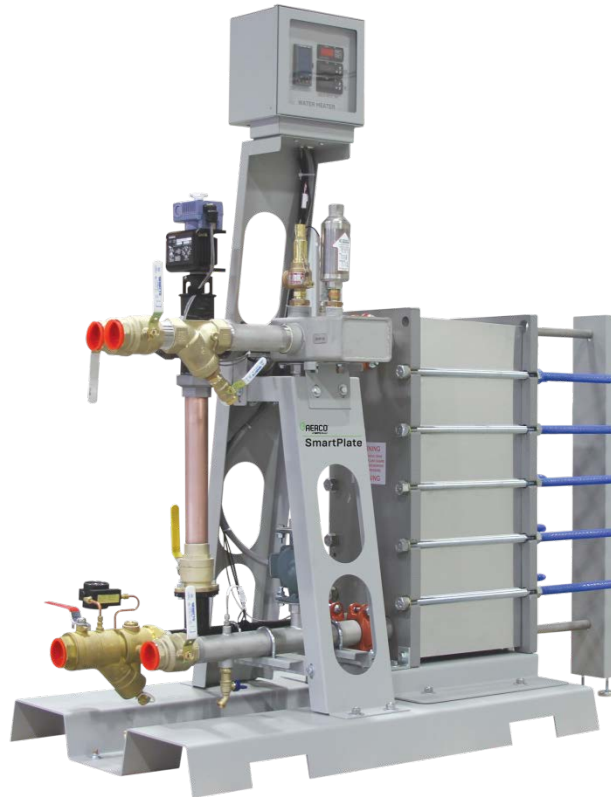


## SmartPlate Application Guide for Boiler Interface

For All SmartPlate Models:

- **SP23**
- **SP33**
- **SP45**
- **SP69**
- **SP150**
- **SPDW23**
- **SPDW32**
- **SPDW42**
- **SPDW61**
- **SPDW113**



**Last Revised: 01/08/2016**

**Technical Support:**  
(Mon–Fri, 8am–5pm EST)  
**1-800-526-0288**

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### --DISCLAIMER--

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## 1. General

The SmartPlate is an instantaneous water heater that satisfies diversified domestic hot water demands and maintains accurate temperature control under varying loads without requiring domestic water storage. These objectives are achieved using digital controls with feed-forward sensing and a fast-acting electronic control valve.

The SmartPlate's control valve accurately regulates the primary energy source (boiler water) in the proper proportion to satisfy the secondary (domestic water) load requirements. The SmartPlate transfers energy between the boiler water and domestic water using either a single-wall brazed plate heat exchanger or a double-wall plate-and-frame heat exchanger. Because these plate heat exchangers are so efficient, they are capable of functioning effectively with as little as a 5°F approach. This allows for a lower boiler water supply temperature, which will increase condensing boiler system efficiency.

The availability of boiler water at the proper flow and at a reasonably stable temperature ( $\pm 10^\circ\text{F}$ ) is key factor to the success of this design. The specifying engineer must consider what type of hydronic heating system and boilers the SmartPlate will interface with in order to optimize system performance and maximize boiler efficiency. Keep in mind that the boiler supply temperature to the SmartPlate must be at least 5°F above the desired domestic hot water setting; hence the boilers supply temperature cannot be reset below that point.

## 2. Purpose

The intent of this guide is to enable the specifying engineer applying SmartPlate to ensure acceptable temperature control at the heater and minimize boiler cycling, thus avoiding associated loss in system efficiency and physical wear and tear on the boiler.

## 3. System Categories

Most hydronic heating systems fit into one of two general application categories:

- Large volume systems with sufficient thermal mass and year-round loads to dampen out the peaks and valleys associated with domestic water heating loads.
- Small volume systems with insufficient thermal mass and/or seasonal loads that do not dampen out the peaks and valleys associated with domestic water heating loads.

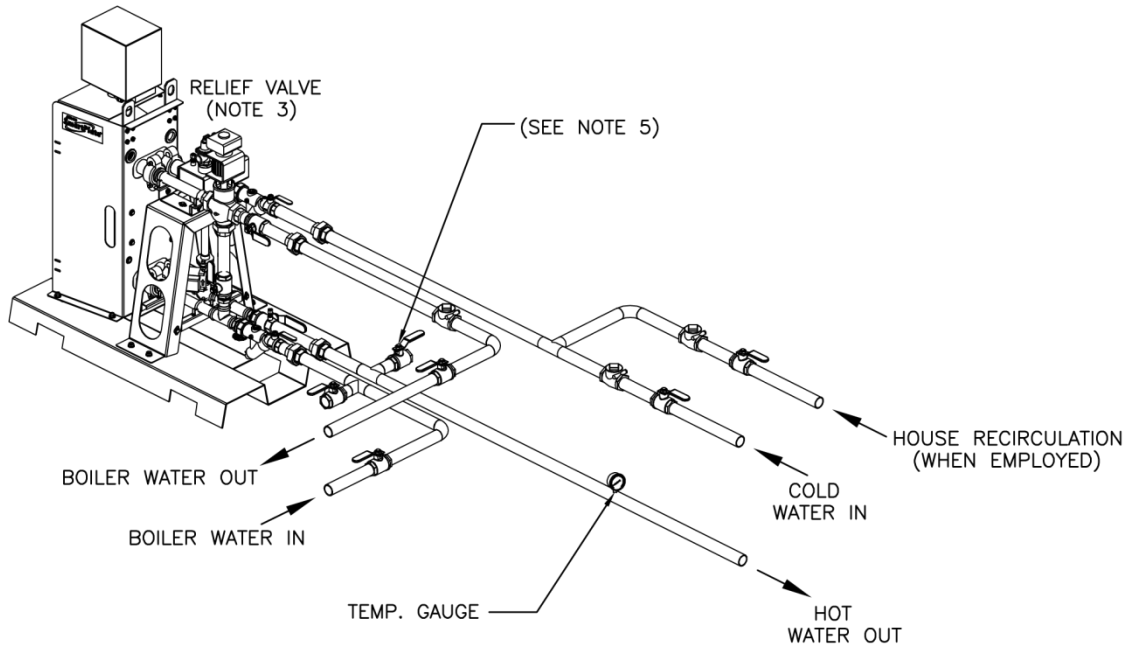
Systems in the second category can induce excessive boiler cycling while working to meet the domestic hot water demand. A properly designed system should not allow any single boiler to cycle more than 2-1/2 times per hour when domestic water heating is the only load - much less during the heating season.

### 3.1 Large Volume Systems

To minimize boiler cycling, sufficient thermal mass must exist in the piping between the boiler & SmartPlate, in each individual boiler, or in both. Sufficient boiler water flow at specified temperature must be provided for the SmartPlate to meet variable potable water load demand. The location of the SmartPlate heater relative to the boiler is also important — the required thermal mass must be between the boiler and the SmartPlate.

Large conventional boilers can contain anywhere from a few hundred to a few thousand gallons of water. In this scenario, the boiler and piping water volumes alone are typically (but not always) sufficient to ensure minimal boiler cycling and smooth operation of the SmartPlate. When this is the case, the SmartPlate should be installed as shown in Figures 1 and 2.

However, designers **should always** contact their local AERCO sales representative to perform the thermal buffer tank calculation discussed in the next section and confirm that sufficient thermal mass already exists in the system.

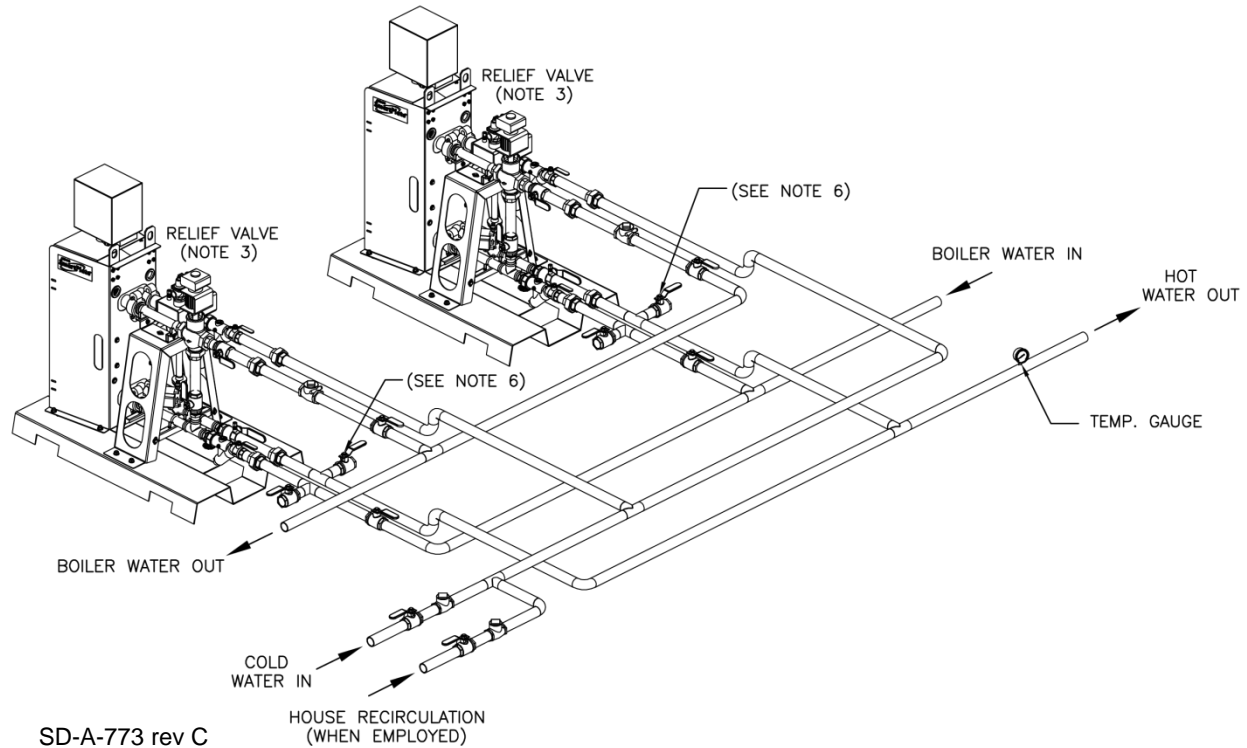


SD-A-772 rev C

NOTES:

1. FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE HEATER, SEE DIMENSIONAL DRAWING.
2. REDUCERS, ON THE WATER INLET SIDE, SHOULD BE LOCATED ADJACENT TO THE HEATER. EXPANSION FITTINGS, ON THE WATER INLET SIDE, SHOULD BE LOCATED AS FAR AS POSSIBLE FROM THE HEATER.
3. DRAIN VALVE SHOULD BE PIPED DIRECTLY TO A FLOOR DRAIN. RELIEF VALVE DISCHARGE SHOULD BE PIPED TO THE NEAREST FLOOR DRAIN. WHEN NO FLOOR DRAIN IS AVAILABLE, THE RELIEF VALVE DISCHARGE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE THE FLOOR.
4. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, TO DETERMINE IF SYSTEM REQUIRES A BUFFER TANK.
5. INSTALL A HOSE CONNECTION AT THE HOT WATER OUTLET.

**Figure 1: Single SmartPlate Heater**

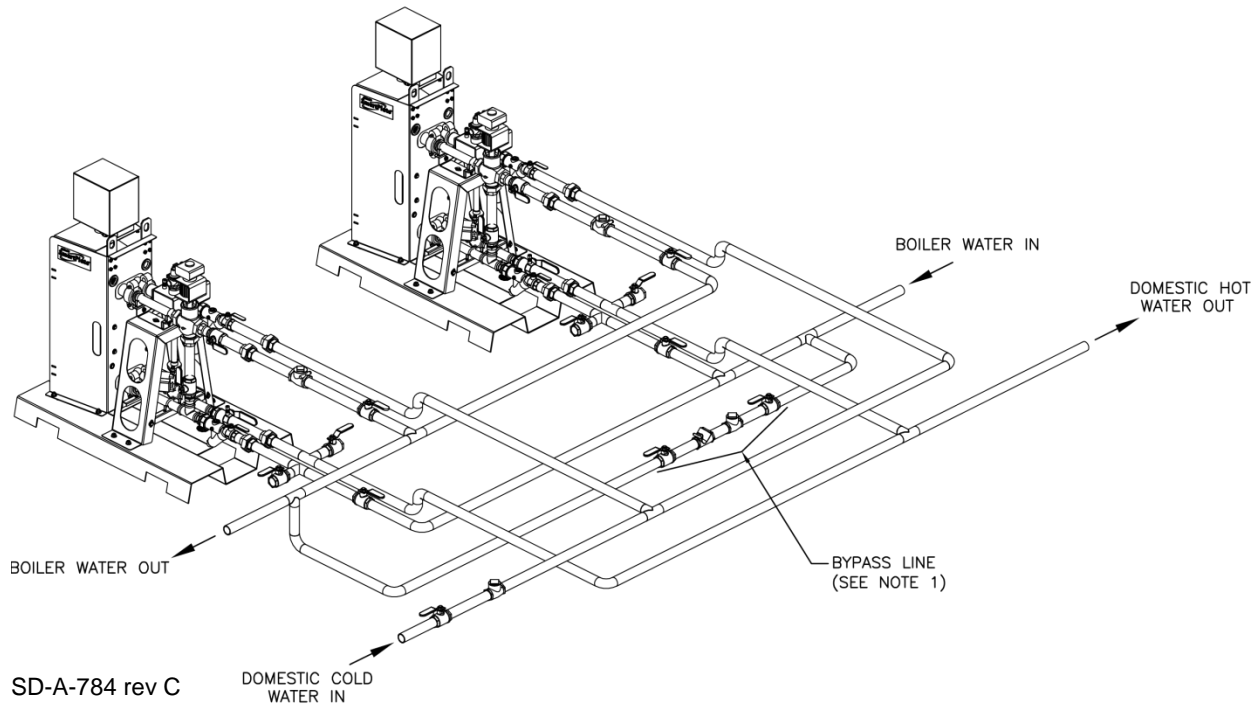


SD-A-773 rev C

NOTES:

1. FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE HEATER, SEE DIMENSIONAL DRAWING.
2. REDUCERS, ON THE WATER INLET SIDE, SHOULD BE LOCATED ADJACENT TO THE HEATER. EXPANSION FITTINGS, ON THE WATER INLET SIDE, SHOULD BE LOCATED AS FAR AS POSSIBLE FROM THE HEATER.
3. DRAIN VALVE SHOULD BE PIPED DIRECTLY TO A FLOOR DRAIN. RELIEF VALVE DISCHARGE SHOULD BE PIPED TO THE NEAREST FLOOR DRAIN. WHEN NO FLOOR DRAIN IS AVAILABLE, THE RELIEF VALVE DISCHARGE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE THE FLOOR.
4. HEATERS SHOULD BE PIPED REVERSE RETURN OR BALANCING DEVICES ON THE OUTLETS SHOULD BE EMPLOYED.
5. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, TO DETERMINE IF SYSTEM REQUIRES A BUFFER TANK.
6. INSTALL A HOSE CONNECTION AT THE HOT WATER OUTLET.

**Figure 2: Multiple SmartPlate Heaters in Parallel**



NOTES:

1. SYSTEM DESIGN ENGINEER MUST SIZE BYPASS LINE BETWEEN HEATING SYSTEM SUPPLY AND RETURN TO ENSURE THAT RETURN WATER TEMPERATURES TO CONVENTIONAL HIGH MASS NON-CONDENSING BOILERS ALWAYS REMAINS ABOVE 140°F
2. REFER TO SMARTPLATE INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION.  
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**Figure 3: Multiple SmartPlate Heaters in Parallel**  
 (This figure depicts boiler water piping only)

Large conventional boilers are not designed to condense; hence they cannot tolerate return water temperatures below 140°F. The average boiler return water temperature from the SmartPlate will be well below 140°F due to the efficient design of the plate heat exchanger.

In order to protect a conventional boiler, the system designer must engineer a bypass line as shown in Figure 3 to ensure that the return water temperature to the non-condensing boiler never drops below 140°F.

### **3.2 Small Volume Systems**

Many of today's high efficiency systems incorporate small modular low-mass condensing boilers operating with 40°F or 60°F temperature differentials.

This design reduces the volume of water in the system and requires the boilers to be capable of modulating quickly across a greater operating range to meet system load transitions. The higher the boiler turndown, the more effective it will be at transitioning to meet load requirements without cycling.

AERCO boilers, which feature the highest turndown in the industry, are best suited for such applications. However, no boiler is capable of matching the speed and diversity of instantaneous domestic load demands without cycling and lowering overall system efficiency induced by cycling losses.

Some thermal mass must be added as a buffer to dampen fast transitions and minimize boiler cycling, which occurs either during zero loads or during low load conditions in which the only load is generated by recirculation piping losses.

AERCO has provided your local sales representative with two sizing programs to calculate the thermal buffer tank volume required to reduce boiler cycling – one for use with AERCO boilers, and another for use with non - AERCO boilers.

The AERCO boiler buffer tank sizing program requires the following inputs:

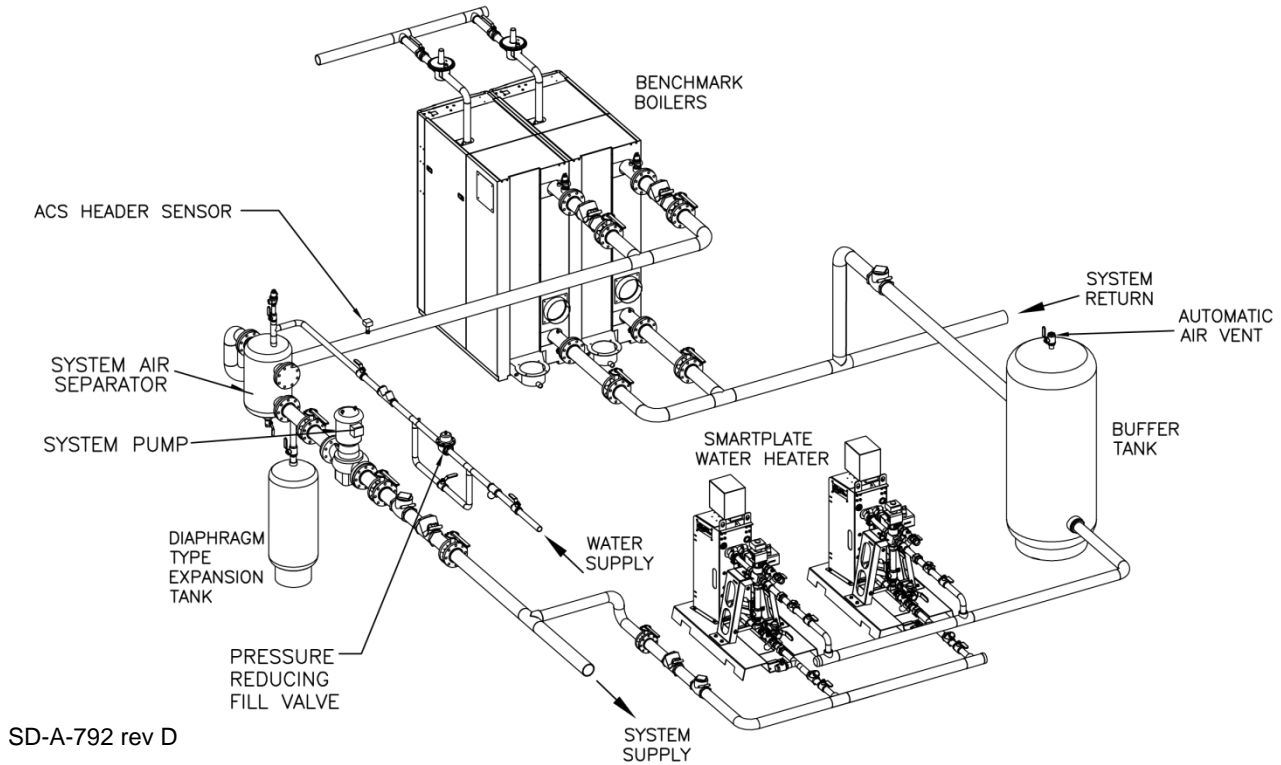
- AERCO boiler model number.
- Quantity of boilers.
- Boiler maximum supply temperature to SmartPlate.
- SmartPlate setpoint temperature.
- SmartPlate model number.
- Quantity of SmartPlates.
- Domestic hot water building design load.
- Building or Application Type. Choices include: elementary school, high school, hospital, hotel, laundry, process, office building, prison, residential apartment, restaurant, university building, and university dorm.
- Pipe diameter and length to calculate piping volume.
- Minimum flow per AERCO boiler.

The buffer tank should be vertical to promote natural stratification. Benchmark can be installed with a two connection or a four connection buffer tank. For the two connection buffer tank, the boiler water return from the SmartPlates should be located in the lower quarter of the tank and the outlet to the boilers should be located in the upper quarter of the tank. Modulex should be installed with a 4 connection buffer tank. The hot water inlet from the boilers and outlet to the system loop should be located in the upper quarter of the tank, and the boiler water return from the system and to the boilers should be located in the lower quarter of the tank.

The system should be piped in one of four arrangements, depending on your system design requirements and the AERCO boiler specified.

- Figure 4 shows the buffer tank and SmartPlate heaters piped as a zone with the Benchmark boilers and the heating system.
- Figure 5 shows the buffer tank and SmartPlate heaters, piped as a zone with the Benchmark boilers and the heating system, and a separate zone, or summer pump. In this arrangement the system pump supplies the buffer tank/SmartPlate zone during the heating season. When the heating season ends, the system pump can be shut down and the zone will be serviced by the separate summer pump to conserve energy.
- Figure 6 shows the buffer tank and SmartPlate heaters piped with Benchmark boilers dedicated solely to domestic water heating.
- Figure 7 shows the 4 - port buffer tank and SmartPlate heaters piped with Modulex boilers. The location of connections on the 4 - port buffer tank, and natural stratification will ensure that the hot outlet water for the boilers will pass through to the system and the colder return water will pass through back to the boilers and allow condensing.





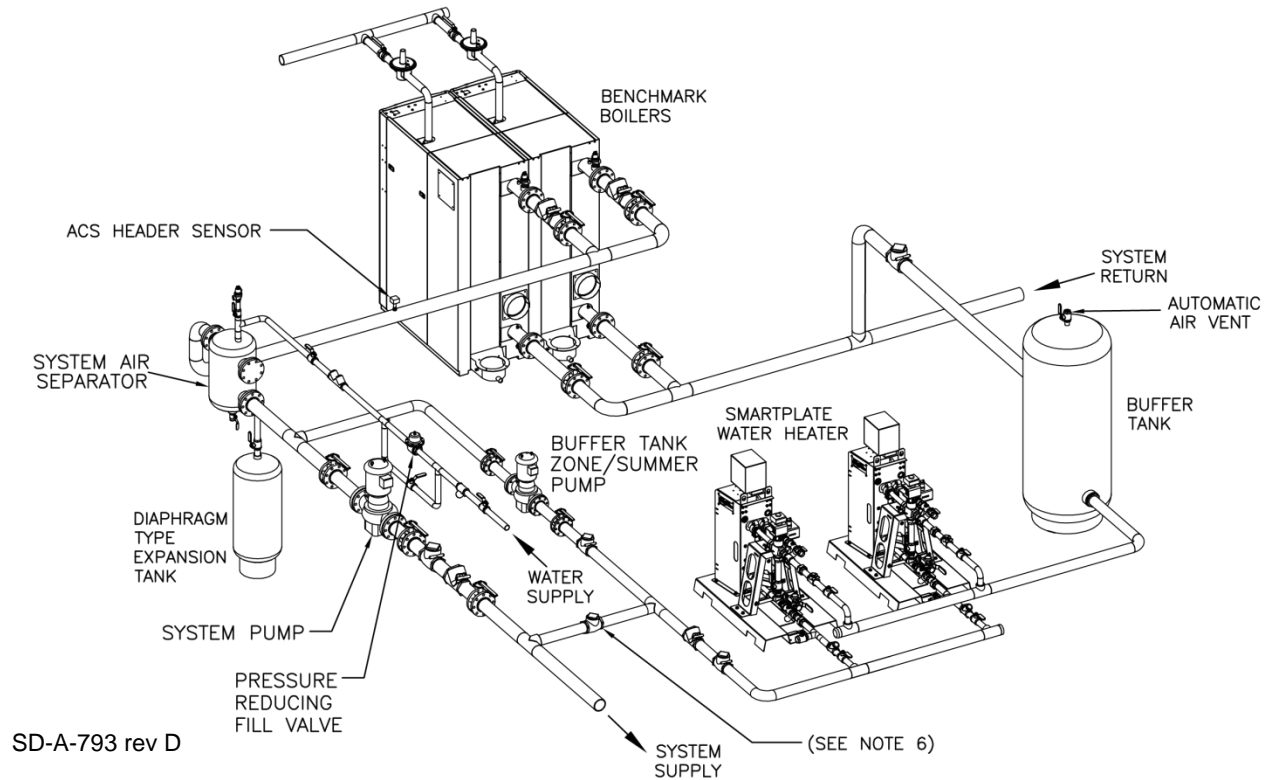
SD-A-792 rev D

**NOTES:**

1. REFER TO BOILER INSTALLATION DRAWINGS FOR RECOMMENDED FIELD INSTALLATION.
2. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, FOR BUFFER TANK SIZING.
3. REFER TO SMARTPLATE INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION.  
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4. BOILER PUMP MUST BE SIZED TO PROVIDE THE APPROPRIATE FLOW AT THE DESIGN  $\Delta T$  OF BOILER PLANT  
 BOILER PUMP MUST MAINTAIN BENCHMARK BOILER(S) REQUIRED MINIMUM FLOW AS PER TECHNICAL DATA SHEET.

**Figure 4: 2-Port Buffer Tank and SmartPlate Heaters  
 Piped as a Zone with Benchmark Boilers and Heating System**  
 (This figure depicts boiler water piping only)

**NOTE:** Figure 9 shows a variation of Figure 4 but with Benchmark dual returns.

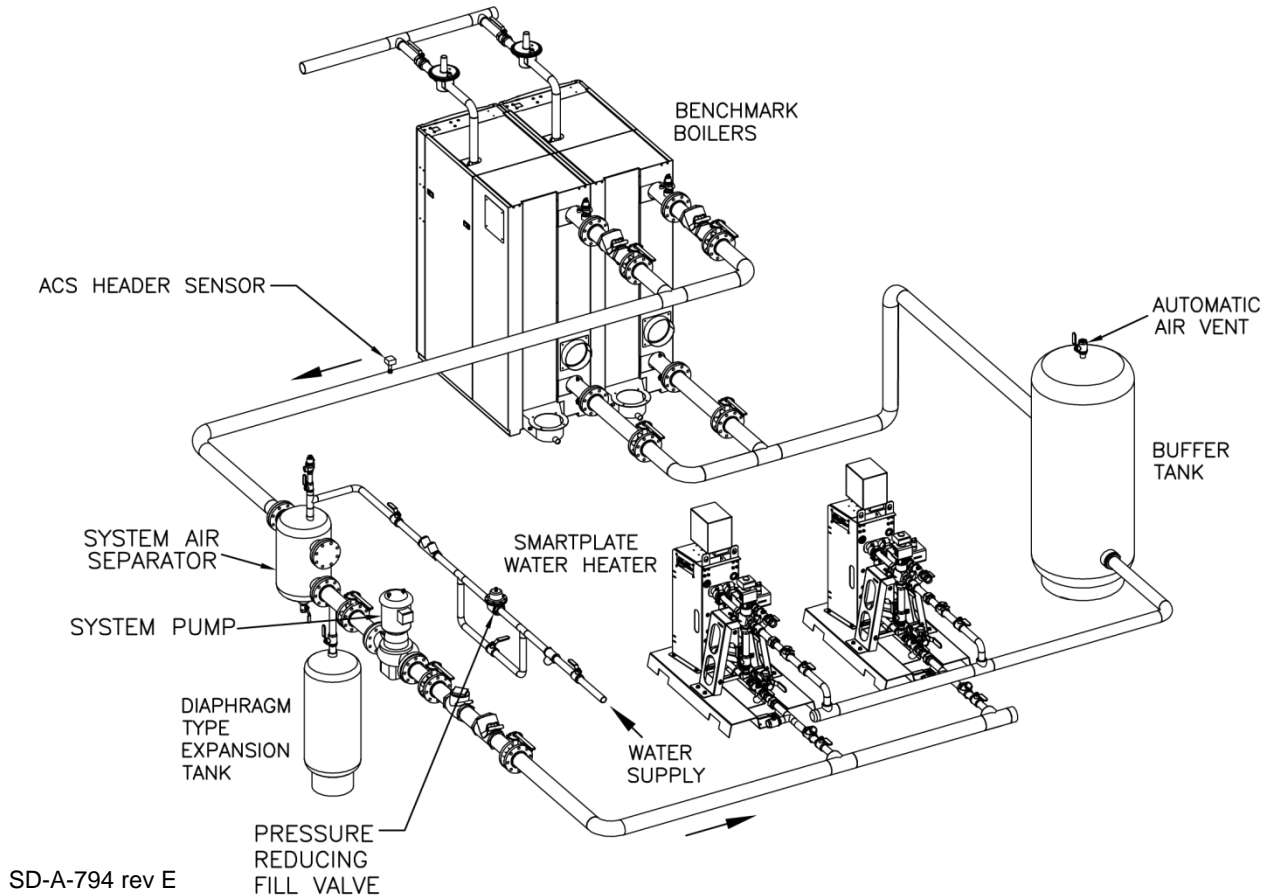


NOTES:

1. REFER TO BOILER INSTALLATION DRAWINGS FOR RECOMMENDED FIELD INSTALLATION.
2. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, FOR BUFFER TANK SIZING.
3. REFER TO SMARTPLATE INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION.  
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4. BOILER PUMP MUST BE SIZED TO PROVIDE THE APPROPRIATE FLOW AT THE DESIGN  $\Delta T$  OF BOILER PLAN  
BOILER PUMP MUST MAINTAIN BENCHMARK BOILER(S) REQUIRED MINIMUM FLOW AS PER TECHNICAL  
DATA SHEET.
5. WHEN SYSTEM PUMP IS TURNED OFF, BUFFER TANK SUMMER PUMP SHOULD BE TURNED ON.
6. WHEN ZONE PUMP IS OPERATED YEAR ROUND, BYPASS LINE CAN BE DELETED

**Figure 5: 2-Port Buffer Tank and SmartPlate Heaters as a Zone with Benchmark Boilers and Heating System with a Separate Zone/Summer Pump**  
(This figure depicts boiler water piping only)



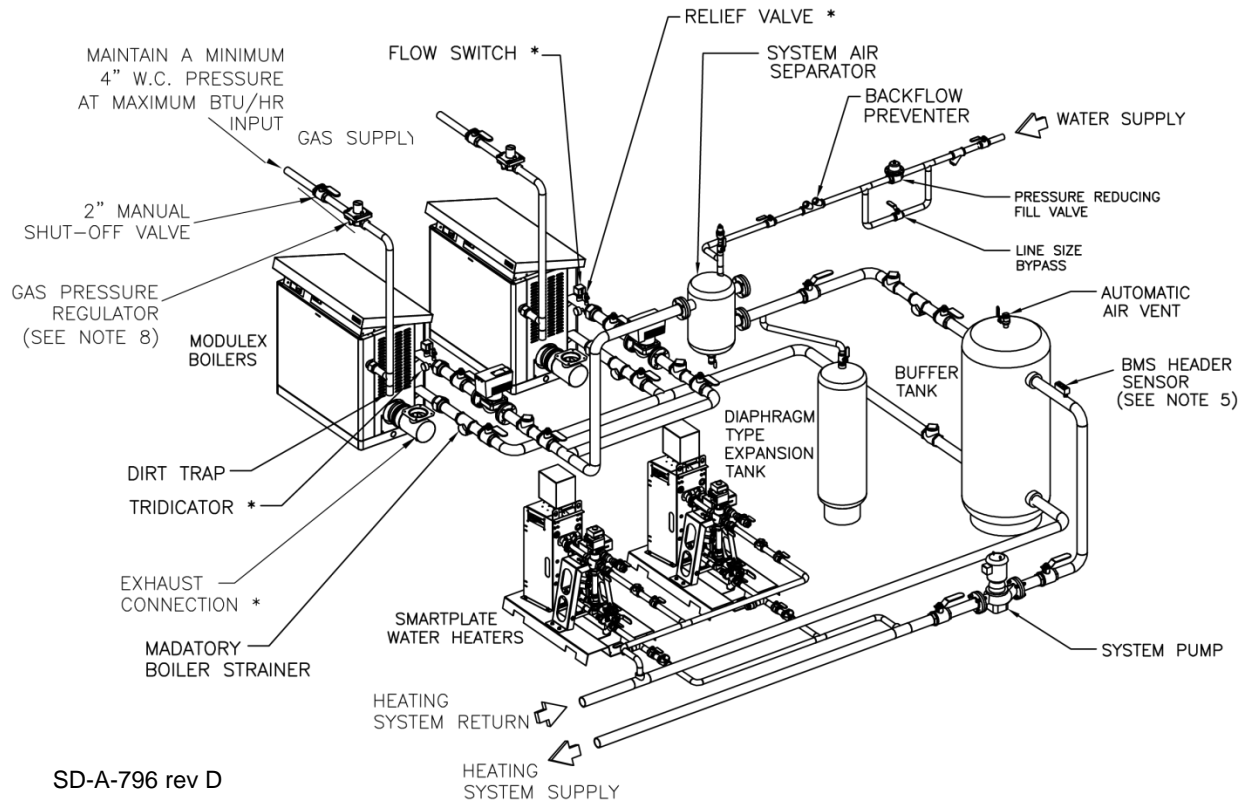


SD-A-794 rev E

**NOTES:**

1. REFER TO BOILER INSTALLATION DRAWINGS FOR RECOMMENDED FIELD INSTALLATION.
2. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, FOR BUFFER TANK SIZING.
3. REFER TO SMARTPLATE INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION.  
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SD-A-775  
SD-A-776  
SD-A-777
4. BOILER PUMP MUST BE SIZED TO PROVIDE THE APPROPRIATE FLOW AT THE DESIGN  $\Delta T$  OF THE BOILER PLANT. BOILER PUMP MUST MAINTAIN BENCHMARK BOILER(S) REQUIRED MINIMUM FLOW AS PER TECHNICAL DATA SHEET.

**Figure 6: 2-Port Buffer Tank and SmartPlate Heaters with Benchmark Boilers Dedicated to Domestic Water Heating**  
(This figure depicts boiler water piping only)



SD-A-796 rev D

**NOTES:**

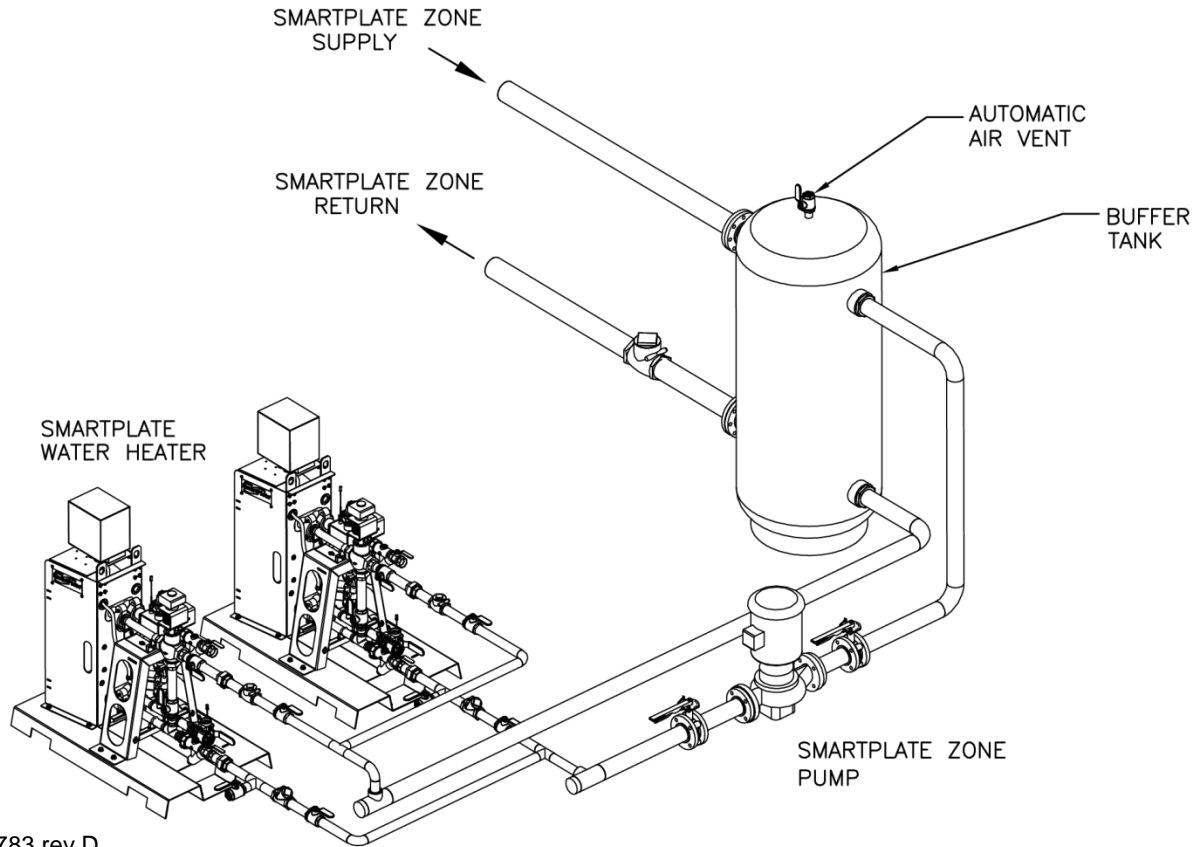
1. REFER TO BOILER INSTALLATION DRAWINGS FOR RECOMMENDED FIELD INSTALLATION.
2. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, FOR BUFFER TANK SIZING.
3. REFER TO SMARTPLATE INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION.  
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4. BOILER PUMP MUST BE SIZED TO PROVIDE THE APPROPRIATE FLOW AT THE DESIGN  $\Delta T$  OF THE BOILER PLANT. BOILER PUMP MUST MAINTAIN MODULEX BOILER(S) REQUIRED MINIMUM FLOW AS PER TECHNICAL DATA SHEET.
5. INSTALL THE BMS HEADER SENSOR IN THE BUFFER TANK SYSTEM SUPPLY PIPING.
6. ALL (\*) ITEMS ARE INCLUDED SEPARATELY IN SHIPMENT FROM FACTORY.
7. THE MANIFOLD FOR THESE COMPONENTS IS ALSO INCLUDED SEPARATELY IN SHIPMENT FROM FACTORY.

**Figure 7: 4-Port Buffer Tank and SmartPlate Heaters with Modulex Boilers**  
(This figure depicts boiler water piping only)

The non-AERCO boiler buffer tank sizing program will require the following inputs:

- Boiler Model.
- Water volume contained in a single boiler.
- Quantity of boilers.
- Boiler primary loop flow rate.
- Boiler maximum supply temperature to SmartPlate.
- Boiler Minimum Input.
- Boiler Maximum Input.
- Boiler Full Fire Efficiency.
- Boiler Type. Choices include: condensing firetube, condensing cast aluminum, scotch marine, all watertube, and all other boilers.
- SmartPlate setpoint temperature.
- SmartPlate model number.
- Quantity of SmartPlates.
- Domestic hot water building design load.
- Building or Application Type. Choices include: elementary school, high school, hospital, hotel, laundry, process, office building, prison, residential apartment, restaurant, university building, and university dorm.
- Pipe diameter and length to calculate piping volume.
- Minimum flow per boiler - per the manufacturer's recommendation.

The SmartPlate system should be piped as a zone of the heating system utilizing non-AERCO low mass boilers, as shown in Figure 8, below.



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NOTES:

1. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, FOR BUFFER TANK SIZING.
2. REFER TO SMARTPLATE INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION.

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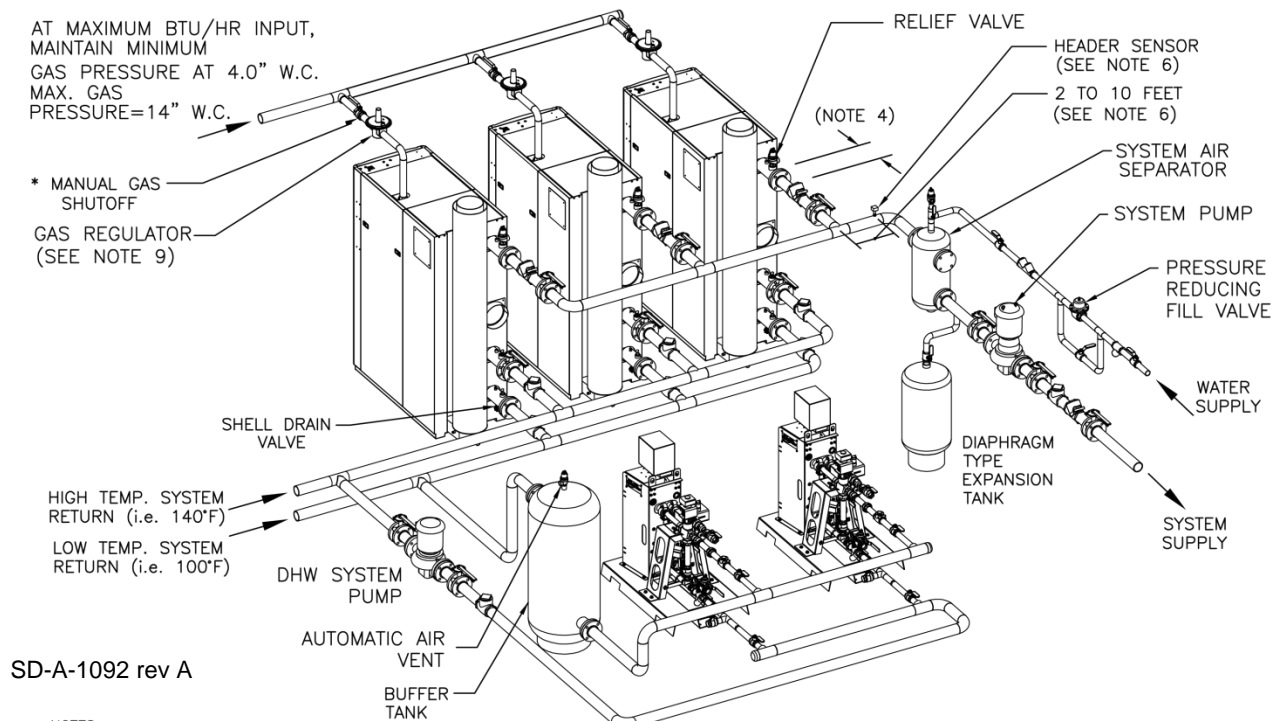
**Figure 8: 4-Port Buffer Tank and SmartPlate Multiple Units with Boiler Side Buffer Tank as a Zone**

(This figure depicts boiler water piping only)

As evident in Figures 6 through 8, a condensing plant has higher efficiency than a traditional boiler plant due to blending of low temperature return water from the SmartPlate.

The plant efficiencies can be further improved by utilizing dual return boilers such as AERCO Benchmark. Instead of blending the low temperature SmartPlate water with high temperature system return, it would be an efficiency gain to pipe the lower return to the Primary inlet (or standard inlet, at the base) and piping the higher temperature return to the Secondary (or higher) inlet. This will allow the boiler heat exchanger to condense more due to the low temperature return of SmartPlate system. Such applications can have efficiency gains up to 6% depending on the flow rate ratios and return water temperature.

Refer to Figure 9 for a variation of Figure 4 but with Benchmark dual returns.



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NOTES:

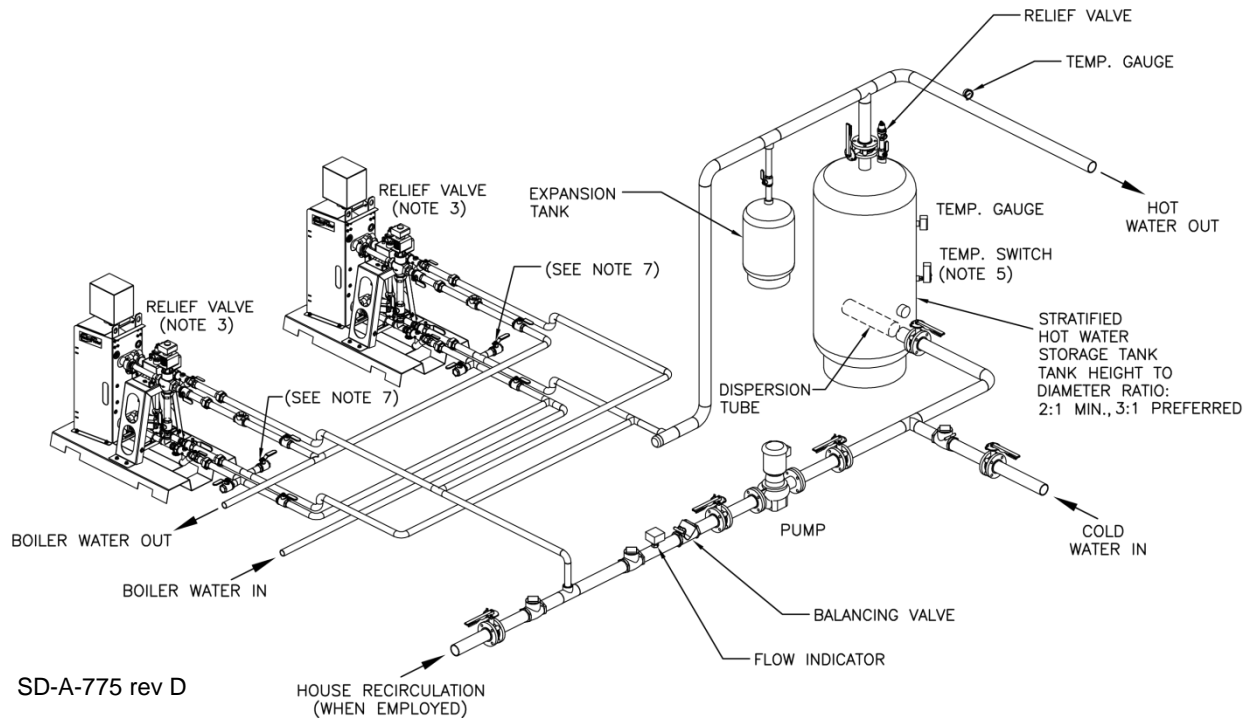
1. FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE HEATER, SEE DIMENSIONAL DRAWING.
2. SHELL DRAIN VALVE AND CONDENSATE HOSE SHOULD BE ARRANGED TO PERMIT THE FLUIDS TO DRAIN FREELY, BY GRAVITY, TO A FLOOR DRAIN. RELIEF VALVE DISCHARGE SHOULD BE PIPED TO THE NEAREST FLOOR DRAIN. WHEN NO FLOOR DRAIN IS AVAILABLE, THE RELIEF VALVE DISCHARGE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE THE FLOOR.
3. ALL (\*) ITEMS ARE INCLUDED SEPARATELY IN SHIPMENT.
4. LOCATE WATER INLET AND OUTLET FITTINGS (i.e. UNIONS, ELBOWS, ETC.) A MINIMUM OF 6" FROM HEATER FITTINGS, TO PREVENT INTERFERENCE WITH REMOVAL OF BOILER PANELS AND COVERS. ALL PIPING AND ELECTRIC CONNECTIONS (SERVICE SWITCHES, CONDUIT BOXES) SHOULD LIKEWISE BE 6" AWAY FROM SIDE PANELS.
4. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, FOR BUFFER TANK SIZING.
5. REFER TO SMARTPLATE INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION:  
SD-A-772, SD-A-773, SD-A-774, SD-A-775, SD-A-776, SD-A-777
6. BOILER PUMP MUST BE SIZED TO PROVIDE THE APPROPRIATE FLOW AT THE DESIGN  $\Delta T$  OF BOILER PLANT. MAXIMUM  $\Delta T$  ACROSS BOILER IS 100°F. BOILER PUMP MUST MAINTAIN BENCHMARK BOILER(S) REQUIRED MINIMUM FLOW OF 40 GPM.
7. THIS IS A TYPICAL INSTALLATION DRAWING. LOCAL CODES AND AUTHORITIES SHOULD BE CONSULTED.
8. WHEN USING THE AERCO CONDENSATE NEUTRALIZER TANK, FOR PROPER CONDENSATE DRAINAGE, THE NEUTRALIZER TANK MUST BE INSTALLED IN A PIT OR THE BOILER AND THE AERCO CONDENSATE TRAP MUST BE ELEVATED HIGHER THAN 4" ABOVE THE FLOOR. SEE CONDENSATE TANK INSTRUCTIONS TID-0074 FOR DETAILS.
9. AT 14" W.C. OR BELOW, A GAS REGULATOR IS OPTIONAL UNLESS REQUIRED BY LOCAL CODE.
10. HEADER SENSOR MUST BE INSTALLED BETWEEN 2 TO 10 FEET FROM JUNCTION AND FROM LAST UNIT.
11. THE DHW SYSTEM PUMP MAY BE ENABLED/DISABLED BY ACS SYSTEM CONTROL.

**Figure 9: 2-Port Buffer Tank and SmartPlate piped as a Zone with Dual return equipped Benchmark Boilers and heating System**

(This figure depicts boiler water piping only)

For certain applications that have a very large instantaneous demand for a short period of time followed by a period with little or no demand until the next cycle, it may be desirable to install a smaller sized (economical) SmartPlate with a storage tank. Refer to Figure 10 for a diagram of such an application.

For storage tank sizing, please consult your local AERCO representative.



**NOTES:**

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2. REDUCERS, ON THE WATER INLET SIDE, SHOULD BE LOCATED ADJACENT TO THE HEATER. EXPANSION FITTINGS, ON THE WATER INLET SIDE, SHOULD BE LOCATED AS FAR AS POSSIBLE FROM THE HEATER.
3. DRAIN VALVE SHOULD BE PIPED DIRECTLY TO A FLOOR DRAIN. RELIEF VALVE DISCHARGE SHOULD BE PIPED TO THE NEAREST FLOOR DRAIN. WHEN NO FLOOR DRAIN IS AVAILABLE, THE RELIEF VALVE DISCHARGE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE THE FLOOR.
4. HEATERS SHOULD BE PIPED REVERSE RETURN OR BALANCING DEVICES ON THE OUTLETS SHOULD BE EMPLOYED.
5. MOUNT TEMPERATURE SWITCH 1/3 UP FROM THE BOTTOM OF THE TANK, SWITCH WILL TURN PUMP ON AND OFF.
6. REFER TO SMARTPLATE APPLICATIONS GUIDE, SP-1010, TO DETERMINE IF SYSTEM REQUIRES A BUFFER TANK.
7. INSTALL A HOSE CONNECTION AT THE HOT WATER OUTLET.

**Figure 10: Two SmartPlate Units with Storage Tank**

(This figure depicts domestic water piping only)



**Change Log:**

<b>Date</b>	<b>Description</b>	<b>Changed By</b>
01/08/2016	Rev B: Various updates, all Figures updated (reference DIR 305)	Chris Blair



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