

**PC700 Outdoor Boiler Reset Control and  
PC702 Two Stage Outdoor Boiler Reset Control**

**PA01**

EFFECTIVE: March 1, 2004

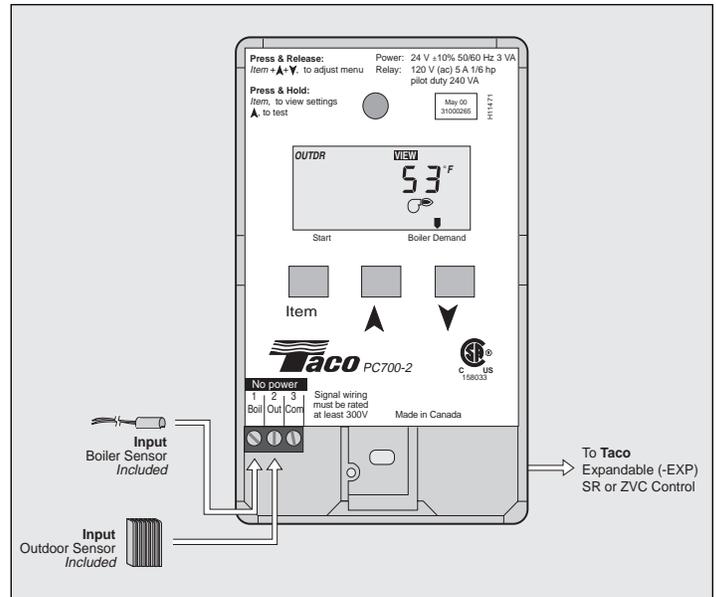
SUPERSEDES: New

**OVERVIEW**

**PC700: Boiler Reset Control**

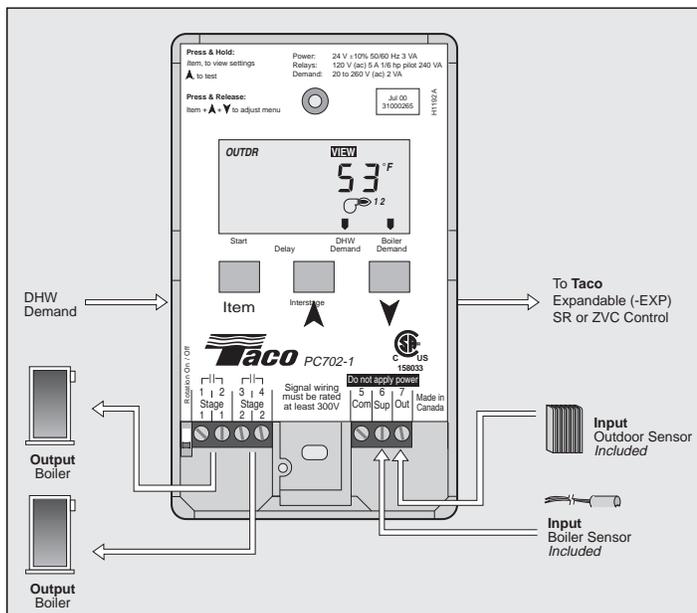
The Taco Boiler Reset Control is a microprocessor-based control designed to regulate the supply water temperature from a single boiler based on the outdoor temperature. To avoid boiler short cycling and large temperature swings, the PC700 is able to continuously adjust the boiler differential. Standard functions include warm weather shut down, minimum boiler supply temperature setting, and a starting water temperature setting. The easy-to-use automatic reset ratio calculation sets the relationship between outdoor temperature and supply water temperature (heating curve) to provide optimum control and comfort. The control has a liquid crystal display that clearly shows the boiler supply temperature as well as the other monitored temperatures and settings.

The operation of a hot water heating system can be improved by modulating the supply water temperature as the outdoor temperature changes. Using this approach, the heat lost from the building is matched by the heat input to the building.



**PC702: Two Stage Boiler Reset Control**

The Taco Two Stage Boiler Reset Control is a microprocessor-based control designed to regulate the supply water temperature from a two stage boiler system based on the outdoor temperature or domestic hot water requirements. The PC702 has all of the features of the PC700 yet also includes an adjustable interstage delay setting, boiler staging using proportional, integral and derivative (PID) logic, optional boiler rotation, and a domestic hot water demand output.



**Features:**

- Plugs into any Taco Expandable (EXP) Switching Relay or -EXP Zone Valve Control
- Increased comfort
- Less fluctuation of indoor temperature
- Reduced expansion noises
- Evens out heat delivery, reducing cold spots
- Reduced possibility of thermal shock
- Energy savings

## CONTROL STRATEGY

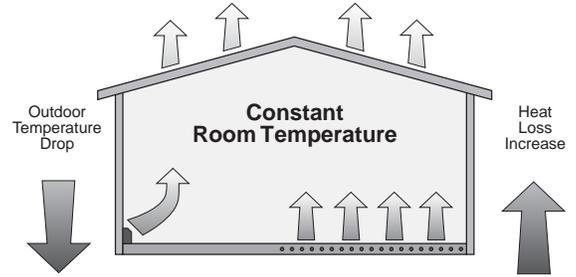
### Outdoor Reset

In order to properly control a hot water heating system, the heat supplied to the building must equal the heat lost by the building.

The heat supplied to the building is directly proportional to the temperature of the water and the surface area of the heating element. The higher the temperature of the water flowing through the heating terminal, the higher the heat output.

The heat lost from a building is dependent on the outdoor temperature. As the outdoor temperature drops, the building heat loss increases.

These two facts lead to the concept of outdoor reset, based on a reset ratio, which increases the supply water temperature as the outdoor temperature drops. Using this approach, the heat lost from the building is matched by the heat provided by the terminal units, therefore providing more comfort and energy savings.



### Reset Ratio

Operation of a hot water heating system can generally be improved by modulating the supply water temperature as the outdoor temperature changes. Using this approach, the heat lost from the building is matched by the heat input to the building. The PC700 and PC702 Boiler Reset Controls utilize a reset ratio to set the relationship between outdoor temperature and supply water temperature. The reset ratio determines the amount the supply water temperature is raised for every 1° drop in outdoor air temperature, and it is determined from the starting point and the system design conditions. In order for the control to automatically determine the reset ratio, a starting point and design conditions must be established. These two points are set by the following 4 adjustments:

#### Outdoor Starting Temperature (OUTDR START)

The Outdoor Starting Temperature is the outdoor air temperature at which the Boiler Starting Temperature is supplied. This setting is typically set to the desired building temperature.

#### Boiler Starting Temperature (BOIL START)

The Boiler Starting Temperature is the starting supply water temperature required to maintain the building interior at the design indoor temperature when the outdoor air temperature is the same as the Outdoor Starting Temperature.

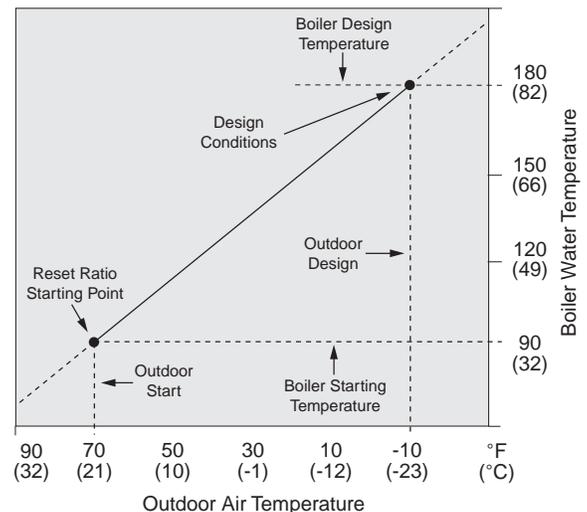
#### Outdoor Design Temperature (OUTDR DSGN)

The Outdoor Design Temperature is the outdoor air temperature that is the typical coldest day of the year where the building is located. This temperature is used when doing the heat loss calculations for the building.

#### Boiler Design Temperature (BOIL DSGN)

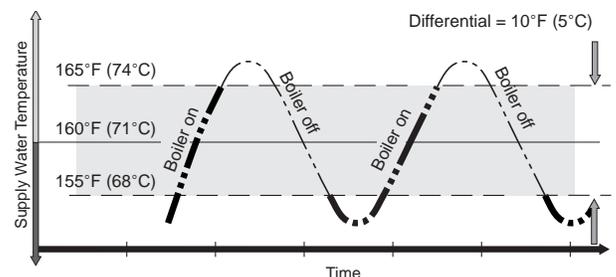
The Boiler Design setting is the supply water temperature required to satisfy the building's heat loss during the coldest outdoor temperature. This adjustment is typically dependent on the type of heating terminal used.

Once these two points have been determined, the system supply temperature is varied based on a straight line between these two points.



## BOILER OPERATION THEORY

The supply water temperature from a boiler can be controlled by cycling the boiler on and off. Modulation of the boiler's operating temperature in hot water heating systems not only provides more comfort but also offers significant energy savings. The cooler the boiler runs, the more efficient it is due to less heat losses up the flue and reduced boiler jacket losses.



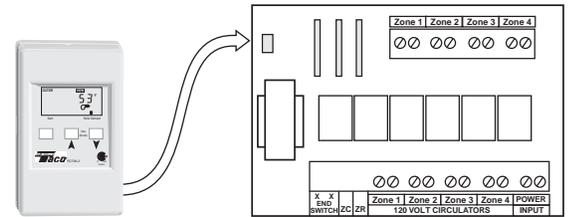
## Differential

An on / off boiler must be operated with a differential in order to prevent short cycling. When the supply water temperature drops below the bottom rail of the differential, the boiler is turned on. The boiler is then kept on until the supply water temperature rises above the top rail of the differential. 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. These controls are either manually set or can automatically calculate 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 control includes a minimum on and off time for the heat source(s), in order to minimize short cycling.

## PC700 & PC702 OPERATION

### Boiler Demand

The PC700 and PC702 obtain a boiler demand through the Taco Expandable (-EXP) Zone Control when a zone calls for heat. While the PC700 and PC702 has a boiler demand, the system supply water temperature is controlled by turning the boiler(s) on and off. The control calculates the target supply water temperature based on the outdoor temperature, the reset ratio settings, and the boiler minimum setting.



### DHW Demand (PC702 Only)

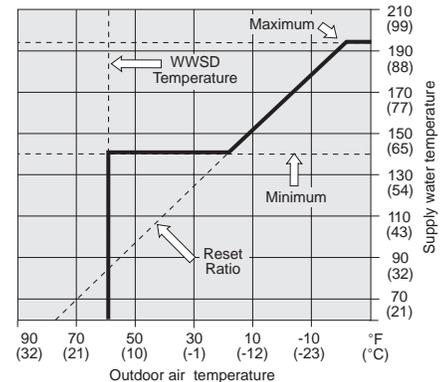
The PC702 obtains a domestic hot water (DHW) demand when a voltage between 24 and 240 V(ac) is applied across the two DHW demand wires (black wires) that come out of the back of the control. The system supply water temperature is controlled by turning the boiler(s) on and off. Most indirect DHW tanks require a relatively high supply water temperature in order to produce adequate amounts of DHW. The control therefore overrides the reset ratio when there is a demand for DHW and raises the system supply temperature to a temperature that is suitable for DHW generation. The PC702 targets a supply water temperature of at least 180°F (83°C).

### Maximum Boiler Supply

The controls do not allow the boiler target temperature to exceed the boiler design temperature setting plus 10°F (6°C) to a maximum of 225°F (107°C).

### Minimum Boiler Supply

The controls have a minimum boiler setting which selects a minimum boiler target temperature in order to prevent corrosion from flue gas condensation. During mild outdoor conditions, the boiler(s) cycles around the minimum boiler setting. This programmed function has an OFF setting for condensing and electric boilers.



### Rotation (PC702 Only)

The PC702 has an optional boiler rotation function, fixed at 48 hours. The firing order of the boilers changes whenever one stage accumulates 48 hours more running time than the other stage. After each rotation, the stage with the least running hours is the first to fire, and the stage with the most running hours is the last to fire. This function ensures that both stages receive equal amounts of use. When the *Rotation On/Off* DIP switch is set to the *Off* position, Stage I is always the first stage to fire. Use the setting for lo-hi fire boilers.

### Staging (PC702 Only)

The PC702 controls up to two stages in order to supply the required target temperature. After the first stage is turned on in the firing sequence, the control waits a minimum amount of time before turning on the next stage. This minimum amount of time is set using the interstage delay setting. After the interstage delay has expired, the PC702 examines the current supply water temperature to determine when the next stage is to fire. The control uses Proportional, Integral and Derivative (PID) logic.

Proportional - compares the actual supply temperature to the boiler target temperature. The colder the supply water temperature, the sooner the next stage is turned on.

Integral - compares the actual supply temperature to the boiler target temperature over a period of time.

Derivative - determines how fast or slow the supply water temperature is changing. If the supply temperature is increasing slowly, the next stage is turned on sooner. If the supply temperature is increasing quickly, the next stage is turned on later, if at all.

## Interstage Delay (PC702 Only)

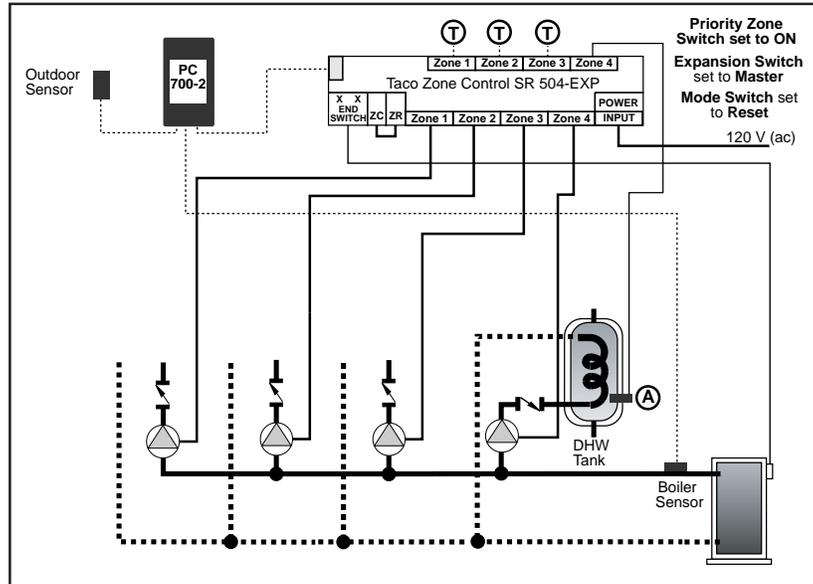
The PC702 has an adjustable interstage delay setting. This setting sets the minimum time delay between the firing of the first stage and the firing of the second stage. Each stage has a minimum on time, and a minimum off time of 30 seconds.

## Warm Weather Shut Down (WWSD)

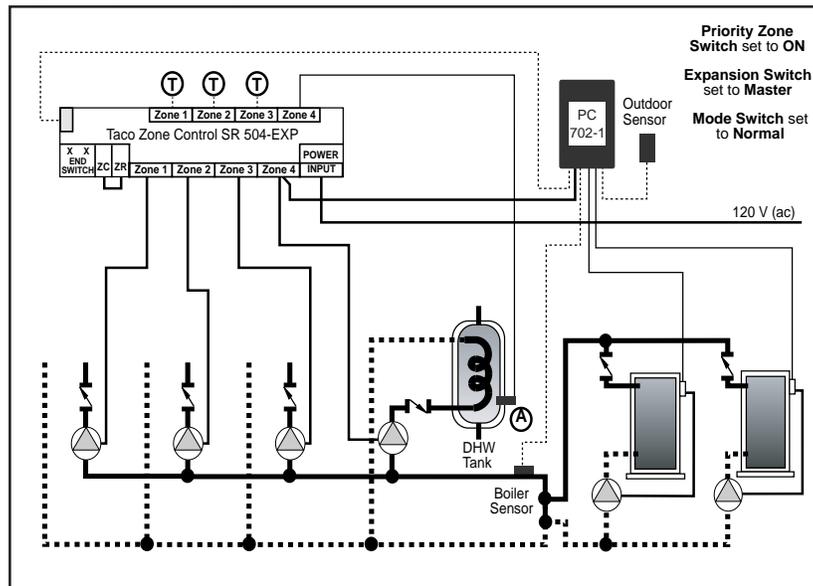
When the outdoor temperature rises above the WWSD setting, the PC702 displays the WWSD segment in the LCD and turns off the boiler(s). If the PC702 receives a boiler demand from the Taco Zone Control while in a WWSD, the boiler(s) remain off. If the PC702 receives a DHW demand while in a WWSD, the boiler(s) are fired to satisfy the DHW demand.

## INSTALLATION

High Temperature System with DHW



High Temperature System with 2 Boilers and DHW



For additional installation diagrams, refer to the Taco Zone Controls Wiring Guide.

## Radiant Made Easy™

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