"	10 1/4"	10 1/4"	10 1/4"	15 3/4"	15 3/4"	15 3/4"
B	15 3/4"	15 3/4"	15 3/4"	15 3/4"	15 3/4"	15 3/4"	15 3/4"	15 3/4"
C*	6 1/4"	6 1/4"	6 1/4"	6 1/4"	6 1/4"	6 1/4"	6 1/4"	6 1/4"
D	10 7/8"	10 7/8"	10 7/8"	10 7/8"	10 7/8"	16 1/8"	16 1/8"	16 1/8"
F	7"	7"	7"	7"	7"	12 1/2"	12 1/2"	12 1/2"
Weight (lbs)	15	15	15	15	15	23	23	23
240 V. Amp.	20.8	29.2	37.5	45.8	58.3	75.0	91.7	116.7
# Elements	2	2	2	2	2	4	4	4
Element KW	2.5	3.5	4.5	5.5	7	4.5	5.5	7
# Breakers (240V)	1	1	1	1	2**	2	2	4***
Breaker (amps)	30	40	50	60	40	50	60	40

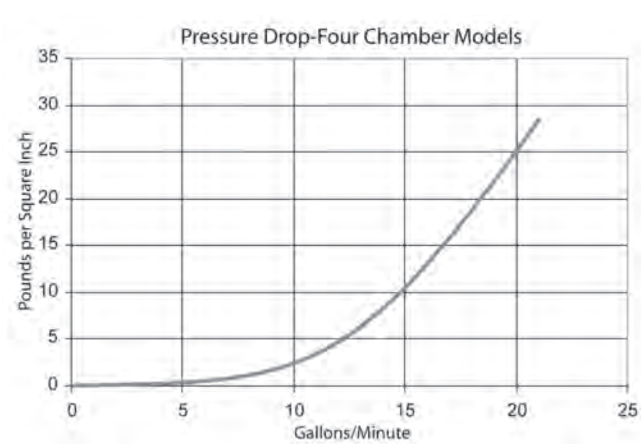
Flow Rate (gpm) @ Temperature Rise (F)

Model	Temp. Rise	65	60	55	50	45	40	35	30	25	20	15
SH-5	gpm	0.53	0.56	0.62	0.68	0.76	0.85	.98	1.1	1.4	1.7	2.3
SH-7	gpm	0.74	0.81	0.88	1.0	1.1	1.2	1.4	1.6	1.9	2.4	3.2
SH-9	gpm	0.95	1.0	1.1	1.2	1.4	1.5	1.8	2.0	2.5	3.1	4.1
SH-11	gpm	1.2	1.3	1.4	1.5	1.7	1.9	2.1	2.5	3.0	3.8	5.0
SH-14	gpm	1.5	1.6	1.7	1.9	2.1	2.4	2.7	3.2	3.8	4.8	6.4
SH-18	gpm	1.9	2.0	2.2	2.5	2.7	3.1	3.5	4.1	4.9	6.1	8.2
SH-22	gpm	2.3	2.5	2.7	3.0	3.3	3.8	4.3	5.0	6.0	7.5	10.0
SH-28	gpm	2.9	3.2	3.5	3.8	4.2	4.8	5.5	6.4	7.6	9.6	12.7

Note: Use this table only when installing Micro-Boiler in a combination space/water heating system.

Pressure Drop Curves





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BASIC RADIANT SPACE HEATING DESIGN CONSIDERATIONS

This Radiant Space Heating Product Guide is designed to help you understand how to apply Microtherm's Micro-Boiler™ in radiant space heating applications. It is not designed as an in-depth technical manual on designing hydronic space heating systems. To design a hydronic space heating system, Microtherm highly recommends that you contact a mechanical contractor or engineer trained in hydronic space heating design. This section of the Space Heating Product Guide is designed to give the user a brief overview of some of the issues that should be considered when using Micro-Boilers in a space heating system.

SYSTEM TYPES

Five basic hydronic heating systems are common; radiant floor, radiant ceiling, fin tube baseboard, wall radiators, and forced air with a hydronic heating coil. Each system has its unique advantages and disadvantages. The current trend in the hydronic space heating market is toward radiant floor for space heating. Over the last 15-20 years, a market has developed using forced air with a hydronic heating coil located in the duct or right in the air handler itself. As consumers across the country have discovered the benefits and efficiency of hydronic heat, the popularity of hydronic radiant space heating has flourished, particularly the radiant floor version. Acceptance of flexible plastic tubing (PEX) in space heating applications for potable water has also grown.

COMPONENTS

The two main ingredients of every hydronic system are the heat source (gas, oil or electric) and the method of putting the heat into the living space or occupied zone. The occupied zone is the area in which we live, floor level to approximately 6 ½ feet above the floor.

The heat source in our case is one or more electric Micro-Boilers. Since the maximum temperature of the heating fluid from the Micro-Boiler is 90°F to 145°F, this is a major design consideration. Radiant space heating using PEX tubing as the radiator generally requires a much lower heating fluid temperature than systems using wall and/or baseboard radiators. The length of the tubing as well as the spacing determines how much heat is radiated through the surrounding environment. Since PEX tubing lengths can be up to 300 ft for ½", the amount of surface area is high. With a high surface area for radiating heat, the temperature of the heating fluid can be lowered. However, in joist heating applications, the temperature may be higher 145°F.

The industry has rapidly reached a consensus that radiant floor space heating is the most comfortable method of heating a home, and it is more efficient than conventional forced air methods, **usually by more than 25%.** Many homes, particularly in the northeast, have used hydronic heating for years, usually with high temperature (above 170F°) systems. High temperature radiators have been around for many years, many of which use as the heating fluid. Using high temperature steam helps minimize the size of the radiator that must be installed in each room. These systems are infamous for making noise especially with prolonged usage over the years.

Finned tube baseboard radiators are very similar to wall radiators. The critical detail to remember is that the lower the heating fluid temperature, the more baseboard radiation surface will be required. With wall and baseboard radiators, burn hazards are always a concern due to accidentally rubbing against the radiator surface. Most products are now manufactured to minimize the hazard with the installation of radiation shields.

Forced air hydronic heating has gained more acceptance in southern climates than in northern climates. The downside is that some customers feel that the air exiting the grilles and registers (air outlets) is not hot enough. In reality, it contains adequate heat to heat the space but feels cool to the customer.

Heat transfer fluid is also a design consideration. hydronic heating systems may use 100% water or a water propylene glycol mixture, commonly 20-30% but as high as 50%. Composition of the heat transfer fluid affects pressure drop throughout the system. Systems utilizing 100% water as the heat transfer fluid may be potable or non-potable. While hybrid potable/space heating systems have grown in popularity over the last several years, they are still relatively new and may be

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BASIC RADIANT SPACE HEATING DESIGN CONSIDERATIONS - CONTINUED

rejected by some code jurisdictions and inspectors. However, this problem is slowly disappearing. Once again, as acceptance grows within the mechanical contractor community and more installers use hybrid systems, this niche market will continue to grow.

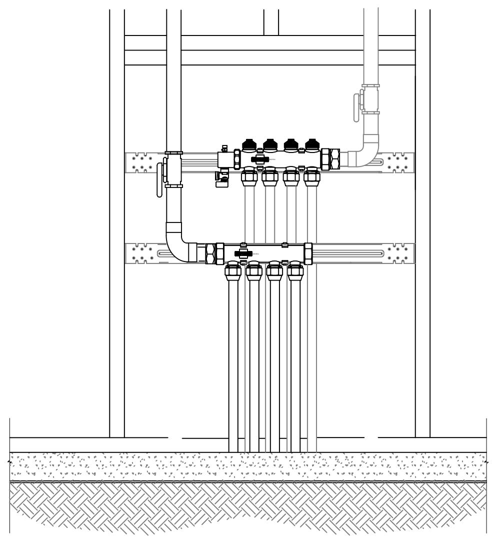
The size and type of PEX tubing used is also a consideration. PEX tubing is manufactured in many sizes. The smaller the tube diameter, the lower the flow rate and the higher the pressure drop throughout the system. Pressure drop and flow rate determine pump size. Tubing is also manufactured with a barrier to prevent oxygen diffusion. Oxygen diffusion is a process whereby dissolved oxygen permeates the walls of the tubing and enters the heating fluid. The oxygen then causes corrosion to components in the rest of the heating system, eventually causing component failures. The standard method of eliminating oxygen diffusion is to prevent oxygen from entering the system or to isolate system components that can corrode. The addition of corrosion inhibitors into heating systems has been a common practice for years.

Hydronic piping systems commonly use headers or manifolds as connections for supply and return lines. Headers allow a large amount of heating fluid to be pumped to a common location and then distributed throughout branches or loops of tubing. The ease of making tubing connections and flow control features of headers is a consideration. Flow control allows the installing contractor to accurately direct the flow of heat transfer fluid to various zones.

Zone control valves allow control of on and off flow of heating fluid to individual zones. A zone is a defined area that a single temperature controller regulates by turning on and off the flow of water. A zone may consist of one of more runs of tubing.

Temperature control components include thermostats that turn zones on and off as well as other electronic controls such as outdoor reset controls and computer controlled logic boards that monitor the entire heating system. Electronic control of the entire system is beyond the scope of this publication. As a matter of information, the Micro-Boiler controls temperature of the heating fluid (90°F -145°F) independently of the rest of the system. Since the Micro-Boiler modulates from 1-100% of full input, the set point of the Micro-Boiler automatically determines the outlet temperature on the Micro-Boiler. The heating system controls utilize the heat from the Micro-Boiler through pumping the heating fluid through various parts of the system as required by the heating system's main control board.

Other components of the system include air purgers, air separators, pump(s), fitting, pressure and temperature gauges, mixing and pressure relief valves, expansion tanks, valves for filling and draining the system, and more.



Sample Uponor Manifold Setup
(4 Loops)

Eliminating air is critical in hydronic space heating systems. Air and oxygen cause corrosion, improper flow of heating fluid throughout the system and a host of other problems. The main goal of air purgers or air separators is to trap and eliminate air. Pressure and temperature gauges allow the installer and user a way to monitor the system's operation.

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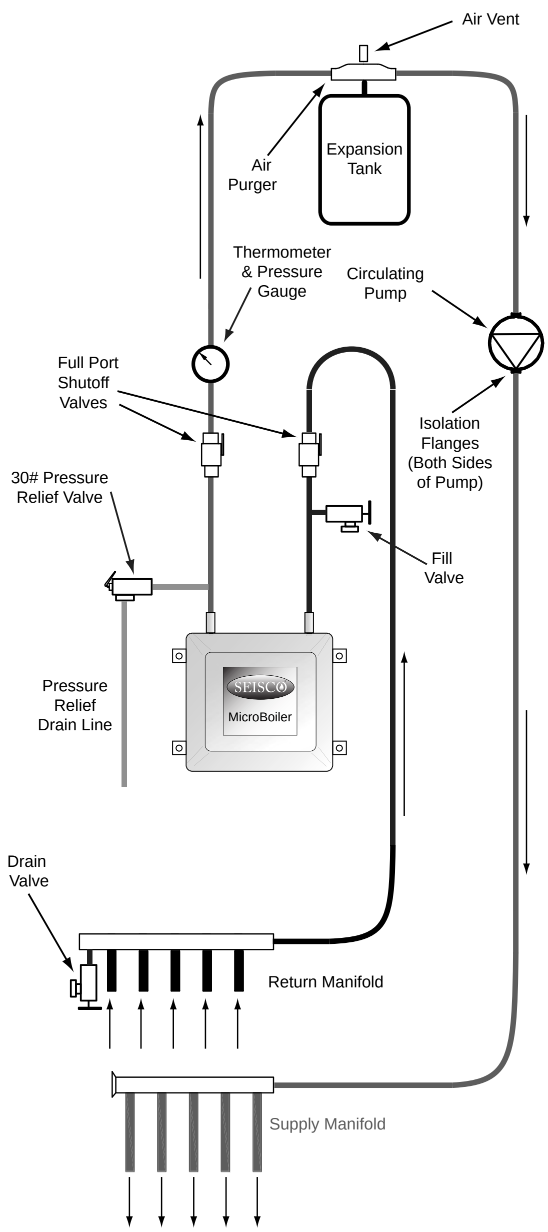
BASIC RADIANT SPACE HEATING DESIGN CONSIDERATIONS - CONTINUED

Mixing valves, although rarely requried with Micro-Boilers, serve two purposes. When used on the space heating side of the system, they reduce water temperature to the zone(s) they serve. When used in a potable water system, they reduce the temperature of water routed to domestic fixtures.

Expansion tanks are used to eliminate excessive pressure buildup in the system as the heating fluid expands and contracts due to heating cycles. Heating fluid expands when it is heated. Given no means for accommodating the expansion or relieving the pressure associated with expansion, the system pressure will quickly exceed the capability of the components to withstand the pressure causing a break in the weakest link of the system. The size of the expansion tank is based on the amount of fluid the system holds and the temperature rise of the heating fluid.

Pressure relief valves, not included with MicroBoilers, serve to protect the system should an overpressure situation occur. They are not designed as a control valve to constantly relieve pressure.

Consult with component suppliers for proper application of system components.



CONSTRUCTION METHODS

Installation of a hydronic heating system varies with the construction method of the structure and the timing of the installation. For example, if a home is constructed using slab on grade, the time to install the tubing for a floor system is during the construction of the slab. An insulating barrier and the tubing can be installed before the concrete is poured. If the home is already built and the owner wants to install a radiant floor heating system, the tubing can be installed on top of the slab with a thin layer of underlayment poured over the tubing. The finished floor is then installed over the underlayment. Other methods of installing radiant heating systems over an existing floor are also used.

Manufacturers provide various methods of installing tubing. The preferred method is poured in concrete or underlayment. This gives the system a very large thermal mass for storing, conducting, and radiating heat more uniformly throughout the structure.

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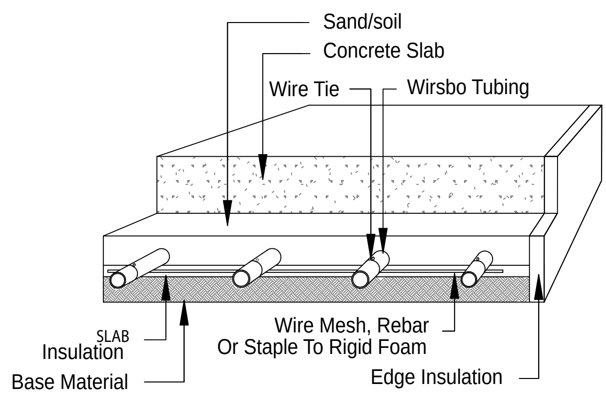
BASIC RADIANT SPACE HEATING DESIGN CONSIDERATIONS - CONTINUED

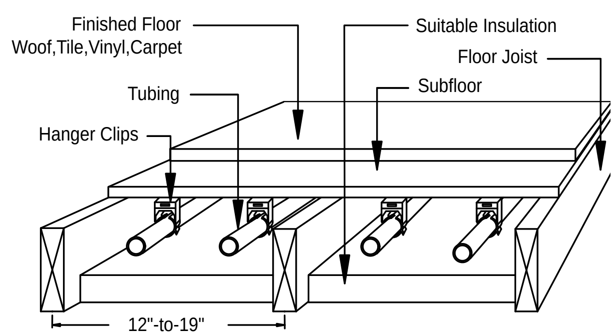
For other than ground floor applications (i.e. joist) and/or pier and beam installations, manufacturers offer a variety of hangers with or without metallic heat transfer/mounting plates. Tubing is installed in a channel in the plate and laid on the subfloor or attached to the subfloor from below. The heat transfer plates are used to conduct the heat away from the tubing and distribute it more evenly through the floor into the occupied zone.

Baseboard and wall radiator installations are similar. However, wall radiators are frequently attached to the wall, but may be attached to the floor. Finned tube baseboard radiators always run along the wall at the bottom. The drawback to baseboard radiators is that they tend to collect dust and dirt and can be difficult to clean. However, they can readily be hidden behind furniture, although not a recommended practice. Wall radiators are much more difficult to conceal but are easier to maintain. The merits of the comfort level provided by either are beyond the scope of this guide.

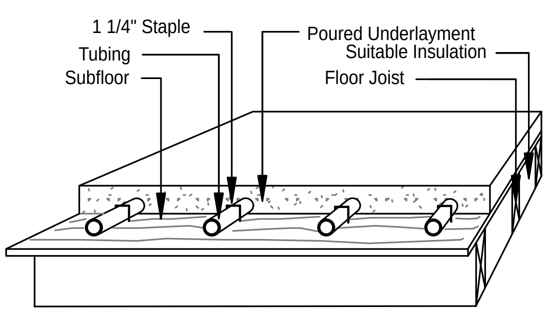
Although radiant ceiling systems are available, their popularity is low. In some instances, the temperature at head level is warmer than that at floor level, just the opposite of the most desirable situation. When the feet feel warm in a relatively warm to somewhat cool environment, the whole body feels more comfortable.



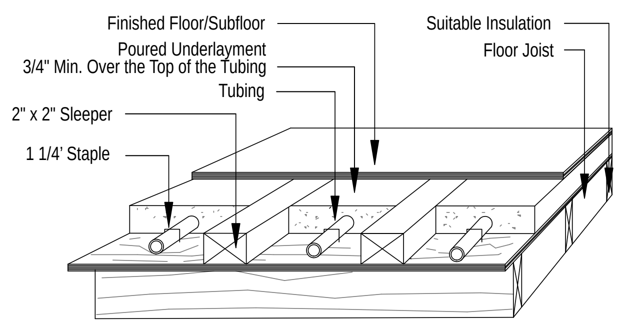
Slab On Or Below Grade Over a Sand Bed



Radiant Floor - Joist Using PEX Hanger Clips



Radiant Floor Heating - Poured Floor Underlayment on Suspended Wood Floor



Radiant Floor Heating - Poured Floor Underlayment Over a Suspended Wood Floor With Sleepers

Illustrations on this page represent several methods of installing radiant floor heating systems. Courtesy of Uponor.

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BASIC RADIANT SPACE HEATING DESIGN CONSIDERATIONS - CONTINUED

HEAT LOSS CALCULATIONS

The single most difficult part of system design is the process of calculating the heat load (loss) on the structure. Because of the difficulty in manually calculating the heat loss of a structure, computer programs have been developed to help the system designer avoid errors of overlooking critical heat loss issues and to automatically calculate heat loss based on electronic forms that are designed for input of all the critical variables. Even with computers, every structure is different and a good working knowledge of heat flux and hydronic systems is necessary.

At a simplified level, heat loss occurs in three basic forms: downward into the surrounding earth, outward from the walls and upward through the roof. Another consideration is infiltration of external air. The number of windows, doors and other wall and ceiling penetrations affect heat loss. Other critical variables are the temperature of the surrounding environment as well as the insulating value of barriers designed to reduce heat loss such as foam insulated walls, etc.

MAXIMUM BTU/FT^2 HEAT LOAD AND BTU/FT^2 INPUT REQUIREMENT

Armed with accurate heat loss calculations, the system designer can then determine the appropriate heat transfer method to achieve the ultimate desired comfort level. For example, the BTU input required to offset the Btu losses determines the size of wall radiators and length of baseboard radiators. Both are also dependent on the temperature of the heating fluid. All manufacturers provide performance charts that clearly guide the system designer to the right product configuration for the heat loss requirement and the design temperature of the heating fluid.

In the case of radiant floor heating, the system designer has the option of adding or subtracting tubing based on the amount of heat required. When more tubing is required in order to increase the amount of heat surface transfer area, the spacing between loops is narrowed. When less tubing is required, the spacing between loops is increased. Common spacing of loops is 6, 9, and 12”, although there is no scientific rule that says it must be this way. The system designer is free to alter the spacing as they see fit based on the calculated heat loss or personal experience. However, some system components are designed for specific tube spacing. The system designer should check for component compatibility before changing the tube spacing outside the norm.

In addition to tube spacing, the designer may concentrate more tubing in high traffic areas or near large heat loss sources such as windows and doors. Tubing layout can vary tremendously. A serpentine layout may follow one wall or two. It could follow a reverse flow or one way flow pattern. The ultimate goal is to provide a tubing layout that puts the most heat near the location of the largest heat losses.

HEATING FLUID FLOW

The system designer not only selects the water temperature, but also the flow rate. The flow rate is normally determined by the desired difference between the temperature of the heating fluid when it leaves the heat source to where it enters the heat source. The temperature difference is call the differential, rise, drop, or change in temperature, depending on the point of reference when referring to temperature differences in the system. Depending on the type of system, it is normally designed for a differential temperature or temperature drop or 10-20°F. In radiant floor heating the differential is usually 10-15°F. In wall and baseboard radiators, it could be over 20°F. In forced air hydronic systems it will be in the 10-40°F degree range. The flow rate of heating fluid throughout the system determines the pressure drop through components in the system, pipes, tubing, valves, etc. Pressure drop and flow rate are the determining factors in selecting pumps for the heating system.

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BASIC RADIANT SPACE HEATING DESIGN CONSIDERATIONS - CONTINUED

BASIC SYSTEM DESIGN

Basic system design consists of the following:

- Determine the basic characteristics of the structure and the desired heating method.
- Perform accurate calculations of the anticipated heat loss (load).
- Evaluate the installation characteristics of the selected heating method. For example, in radiant floor heating, the type of floor, its insulating value (resistance to heat flow), the method of installing tubing, and the desired floor temperature must all be taken into account.
- Use heat loss calculations and the equipment supplier's performance data to determine the correct system design temperature and select the products that perform adequately to do the job. For example, in radiant floor heating, the tube diameter must be selected, the tube spacing, and the heating fluid temperature must be finalized.
- Using the flow requirements of the selected equipment and information from other system components, the pressure drop is calculated and a pump is selected that will overcome the pressure drop at the required flow rate.

The above system design explanation is very simplified and is designed to give users of Microtherm's Micro-Boiler a brief overview of how systems are designed. Other factors will be considered by the system designer, such as the required pumping methodology. Many systems only require one pump. However, some systems require multiple pumps, arranged in a primary/secondary piping system as shown on page 26.

APPLICATION OF MICRO-BOILERS

Determining which Micro-Boiler fits the application requires three considerations:

- What is the heat input requirement? Heat input and output are considered the same for Microtherm's Micro-Boilers. Heat produced by the heating elements is transferred to the hydronic system's heating fluid. When the heat input requirement exceeds the capability of one Micro-Boiler, multiple units can be installed. Multiple units can also be installed in primary/secondary piping or for use in different zones of the heating system.
- What is the design temperature of the system's heating fluid? Micro-Boilers are designed for use in systems with maximum temperatures of 145°F.
- What is the flow rate through the Micro-Boiler? If the flow rate exceeds the Micro-Boiler's ability, several Micro-Boilers can be used in a primary/secondary piping configuration to reduce the individual flow rate through each unit. Generally speaking, as long as the flow rate is below 10 gpm, the pressure drop will be less than 2.5 psi or 6 ft of head.

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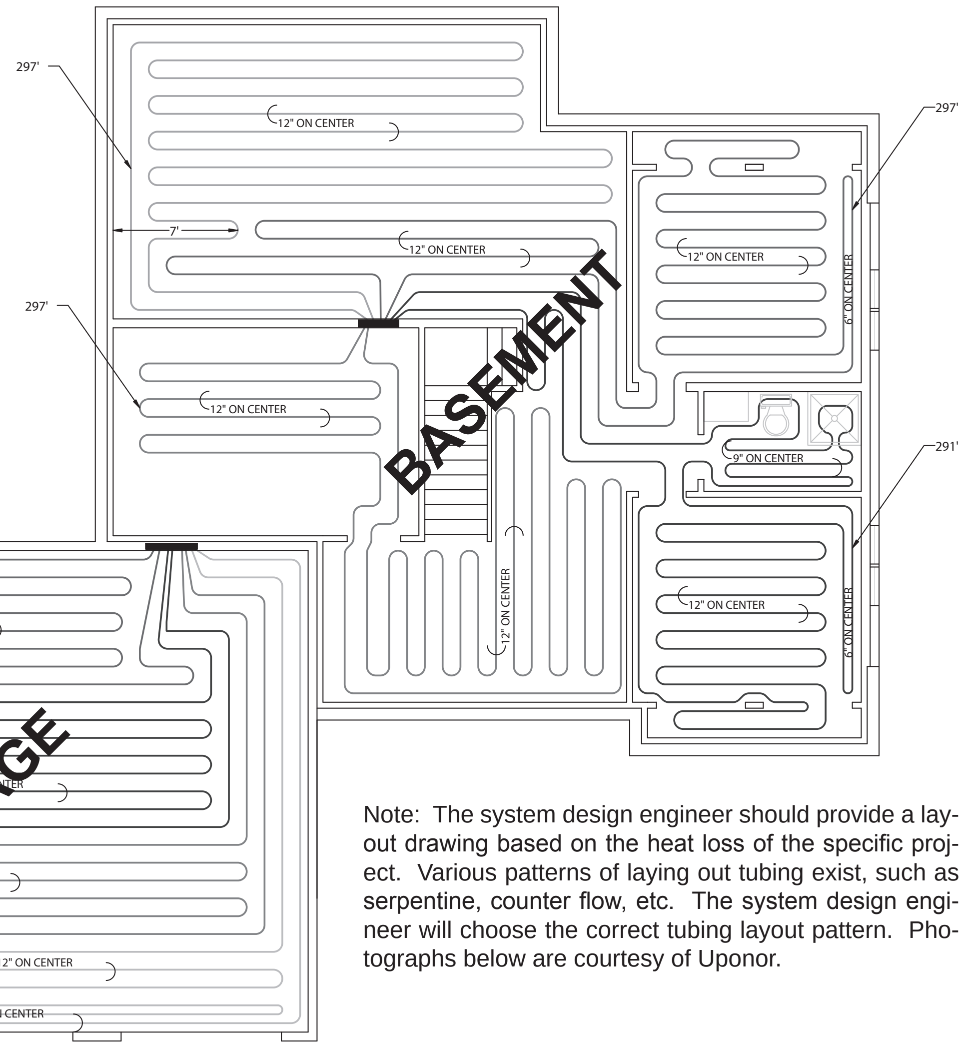
SAMPLE TUBING LAYOUT FOR A RADIANT FLOOR SPACE HEATING PROJECT

This is a sample tubing installation layout. On this job, most of the tubing was positioned on 12” centers. However, in certain locations, such as along walls with a window or outside walls, the tubing was positioned on 6” centers.



Note: The system design engineer should provide a layout drawing based on the heat loss of the specific project. Various patterns of laying out tubing exist, such as serpentine, counter flow, etc. The system design engineer will choose the correct tubing layout pattern. Photographs below are courtesy of Uponor.

Photography on this page courtesy of Watts Radiant.

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HOW TO SELECT THE RIGHT MODEL MICRO-BOILER FOR YOUR PROJECT

Using Tables To Select Micro-Boilers

The scope of this Space Heating Application Guide does not allow for every system configuration to be tabulated. However, the tables that follow allow the user to determine the correct Micro-Boiler and pump for many applications that use 1/2" ID PEX tubing. This is the most popular size tubing used for radiant space heating due to its cost and performance characteristics as well as its ease of installation.

To use the tables on pages 18-23, you must know:

1. The size of the project in square feet.
2. The tables are based on tubing spaced on 12" centers
3. The water temperature differential, 10 or 20°F.
4. The heat load/ft^2: 10, 15, 20, 25, or 30°F.

Note: When calculating input, Microtherm, Inc. adds 20% to the actual calculated heat load. This allows the Micro-Boiler to operate at less than full input almost 100% of the time. It does not increase the amount of electricity used in the heating process. This also assists the system with a heat boost on cold start up.

To use the tables:

1. Locate the table that use the system's design temperature differential. Table 1 uses 10°F while Table 2 uses 20°F.
2. Locate the portion of the table that uses the correct BTU/ft^2 heat load.
3. Use the first column to locate the project's total square feet of heated area.
4. Read across the table and identify the MicroBoiler model and the pump model required.
5. If the tube spacing is 9" on center, multiply the project square feet by 1.5 and use the newly calculated square footage as the Project Square Feet in column 1. Repeat steps 3-4.
6. If the tube spacing is 6" on center, multiply the project square feet by 2 and use the newly calculated square footage as the Project Square Feet in column 1. Repeat step 3-4 to select the MicroBoiler and pump.
7. When the square footage value exceeds the maximum Project Square Feet in column one, you must manually size and design the entire radiant floor space heating job and use the procedure for selecting the Micro-Boiler that follows.

Manually Selecting Micro-Boilers

As explained earlier in this Space Heating Product Guide, application of Micro-Boilers is simply a function of heat input/output required for the structure and the pumping requirements of the system.

Therefore, after the system designer has determined the required heat input/output, the Micro-Boiler is selected as follows:

1. Convert total BTUs requirements to KW if necessary, (BTU/3413)=KW.
2. Multiply the required input/output by 1.20
3. Select the Micro-Boiler that has an input equal to or greater than the KW calculated in step 2.
4. Identify the pump rate in gallons/minute that must be pumped through the Micro-Boiler and refer to the pressure drop charts on page nine to determine the pressure loss through the Micro-Boiler at the system's designed pump rate.
5. If the pressure drop is too high, divide the total KW calculated in step 2 by 2.
6. Select a Micro-Boiler that has an input equal to or greater than the KW calculated in step 5. Two units will be required for the job preferrably using primary/secondary pumping.*
7. Divide the pump rate in gallons/minute found in step 4 by 2, and look up the new pressure drop for the model selected in step 6.
8. Select the pump that best fits the gpm and pressure requirements

Note: Micro-Boilers are designed for a maximum temperature of 145°F. Always make sure the heating fluid temperature designed for the system is equal to or less than 145°F. If the pump rate is below 10 gpm, the pressure drop will be less than 2.5 psi or 6 feet of head, a rate that is usually negligible.

*In multi-MicroBoiler installations, if each MicroBoiler is not supplied by its own circulating pump, a flow regulating plug cock should be installed with a bypass line to adjust equal flow through each MicroBoiler. The flow through each MicroBoiler can be checked while the system is in operation by measuring the amp draw of the heating elements while the MicroBoiler operates. The amperage should be the same for all MicroBoilers. If not, adjust the flow through each MicroBoiler until the amperage readings are equal, thus assuring equal flow through all MicroBoilers.

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RADIANT FLOOR SYSTEM SIZING TABLES

Table 1-10°F. Temperature Differential, 120°F. Water Temperature, 1/2" Tubing, 12" On Center, 100% Water

Project Square Feet	Number of Loops	Loop Length*	BTU Heat Load	Seisco Model	Total Feet of Head	Grundfos Pump Model	Armstrong Pump Model	Taco Pump Model
10 BTU/Ft² (.61 gpm flow through each loop)								
275	1	300	3300	SH-05	7.13	UPS15-58F	Astor 30	005-F2
550	2	600	6600	SH-05	7.13	UPS15-58F	Astor 30	005-F2
825	3	900	9900	SH-05	7.13	UPS15-58F	Astor 30	005-F2
1100	4	1200	13200	SH-05	7.13	UPS15-58F	Astor 30	005-F2
1375	5	1500	16500	SH-05	7.13	UPS15-58F	Astor 30	005-F2
1650	6	1800	19800	SH-07	7.13	UPS15-58F	Astor 30	005-F2
1925	7	2100	23100	SH-07	7.13	UPS15-58F	Astor 30	005-F2
2200	8	2400	26400	SH-09	7.13	UPS15-58F	Astor 30	005-F2
2475	9	2700	29700	SH-09	7.13	UPS15-58F	Astor 30	005-F2
2750	10	3000	33000	SH-11	7.13	UPS15-58F	Astor 30	005-F2
15 BTU/Ft² (.91gpm flow through each loop)								
275	1	300	4950	SH-05	11.5	UPS15-58F	Astor 30	0010-F3
550	2	600	9900	SH-05	11.5	UPS15-58F	Astor 30	0010-F3
825	3	900	14850	SH-05	11.5	UPS15-58F	Astor 30	0010-F3
1100	4	1200	19800	SH-07	11.5	UPS15-58F	Astor 30	0010-F3
1375	5	1500	24750	SH-09	11.5	UPS15-58F	Astor 30	0010-F3
1650	6	1800	29700	SH-09	11.5	UPS15-58F	Astor 30	0010-F3
1925	7	2100	34650	SH-11	11.5	UPS15-58F	Astor 30	0010-F3
2200	8	2400	39600	SH-14	11.8	UPS15-58F	Astor 50	0010-F3
2475	9	2700	44550	SH-14	12.2	UPS15-58F	Astor 50	0010-F3
2750	10	3000	49500	SH-18	11.7	UPS15-58F	Astor 50	0010-F3
20 BTU/Ft² (1.2 gpm flow through each loop)								
275	1	300	6600	SH-05	17.3	UP26-64F	Astor 50	0014-F1
550	2	600	13200	SH-05	17.3	UP26-64F	Astor 50	0014-F1
825	3	900	19800	SH-07	17.3	UP26-64F	Astor 50	0014-F1
1100	4	1200	26400	SH-09	17.3	UP26-64F	Astor 50	0014-F1
1375	5	1500	33000	SH-11	17.3	UP26-64F	Astor 30	0014-F1
1650	6	1800	39600	SH-14	17.5	UP26-64F	Astor 30	0014-F1
1925	7	2100	46200	SH-14	18.1	UP26-64F	Astor 30	0014-F1
2200	8	2400	52800	SH-18	18.3	UP26-64F	Astor 30	0014-F1
2475	9	2700	59400	SH-18	21.0	UP26-64F	E13	0014-F1
2750	10	3000	66000	SH-22	24.5	UP26-96F	E13	0014-F1

*Loop length includes floor loop length plus supply/return leader.

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RADIANT FLOOR SYSTEM SIZING TABLES

Table 1 Continued-10°F. Temperature Differential, 120°F. Water Temperature, 1/2" Tubing, 12" On Center, 100% Water

Project Square Feet	Number of Loops	Loop Length*	BTU Heat Load	Seisco Model	Total Feet of Head	Grundfos Pump Model	Armstrong Pump Model	Taco Pump Model
25 BTU/Ft² (1.52 gpm flow through each loop)								
275	1	300	8250	SH-05	24.3	UP26-99F	E11	0011-F4
550	2	600	16500	SH-05	24.3	UP26-99F	E11	0011-F4
825	3	900	24750	SH-09	24.3	UP26-99F	E11	0011-F4
1100	4	1200	33000	SH-11	24.3	UP26-99F	E11	0011-F4
1375	5	1500	41250	SH-14	24.7	UP26-99F	E11	0011-F4
1650	6	1800	49500	SH-18	24.5	UP26-99F	E11	0013-F3
1925	7	2100	57750	SH-18	27.6	UP26-99F	E11	0013-F3
2200	8	2400	66000	SH-22	32.0	P/S	E9	P/S
2475	9	2700	74250	SH-22	38.0	P/S	E12	P/S
2750	10	3000	82500	SH-28	45.5	P/S	E12	P/S
30 BTU/Ft² (1.82 gpm flow through each loop)								
275	1	300	9900	SH-05	32.5	P/S	E9	0013-F3
550	2	600	19800	SH-07	32.5	P/S	E9	0013-F3
825	3	900	29700	SH-09	32.5	P/S	E9	0013-F3
1100	4	1200	39600	SH-14	32.7	P/S	E9	P/S
1375	5	1500	49500	SH-18	32.7	P/S	E9	P/S
1650	6	1800	59400	SH-18	36.5	P/S	E9	P/S
1925	7	2100	69300	SH-22	42.3	P/S	E12	P/S
2200	8	2400	79200	SH-28	50.4	P/S	P/S	P/S
2475	9	2700	89100	SH-28	60.5	P/S	P/S	P/S
2750	10	3000	82500	SH-28	64.6	P/S	P/S	P/S

Table 1 Notes: Maximum loop length is 300'. Head includes tubing loss as well as loss through the Micro-Boiler. P/S = Use primary/secondary pump arrangement.

*Loop length includes floor loop length plus supply/return leader.

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RADIANT FLOOR SYSTEM SIZING TABLES

Table 2-20°F. Temperature Differential, 120°F. Water Temperature, 1/2" Tubing, 12" On Center, 100% Water

Project Square Feet	Number of Loops	Loop Length*	BTU Heat Load	Seisco Model	Total Feet of Head	Grundfos Pump Model	Armstrong Pump Model	Taco Pump Model
10 BTU/Ft² (.3 gpm flow through each loop)								
275	1	300	3300	SH-05	4.2	UPS15-58F	Astor 30	005-F2
550	2	600	6600	SH-05	4.2	UPS15-58F	Astor 30	005-F2
825	3	900	9900	SH-05	4.2	UPS15-58F	Astor 30	005-F2
1100	4	1200	13200	SH-05	4.2	UPS15-58F	Astor 30	005-F2
1375	5	1500	16500	SH-05	4.2	UPS15-58F	Astor 30	005-F2
1650	6	1800	19800	SH-07	4.2	UPS15-58F	Astor 30	005-F2
1925	7	2100	23100	SH-07	4.2	UPS15-58F	Astor 30	005-F2
2200	8	2400	26400	SH-09	4.2	UPS15-58F	Astor 30	005-F2
2475	9	2700	29700	SH-09	4.2	UPS15-58F	Astor 30	005-F2
2750	10	3000	33000	SH-11	4.2	UPS15-58F	Astor 30	005-F2
15 BTU/Ft² (.45 gpm flow through each loop)								
275	1	300	4950	SH-05	5.5	UPS15-58F	Astor 30	005-F2
550	2	600	9900	SH-05	5.5	UPS15-58F	Astor 30	005-F2
825	3	900	14850	SH-05	5.5	UPS15-58F	Astor 30	005-F2
1100	4	1200	19800	SH-07	5.5	UPS15-58F	Astor 30	005-F2
1375	5	1500	24750	SH-09	5.5	UPS15-58F	Astor 30	005-F2
1650	6	1800	29700	SH-09	5.5	UPS15-58F	Astor 30	005-F2
1925	7	2100	34650	SH-11	6.3	UPS15-58F	Astor 30	005-F2
2200	8	2400	39600	SH-14	6.1	UPS15-58F	Astor 30	005-F2
2475	9	2700	44550	SH-14	5.8	UPS15-58F	Astor 30	005-F2
2750	10	3000	49500	SH-18	4.2	UPS15-58F	Astor 30	005-F2
20 BTU/Ft² (.61 gpm flow through each loop)								
275	1	300	6600	SH-05	7.1	UPS15-58F	Astor 30	005-F2
550	2	600	13200	SH-05	7.1	UPS15-58F	Astor 30	005-F2
825	3	900	19800	SH-07	7.1	UPS15-58F	Astor 30	005-F2
1100	4	1200	26400	SH-09	7.1	UPS15-58F	Astor 30	005-F2
1375	5	1500	33000	SH-11	7.1	UPS15-58F	Astor 30	005-F2
1650	6	1800	39600	SH-14	7.1	UPS15-58F	Astor 30	005-F2
1925	7	2100	46200	SH-14	7.4	UPS15-58F	Astor 30	005-F2
2200	8	2400	52800	SH-18	5.8	UPS15-58F	Astor 30	005-F2
2475	9	2700	59400	SH-18	5.8	UPS15-58F	Astor 30	005-F2
2750	10	3000	66000	SH-22	5.8	UPS15-58F	Astor 30	005-F2

*Loop length includes floor loop length plus supply/return leader.

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RADIANT FLOOR SYSTEM SIZING TABLES

Table 2 Continued-20°F. Temperature Differential, 120°F. Water Temperature, 1/2” Tubing, 12” On Center, 100% Water

Project Square Feet	Number of Loops	Loop Length*	BTU Heat Load	Seisco Model	Total Feet of Head	Grundfos Pump Model	Armstrong Pump Model	Taco Pump Model
25 BTU/Ft² (.76 gpm flow through each loop)								
275	1	300	8250	SH-05	9.0	UPS15-58F	Astor 30	005-F2
550	2	600	16500	SH-05	9.0	UPS15-58F	Astor 30	005-F2
825	3	900	24750	SH-09	9.0	UPS15-58F	Astor 30	005-F2
1100	4	1200	33000	SH-11	9.9	UPS15-58F	Astor 30	005-F2
1375	5	1500	41250	SH-14	9.5	UPS15-58F	Astor 30	005-F2
1650	6	1800	49500	SH-18	7.7	UPS15-58F	Astor 30	005-F2
1925	7	2100	57750	SH-18	7.7	UPS15-58F	Astor 30	005-F2
2200	8	2400	66000	SH-22	7.7	UPS15-58F	Astor 30	005-F2
2475	9	2700	74250	SH-22	7.7	UPS15-58F	Astor 30	005-F2
2750	10	3000	82500	SH-28	7.7	UPS15-58F	Astor 30	005-F2
30 BTU/Ft² (.9 gpm flow through each loop)								
275	1	300	9900	SH-05	11.5	UPS15-58F	Astor 30	005-F2
550	2	600	19800	SH-07	11.5	UPS15-58F	Astor 30	005-F2
825	3	900	29700	SH-09	12.7	UPS15-58F	Astor 30	005-F2
1100	4	1200	39600	SH-14	11.7	UPS15-58F	Astor 30	005-F2
1375	5	1500	49500	SH-18	10.2	UPS15-58F	Astor 30	005-F2
1650	6	1800	59400	SH-18	10.2	UPS15-58F	Astor 30	005-F2
1925	7	2100	69300	SH-22	10.2	UPS15-58F	Astor 30	005-F2
2200	8	2400	79200	SH-28	10.2	UPS15-58F	Astor 30	005-F2
2475	9	2700	89100	SH-28	10.6	UPS15-58F	Astor 30	005-F2
2750	10	3000	82500	SH-28	11.6	UPS15-58F	Astor 30	005-F2

Table 1 Notes: Maximum loop length is 300’. Head includes tubing loss as well as loss through the Micro-Boiler. P/S = Use primary/secondary pump arrangement.

*Loop length includes floor loop length plus supply/return leader.

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RADIANT FLOOR SYSTEM SIZING TABLES

Table 2 Continued-20°F. Temperature Differential, 120°F. Water Temperature, 1/2” Tubing, 12” On Center, 100% Water

Project Square Feet	Number of Loops	Loop Length*	BTU Heat Load	Seisco Model	Total Feet of Head	Grundfos Pump Model	Armstrong Pump Model	Taco Pump Model
35 BTU/Ft² (1.06 gpm flow through each loop)								
275	1	300	11550	SH-05	13.6	UPS15-58F	Astor 30	008-F6
550	2	600	23100	SH-07	13.6	UPS15-58F	Astor 30	008-F6
825	3	900	34650	SH-11	13.6	UPS15-58F	Astor 30	008-F6
1100	4	1200	46200	SH-14	13.6	UPS15-58F	Astor 30	008-F6
1375	5	1500	57750	SH-18	12.5	UPS15-58F	Astor 30	008-F6
1650	6	1800	69300	SH-22	11.9	UPS15-58F	Astor 30	008-F6
1925	7	2100	80850	SH-28	11.9	UPS15-58F	Astor 30	008-F6
2200	8	2400	92400	SH-28	12.7	UP26-64F	Astor 70	008-F6
2475	9	2700	103950	2 SH-18	14.2	P/S	P/S	P/S
2750	10	3000	115500	2 SH-18	16.5	P/S	P/S	P/S
40 BTU/Ft² (1.21 gpm flow through each loop)								
275	1	300	13200	SH-05	17.3	UP26-64F	Astro 50	0014-F1
550	2	600	26400	SH-07	17.3	UP26-64F	Astro 50	0014-F1
825	3	900	39600	SH-14	17.3	UP26-64F	Astro 50	0014-F1
1100	4	1200	52800	SH-18	15.9	UP26-64F	Astro 50	0014-F1
1375	5	1500	66000	SH-22	15.9	UP26-64F	Astro 50	0014-F1
1650	6	1800	79200	SH-28	15.9	UP26-64F	Astro 50	0014-F1
1925	7	2100	92400	SH-28	16.7	UP26-64F	Astro 50	0014-F1
2200	8	2400	105600	2 SH-18	18.5	P/S	P/S	P/S
2475	9	2700	118800	2 SH-18	21.2	P/S	P/S	P/S
2750	10	3000	132000	2 SH-22	24.8	P/S	P/S	P/S

Table 1 Notes: Maximum loop length is 300’. Head includes tubing loss as well as loss through the Micro-Boiler. P/S = Use primary/secondary pump arrangement.

*Loop length includes floor loop length plus supply/return leader.

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RADIANT FLOOR SYSTEM SIZING TABLES

Table 2 Continued-20°F. Temperature Differential, 120°F. Water Temperature, 1/2" Tubing, 12" On Center, 100% Water

Project Square Feet	Number of Loops	Loop Length*	BTU Heat Load	Seisco Model	Total Feet of Head	Grundfos Pump Model	Armstrong Pump Model	Taco Pump Model
45 BTU/Ft² (1.36 gpm flow through each loop)								
275	1	300	14850	SH-05	20.7	UP26-64F	Astor 50	0014-F1
550	2	600	29700	SH-09	20.7	UP26-64F	Astor 50	0014-F1
825	3	900	44550	SH-14	20.7	UP26-64F	Astor 50	0014-F1
1100	4	1200	59400	SH-18	19.2	UP26-64F	Astor 70	0014-F1
1375	5	1500	74250	SH-22	19.2	UP26-64F	Astor 70	0011-F4
1650	6	1800	89100	SH-28	19.8	UP26-96F	E7	0011-F4
1925	7	2100	103950	2 SH-18	21.6	P/S	P/S	P/S
2200	8	2400	118800	2 SH-18	24.6	P/S	P/S	P/S
2475	9	2700	133650	2 SH-22	28.7	P/S	P/S	P/S
2750	10	3000	148500	2 SH-22	34.1	P/S	P/S	P/S
50 BTU/Ft² (1.52 gpm flow through each loop)								
275	1	300	16500	SH-05	24.3	UP26-96F	Astor 70	0011-F4
550	2	600	33000	SH-11	24.3	UP26-96F	Astor 70	0011-F4
825	3	900	49500	SH-18	24.4	UP26-96F	Astor 70	0011-F4
1100	4	1200	66000	SH-22	23.0	UP26-96F	E7	0011-F4
1375	5	1500	82500	SH-28	23.0	UP26-96F	E7	0011-F4
1650	6	1800	99000	2 SH-18	24.5	P/S	P/S	P/S
1925	7	2100	115500	2 SH-18	27.6	P/S	P/S	P/S
2200	8	2400	132000	2 SH-22	32.0	P/S	P/S	P/S
2475	9	2700	148500	2 SH-22	38.0	P/S	P/S	P/S
2750	10	3000	165000	2 SH-28	45.5	P/S	P/S	P/S

Table 1 Notes: Maximum loop length is 300'. Head includes tubing loss as well as loss through the Micro-Boiler. P/S = Use primary/secondary pump arrangement.

*Loop length includes floor loop length plus supply/return leader.

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INTRODUCTION TO PIPING DIAGRAMS

Location: The best practice is to locate the Micro-Boiler in a central location that minimizes tubing runs between manifold headers and the Micro-Boiler. Location for easy access for servicing and setup during the installation process is also desirable.

Piping/Pumping Methods: For most jobs, the Micro-Boiler will be piped in a standard configuration using one circulating pump for moving heating fluid throughout the entire radiant heating system. This works well up to 10 gpm as the pressure drop through the Micro-Boiler is low. Pumping the entire flow of the heating system through the Micro-Boiler is not a problem as long as the pressure drop does not become an issue. This piping application is shown on page 25.

However, when flow rates increase above a desirable pressure drop, two or more Micro-Boilers may be used in parallel. This effectively divides the flow rate by the number of Micro-Boilers.

As an alternative, a primary/secondary pumping method may be used. In a primary/secondary system, the pumps that circulate heating fluid through the radiant heating system do not circulate the heating fluid through the Micro-Boiler(s). The system circulating pumps route return water through a main system header that travels past the Micro-Boiler(s). A separate pump draws heating fluid from the main header and routes it through the Micro-Boiler(s) where it is heated and immediately returned to the main header, mixing with the balance of the bypassed water.

The piping diagram on page 26 is a typical primary/secondary pumping application. In the example diagram, six separate pumps are used in the system. Each of three zones has its own circulating pump. Each Micro-Boiler also has its own circulating pump.

Many other applications and piping arrangements are available that are not shown in this Space Heating Product Guide. Refer to your local profession radiant system designer for specifics involving your project.

Hydro-heat System or Radiant Heating System With Plate Heat Exchanger: When sizing the pump for a hydro-heat system the pressure loss through the coil, all system components and the Micro-Boiler are added together. The flow rate is established by the requirements of the heating coil. When a plate heat exchanger is used as shown on page 28, at least two pumps are always used, one to circulate hot water between the Micro-Boiler and the plate heat exchanger and one to circulate non-potable heating fluid throughout the radiant heating system. The requirements for each pump are determined separately.

Left photo courtesy of Watts Radiant, right photo courtesy of Uponor.

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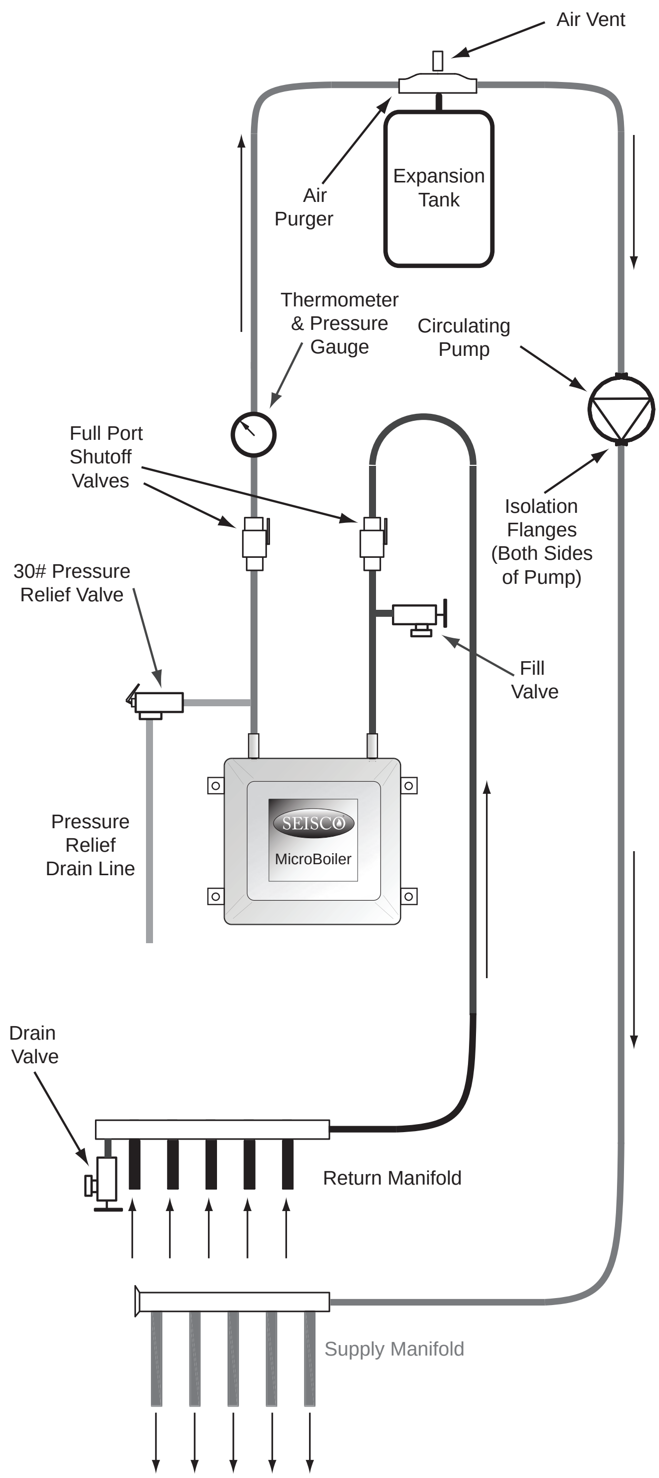
MICRO-BOILER PIPED FOR RADIANT FLOOR SPACE HEATING USING PRIMARY PUMPING SYSTEM



Note: All heating fluid is circulated through the Micro-Boiler. See Model Selection tables for limitations of this piping application.

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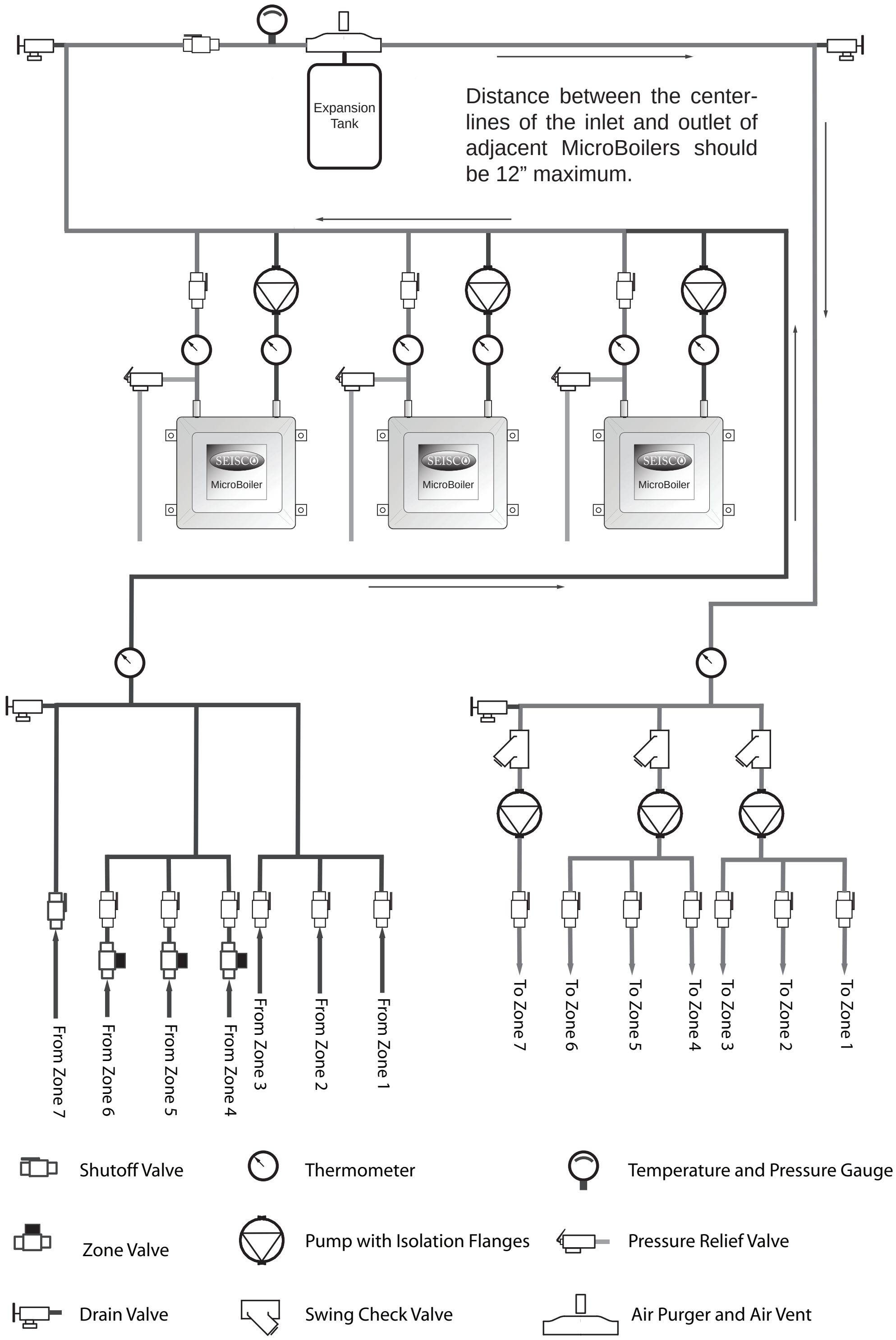
Residential Piping Diagrams

MULTIPLE MICRO-BOILERS PIPED FOR RADIANT FLOOR SPACE HEATING USING PRIMARY/SECONDARY PUMPING SYSTEM



Note: Each Micro-Boiler has its own circulating pump. All heating fluid is not circulated through each Micro-Boiler. See Model Selection tables for using this piping application.

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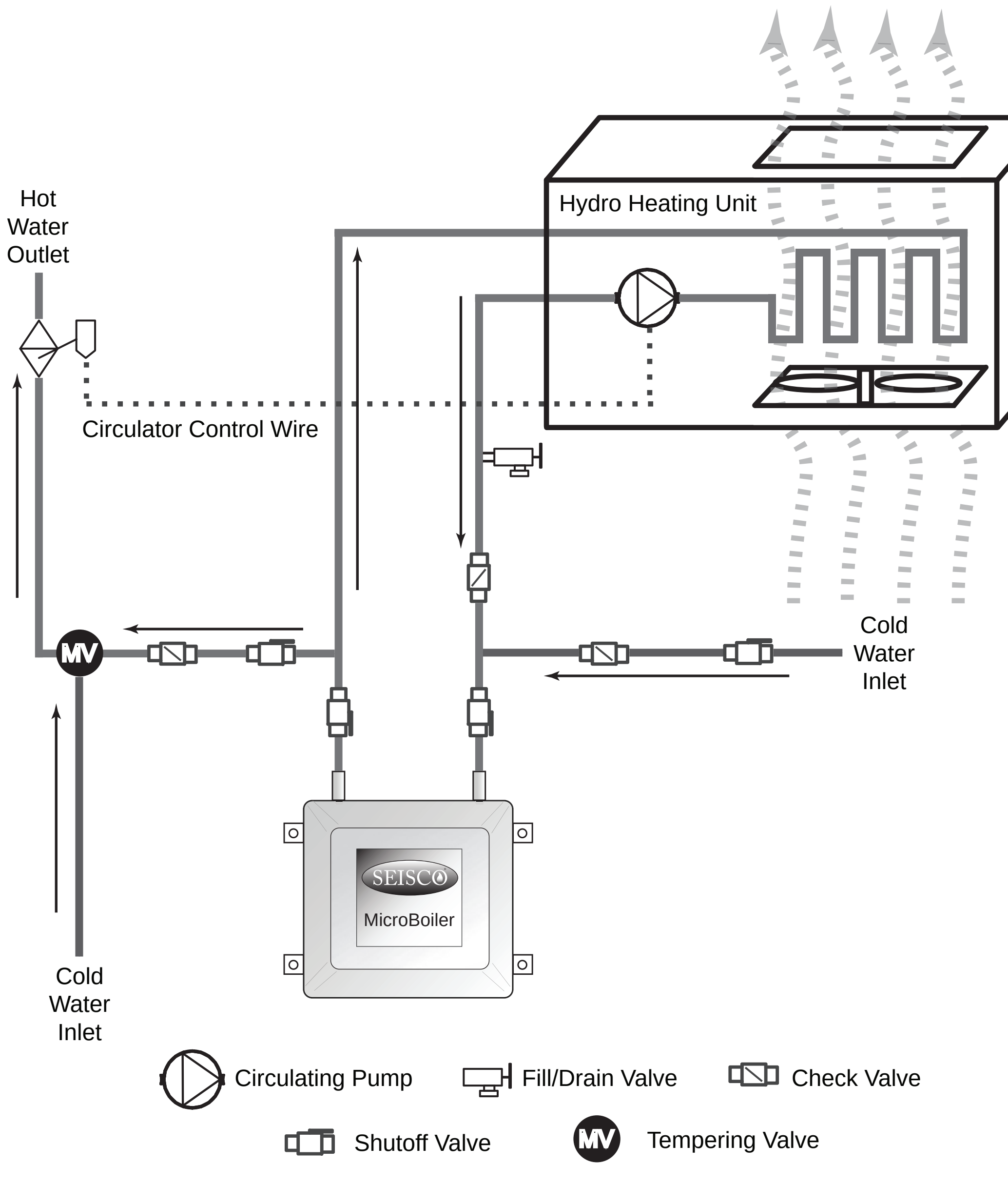
COMBINED DOMESTIC HOT WATER AND HYDRO-HEAT



Hydro-heat systems are generally used for apartments and condominiums throughout the central and southern regions of the United States. Typically, the BTU ratings for these systems range from approximately 27,000 to 40,000 BTU. Micro-Boiler Model SH-28 is rated for over 96,000 BTU output.

For the Hydro-heat system to obtain it's maximum BTU rating, the Micro-Boiler temperature setting should be set between 125° and 135°F.

The priority flow switch can be replaced with a surface mounted thermostat. Either one serves the same function of turning off both circulating pumps when domestic hot water flow is sensed, giving domestic hot water priority over space heating.

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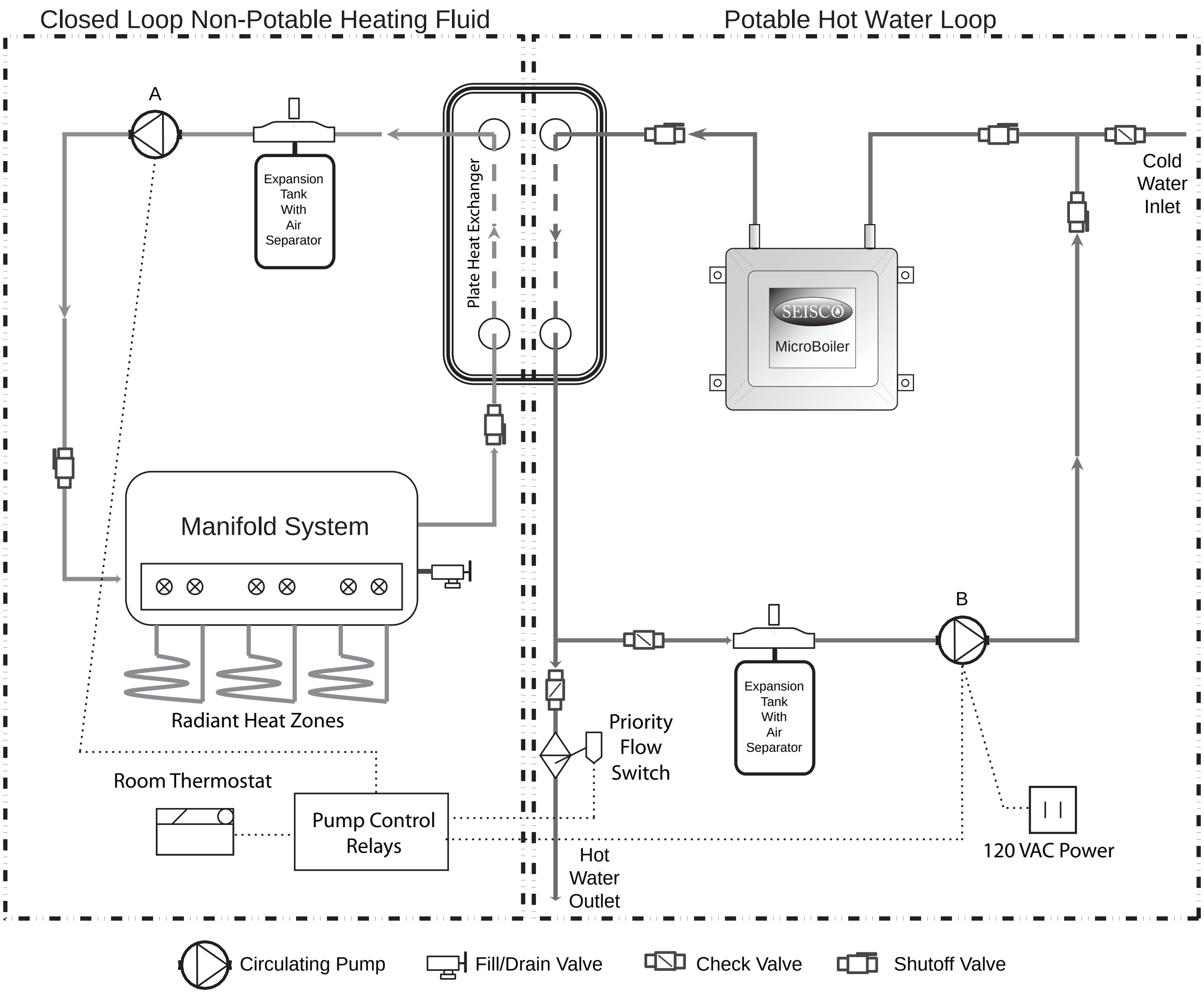
COMBINED DOMESTIC HOT WATER AND RADIANT HEAT USING NON-POTABLE HEATING FLUID



SPACE HEATING OPERATION: When the room thermostat calls for heat, both circulating pumps 'A' & 'B' will turn on. Pump 'B' circulates water through the Micro-Boiler creating heated water that flows through the plate heat exchanger. Heat is transferred to the closed loop radiant floor heating system and circulated by pump 'A' until the thermostat is satisfied. When satisfied, the room thermostat will signal both pumps to turn off.

DOMESTIC HOT WATER OPERATION: The priority flow switch will sense flow while domestic hot water is being used and prevent pumps 'A' & 'B' from turning on. The circulating pumps will not turn on until the demand for domestic hot water stops, even if the room thermostat calls for heat.

The priority flow switch can be replaced with a surface mounted thermostat. Either one serves the same function of turning off both circulating pumps when domestic hot water flow is sensed, giving domestic hot water priority over space heating.

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GENERAL ELECTRICAL INFORMATION

Electrical Service-Micro-Boilers require a supply circuit voltage nominally rated for 220- 240 volts (VAC) (or 208 VAC). Some models require multiple double pole circuits and breakers (see the chart below for 240 volt electrical ratings and requirements). Models rated for 208 volt service are available. Consult the factory before ordering 208 volt models.

In the U.S., Micro-Boilers are classified as a space heating appliances and are generally added to the total electrical load at 65 or 100% of full amp draw capacity. The overall service load of the home can be calculated using the optional methods from the National Electrical Code, sections NEC 220.82 or 220.83. The methods and rules for calculating these loads can be found on pages 30-32.

For new residential dwellings, the service load should be calculated using NEC 220.82. For existing residential dwellings, the service load should be calculated using NEC 220.83.

Sub-panels-Electrical sub-panels, containing circuit breakers, may be used with appliances such as the Micro-Boiler, particularly for the models requiring multiple circuits, (see pages 35-37 in this publication).

In new residential construction, there are usually enough spaces for additional breakers in the main electrical panel to accommodate multiple circuit breakers for the Micro-Boiler. However, in existing homes, the main electrical panel may be nearly full with circuit breakers serving existing loads. In these cases, a single large breaker, rated for 125% of the entire load of the Micro-Boiler, can be installed at the main panel.

From the main panel, a single circuit or sub-feed is then installed to a sub-panel where the appropriate number of circuit breakers can be installed for the Micro-Boiler. Refer to the electrical wiring & breaker diagrams in this section for options that can be used to serve various Micro-Boiler models requiring multiple circuits.

Branch Circuits and Breakers-The branch circuit wires and breakers protecting the appliance must be sized to 125% (percent) of maximum amperage rating. It is recommended that the wire and breakers of the branch circuits and sub-feeds be rated for at least 75°C. This is particularly important to avoid over heating of the wires at the connections to the breakers. Over heating at the breaker connections may cause nuisance or premature breaker trips. Refer to D. National Electrical Code Rules – Branch Circuit Protection in this section for further detail and explanation.

240 Volt Model Electrical Ratings and Basic Circuit Requirements

Model	Max. kW	Voltage	Max. Amps.	# OF 2-Wire Circuits	# Double-Pole Circuit Breakers	Circuit Breaker Size (amps)
SH-05	5	240	20.8	1	1	30
SH-07	7	240	29.2	1	1	40
SH-09	9	240	37.5	1	1	50
SH-11	11	240	45.8	1	1	60
SH-14	14	240	58.3	2*	2	40
SH-18	18	240	75.0	2	2	50
SH-22	22	240	91.7	2	2	60
SH-28	28	240	116.7	4**	4	40

*Optional: One 75 amp. breaker may be used in lieu of 2 40-amp breakers. **Two 75 amp breakers may be used in lieu of 4 40 amp breakers.

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NATIONAL ELECTRIC CODE-LOAD CALCULATIONS

Optional Calculations for Computing Feeder and Service Loads 220.82. Optional Calculation — New Dwelling Unit

(a) Feeder and Service Load-For a dwelling unit having the total connected load served by a single 3-wire, 120/240-volt or 208Y/120-volt set of service-entrance or feeder conductors with an ampacity of 100 or greater, it shall be permissible to compute the feeder and service loads in accordance with this NEC section. The calculated load shall be the result of adding the loads from (b) and (c). Feeder and service-entrance conductors whose demand load is determined by this optional calculation shall be permitted to have the neutral load determined by Section 220.61.

(b) General Loads. The general calculated load shall be not less than 100 percent of the first 10 kVA plus 40 percent of the remainder of the following loads:

1. 1500 volt-amperes for each 2 wire, 20 ampere small-appliance branch circuit and each laundry branch circuit specified in Section 220.52.
2. 3 volt-amperes per square foot (0.093 m2) for general lighting and general-use receptacles
3. The nameplate rating of all appliances that are fastened in place, permanently connected, or located to be on a specific circuit, ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers, and **water heaters**
4. The nameplate ampere or kVA rating of all motors and of all low-power-factor loads

(c) Heating and Air-Conditioning Load. Include the largest of the following six selections (load in kVA).

1. 100 percent of the nameplate rating(s) of the air conditioning and cooling.
2. 100 percent of the nameplate rating(s) of the heating when a heat pump is used without any supplemental electric heating.
3. 100 percent of the nameplate ratings of electric thermal storage and other heating systems where the usual load is expected to be continuous at the full nameplate value. Systems qualifying under this selection shall not be calculated under any other selection in (c).
4. 100 percent of the nameplate rating(s) of the heat pump compressor and 65 percent of the supplemental electric heating for central space heating. If the compressor cannot operate at the same time as the supplemental heating, the central space heating load is based on 65 percent of the supplemental heating load.
5. 65 percent of the nameplate rating(s) of electric space heating if less than four separately controlled units.
6. 40 percent of the nameplate rating(s) of electric space heating if four or more separately controlled units.

220.83. Optional Calculation for Additional Loads in Existing Dwelling Unit

For an existing dwelling unit presently being served by an existing 120/240-volt or 208Y/120-volt, 3 wire service, it shall be permissible to compute load calculations as follows:

Load (kVa)	Percent of Load
First 8 kVA of load at	100
Remainder of load at	40

Load calculations shall include lighting at 3 volt-amperes/ft^2 (0.093 m2); 1500 volt-amperes for each 2 wire, small-appliance branch circuit and each laundry branch circuit as specified in Section 220.52; range or wall-mounted oven and counter-mounted cooking unit; other appliances that are permanently connected or fastened in place, at nameplate rating.

If air-conditioning equipment or electric space-heating equipment is to be installed, the following formula shall be applied to determine if the existing service is of sufficient size.

Air-conditioning equipment*	100%
Central electric space heating*	100%
Less than four separately controlled space heating units*	100%
First 8 kVA of all other loads	100%
Remainder of all other loads	40%

*Use larger connected load of air conditioning and space heating, but not both.

Other loads shall include the following:

1. 1500 volt-amperes for each 20 ampere appliance circuit
2. Lighting and portable appliances at 3 volt-amperes/ft^2 (0.093 m2)
3. Household range or wall-mounted oven and counter-mounted cooking unit
4. All other appliances fastened in place, including four or more separately controlled space-heating units, at nameplate rating

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NATIONAL ELECTRIC CODE-SAMPLE RESIDENTIAL LOAD CALCULATION FOR NEW HOME PER NEC 220.82

Homes of various square footages in the following sample calculations are 100% electric with a standard electric water heater, an electric range (12kW), a dishwasher (1.2kVA), electric clothes dryer (5kW), and one or two 3.5 ton air conditioners with air handler(s) (21.2 amp draw for combination of one air conditioner and one air handler). Heat load calculations used in the table are based on 25 BTU/FT² a worst case scenario for most of the U.S. Each example is recalculated for 10, 15, and 20 BTU/FT² in the lower part of the table.

		1	2	3	4	5	6	7
	Example	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Sqr. Ft.	**3000**	**2750**	**2500**	**2250**	**2000**	**1750**	**1500**
Lighting	3 VA/ft² X dwelling area	9,000	8,250	7,500	6,750	6,000	5,250	4,500
Appliance	2 X 1500 VA	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Laundry	1500 VA	1,500	1,500	1,500	1,500	1,500	1,500	1,500
	Subtotal (VA)	**13,500**	**12,750**	**12,000**	**11,250**	**10,500**	**9,750**	**9,000**
Range	12 kW	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Water Heater	4.5 kW	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Dishwasher	1.2 VA	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Dryer	5 kW	5,000	5,000	5,000	5,000	5,000	5,000	5,000
	Total Other Load (VA)	**22,700**	**22,700**	**22,700**	**22,700**	**22,700**	**22,700**	**22,700**
Demand Factors	10 kW @ 100%	10,000	10,001	10,002	10,003	10,004	10,005	10,006
	Remainder @ 40%	10,480	10,180	9,880	9,580	9,280	8,980	8,680
3.5 Ton A/C*	AC 240V X 21.2Amps	5,088	5,088	5,088	5,088	5,088	5,088	5,088
3.5 Ton A/C*	AC 240V X 21.2Amps	5,088	5,088	5,088	5,088	0	0	0
Heat Load Calculation** (reference only)		100,000	91,667	83,333	75,000	66,667	58,333	50,000
Micro-Boiler kW Input		36	28	28	22	22	18	18
Micro-Boiler kW Input X 1000 x .65***		23,400	18,200	18,200	14,300	14,300	11,700	11,700
	Service Load (VA)	**54,056**	**48,557**	**48,258**	**44,059**	**38,672**	**35,773**	**35,474**
	Service Load/240V=Current (Amps)	225	202	201	184	161	149	148
	Service Panel (Amps)	250	200	200	200	200	150	150
	Heat Load for 10 BTU/FT²	40000	36667	33333	30000	26667	23333	20000
	Heat Load for 15 BTU/FT²	60000	55000	50000	45000	40000	35000	30000
	Heat Load for 20 BTU/FT²	80000	73333	66667	60000	53333	46667	40000
	Micro-Boiler kW X 1000 (10 BTU/FT²)	14000	11000	11000	9000	9000	7000	7000
	Micro-Boiler kW X 1000 (15 BTU/FT²)	18000	18000	18000	14000	14000	11000	9000
	Micro-Boiler kW X 1000 (20 BTU/FT²)	28000	22000	22000	18000	18000	14000	14000
	Service Load/240V=Current (Amps)	186	172	171	161	139	129	128
	Service Load/240V=Current (Amps)	203	201	200	182	160	146	137
	Service Load/240V=Current (Amps)	244	218	217	199	177	159	157
	Service Panel (Amps) for 10 BTU/FT²	200	200	200	200	150	150	150
	Service Panel (Amps) for 15 BTU/FT²	250	250	200	200	200	150	150
	Service panel (Amps) for 20 BTU/FT²	250	250	250	200	200	200	200

*21.1A includes 3.3 amp draw air handler.
**Heat load calculation is used for determining the kW input/output of the Micro-Boiler. In the above examples, it is based on 25 BTU/FT² heat loss and 25% extra heat input. For 10, 15, or 20 BTU/FT², refer to the bottom section of the table.
***Micro-Boiler load is calculated at 65% per NEC 220.82.c.5.

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Micro-Boiler™

NATIONAL ELECTRIC CODE-CALCULATION FORM TO ADD A MICRO-BOILER TO AN EXISTING DWELLING PER NEC 220.83

Use this form to calculate the maximum total kW Micro-Boiler that may be installed in an existing home using the home's existing service panel. This form assumes that additional breaker slots are available for the Micro-Boiler selected. If not, installation of an additional subpanel may be required. The sample calculation on this page is based on the same home configuration used on Example 1 on the preceding page.

			Sample Calculation	Your Information
A	Lighting	Dwelling _____________ sq. ft. X 3 VA	9,000	
B	Appliance Loads	1500 VA X ____________ circuits	3,000	
C	Laundry	1500 VA X ____________ circuits	1,500	
D		**Subtotal VA (add rows A through C)**	**13,500**	
E	Range VA	kW X 1000 X _________circuits	12,000	
F	Cook top VA	kW X 1000 X _________circuits	0	
G	Oven (s) VA	kW X 1000 X _________circuits	0	
H	Existing Water Heater VA	kW X 1000 X _________circuits	4,500	
I	Dishwasher VA	1200 VA	1,200	
J	Dryer VA	kW X 1000 X _________circuits	5,000	
K	Disposal VA		0	
L	Microwave Oven VA		0	
M	Built-in Vacuum VA		0	
N	Spa Bathtub VA		0	
O	Other VA		0	
P	**Total Other Load VA (add rows E through O)**		**22,700**	
Q	**Subtotal VA (add rows D and P)**		**36,200**	
R	Demand Factors	Subtract 8,0000 VA	28,200	
S		Multiply Row R by .4	11,280	
T		**Add 8,000 to Row S**	**19,280**	
U	Air Conditioner #1 VA	AC 240V X _____ Amps	0*	
V	Air Conditioner #2 VA	AC 240V X _____ Amps	0*	
W	Strip Heat VA	kW X 1000 X _________circuits	0	
X	**Total Service Load VA (Add Rows T through W)**		**19,280**	
Y	Panel Usage in Amps (Divide row W by 240)		80	
Z	Existing Service Panel (Amps)		200	
AA	**Available Amps For Micro-Boiler (Subtract Row Y from Row Z)**		**120**	
BB	Available VA Capacity	Multiply Row AA by 240	28,720	
CC	Available kW Capacity	Divide Row BB by 1000	29	
DD	**Convert kW to BTU**	**Multiply by 3413**	**98021**	
EE	**Choose Micro-Boiler with input less than or equal to row DD**		**RA-28 (95,564 BTU)**	
FF	**Max. heat load/ft2 that can be accommodated** (divide row EE by 3000)**		**32**	

*Per NEC 220.83 "Use larger connected load of air conditioning and space heating, but not both." **Use smaller unit to match BTU heat load if the calculated heat load multiplied by 1.25 is less than Row FF. If calculated heat load times 1.25 is more than row FF, the existing electrical service will not accommodate sufficient electrical capacity to use the Micro-Boiler.

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NATIONAL ELECTRIC CODE-BRANCH CIRCUIT PROTECTION

422-10. Branch-Circuit Rating

This section specifies the ratings of branch circuits capable of carrying appliance current without overheating under the conditions specified.

(a) Individual Circuits. According to NEC 422.10, the rating of an individual branch circuit shall not be less than the marked rating of the appliance or the marked rating of an appliance having combined loads as provided in Section 422-62.

The rating of an individual branch-circuit for motor-operated appliances not having a marked rating shall be in accordance with Part B of Article 430.

The branch-circuit rating for an appliance that is continuously loaded, other than a motor-operated appliance, shall not be less than 125 percent of the marked rating; or not less than 100 percent of the marked rating if the branch-circuit device and its assembly are listed for continuous loading at 100 percent of its rating.

NOTE: Even though not rated as such, Micro-Boilers are treated as a continuous load. Branch circuits are rated at 125% of the maximum load that they carry.

Continuous Load- A load for which the maximum current is expected to continue for 3 hours or more.

NEC 422-11. Overcurrent Protection

Appliances shall be protected against overcurrent in accordance with (a) through (g) and Section 422-10.

(a) Branch-Circuit Overcurrent Protection. Branch circuits shall be protected in accordance with Section 240-3.

If a protective device rating is marked on an appliance, the branch-circuit overcurrent device rating shall not exceed the protective device rating marked on the appliance.

NEC 422-11(f), (3): (2005 Edition) Water Heaters and Steam Boilers

Water heaters and steam boilers employing resistance-type immersion electric heating elements contained in an ASME-rated and stamped vessel or **listed instantaneous water heaters shall be permitted to be subdivided into circuits not exceeding 120 amperes and protected at not more than 150 amperes.**

For example; the SH-28 with four 7000-Watt elements can each draw 29 amperes at 240 volts. Thus, under NEC 422-11(f), (3) above, and as listed with U.L., the SH-28 Space Heating Model can be supplied with two (2) – 75 ampere circuits. Likewise, the SH-14 model with one (1) – 75 ampere circuit.

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CONDUCTOR SIZING CHART

Table 310-16. Allowable Ampacities of Insulated Conductors Rated 0 Through 2000 Volts, 60ºC Through 90ºC (140ºF Through 194ºF) Not More than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30ºC (86ºF).

Size	Temperature Rating of Conductor (See Table 310-13)						Size
	60ºC (140ºF)	75ºC (167ºF)	90ºC (194ºF)	60ºC (140ºF)	75ºC (167ºF)	90ºC (194ºF)	
AWG or kcmil	Types TW, UF	Types FEPW, RH, RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RH, RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH< XHHW, XHHW-2, ZW-2	AWG or kcmil
	COPPER			**ALUMINUM OR COPPER-CLAD ALUMINUM**			
18	—	—	14	—	—	—	—
16	—	—	18	—	—	—	—
14*	20	20	25	—	—	—	—
12*	25	25	30	20	20	25	12*
10*	**30**	**35**	**40**	**25**	**30**	**35**	**10***
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0

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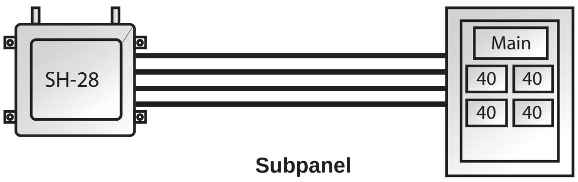
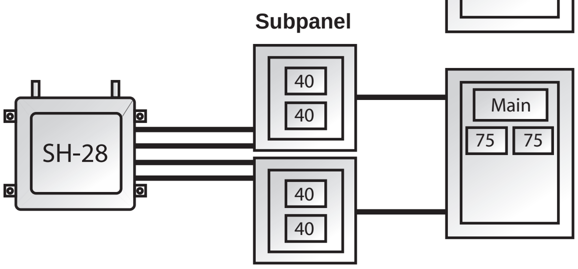
Electrical Requirements

MICRO-BOILER WIRE AND BREAKER SIZING



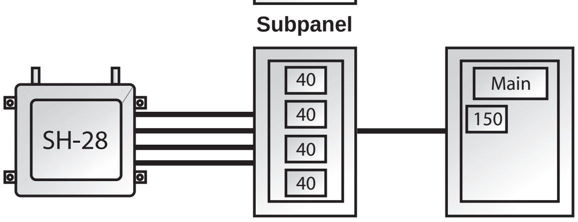
Option A

Main panel requires 8 spaces or four (4) double-pole, 40 amp, 240 volt breaker positions. Breaker lugs must have a 75°C rating. A 200 AMP MAIN SERVICE IS RECOMMENDED. Four pairs of #8 Cu AWG with ground are required between the SH-28 and the main panel.



Option B

Main panel requires 4 spaces or two (2) double-pole, 75 amp, 240 volt breaker positions. Breaker lugs must have 75°C rating to feed sub-feed, from main panel. A 200 AMP MAIN SERVICE IS RECOMMENDED. Four pairs of #8 Cu AWG with ground are required between SH-28 and subpanel. Two pairs of #6 Cu AWG with ground are required between the subpanels and the main panel.



Option C

Main panel requires 2 spaces or one (1) double-pole, 150 amp, 240 volt breaker position. Breaker lugs must have 75°C rating to feed sub-feed, from main panel. A 200 AMP MAIN SERVICE IS RECOMMENDED. Four pairs of #8 Cu AWG with ground are required between SH-28 and subpanel. One pair of #1 Cu AWG with ground or one pair #2/0 AL with ground is required between the subpanel and the main panel.

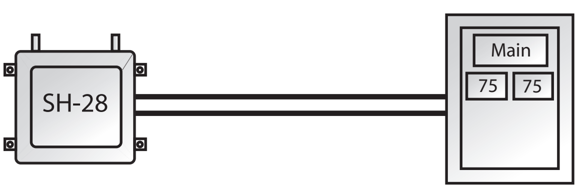
Under the 2005 Edition of the National Electric Code (NEC), article 422.11(f)(3), water heaters and steam boilers employing resistance-type immersion electric heating elements contained in an ASME-rated and stamped vessel or listed instantaneous water heaters shall be permitted to be subdivided into circuits not exceeding 120 amperes and protected at not more than 150 amperes.

As a result, U.L. has given authorization to Microtherm, Inc., under U.L. Standard 499, to use their U.L. marking on the Micro-Boiler® model SH-28 for connections to two (2) 75 Amp branch circuits instead of the four (4) 40 Amp branch circuits, as was previously required.

The wiring guide below illustrates two new wiring options for the SH-28. In accordance with NEC 422.11(f)(3), two 75 Amp branch circuits are shown connected to the SH-28 directly from the Main Service Panel in the Option A diagram below. In Option B, two 75 Amp branch circuits are shown connected to the SH-28 directly from a sub-panel downstream from the Main Service Panel.

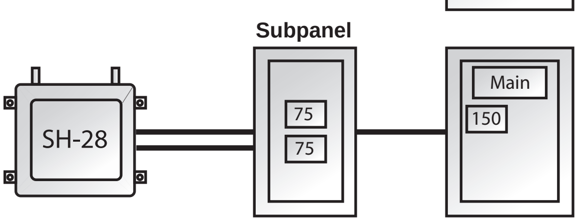
- - - CAUTION - - -

Before using this two circuit option for the SH-28 Model, check with the Manufacturer to make sure that either the jumpers have been installed on the control board at the factory or they have been ordered or shipped with the unit. There should be four jumpers, 4 inches in length, 2 red and 2 black.



Option A

Main panel requires 4 spaces or two (2) double-pole, 75 amp, 240 volt breaker positions. Breaker lugs must have 75°C rating from main panel. A 200 AMP MAIN SERVICE IS RECOMMENDED. Two pairs of #6 Cu AWG with ground are required between the SH-28 and the main panel.



Option B

Main panel requires 2 spaces or one (1) double-pole, 150 amp, 240 volt breaker position. Breaker lugs must have 75°C rating to feed sub-feed, from main panel. A 200 AMP MAIN SERVICE IS RECOMMENDED. Two pairs of #6 Cu AWG with ground are required between the SH-28 and the subpanel. One pair of #1 Cu AWG with ground or one pair of #2/0 AL with ground is required between the subpanel and the main panel.

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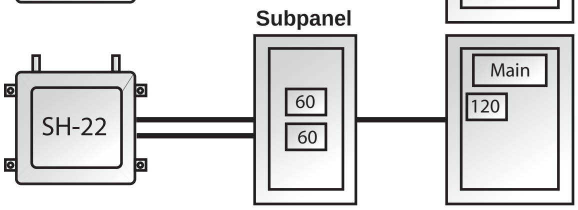
MICRO-BOILER WIRE AND BREAKER SIZING

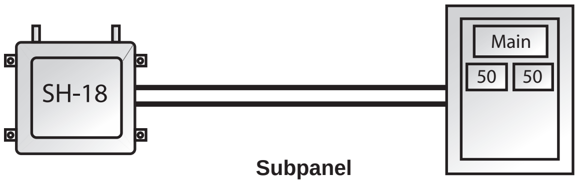
Option A

Main panel requires 4 spaces or two (2) double-pole, 60 amp, 240 volt breaker positions. Two pairs of #6 Cu AWG are required between the SH-22 and the main panel.



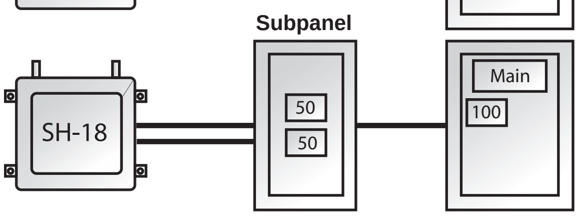
Option B

Main panel requires 2 spaces or one (1) double-pole, 120 amp, 240 volt breaker position. Two pairs of #6 Cu AWG with ground are required between the SH-22 and the sub-panel. One pair of #3 Cu AWG with ground or one pair of #1 AL with ground is required between the subpanel and the main panel.



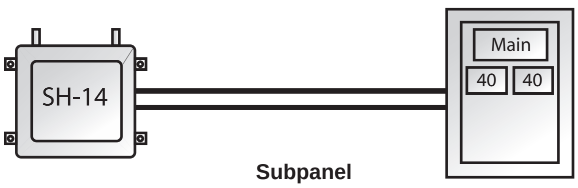
Option A

Main panel requires 4 spaces or two (2) double-pole, 50 amp, 240 volt breaker positions. Two pairs of #8 Cu AWG are required between the SH-18 and the main panel.



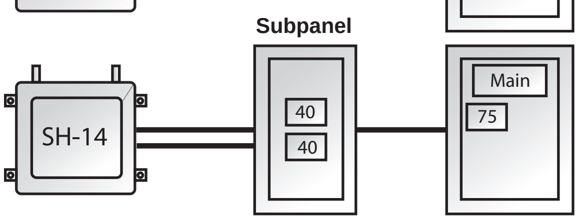
Option B

Main panel requires 2 spaces or one (1) double-pole, 100 amp, 240 volt breaker position. Two pairs of #8 Cu AWG with ground are required between the SH-18 and the sub-panel. One pair of #4 Cu AWG with ground or one pair of #2 AL with ground is required between the subpanel and the main panel.



Option A

Main panel requires 4 spaces or two (2) double-pole, 40 amp, 240 volt breaker positions. Two pairs of #8 Cu AWG are required between the SH-14 and the main panel.



Option B

Main panel requires 2 spaces or one (1) double-pole, 75 amp, 240 volt breaker position. Two pairs of #8 Cu AWG with ground are required between the SH-14 and the sub-panel. One pair of #6 Cu AWG with ground or one pair of #4 AL with ground is required between the subpanel and the main panel.

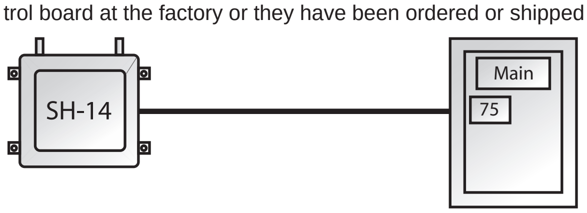
Under the 2005 Edition of the National Electric Code (NEC), article 422.11(f)(3), Water heaters and steam boilers employing resistance-type immersion electric heating elements contained in an ASME-rated and stamped vessel or listed instantaneous water heaters shall be permitted to be subdivided into circuits not exceeding 120 amperes and protected at not more than 150 amperes.

As a result, U.L. has given authorization to Microtherm, Inc., under U.L. Standard 499, to use their U.L. marking on the Micro-Boiler® model SH-14 for connections to one (1) 75 Amp branch circuit instead of the two (2) 40 Amp branch circuits, as was previously required.

The wiring guide below illustrates the new wiring option for the SH-14. In accordance with NEC 422.11(f)(3), one 75 Amp branch circuit is shown connected to the SH-14 directly from the Main Service Panel in the diagram below.

- - - CAUTION - - -

Before using this one circuit option for the SH-14 Model, check with the Manufacturer to make sure that the jumpers have been installed on the control board at the factory or they have been ordered or shipped with the unit. There should be two jumpers, 4 inches in length, 1 red and 1 black.



Optional One Circuit Method

Main panel requires 2 spaces or one (1) double-pole, 75 amp, 240 volt breaker positions. One pair of #6 Cu AWG with ground is required between the SH-14 and the main panel.

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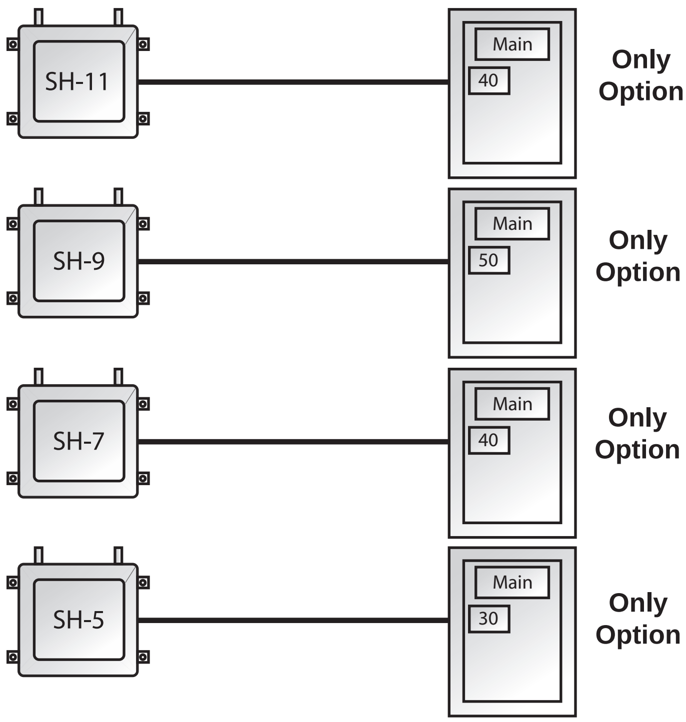
MICRO-BOILER WIRE AND BREAKER SIZING



Main panel requires 2 spaces or one (1) double-pole, 60 amp, 240 volt breaker positions. One pair of #6 Cu AWG with ground is required between the SH-11 and the main panel.

Main panel requires 2 spaces or one (1) double-pole, 50 amp, 240 volt breaker positions. One pair of #8 Cu AWG with ground is required between the SH-9 and the main panel.

Main panel requires 2 spaces or one (1) double-pole, 40 amp, 240 volt breaker positions. One pair of #10 Cu AWG with ground is required between the SH-7 and the main panel.

Main panel requires 2 spaces or one (1) double-pole, 30 amp, 240 volt breaker positions. One pair of #12 Cu AWG with ground is required between the SH-5 and the main panel.

Single and Three -Phase Connections

Single-Phase Connections--Micro-Boilers are designed for single-phase, standard 220/240 VAC operation on residential and light commercial electrical services. When properly connected, the load of the Micro-Boiler is automatically balanced across both legs (or poles) of the service. It doesn't matter how many circuits the Micro-Boiler requires, the load will always be balanced on a single-phase service. However, the only way it will work properly, is with both distinct poles and legs connected to each circuit. If the legs making up the circuit are from the same side of the service bus, then they will cancel and the resultant voltage will be zero (0) volts instead of 220/240 volts. This is usually referred to as "out-of-phase" or simply having the circuit wires crossed or out of sequence. Refer to the single-phase wiring diagram that illustrates the correct connections to the single-phase service on the next two pages of this publication.

Three-Phase Connections to Single-Phase Heater- Consult the factory for three phases applications.

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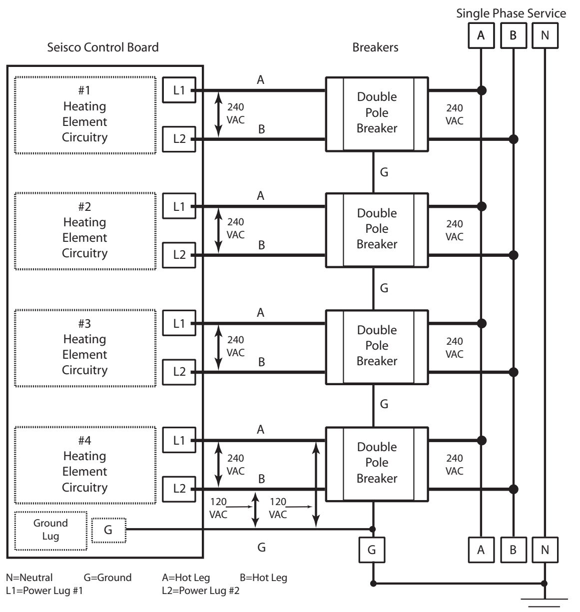
STANDARD SH MODEL CONNECTION DIAGRAMS

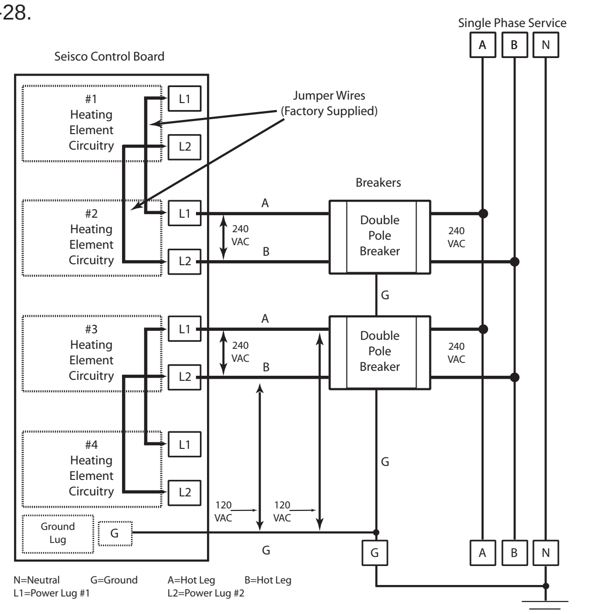
Single Phase 240 VAC Supply--SH-28 Models

Note: Breaker size is 40 Amps.



Single Phase 240 VAC Supply--SH-22, SH-18 or SH-28 Using Optional 75 Amp Breakers

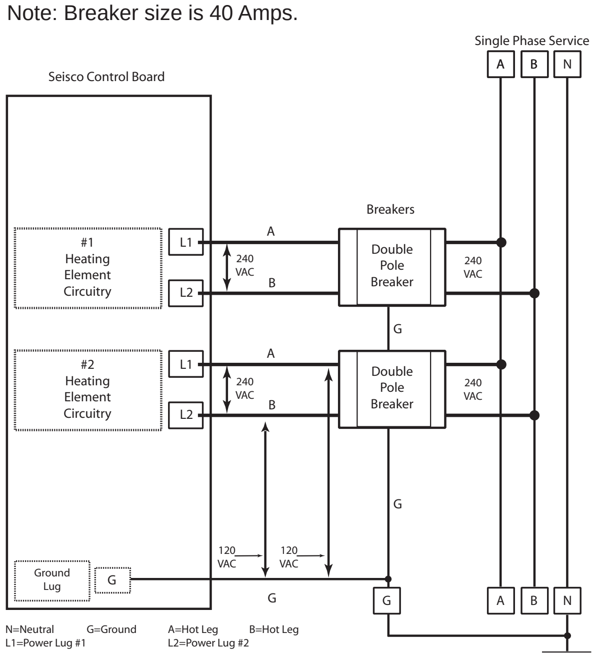
Note: Breaker size is 60 Amp for SH-22, 50 Amp for SH-18, and 75 Amp for SH-28.



SH Connection Diagrams-Two Chamber Models

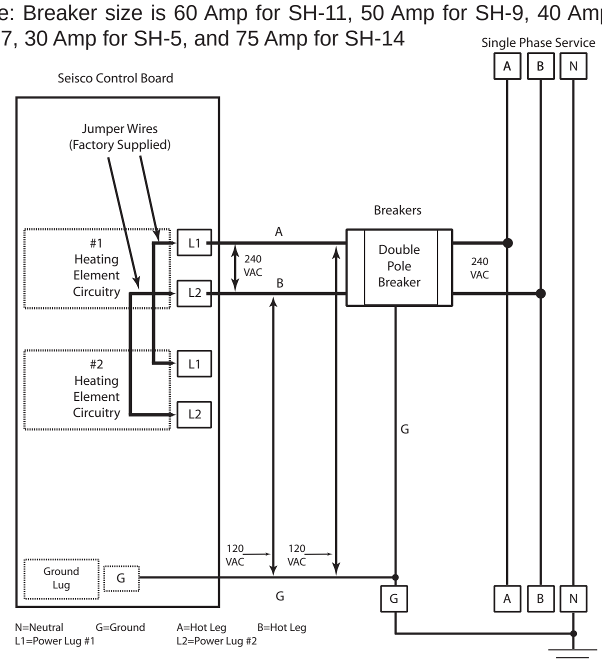
Single Phase 240 VAC Supply--SH-14

Note: Breaker size is 40 Amps.



Single Phase 240 VAC Supply--SH-11, SH-9, SH-7, SH-5, or SH-14 Using Optional 75 Amp Breaker

Note: Breaker size is 60 Amp for SH-11, 50 Amp for SH-9, 40 Amp for SH-7, 30 Amp for SH-5, and 75 Amp for SH-14



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MICROTHERM® INCORPORATED

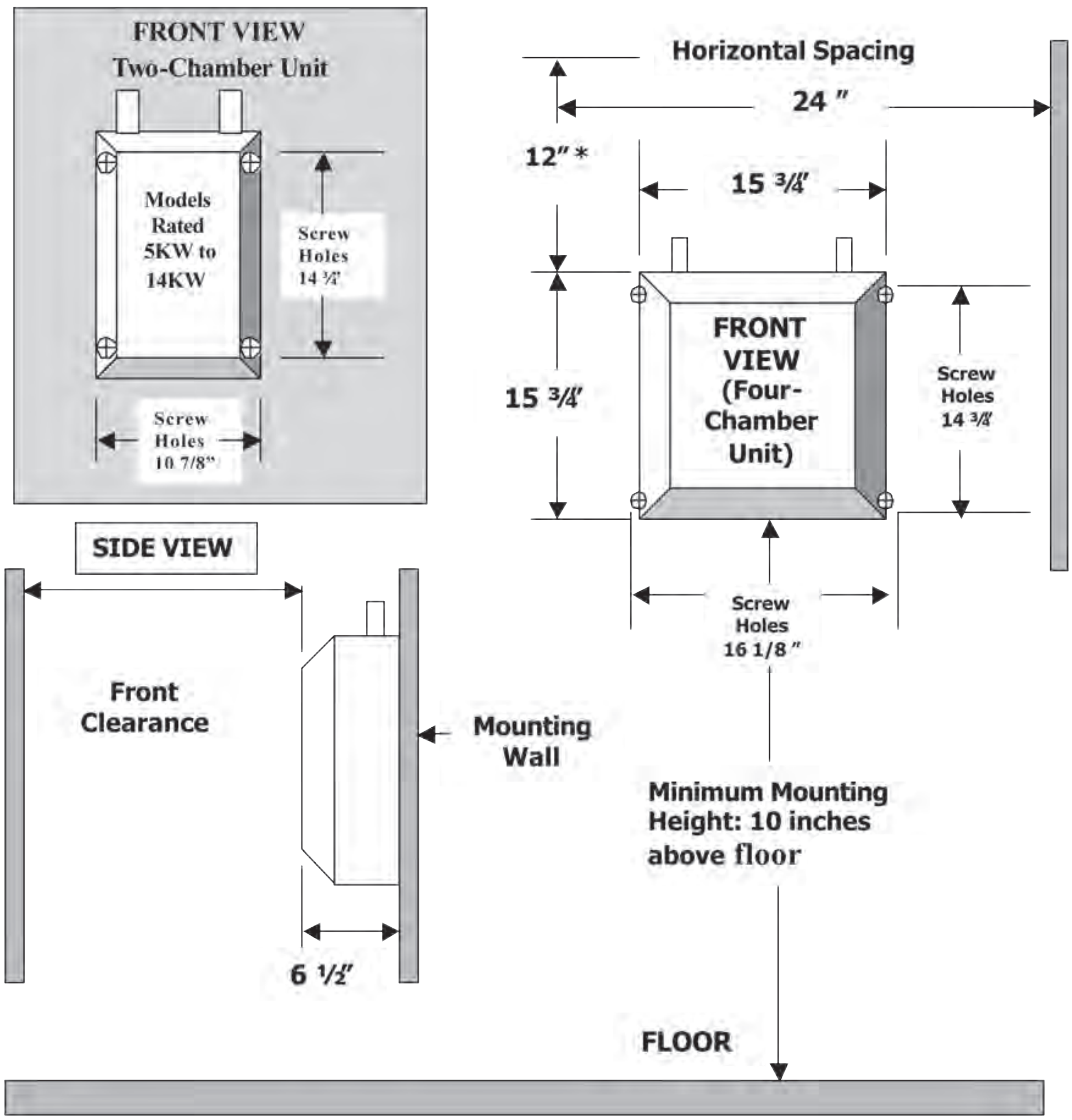
Installation Considerations

Top Clearance- For removal of heating elements and to provide room for plumbing connections, a minimum of 12 inches is required.

Side Clearance- Allow an overall minimum horizontal space for the heater of 24 inches for removal of protective cover screws and access to electrical wires entering the heater from the side.

Mounting Height- For safety, ease of installation and service, the suggested height above the floor is 42 to 48 inches, (minimum 10 inches). Do not install electrical disconnect or sub-panels below heater as this may interfere with access to the clean out plates located under the heater.

Front Clearance- In the absence of a door or removal access panel in front of the heater, allow 32 to 36 inch clearance in front of the heater for protective cover removal and ease of service.



Note: MicroBoilers will not function properly if inlet and outlet fittings are not oriented as shown in this diagram. They may not be oriented on either side or facing the floor.

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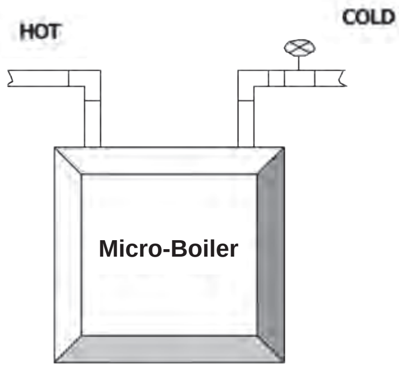

Above diagram shows approved plumbing connections without T&P Valve (T&P NOT REQUIRED BY MANUFACTURERER).

PLUMBING INSTALLATION

NOTE: This Micro-Boiler must be installed to meet the current National Electric Code, and any applicable Local Plumbing, Electrical, Heating and Air Conditioning Codes.

General-Unpack the Micro-Boiler from the shipping carton carefully. DO NOT CUT THE SHIPPING CARTON WITH A SHARP INSTRUMENT. Stand the unit upright and remove the plastic wrap. Locate the four (4) mounting holes in the metal back plate. Position the unit against the wall with the two inlet and outlet fitting tubes pointed up toward the ceiling. Refer to *Mounting Clearances* in this section of the manual to ensure compliance with all mounting clearances. Make sure the unit is level and attach to the wall with ¼ inch or larger lag bolts that are at least 1 ½ inches long. If attaching to sheet-rock or paneling, anchors or molly bolts should be used to prevent the screws from pulling through the wall. If the heater is installed on a cinder block or concrete wall, attach a ½ or ¾ inch section of plywood (20” x 20 “ square) to the wall first. Then use wood screws to attach the heater to the plywood.

PROPERTY DAMAGE PROTECTION

IF THE Micro-Boiler IS INSTALLED IN AN AREA WHERE A WATER LEAK CAN RESULT IN DAMAGE TO THE AREA ADJACENT TO THE WATER HEATER, A SUITABLE DRAIN PAN SHALL BE INSTALLED AND PIPED TO A DRAIN OR TO THE OUTSIDE. THE DRAIN PAN MUST MEET ALL APPLICABLE PLUMBING CODES AND BE AT LEAST 1-1/2” DEEP, EXTENDING BEYOND THE UNIT’S BASE PLATES, MUST PROTECT AN AREA AT LEAST GREATER THAN THE LOWER EXTERNAL DIMENSIONS OF THE WATER HEATER, AND INCLUDE A SPLASH COVER FOR THE AREA OF ATTACHMENT TO THE WALL.

Attaching The Water Supply-**WARNING #1**: Always use two wrenches when making any attachments to the water supply. Hold the unit’s inlet and outlet fittings secure while attaching the cold water and hot water lines. Never attempt to attach water lines to the heater’s fittings without using a second wrench to hold the fittings secure. The heater’s inlet and outlet fittings are designed to turn freely.

WARNING #2: Never solder the unit’s supply lines to the fittings. Heat from the soldering may damage the heat exchanger.

WARNING #3: Do not use plumber’s putty or PVC/CPVC primer and glue on the threads of the unit’s inlet and outlet fittings. Some of the putty compounds on the market are very aggressive and could potentially dissolve the threads on the unit’s fittings. PVC/CPVC primer and glue will also dissolve the threads on the unit’s fittings. **Teflon tape is the only sealer that should be used on the threads of the inlet and outlet fittings.**

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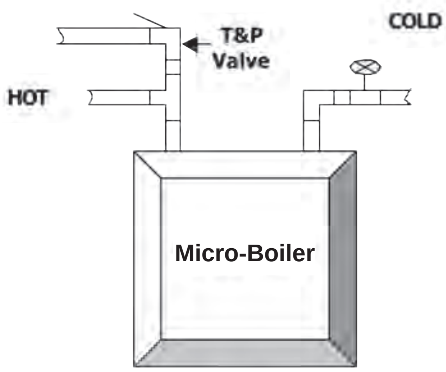

Above diagram shows plumbing connections with a T&P Valve if required by local codes.

Temperature & Pressure Relief Valve-SINCE THE Micro-Boiler DOES NOT UTILIZE A STORAGE TANK, THE USE OF A T&P RELIEF VALVE IS NOT REQUIRED BY MANY NATIONAL STANDARDS, INCLUDING UL STANDARD 499. However, a pressure relief valve should be installed near the Micro-Boiler with no shutoff valves between the Micro-Boiler and the pressure relief valve. Micro-Boilers are designed with control logic as well as electromechanical high limit thermostat switches for over-temperature protection. With these built-in safety features, the use of a T&P Relief Valve is not required.

When used in a combination water/space heating system, a temperature and pressure relief valve (T&P Valve) may be required by local code. When a T&P valve is installed (which is not provided by the manufacturer), it should be checked after the water supply to the Micro-Boiler is turned on. With the water supply on, there should be no water flowing from the valve. Operate the valve manually two or three times to purge the trapped air from the top of the heater's chamber. CLOSE VALVE. Water should stop flowing completely prior to connecting the drain piping to the valve.

Drain Pan-If the Micro-Boiler is installed in an area where water damage can occur to the area adjacent to the unit, a drain pan must be installed. The pan must be at least 1½ inches deep and large enough to protect the area below the unit (the pan should be at least larger than the lower external dimensions of the heater) and must be piped by 3/4 inch, or larger, pipe to a suitable drain. A splash cover must be included to protect the area of attachment to the wall.

ELECTRICAL INSTALLATION GUIDE

Connection To Power Supply-

WARNING

INSTALLATION AND SERVICE MUST BE BY QUALIFIED PERSONNEL ONLY!

NOTE: This unit must be installed to meet the current National Electric Code, and any applicable local plumbing, electrical, heating and air conditioning codes.

Install wiring (see wiring diagram) from the unit to the Main Power Circuit Breaker Panel. Connect the wiring to the unit as shown on the wiring diagram attached to the inside of the unit's cover.

WARNING

MODELS SH-14 THROUGH SH-28 REQUIRE MULTIPLE POWER SOURCES. WHEN WIRED DIRECTLY TO THE BREAKER BOX, THEY REQUIRE MORE THAN ONE DOUBLE POLE CIRCUIT BREAKER.

RISK OF ELECTRICAL SHOCK. HEATING ELEMENT IS NOT GROUNDED. SOME UNITS HAVE MULTIPLE POWER SUPPLIES. DISCONNECT ALL POWER SUPPLIES BEFORE SERVICING.

IF USING STRANDED WIRE, MAKE SURE THAT ALL STRANDS ARE IN SECURE PLACEMENT IN THE TERMINAL BLOCK. A LOOSE STRAND IN CONTACT WITH THE CIRCUIT BOARD CAN IMPAIR PERFORMANCE OR DAMAGE THE BOARD.

SUPPLY SIDE CONNECTION

FOR MODELS SH-5 THROUGH SH-11, ONE PAIR OF WIRES SHOULD BE ATTACHED WITHIN THE UNIT AT POWER CIRCUIT 1 (CKT 1)-ONE WIRE TO L1 AND ONE WIRE TO L2. FOR MODELS SH-14 THROUGH SH-22, A SECOND PAIR OF WIRES MUST ALSO BE ATTACHED AT POWER CIRCUIT 2 (CKT2)-ONE TO Ll AND ONE TO L2. FOR MODEL SH-28, A THIRD AND FOURTH PAIR OF WIRES ARE REQUIRED FOR POWER CIRCUITS 3 AND 4 (CKT 3 & CKT 4).

WHERE REQUIRED BY CODE, USE A DISCONNECT SWITCH ADJACENT TO THE HEATER. WHEN MAKING THIS TYPE OF INSTALLATION, BE SURE THE MAIN FEEDER WIRES USED ARE PROPERLY SIZED.

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Install the proper size circuit breaker (see the section Wire and Breaker Sizing in this publication). Be sure that the power supply circuits are properly connected inside the water heater. For models SH-5 through SH-11, the pair of feeders attached to power circuit 1 (CKT 1) should be attached to one 2-pole breaker, and for models SH-14 through SH-22, the second pair attached to power circuit 2 (CKT 2) should be attached to a second 2-pole breaker such that the total load will be balanced. For model SH-28, two additional breakers are required for power circuits 3 and 4 (CKT 3 & 4).

*NEC branch circuit rule has changed which allows the option to wire the 14 kW unit with one circuit and the 28 kW unit with two circuits. Refer to pages 33-37, *Wire and Breaker Sizing,* for circuit breaker size by model number. Contact the manufacturer for jumpers that must be installed on the control board before using these wiring options.

PRE-POWER CHECK

1. After all electrical connections have been made, every effort should be made to verify a safe installation. Again check to be sure all connections in the unit disconnect and/or circuit breaker panel are secure. Check to be sure that an adequate ground has been properly connected. Check to be sure that adequate size breakers have been installed properly. Remember that breakers that are too large are more dangerous than breakers that are too small.

2. Run water through the unit until air is purged..

POWER CHECK

Check only after the Pre-Power Check has been completed and the unit filled with water. Turn on the Main Power Circuit Breakers. Verify that the Micro-Boiler's GREEN POWER-ON indicator light is illuminated.

USE EXTREME CAUTION WHEN CHECKING VOLTAGE TO THE UNIT.

Check the voltage available to each active power circuit. Models SH-5 to SH-28 are designed to operate from a 208V to 240V power supply. Connect a voltmeter at power circuit 1 (CKT 1) between L1 and L2. (For models with multiple power circuits utilized, continue to check voltage at each additional power circuit.)

OPERATIONAL CHECKS

When the heating system calls for heat and signals the Micro-Boiler to turn on, you will hear a "click" as the relays on the circuit board engage. It is normal to hear a "hissing" or "crackling" noise from the heat exchanger after the unit is started. With the unit's cover removed, verify with an ammeter that there is ELECTRICAL CURRENT through each heating element circuit. DISREGARD THE WATER TEMPERATURE WHILE DOING THIS TEST.

Thermostat settings are factory preset for units employing a circuit board potentiometer (thermostat).

THIS INSTALLATION MUST BE DONE BY QUALIFIED AND LICENSED CONTRACTORS. Refer to your local electrical and plumbing codes for additional information.

Functional Checks-After the initial start-up, following the Pre-Power and Operational Checks described on this page, it may be necessary to make adjustments to the system to insure that the Micro-Boiler is functional.

BEEPS & FLASHING LIGHTS

It is normal at start-up or any time the Micro-Boiler is powered-on for the control board to beep and the LED to flash red and then green. Normal status is for the control to flash all green repeatedly. The initial 2 to 4 red flashes and beeps after power-on are normal, but should not continue.

ON-BOARD SELF DIAGNOSTICS

However, in the event that the LED light continues to flash a red sequence after power-on, then there may be a need for further investigation. The heater's control provides self diagnostics by emitting a red flashing code. The code definitions and possible solutions can be found in the Trouble Shooting section of the Seisco Service Manual.

Some of the most common problems discovered during installation and initial start-up are as follows:

- Circuit breakers are not turned-on (especially, units with multiple circuits)
- Incoming power wires to the unit are out-of-phase (heaters with multiple circuits)
- Improper filling of the system with heating fluid and purging of air in the heating chambers, no heating fluid in the heating chamber
- Inlet/outlet lines are reversed; hot and cold reversed
- Inlet/out connection(s) are leaking
- T&P Relief Valve (where required by local code) is leaking or stuck open

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LEAK DETECTION*

Diagnostic codes are designed to tell the installer or user if there is a problem and what the problem might be. Also, the Micro-Boiler has a built in alarm that will sound if there is water or heating fluid leaking inside the unit, possibly from a leaky inlet/outlet connection or from a leaky T&P Relief Valve. **Turn off all of the circuit breakers to the unit whenever a leak is detected to prevent possible damage to the control board.** After the leak is discovered and repaired, it is important to dry any moisture or water accumulation on the unit. This can be done with a standard household hair dryer or dry towels. Any attempts to dry the unit should be done with all electrical power disconnected.

COMBINATION HOT WATER/SPACE HEATING SYSTEMS

When a Micro-Boiler is selected for the home or building and is used in a combination hot water/space heating application, the faucets should be selected to match the flow rate and temperature rise specifications of the unit. The unit's specifications can be found in this manual and on specification sheets provided by Microtherm. Sometimes, this is overlooked and the user discovers that the faucets in the home are a higher flow rate than the design of the Micro-Boiler model(s) selected. For complete sizing and application information, consult Microtherm's' *Water Heating Product Guide.* A table of typical flow rates by fixture type is provide below for reference.

SOLUTIONS FOR HIGH FLOW APPLICATIONS

Another oversight may be the lifestyle of the user. For instance, if the user wants to take two showers at the same time or run the washing machine and the bath tub at the same time, then the flow rate demands of the Micro-Boiler are increased, sometimes beyond the capability of the unit. Multiple units are used for higher flow applications, such as for multiple task lifestyles, whirl pool and Jacuzzi tubs and body spa showers as well. Refer to Microtherm's *Water Heating Product Guide* for recommended multiple unit arrangements. Note, it is important to evaluate the electrical capacity of the home or building when selecting multiple Micro-Boilers for a high flow application. Refer to the electrical requirements and load calculations discussed in this manual.

TEMPERATURE ADJUSTMENT IN COMBINATION SYSTEMS

After the unit has been installed and the operational checks are completed, the output temperature of the hot water can be measured and adjusted if necessary. The temperature adjusting knob can be found on the left side of the control board. The factory setting is usually between 117 and 120 degrees F. The knob will usually be in the 2 to 3 o'clock position. Turning the knob to the left decreases the temperature and turning it to the right increases the temperature. Note: it is important to understand the effects of increasing the temperature above the factory setting as follows:

1. ***The heater will use more power to heat the water; energy savings are reduced.***
2. ***There will be a greater chance that the heater will produce scaling and sediment build-up.***
3. ***The heater may not have the power to achieve temperatures higher than factory settings.***
4. ***Safety; with higher temperatures, there will be a higher risk of scalding and personal injury.***

Typical Domestic Hot Water Fixture Flow Rates (gallons/minute)

Fixture Type	Lavatory	Bathtub	Shower	Kitchen Sink	Pantry Sink	Laundry Sink	Dish-washer	Washing Machine
Flow Rate	.5 - 1.5	2.0 - 6.0	1.5 - 3.0	1.0 - 1.5	1.5 - 2.5	2.5 - 3.0	1.5 - 3.0	1.0 - 3.0

*Leak detector applies to four chamber models only, not two chamber models. Combination space/water heating models do not include a leak detector.

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TROUBLESHOOTING GUIDE

Symptom	Possible Cause	Corrective Action
Heating fluid/hot water is warm but does not get HOT!	Domestic hot water flow is too high (combination systems only)*	Reduce flow or install more heating capacity
	One of the main power breakers may be tripped.	Check power panel and reset breaker if tripped
	Bad heating element	Contact local service contractor**
	Bad temperature sensor	Contact local service contractor**
Heating fluid/outlet water supply is COLD!	Flow is too high*	Reduce flow or install larger unit
	Heat load is beyond the capacity of the unit or the pump rate is too high**	Verify system sizing information and check the amp draw of each heating element to ensure proper heating.
	High temperature limit switch may be tripped	Verify if limit switch is tripped and reset if necessary
	One of the main power breakers may be tripped	Check power panel and reset breaker if tripped
	Bad heating element or temperature sensor	Contact local service contractor or Microtherm***
	Circuit board failure	Contact local service contractor or Microtherm***
Hot water supply temperature fluctuates	Domestic hot water flow is too high (combination system only)*	Reduce flow or install more heating capacity
	One of the main power breakers may be tripped	Check power panel and reset breaker if tripped
	Bad heating element	Contact local service contractor***
	Bad temperature sensor	Contact local service contractor***

* Do not attempt to fill a large bathtub at full faucet flow. Tub faucets are designed to literally dump hot water from a storage tank heater to maximize the useful quantity available. The Micro-Boiler will fill a tub slightly slower, but you will continue to have hot water for as long as you wish. In space heating, excessive flow can occur with too large of a circulator pump or excessive system pressure or flow in the circulatory loop connected to the Micro-Boiler. It may be necessary to reduce flow or select a model capable of matching the flow and temperature rise required for your heating system.

**Verify that the amount of heat load and the size of the heating system are compatible. If the system is radiating more heat than the Micro-Boiler can produce, the heating fluid will not warm up to the proper operating temperature. Likewise, if the pump rate is too high, it may take a long period of time before the outlet temperature on the unit is noticeably higher.

*** Check listings in your area for local Heating & Plumbing or Appliance Repair companies for labor estimates. Check for Warranty coverage on labor charges. **FOR FURTHER ASSISTANCE, CALL MICROTHERM, INC. AT 888-296-9293, CENTRAL TIME, DURING REGULAR BUSINESS HOURS FOR AVAILABLE PARTS, DIAGNOSTICS AND REPAIR INFORMATION.**

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208/380 VOLT MODELS

208 & 380 Volt Model Specifications

Residential Model	kW Input	Voltage (VAC)	Max Amp Draw	Max BTU/ HR Output	kG-Cal Per Hr.	# Heating Circuits	AMPS Per Circuit
SH-24	24	208	115	81,910	20,652	4	29
SH-20	20	208	96	68,260	17,210	2	48
SH-16	16	208	77	54,600	13,768	2	38.5
SH-12	12	208	58	40,950	10,326	2	29
SH-10	10	208	48	34,130	8,605	1	48
SH-08	8	208	39	27,300	6,884	1	39

Note: For three phase applications, contact your local Microtherm, Inc. sales representative or call 888-296-9293.

208 Volt Heating Capacity (gpm @ Temperature Rise (F)

kW Input	65	60	55	50	45	40	35	30	25	20	15
SH-24	2.5	2.7	3.0	3.3	3.6	4.1	4.7	5.5	6.6	8.2	10.9
SH-20	2.1	2.3	2.5	2.7	3.0	3.4	3.9	4.6	5.5	6.8	9.1
SH-18	1.9	2.0	2.2	2.5	2.7	3.1	3.5	4.1	4.9	6.1	8.2
SH-16	1.7	1.8	2.0	2.2	2.4	2.7	3.1	3.6	4.4	5.5	7.3
SH-12	1.3	1.4	1.5	1.6	1.8	2.0	2.3	2.7	3.3	4.1	5.5
SH-10.5	1.1	1.2	1.3	1.4	1.6	1.8	2.0	2.4	2.9	3.6	4.8
SH-10	1.1	1.1	1.2	1.4	1.5	1.7	2.0	2.3	2.7	3.4	4.6
SH-8	0.8	0.9	1.0	1.1	1.2	1.4	1.6	1.8	2.2	2.7	3.6

Note: This table reflects recovery when 208 heating elements are installed in the product. This table should only be used for combination water/space heating applications.

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240 VOLT MODELS CONNECTED TO 208 VOLT SERVICE

240 Volt Models Connected to 208 Volt Service

Heating Capacity (gpm) @ Temperature Rise (F)

kW 240V / kW 208V	Recovery	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15
5 **3.75**	gpm	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.7	0.8	0.8	1.1	1.3	1.7
7 **5.25**	gpm	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.8	0.9	1.1	1.2	1.4	1.8	2.4
9 **6.75**	gpm	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.1	1.1	1.4	1.5	1.9	2.3	3.1
11 **8.25**	gpm	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.1	1.1	1.3	1.4	1.6	1.9	2.3	2.9	3.8
14 **10.5**	gpm	0.8	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.4	1.6	1.8	2.0	2.4	2.9	3.6	4.8
18 **13.5**	gpm	1.1	1.1	1.1	1.2	1.4	1.4	1.5	1.7	1.9	2.0	2.3	2.6	3.1	3.7	4.6	6.2
22 **16.5**	gpm	1.3	1.4	1.4	1.5	1.6	1.7	1.9	2.0	2.3	2.5	2.9	3.2	3.8	4.5	5.6	7.5
28 21	gpm	1.6	1.7	1.8	2.0	2.0	2.2	2.4	2.6	2.9	3.2	3.6	4.1	4.8	5.7	7.2	9.5

Note: The table above reflects a 25% derating for 240-volt models connected to 208-volt service. This table should only be used for combination water/space heating systems.

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WARRANTY FACT SHEET

	RA Models	SH Models	CA Models
Warranty Term	10-Year Limited	10-Year Limited	5-Year Limited
Warranty Activation	Original Purchase Date	Original Purchase Date	Original Purchase Date
Warranty Application Coverage	Residential Water Heating Only Including Apartments	Space Heating Applications Only	Commercial/Industrial Water Heating Only
Labor reimbursement for part, replacement of repair	Limited Amount Paid During First Year of Warranty Activation	Limited Amount Paid During First Year of Warranty Activation	Limited Amount Paid During First Year of Warranty Activation
Parts replacement for defective part or manufacturing workmanship	Year 1: All parts including heating elements, temperature sensors, limit switches, wires, etc. Years 1-3: Circuit Board and Chamber Body Years 4-10: Circuit Board and Chamber Body with up to 15% cost of original retail purchase price of the water heater	Year 1: All parts including heating elements, temperature sensors, limit switches, wires, etc. Years 1-3: Circuit Board and Chamber Body Years 4-10: Circuit Board and Chamber Body with up to 15% cost of original retail purchase price of the water heater	Year 1: All parts including heating elements, temperature sensors, limit switches, wires, etc. Years 1-3: Circuit Board and Chamber Body Years 4-5: Circuit Board and Chamber Body with up to 15% cost of original retail purchase price of the water heater

Warranty Notes: Reimbursements do not include shipping and handling charges. This fact sheet is intended as a guide only and does not supersede the Original Written Warranty. Consult the written warranty with each model for details.

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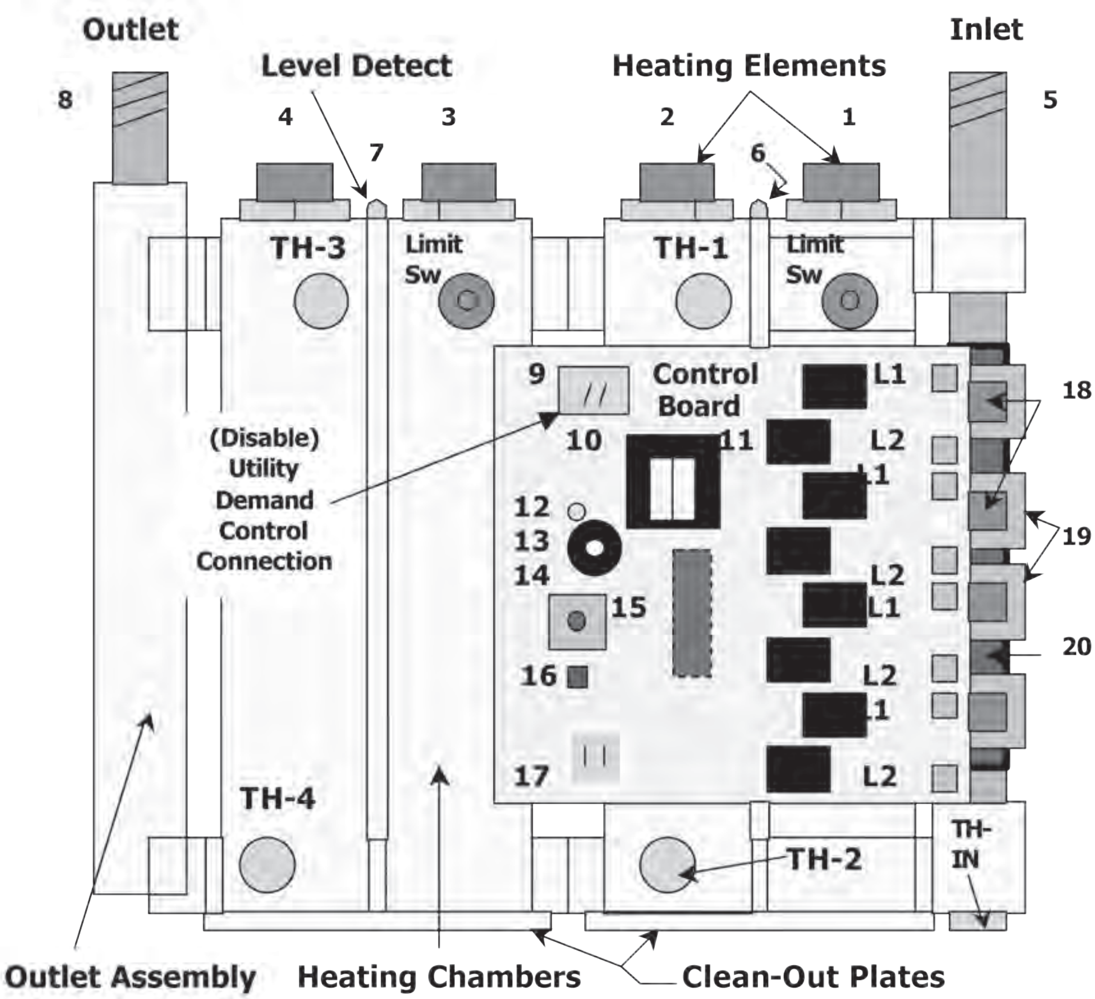
4-CHAMBER MODELS



LEGEND

1 – Heating Element #1
2 – Heating Element #2
3 – Heating Element #3
4 – Heating Element #4
5 – Inlet Water Tube, ¾
6 – Water-Level Detect Screw
7 – Water-Level Detect Screw
8 – Outlet Water Tube, ¾
9 – Disable, Demand Control Switch
10 – Transformer
11 – Heating Element Relays (8 ea.)
12 – LED Light Indicator
13 – Audible Speaker
14 – Output Temperature Control

LEGEND

15 – Microprocessor Control Chip
16 - Blue Button; Manual Audible Activation
17 – Terminal Spades for Leak Detect Wires
18 – Triacs (4 each)
19 – Triac Mounting Blocks to Heat Sink (4 ea.)
20 – Copper Heat Sink Tube
L1 – Power Connection Lugs (208 – 240 VAC)
L2 – Power Connection Lugs (208 – 240 VAC)
Limit Sw : Over Temperature Limit Switches (2)
TH-IN : Inlet Temperature Sensor
TH-1 : Chamber Temperature Sensor #1
TH-2 : Chamber Temperature Sensor #2
TH-3 : Chamber Temperature Sensor #3
TH-4 : Chamber Temperature Sensor #4

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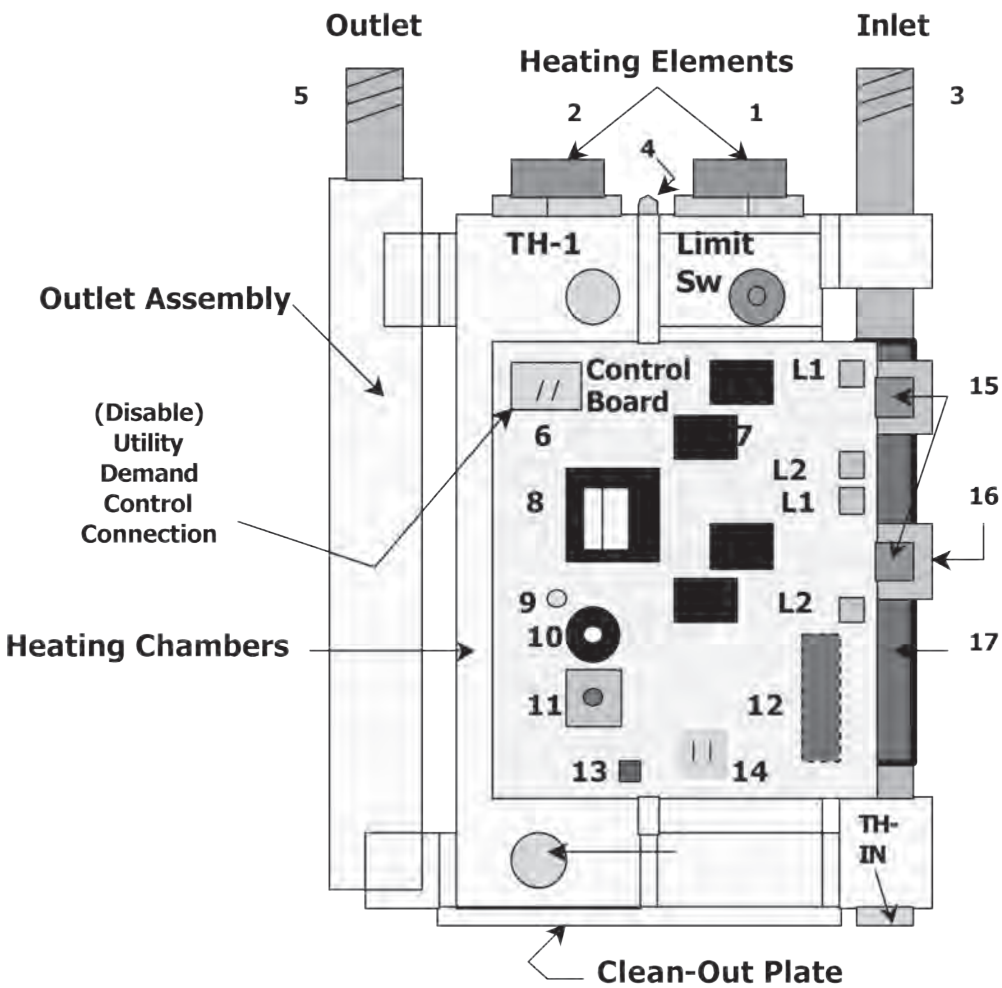
Parts Identification

2-CHAMBER MODELS



LEGEND

1 – Heating Element #1
2 – Heating Element #2
3 – Inlet Water Tube, ¾
4 – Water-Level Detect Screw
5 – Outlet Water Tube, ¾
6 – Disable, Demand Control Switch
7 – Heating Element Relays (4)
8 – Transformer
9 – LED Light Indicator
10 – Audible Speaker
11 – Output Temperature Control
12 – Microprocessor Control Chip
13 – Blue Button; Manual Audible Activation

LEGEND

14 – Terminal Spades for Leak Detect Wires
15 – Triacs (2)
16 – Triac Mounting Blocks to Heat Sink (2)
17 – Copper Heat Sink Tube

L1 – Power Connection Lugs (208 – 240 VAC)
L2 – Power Connection Lugs (208 – 240 VAC)

Limit Sw : Over Temperature Limit Switch
TH-IN : Inlet Temperature Sensor
TH-1 : Chamber Temperature Sensor #1
TH-2 : Chamber Temperature Sensor #2

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CALCULATIONS AND OTHER INFORMATION

WATER HEATING

Recovery GPH

Electric = (kW X 3413)/(8.33 X ΔT)

Gas = (BTU Input X Efficiency)/(8.33 X ΔT)

To find recovery in gallons/minute, divide by 60.

Required Input

kW = (Gals. X 8.33 X ΔT)/3413

BTU = (Gals X 8.33 X ΔT)/% Efficiency

kW = kilowatt input
8.33 = weight of one gallon of water
ΔT = temperature rise
BTU = British Thermal Unit-the amount of energy it takes to raise one pound of water one degree F.

% Hot or Cold in A Mixture

% Hot = (M-C)/(H-C)

% Cold = (H-M)/(H-C)

H = Cold Water Temperature
C = Hot Water Temperature
M = Mixed Water Temperature

Miscellaneous

gpm = (kW X 6.83)/(temp. rise)

temp. rise = (kW X 6.83)/gpm

% Efficiency = (GHP X 8.33 X ΔT)/Btu/Hr. Input

Btu Output = GPH X 8.33 X ΔT

Water expands 4.34% when heated from 40°F to 212°F.

TEMPERATURE CONVERSIONS

Fahrenheit (F) to Centigrade(C)=(F-32) X .556

Centigrade (C) to Fahrenheit (F)=(C X 1.8) + 32

ELECTRICITY

Singe Phase Power

Watts = Amps X Volts

Amps = Watts/Volts

Volts = Watts/Amps

Three Phase Power

Amps = (kW X 1000)/(Volts X 1.732)

Volts = (kW X 1000)/(Amps X 1.732)

Watts = Amps X Volts X 1.732

GAS/OIL

Oil #1 Fuel=136,000 BTU/Gal.
Oil #2 Fuel=138,500 BTU/Gal.
Oil #3 Fuel=141,000 BTU/Gal.
Oil #5 Fuel=148,500 BTU/Gal.
Oil #6 Fuel=152,000 BTU/Gal.
Gas (natural)=1,000 to 1,100 BTU/ft^3
Gas (manufactured)=500-550 BTU/ft^3
Gas (propane)=2,570 BTU/ft^3
Gas (propane)=21,600 BTU/lb
Gas (propane)=91,000 BTU/Gal.
Gas (butane)=3,260 BTU/lb
Gas (butane)=102,600/Gal

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Take the next step...Tankkless

More Usable Space

Reclaim space used for your current water heater or enjoy an extra closet in your new home. 5-14kW models are only 10" W X 16" H X 6" D. 18-32KW models are only 16" W X 16" H X 6" D. Install your Seisco almost anywhere.

10-Year Limited Warranty* - Due to superior construction, Seisco's warranty is 67% longer than a standard tank type water heater's 6-year warranty. Seisco's internal water passages are constructed of a rugged DuPont® nylon and will last more than twice the length of the warranty.

Microprocessor Controlled - With on-board computer logic, Seisco's microprocessor provides accurate temperature control to avoid uncomfortable temperature variations, self-diagnostics to make servicing easy, a water leak detector to shut down the water heater and sound an alert should a leak occur, and power sharing to the heating elements to prolong heating element life.

Thermistor Temperature Sensing - Five immersion temperature sensors, like those commonly used in expensive commercial water heaters, provide accurate readings to the microprocessor control to facilitate extremely accurate temperature control and to prevent sudden changes in water temperature while you shower.

Lower Electric Bills

Seisco can save up to 25% on your water heating bill! With an efficiency rating of over 99%, Seisco is the perfect addition to your home. Seisco eliminates expensive standby energy losses associated with tank type water heaters.

Flow Sensing Without A Switch - Since Seisco senses water flow by using very accurate electronic sensors, the need for a mechanical flow switch is eliminated. Flow switch failure is a common service issue associated with other tankless water heaters.

Standard Heating Elements - Seisco uses heating elements like those found in standard tank type electric water heaters making replacement simple, no special parts to purchase and no special skills required.

Easy to Service - Although seldom required, cleanout plates on the bottom of the Seisco allow quick easy access for removing sediment or sand. Seisco's self-diagnostic control and an LED light identify service issues through a series of flashes. An audible beep can be used by Microtherm's customer service department to diagnose issues over the phone





SEISCO

Endless Hot Water

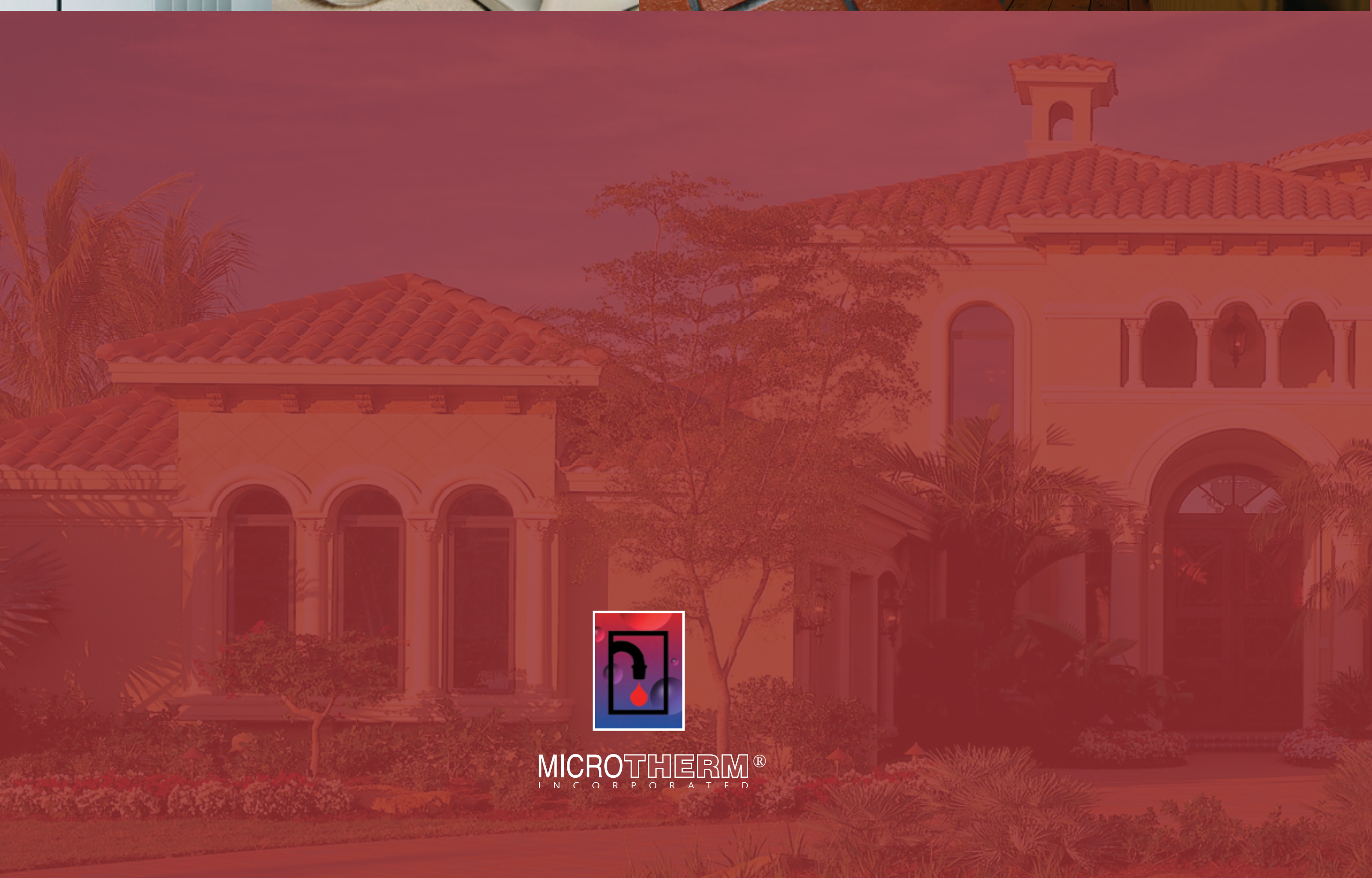
Every member of the family can take a shower one after the other without running out of hot water. Fill the bathtub and have endless hot water to keep it warm. Never run out of hot water again. Switch to Seisco and end the worry!

PowerShare™ Technology - Seisco uses only the power necessary to heat the amount of water being used. Seisco's microprocessor uses electronic triacs to adjust the amount of heat produced by the heating elements from 1-100%. In fact, most of the time, Seisco is operating well below its maximum heating capacity. This also helps prevent harmful scale buildup and reduces heating element failures.

"The electrical energy savings of the demand (Seisco) water heaters with a parallel piping system over the standard tank with a tree-piping system (tank-tree system) was 34% for the low-use home and 14% for the hi-use home."

–August 2003 report from the National Association of Home Builder's Research Center based on data developed through testing by the National Renewable Energy Laboratories NREL, (***Seisco added***)

Superior Technology and Reliability



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