

Taco Radiant Made Easy Application Guide

Radiant Mixing Block

Products & Applications

PA09

EFFECTIVE: March 1, 2004

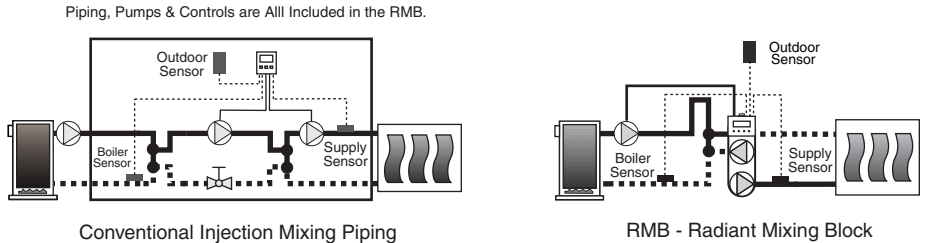
SUPERSEDES: New

OVERVIEW

Radiant Mixing Block

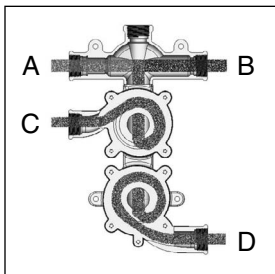
The Taco Radiant Mixing Block (RMB) is a complete injection mixing system. Integral to the unit is a variable speed injection circulator, constant speed system circulator, air elimination, and the electronics to drive it all. With only four piping connections needed, the RMB greatly reduces the time and space required for installation (see Figure A). The RMB can be set up to operate as an outdoor reset control or a setpoint control with or without delta T limiting, creating flexibility never seen before in a single unit.

Figure A



OPERATION

Hot water from the boiler loop enters the RMB at the Boiler Supply port (A). The cooler return water from the radiant loops enters at the System Return port (B). In the middle of these two ports, any air in the system is purged through the integral Taco Hy-Vent. The injection circulator varies in speed to blend the two temperatures, injecting the excess required temperature back through the Boiler Return port (C). The constant speed system circulator delivers the required blended water temperature to the radiant loop through the Radiant Supply port (D).



Features:

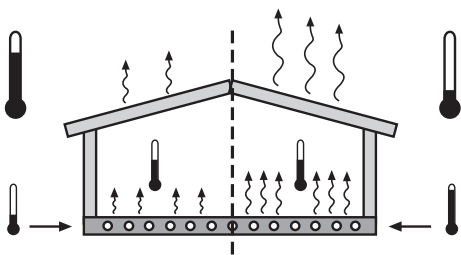
- All-in-one injection piping, pumping, air elimination & control package
- Only 4 pipe connections required
- Plug-in low voltage connections
- Solid state microprocessor design
- Greatly decreases installation time
- Substantial space savings
- Line cord included, hard wire option
- Bronze casing for open or closed systems
- Replaceable cartridge design
- Maintenance free, wet-rotor circulators
- 2 operation modes: outdoor reset and setpoint with or without delta T with limiting
- Powered or unpowered demand signal
- Integral check valve
- Main system pump contact
- 100% pump operation / control override switch
- Automatic pump exercise
- Adjustable reset ratio
- Warm weather shutdown
- Boiler control or enable setting
- Boiler protection
- Large LCD display
- °C or °F
- 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 Radiant Mixing Control (RMC), the RMC 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

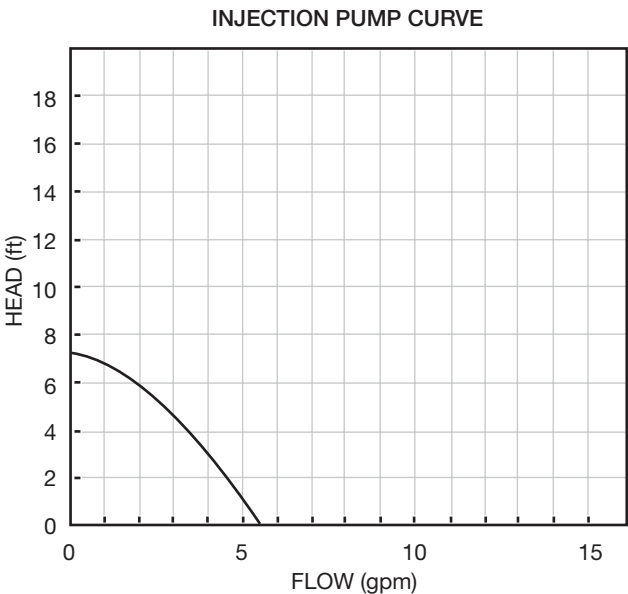
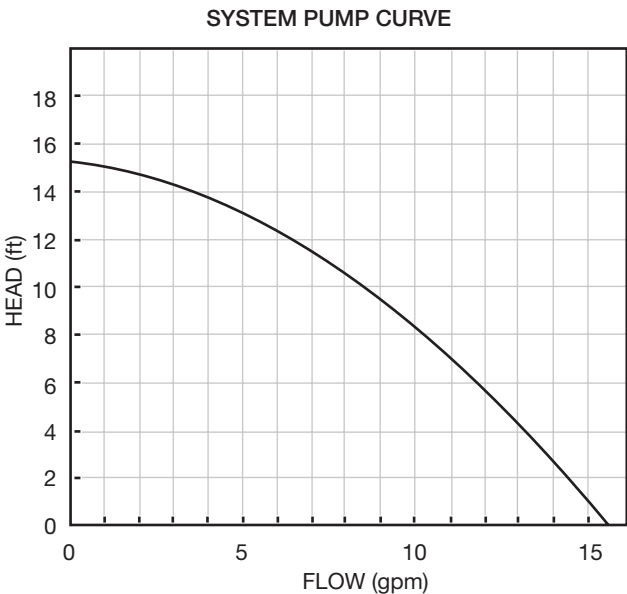
In certain applications, it is desirable to maintain a fixed supply water temperature. This type of application is a setpoint application. Examples of setpoint applications include heat pump loops, reheat coils and floor warming.

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 Setpoint with Delta T Max.

DESIGN

Design Procedure

1. Using the pump curve located below, ensure that the System Pump of the Radiant Mixing Block will provide adequate flow for the system in which it is to be installed.
2. Using the table or equation below, determine the required flow rate for the Injection Pump.
3. Using the pump curve located below, ensure that the Injection Pump of the Radiant Mixing Block will provide adequate flow for the system in which it is to be installed.



Required Injection Pump Flow Rate

Tb = Boiler Supply Temperature

Ts = Radiant Supply Temperature

$$\text{Injection Flow Rate (GPM)} = \frac{\text{BTU's}}{(\text{Tb} - \text{Ts}) \times 500}$$

Required Injection Flow Rate (GPM)

Tb - Ts	BTU's x 1000					
	20	40	60	80	100	120
100	0.4	0.8	1.2	1.6	2.0	2.4
80	0.5	1.0	1.5	2.0	2.5	3.0
60	0.7	1.3	2.0	2.7	3.3	4.0
40	1.0	2.0	3.0	4.0	5.0	
20	2.0	4.0				

OPERATION

Outdoor Reset

When the Radiant Mixing Control (RMC) receives a Demand and it is not in a warm weather shutdown (WWSD), the RMC turns on the system pump and calculates a Mixing Target temperature. The variable speed injection pump is then operated to maintain the Mixing Target temperature at the mixing supply sensor.

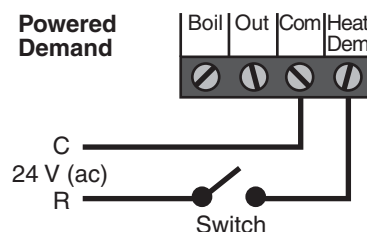
The boiler contact operates as described in the Boiler Operation section. The RMC also provides boiler protection as described in the Boiler Operation section.

Demand

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

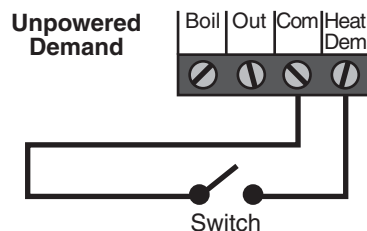
Powered Demand

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



Unpowered Demand

The RMC recognizes an Unpowered Demand signal when a switch is closed between the Com and Heat Dem terminals.



System Pump Operation

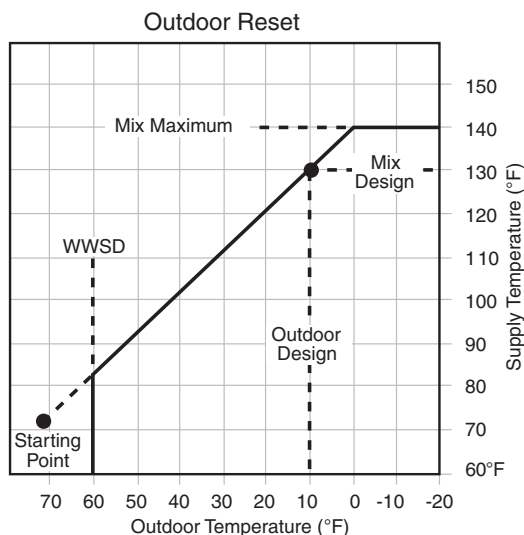
The RMC has an internal system pump contact. This contact turns on when the RMC has a mixing demand and is not in a WWSD. The integrated system pump as well as an external boiler pump may be controlled by this relay. By providing proper flow in the boiler loop, the boiler temperature can be accurately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

Heating Curve Settings

In order to establish the heating curve, the RMC 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 RMC is fixed at 72°F. This means that when the outdoor temperature is 72°F, the RMC 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 RMC 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 RMC 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 RMC has a demand and is not in WWSD.

Warm Weather Shut Down (WWSD)

When the outdoor temperature is warmer than the WWSD setting, the RMC turns off the boiler and the variable speed injection pump. If a demand is received while the RMC is in a WWSD, the RMC indicates that the demand has been received by displaying the Demand pointer however, the MIX TRG remains as “- - -”. The RMC 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

If the RMC is to operate as a setpoint control, the Outdoor Design temperature must be set to OFF and the Mixing Target temperature must be set to the desired temperature.

If the RMC is to operate as a Delta T control, a mixing return sensor must be installed, the Outdoor Design temperature must be set to OFF and both the Delta T Max setting and the Mixing Target temperature must be set to the desired temperature. In both of these applications, the outdoor sensor is not to be installed.

When the RMC 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 injection 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 boiler contact operates as described in the Boiler Operation section. The RMC also provides boiler protection as described in the Boiler Operation section.

Demand

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

Powered Demand

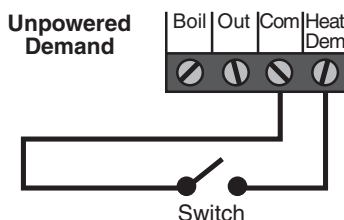
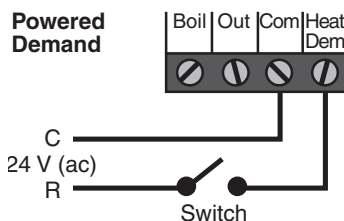
The RMC recognizes a Powered Demand Signal when 24 V (ac) is applied across the Com and Heat Dem terminals.

Unpowered Demand

The RMC recognizes an Unpowered Demand signal when a switch is closed between the Com and Heat Dem terminals.

System Pump Operation

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



Outdoor Design

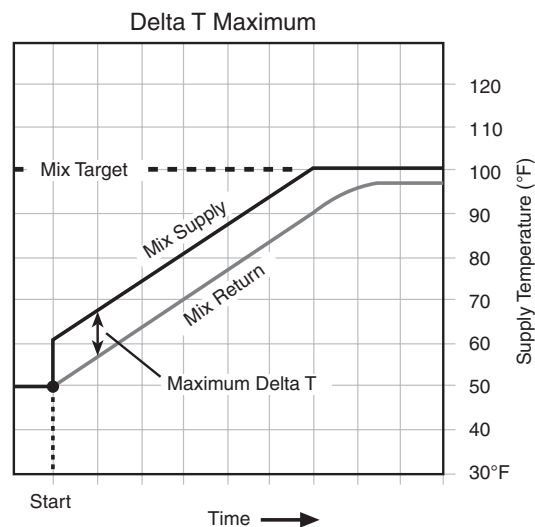
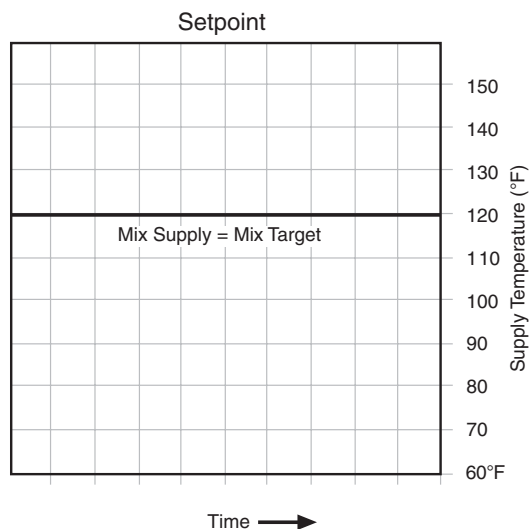
The Outdoor Design temperature must be set to OFF.

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 mixing return temperature and the mixing supply temperature. In order to adjust this setting, a mixing return sensor must be connected to the control.



BOILER OPERATION

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

- If the DIP switch is set to On, the RMC will “Control” the boiler.
- If the DIP switch is set to Off, the RMC will “Enable” the boiler.
- If the Boiler Sensor has not been installed, the RMC will “Enable” the boiler.



Boiler Control

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

Differential

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

Boiler Enable

When the RMC “Enables” the boiler, the RMC opens and closes the boiler contact based on the output of the variable speed injection pump. The actual temperature and cycling of the boiler is then determined by other controls or the aquastats on the boiler itself. When operating in the boiler enable mode, the boiler contact turns on once the variable speed output exceeds 25%. The boiler 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 RMC.

Boiler Protection (Boiler Minimum)

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

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

Boiler Protection with Boiler Enable

When the Boiler Sensor is set to the “Return” setting the control begins to back off the variable speed injection pump when the boiler temperature drops below the Boiler Minimum Setting.

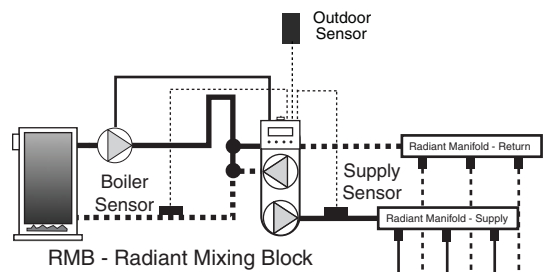
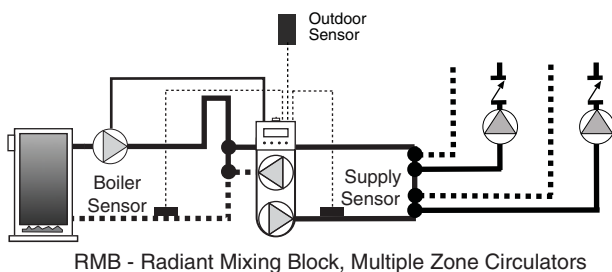
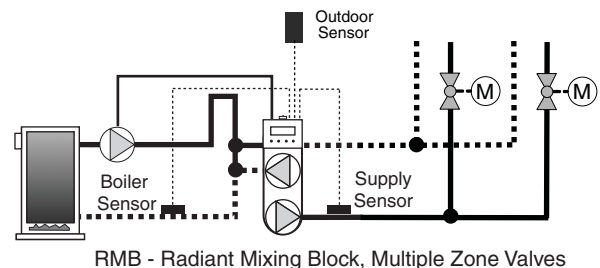
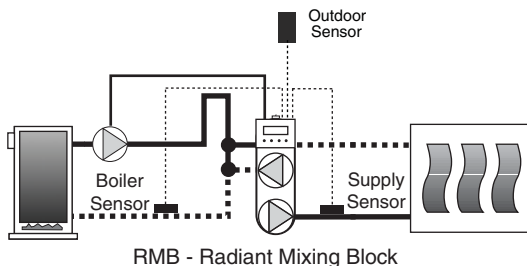
Boiler Protection with Boiler Control

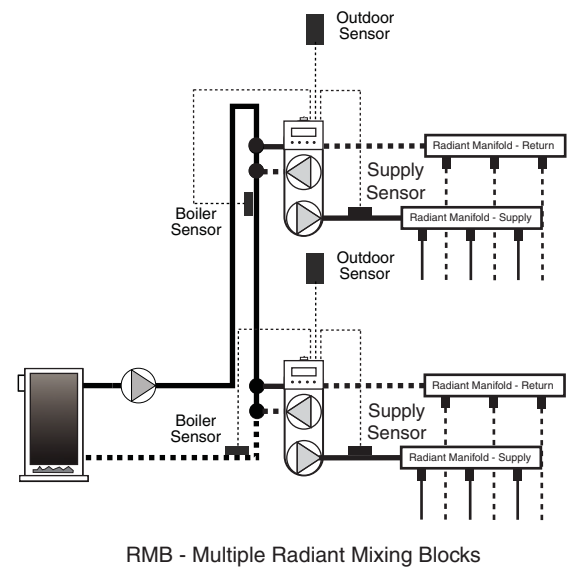
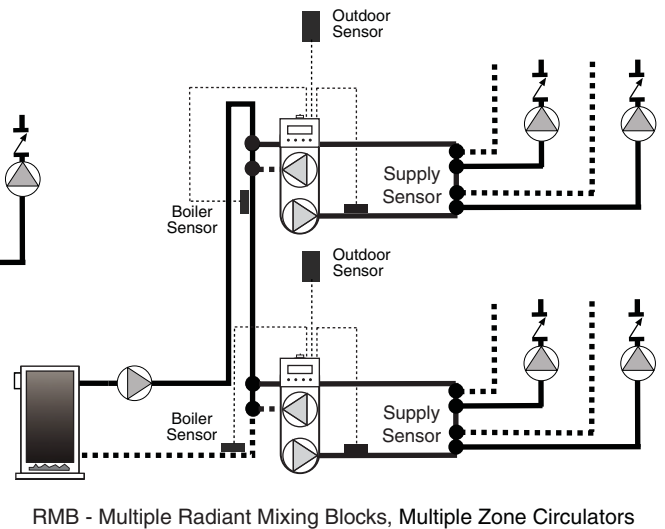
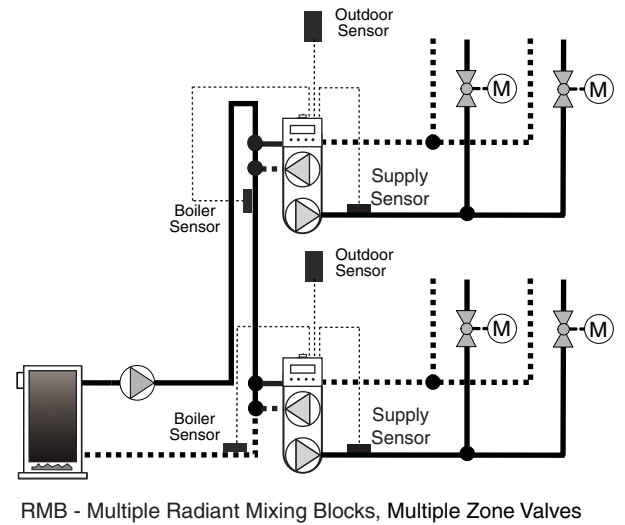
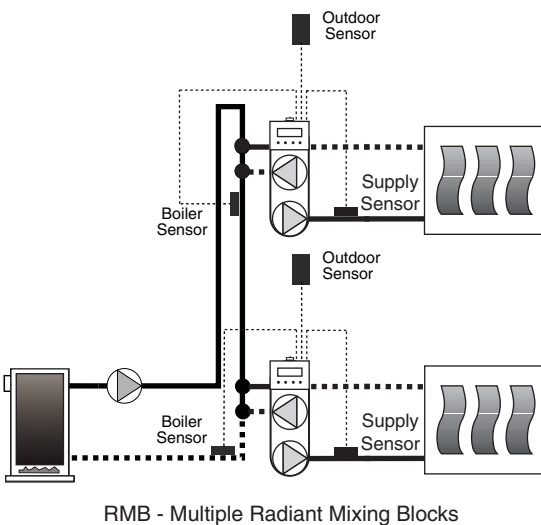
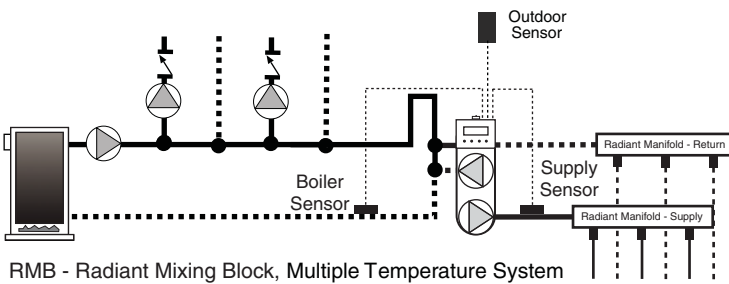
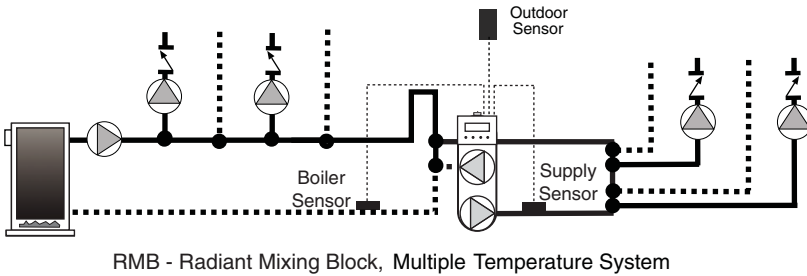
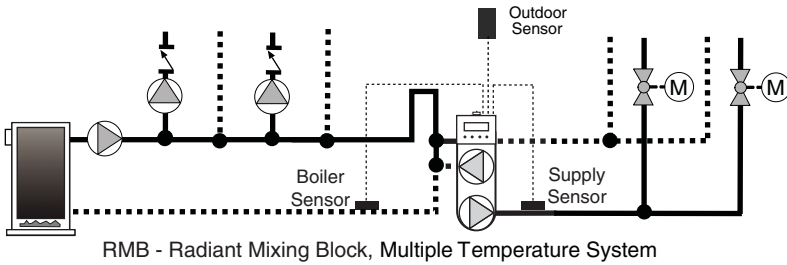
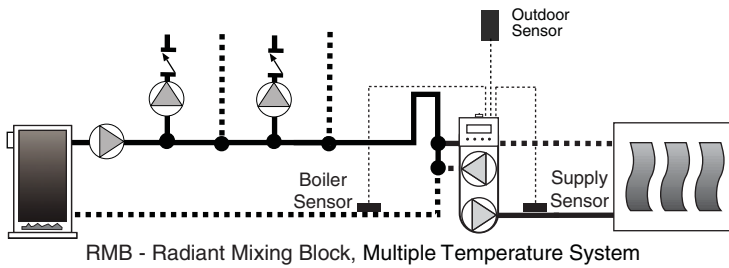
When the Boiler Sensor is set to the “Supply” setting the control begins to back off the variable speed injection pump when the boiler temperature drops 1/2 of the Differential below the Boiler Minimum Setting.

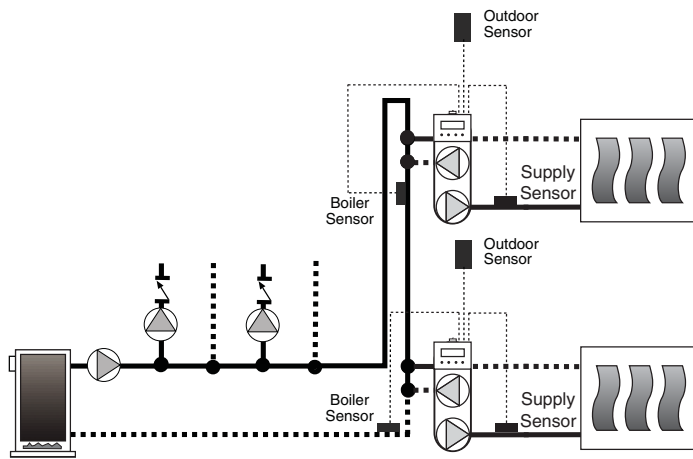
Note: If a boiler sensor is not installed, the RMC cannot provide boiler protection.

INSTALLATION

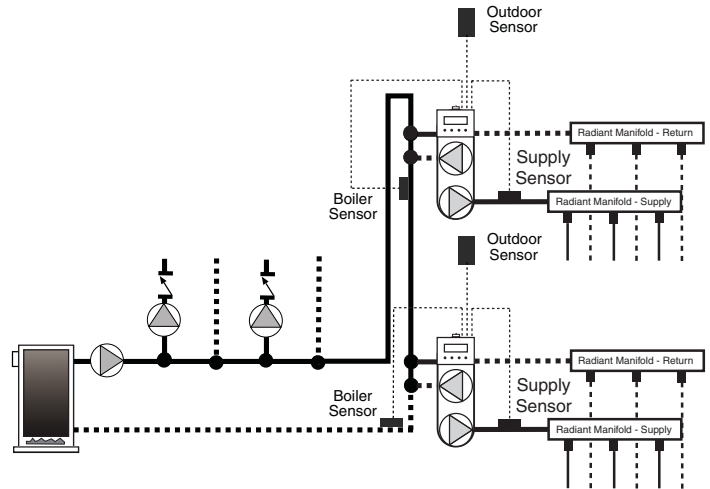
For installations where boiler protection is **NOT** required, the boiler sensor does not need to be installed.





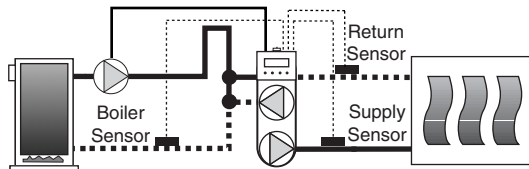


RMB - Multiple Radiant Mixing Blocks, Multiple Temperature System

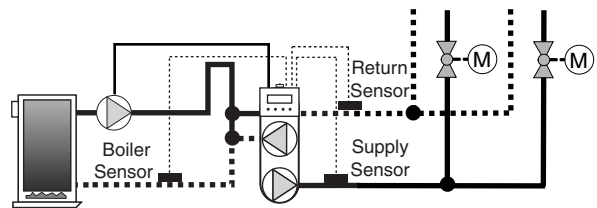


RMB - Multiple Radiant Mixing Blocks, Multiple Temperature System

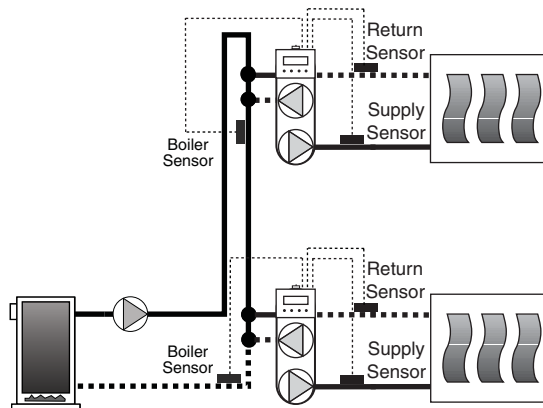
Setpoint with Delta T Max. Operation Mode



RMB - Radiant Mixing Block



RMB - Radiant Mixing Block, Multiple Zone Valves



RMB - Multiple Radiant Mixing Blocks

Radiant Made Easy™

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