

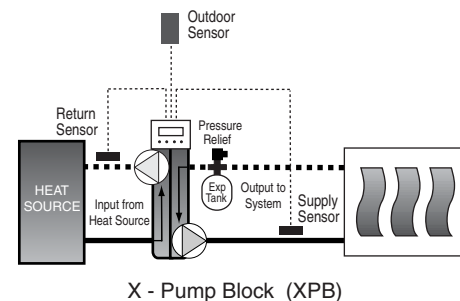
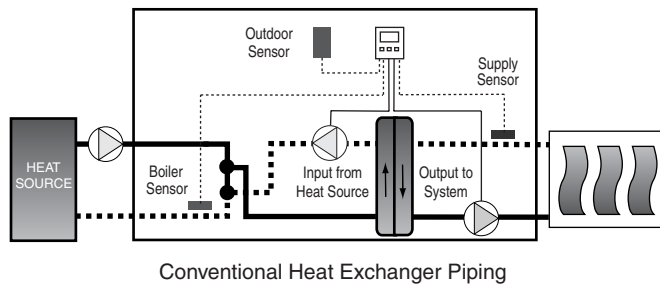
EFFECTIVE: August 15, 2005

SUPERSEDES: New

OVERVIEW

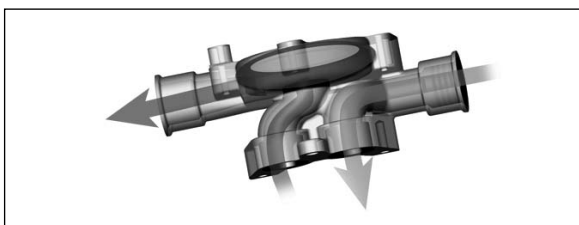
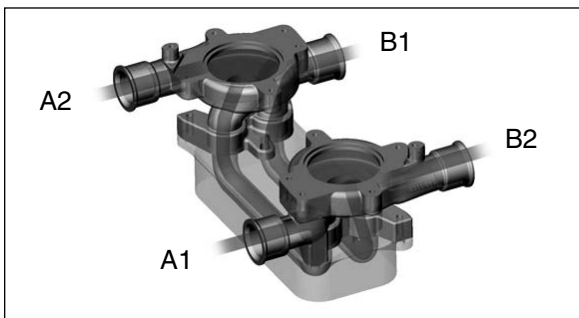
X - Pump Block

The X-Pump Block (XPB) is a complete mixing system with an attached brazed plate, counterflow style heat exchanger for system isolation. Integral to the unit is a variable speed heat source circulator, constant speed system circulator and the electronics to drive it all. The XPB can be set up to operate as an outdoor reset control, a setpoint control or a delta T limiting control. This unparalleled flexibility within a single unit creates a pumping and control package that can be used in systems combining any style heat source (boiler, water heater, etc.) with any style heat delivery method or system condition (radiant tubing, glycol based snowmelt, baseboard, etc.). With just 4 piping connections needed, the XPB greatly reduces the time and space required for installation.



OPERATION

Hot water from the heat source, such as a boiler, enters the X-Pump Block's integral heat exchanger at port (A1) and exits at (A2). The variable speed circulator controls the speed of the water flowing through the A side of the heat exchanger to satisfy the heat transfer requirements between the A side of the heat exchanger and the B (system) side. The heat exchanger is a counterflow style, so system water enters at port (B1) and exits at port (B2). A constant speed circulator moves the water around the B (system) side.



In certain applications, such as snowmelt, the system pump motor can be switched with the variable speed motor in order to protect the heat exchanger from freezing up by ensuring constant flow on the heat source side.

Features:

- All-in-one heat exchanger, dual-sided circulators and mixing control package
- Brazed plate heat exchanger
 - Provides complete isolation
 - Stainless steel
 - Easily removable
 - Double wall optional
- Only 4 pipe connections required
- Plug-in low voltage connections
- Solid state microprocessor design
- Greatly decreases installation time
- Substantial space savings
- Line cord included, hard wire option
- Bronze casings for open or closed systems
- Replaceable cartridge design
- Maintenance free, wet-rotor circulators
- 2 operation modes: outdoor reset and setpoint with or without delta T limiting
- Main system pump contact
- 100% pump operation / control override switch
- Automatic pump exercise
- Adjustable reset ratio
- Warm weather shutdown
- Large LCD display
- Outdoor and 2 strap-on sensors included

CONTROL STRATEGY

Outdoor Reset Mode of Operation

In order to properly control a hot water heating system, the amount of heat supplied to the building must equal the amount of heat lost by the building. The amount of heat delivered into a building depends on the temperature of the water in the heating unit and the surface area of the heating unit. Heating units with a small surface area, such as baseboard radiators, require a higher water temperature than heating units with a larger surface area such as radiant floors.

The amount of heat lost from a building depends on the outdoor temperature. As the outdoor temperature becomes colder, the amount of heat a building loses increases.

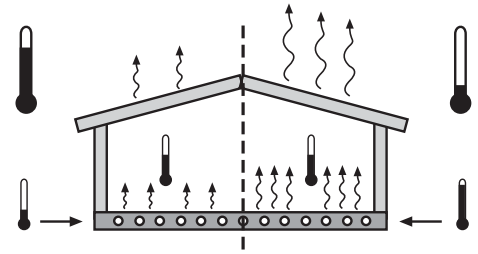
The operation of a hot water heating system can generally be improved by adjusting the supply water temperature to the system as the outdoor temperature changes. Using this approach, the heat input to the building can be matched to the heat lost from the building. This method of controlling the supply water temperature to a heating system greatly improves the comfort of the system and is known as Outdoor Reset.

When a Taco Outdoor Sensor is connected to the Variable Speed Mixing Control (VSMC), the VSMC provides outdoor reset. When operating in the outdoor reset mode of operation, the installer must set the Outdoor Design Temperature and the Design Supply Temperature in order to establish the relationship between the outdoor temperature and the supply water temperature. This is known as setting the Heating Curve.

Setpoint and Setpoint with Delta T Max Mode of Operation

In certain applications, it is desirable to maintain a fixed supply water temperature. This type of application is a setpoint application. Examples of setpoint applications include heat pump loops, reheat coils and floor warming.

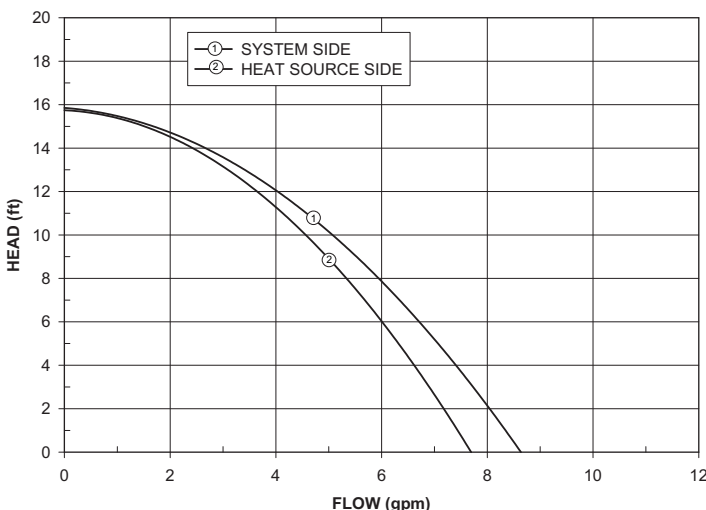
In specialized applications, such as snow melting, it is desirable to limit the rate of temperature increase in the system from the system's starting temperature to its operating setpoint. This is desired in order to prevent thermal shock of the system. This type of application is a Delta T application.



DESIGN

Design Procedure

1. Using the pump curve located below, ensure that the System Pump of the X - Pump Block will provide adequate head and flow for the system in which it is to be installed. If flow rate is unknown, then use Equation No. 1 below to determine required flow.
2. Using the pump curve located to the right, ensure that the Heat Source Pump of the X - Pump Block will provide adequate head and flow for the system in which it is to be installed. If flow rate is unknown, then use Equation No. 1 below to determine required flow.
3. Use Equation No. 1 to verify flow rates. Example: 25000 BTU radiant load with supply temperature of 100° and return temperature of 90°.



$$\text{EQUATION NO. 1: Flow Rate (GPM)} = \frac{\text{BTU's}}{500 \times \text{delta T}}$$

$$\text{EXAMPLE: } \frac{25,000}{500 (100 - 90)} = 5 \text{ GPM}$$

OPERATION

Outdoor Reset

When the VSMC receives a Demand and it is not in warm weather shut down (WWSD), the VSMC turns on the system pump and calculates a Mixing Target temperature. The variable speed heat source side pump is then operated to maintain the Mixing Target temperature at the mixing supply sensor.

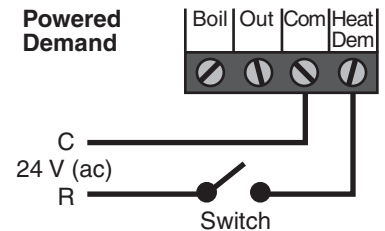
The heat source contact operates as described in the Heat Source Operation section. The VSMC also provides heat source protection as described in the Heat Source Operation section.

Demand

The VSMC requires a demand signal before it will begin operation. The VSMC can use either a powered or an unpowered demand signal. Once a demand signal is received, the VSMC displays the demand icon in the display and operates as described above.

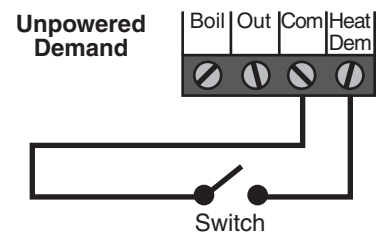
Powered Demand

The VSMC recognizes a Powered Demand Signal when 24 V (ac) is applied across the Com and Heat Dem terminals.



Unpowered Demand

The VSMC recognizes an Unpowered Demand signal when a switch is closed between the Com and Heat Dem terminals (relay type thermostat or end switch on zone control).



System Pump Operation

The VSMC has an internal system pump contact. This contact turns on when the VSMC has a mixing demand and is not in a WWSD. The integrated system pump as well as an external heat source pump may be controlled by this relay. By providing proper flow in the heat source loop, the heat source temperature can be accurately controlled based on the mixing load.

Heating Curve Settings

In order to establish the heating curve, the VSMC must be given two points to work with. The first point is the Outdoor Reset Starting Point and the second point is the Design Condition.

Outdoor Reset Starting Point

The Outdoor Reset Starting Point for the VSMC is fixed at 72°F. This means that when the outdoor temperature is 72°F, the VSMC calculates a required supply water temperature (Mix Target) of 72°F.

Design Conditions

The design conditions represent the supply water temperature required to satisfy the heating system on the typical coldest day of the year. These are the conditions that are used when calculating the size of the heating equipment needed to heat the building. The Design Conditions are made up of an outdoor temperature (Outdoor Design) and a supply water temperature (Design Supply).

Outdoor Design

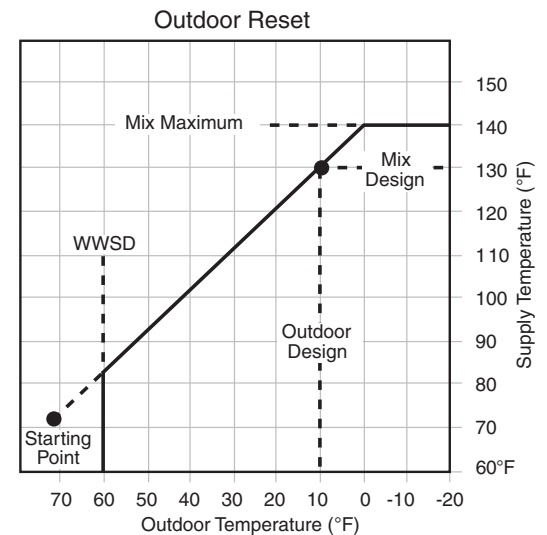
The Outdoor Design temperature is the average coldest day of the year for the area in which the building is located.

Design Supply

The Design Supply temperature is the supply water temperature that is required to heat the building when the outdoor air temperature is as cold as the Outdoor Design temperature.

Maximum System Supply

Some systems, such as hydronic radiant floor heating, may require the maximum supply water temperature to be limited in order to protect certain system components from high temperatures. The VSMC has a Maximum Supply setting that can be used to limit the maximum temperature that the control is allowed to use for a Mixing Target (MIX TRG) temperature.



Minimum System Supply

Some applications, such as floor warming, may require the minimum supply water temperature to be limited in order to provide a certain level of occupant comfort. The VSMC has a Minimum Supply setting that can be used to limit the minimum temperature that the control is allowed to use for a Mixing Target (MIX TRG) temperature. This minimum applies as long as the VSMC has a demand and is not in WWSD.

Warm Weather Shut Down (WWSD)

When the outdoor temperature is warmer than the WWSD setting, the VSMC turns off the heat source and the system pump. If a demand is received while the VSMC is in a WWSD, the VSMC indicates that the demand has been received by displaying the Demand pointer however, the MIX TRG remains as “- -”. The VSMC has a freeze protection feature that does not allow the supply water temperature to drop below 35°F (2°C) as long as there is a mixing demand signal.

Setpoint and Delta T

When the VSMC receives a Demand, the system pump is turned on.

If the Delta T Max setting is set to OFF, the variable speed injection pump is operated to maintain the mixing supply sensor at the Mixing Target temperature set by the installer.

If the Delta T Max setting is not set to off, the variable speed heat source pump is operated to maintain the mixing supply sensor at either the Mixing Return temperature plus the Delta T Max setting or the Mixing Target temperature set by the installer whichever is lower. The heat source contact operates as described in the Heat Source Operation section. The VSMC also provides heat source protection as described in the Heat Source Operation section.

Demand

The VSMC requires a demand signal before it will begin operation. The VSMC can use either a powered or an unpowered demand signal. Once a demand signal is received, the VSMC displays the demand pointer in the display and operates as described above.

Powered Demand

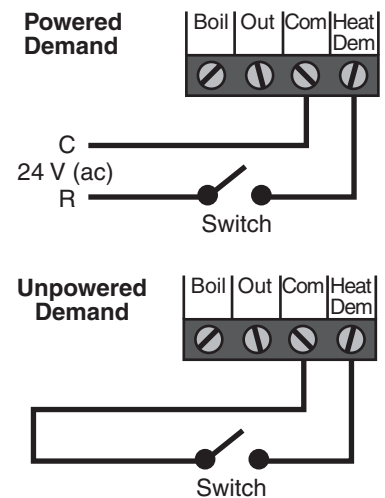
The VSMC recognizes a Powered Demand Signal when 24V (ac) is applied across the Com and Heat Dem terminals.

Unpowered Demand

The VSMC recognizes an Unpowered Demand signal when a switch is closed between the Com and Heat Dem terminals (relay type thermostat or end switch on zone control).

System Pump Operation

The VSMC has an internal system pump contact. This contact turns on when the VSMC has a mixing demand. The system pump as well as an external heat source pump may be controlled by this relay. By providing proper flow in the heat source loop, the heat source temperature can be accurately controlled based on the mixing load.



Setpoint and Delta T Settings

Outdoor Design

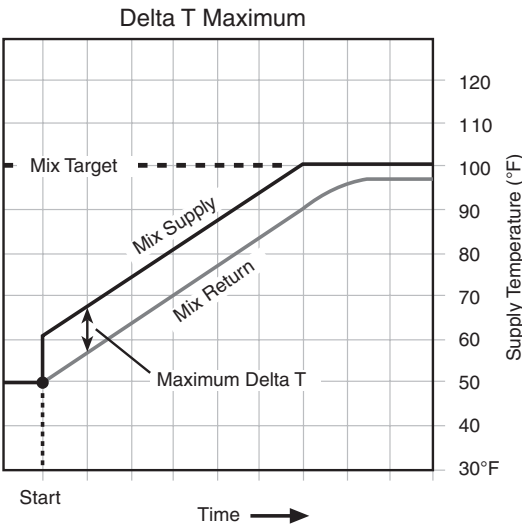
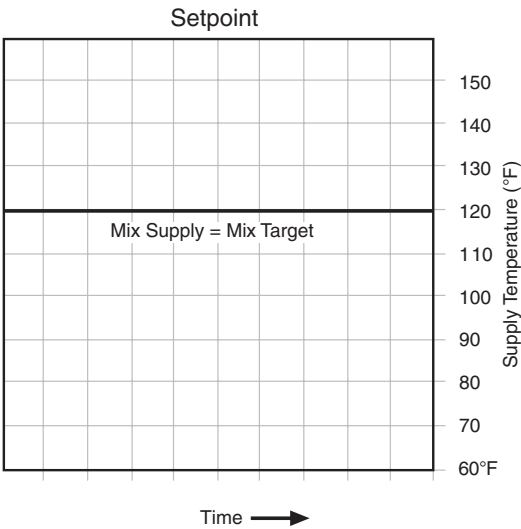
The Outdoor Design temperature must be set to OFF.

Mixing Target

The Mixing Target temperature is set to the desired operating temperature of the system.

Delta T Max

The Delta T Max temperature is set to the maximum temperature difference that is desired between the system return temperature and the system supply temperature. In order to adjust this setting, a system return sensor must be connected to the control.



HEAT SOURCE OPERATION

The VSMC operates the heat source in two basic modes of operation. The VSMC can either “Control” the heat source or “Enable” the heat source. The mode of operation is determined by the Heat Source Sensor location. The heat source sensor location is determined using the DIP switch on the back of the circuit board. If the DIP switch is set to ON, the heat source sensor is to be located on the heat source supply. If the DIP switch is set to OFF, the heat source sensor is to be located on the heat source return.



- If the DIP switch is set to On, the VSMC will “Control” the heat source (**sensor on supply**).
- If the DIP switch is set to Off, the VSMC will “Enable” the heat source (**sensor on return**).
- If the Heat Source Sensor has not been installed, the VSMC will “Enable” the heat source.

Heat Source Control

When the VSMC controls the heat source, the VSMC opens and closes the heat source contact in order to control the temperature of the heat source supply water temperature. When the VSMC is controlling the heat source temperature, the VSMC will determine the heat source supply water temperature that is required to satisfy the demands of the system. The VSMC will also determine a differential that is sufficient to minimize short cycling of the heat source. The VSMC will then cycle the heat source using these parameters.

Differential

An on / off heat source must be operated with a differential in order to prevent short cycling. When the supply water temperature drops 1/2 of the differential below the required heat source supply temperature, the heat source is turned on. The heat source is then kept on until the supply water temperature rises 1/2 of the differential above the required heat source supply temperature. If the differential is too wide, there can be large supply water temperature swings; however, if the differential is too narrow, the heat source short cycles and operates inefficiently. This control automatically calculates the heat source differential in order to achieve an appropriate balance between temperature swings and heat source efficiency. This also permits the control to adapt to changing loads and conditions. The VSMC only operates the heat source once the output of the injection circulator exceeds 10% of flow.

Heat Source Enable

When the VSMC “Enables” the heat source, the VSMC opens and closes the heat source contact based on the output of the variable speed pump. The actual temperature and cycling of the heat source is then determined by other controls or the aquastats on the heat source itself.

When operating in the heat source enable mode, the heat source contact turns on once the variable speed output exceeds 25%. The heat source contact shuts off if the output of the variable speed drops below 5% for more than three minutes or if the demand is removed from the VSMC.

Heat Source Protection (Heat Source Minimum)

Cool water is often returned to the heat source from low temperature radiant floor heating systems or snow melting systems. This cool heat source return water may cause the heat source to operate at such a low temperature that the flue gases condensate. Alternatively, when the heat source surfaces are hot due to previous loads such as domestic hot water generation, the large temperature difference (Delta T) between the heat source and its return water can cause the heat source to become thermally shocked. Proper protection of the heat source under these circumstances is required.

When a heat source sensor is connected to the control, the VSMC is capable of providing heat source protection. When providing heat source protection, the VSMC limits the output of the variable speed pump in order to reduce the amount of cool water being returned to the heat source. This allows the heat source temperature to increase to a point that avoids flue gas condensation.

Heat Source Protection with Heat Source Enable

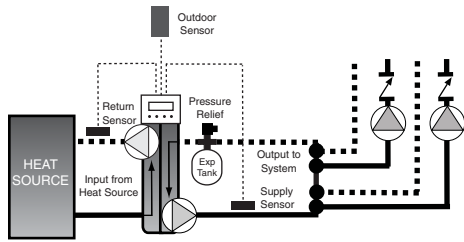
When the Heat Source Sensor is set to the “Return” setting the control begins to back off the variable speed pump when the heat source temperature drops below the Heat Source Minimum Setting.

Heat Source Protection with Heat Source Control

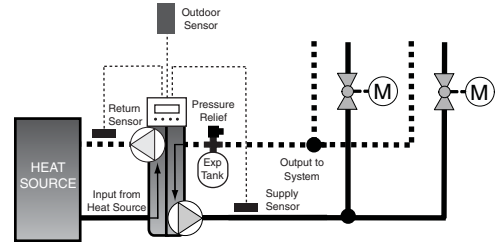
When the Heat Source Sensor is set to the “Supply” setting the control begins to back off the variable speed pump when the heat source temperature drops 1/2 of the Differential below the Heat Source Minimum Setting.

Note: If a heat source sensor is not installed, the VSMC cannot provide heat source protection.

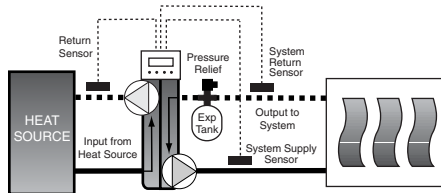
INSTALLATION



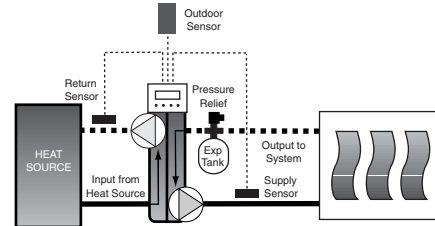
X - Pump Block (XPB), Multiple Zones - Circulators



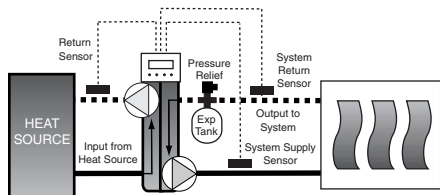
X - Pump Block (XPB), Multiple Zones - Zone Valves



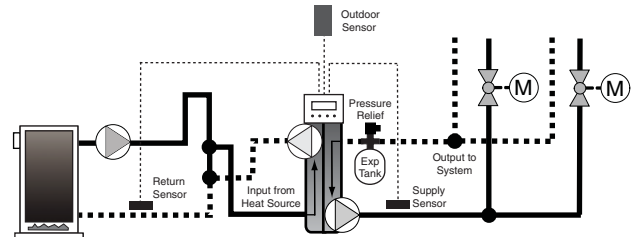
X - Pump Block (XPB)



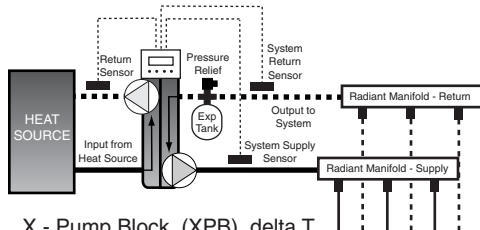
X - Pump Block (XPB)



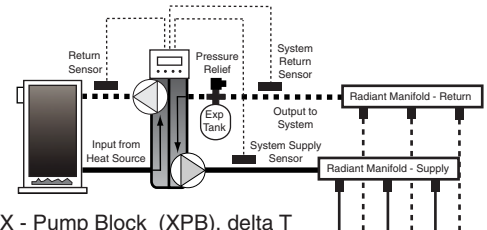
X - Pump Block (XPB), delta T Snow Melt System



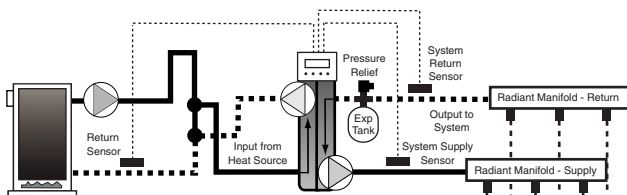
X - Pump Block (XPB), Multiple Temperature System



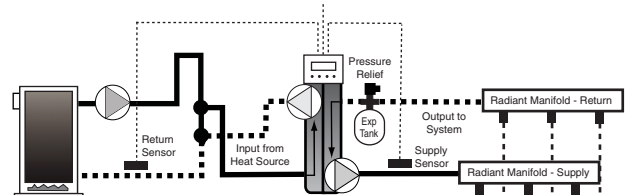
X - Pump Block (XPB), delta T



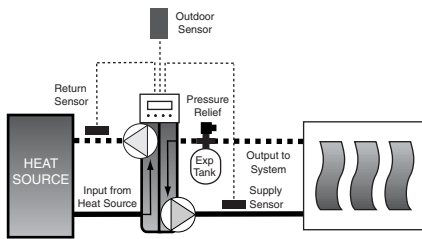
X - Pump Block (XPB), delta T



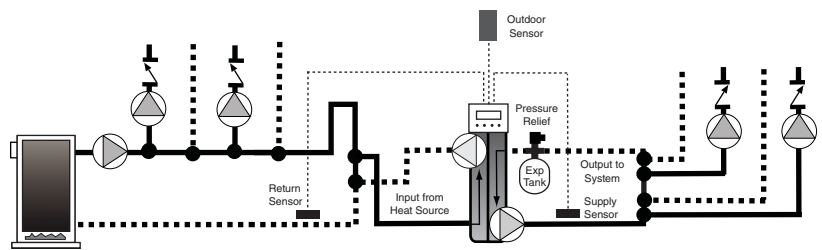
X - Pump Block (XPB), Setpoint Temp with delta T



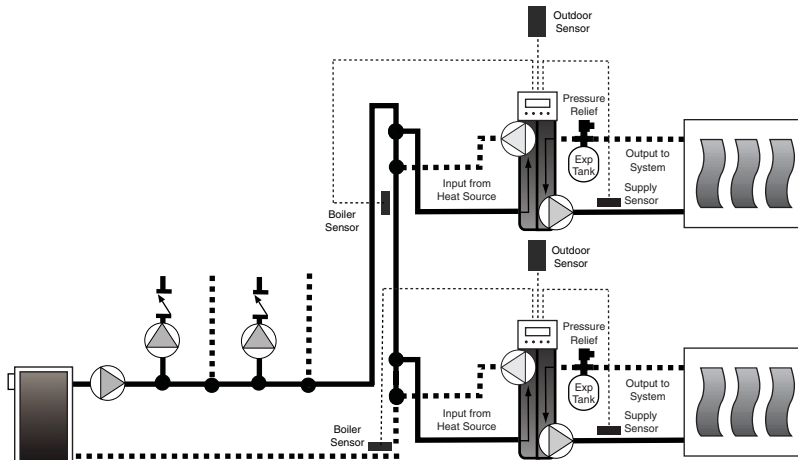
X - Pump Block (XPB), Primary / Secondary Piping



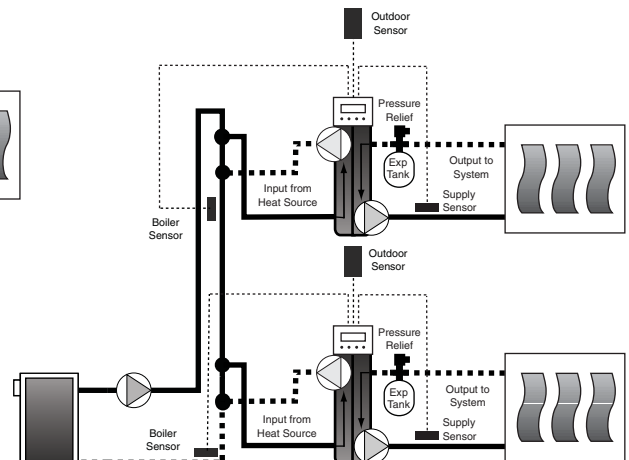
X - Pump Block (XPB)



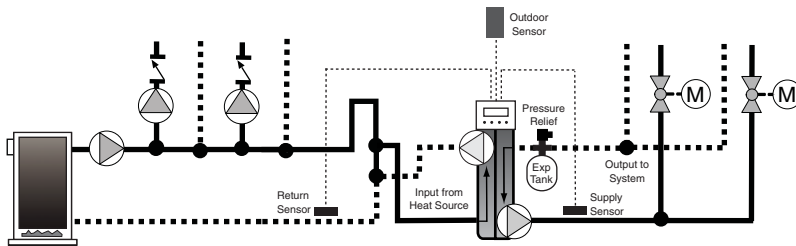
X - Pump Block (XPB), Multiple Temperature System



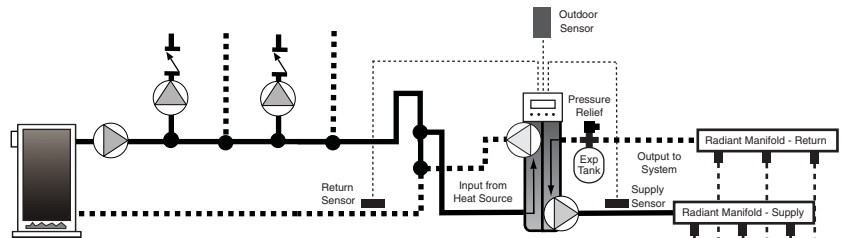
X - Pump Block (XPB), Multiple Temperature System



X - Pump Block (XPB), Multiple Temperature System



X - Pump Block (XPB), Multiple Temperature System



X - Pump Block (XPB), Multiple Temperature System

Radiant Made Easy™

TACO, INC., 1160 Cranston Street, Cranston, RI 02920 Telephone: (401) 942-8000 FAX: (401) 942-2360.

TACO (Canada), Ltd., 6180 Ordan Drive, Mississauga, Ontario L5T 2B3. Telephone: 905/564-9422. FAX: 905/564-9436.

Visit our web site at: <http://www.taco-hvac.com>

Printed in USA

Copyright 2005

TACO, Inc.