COMBINATION CONTROL PANEL
MODEL CCP

Domestic Water/Space Heating
Multiple Boiler Controller

Concept
AERCO International recommends individual KC water heating and space heating systems wherever possible. Individual water heaters and boilers achieve maximum efficiency and precise temperature control. However, when factors such as existing indirect storage water heaters, restricted fuel input, or space limitations are conditions to be met, AERCO KC Boilers can be used in a dual service role.

Combination System Description
In order to accommodate the requirements for both space heating and the production of domestic hot water, multiple KC style boilers can be used in a combination space heating and domestic water heating plant. Boiler modules are piped in a multiple boiler arrangement as they would be in a multiple unit space heating plant. See Combination Boiler Plant Sizing section for recommendations on number of modules required. The necessary number of modules for domestic water production are isolated from the heating system in the supply piping by means of a normally closed two way motorized valve. An external hot water storage generator is used to convert boiler water to produce potable water through a closed loop coil. Upon demand for domestic water, the isolated (combination duty) boilers produce a constant temperature supply (70.220°F) by operating in the internal setpoint mode.

The AERCO Combination Control Panel (CCP) is an accessory panel designed to work in conjunction with an AERCO Model 168 Boiler Management System (BMS) to control the firing of the combination boiler modules and the associated accessories for domestic water production. The CCP panel allows operation of the combination boiler modules to produce domestic water through the external generator coil, and activates the circulating pump between the boilers and the coil. The CCP uses a simple tank aquastat to start domestic water production. It allows control of up to four KC Boilers (Boiler Control Code -6) in the constant set point mode, and allows a transfer of the motorized valve and the control of the modules to the BMS when the space heating requires their added input.

By utilizing a CCP Panel in tandem with a Model 168 Boiler Management System, the KC Boilers efficiency will be maximized. Only the required energy (input) for domestic water will be used, and the heating plant can operate at lowest required temperatures for space heating to maximize condensing efficiency.

Domestic Water Mode
The tank aquastat, or domestic water demand device, is wired to the CCP to signal a demand for domestic water. The CCP supplies 12VDC to the dry contacts of the domestic water demand device (aquastat). Upon a demand for domestic water, the CCP enables the combination boiler modules to begin firing to their internal setpoint temperature. Each module will automatically modulate its input to meet the requirement of domestic water production. The closed motorized valve isolates the normally higher temperature boiler water from the heating system. The circulating pump between the combination modules and the coil is activated simultaneously with the combination modules. The boilers and pump will operate continually until the domestic water aquastat is satisfied.

Heating Mode
The Boiler Management System (BMS) will activate the heating plant and sequence/modulate the heating-only boilers in the selected mode. When all dedicated heating modules are operating at 100% input, the BMS will close the Auxiliary contacts wired to the CCP Panel. The CCP will then activate the motorized valve to open piping between the heating system loop and the combination boiler loop. The CCP supplies line voltage (120/1/60) directly to the valve operator. The valve must be a three wire control type with power open/power closed operator. Operator timing on motorized valves should be in the 8 to 45 second range, and must be equipped with a dry contact SPST N.O. end switch. When the valve reaches the full open position, the dry contact end switch of the valve will close, signaling the supply piping between the heating system loop and the combination boiler loop. The BMS will then add the combination modules to the heating system, and modulate them to their required input level. The boiler modules will be sequenced at the adjusted percentage as set in the BMS. As the added input from the combination modules allow the heating load (setpoint) to satisfy, the auxiliary contacts of the BMS will open. The motorized valve will then be
driven closed by the CCP Panel. The combination boilers will be de-activated until needed either for domestic water or for heating again. If domestic water is called for while the valve is open for heating the CCP will automatically close the motorized valve and transfer the control of the combination modules back to domestic water production.

Combination Plant Sizing

The required size of a combination boiler plant is not necessarily the simple sum of the heating modules and the domestic water modules. ASHRAE has documented and developed a method of sizing combination plants based on the diversity of the loads. ASHRAE Systems 1984 Handbook published a researched method of establishing a relationship of domestic water load to heating load, and a table of recommended percentage of additional BTUH to be added to the heating plant to handle both loads.

Simply expressed,

\[
\text{Domestic Water Load} = \frac{\text{Diversity Factor} \times \text{Heating Load}}{\text{Heating Load}}
\]

The diversity factor is then converted to a percentage increase in the base heating load plant from Table A.

<table>
<thead>
<tr>
<th>Diversity Factor</th>
<th>2</th>
<th>1</th>
<th>.8</th>
<th>.6</th>
<th>.5</th>
<th>.4</th>
<th>.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Heating %</td>
<td>60%</td>
<td>50%</td>
<td>40%</td>
<td>30%</td>
<td>20%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Load to be added to Heating Boiler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

Example -

From conventional calculations on a typical design:

\[
\text{Space Heating Load} = 2840 \text{ MBH} \\
\text{Domestic Water Load} = 1705 \text{ MBH} \\
\text{Diversity} = \frac{1705 \text{ MBH}}{2840 \text{ MBH}} = .60 \\
\text{Factor} = 2.840 \text{ MBH}
\]

From Table A, a diversity factor of .60 indicates a minimum of 30% of the domestic water heating load requirement should be added to the heating load for Total Boiler Plant Capacity.

\[
\text{Total Plant Capacity} = 2840 \text{ MBH} + (.3 \times 1705 \text{ MBH}) = 3352 \text{ MBH}
\]

\[
\text{Total Load Output/Boiler} = \frac{3352 \text{ MBH Output}}{4 \text{KC Boilers}} = \frac{870 \text{ MBH/Boiler}}
\]

Component Design

Domestic water sizing for a combination plant should be done in accordance with ASHRAE and ASPE standards. The storage tank size should be adequate for small domestic water draws without short cycling the domestic tank aquastat. The combination of recovery and storage should be as prescribed in the ASHRAE/ASPE methods.

The recovery of the storage tank coil exchanger should be based on a temperature drop of 2OF, or the same temperature drop as the heating system that the plant supplies. When sizing the circulating pump between the combination boiler(s) and the tank coil, the flow of the pump must be greater than the minimum module flow of 25 gpm per module. The head of the pump must be capable of overcoming the pressure drop of the boilers, the tank coil, and the frictional resistance of all piping/accessories between them. Air elimination and expansion accessories may be required in the coil loop as well as the main heating loop.
Recommended Piping and Wiring Details

Figure 1 -- Four Boiler Combination Plant Piping

Figure 2 -- Four Boiler Combination Plant Wiring
Sequence of Operation

The four KC Boiler Combination plant shown in Figures 1 and 2 is typical of plant piping and wiring arrangements. The KC boilers dedicated for heating-only must be ordered for Control Mode -5 for BMS mode operation. The boilers for combination duty must be ordered for Combination Mode -6. The Combination mode boilers internal setpoint should be adjusted to the design water temperature used to size the coil in the storage/generator. The tank aquastat should be set at the desired domestic water tank temperature.

As the tank aquastat closes sensing a demand for domestic water recovery, the CCP will activate the coil pump and Combination Boilers #1 & #2. The boilers will modulate their own input as needed to maintain their setpoint. The boilers will automatically reduce their input as the coil water temperature approaches setpoint. Under heavy load, the boilers will increase their input for maximum recovery. The boilers and coil circulating pump will continue to operate until the tank aquastat is satisfied.

The system start within the Model 168 Boiler Management System(BMS) activates the heating system circulating pump and the heating-only modules. Heating Boilers #1 & #2 will fire normally as controlled by the BMS and modulate input up as the heating load increases. When both dedicated heating modules reach 100% input, the BMS Auxiliary contacts will close, activating the CCP panel. The CCP will then open the motorized valve in the supply piping. When the valve reaches 100% open, the end switch will allow the CCP to transfer the control of both combination boilers to the BMS. The BMS will modulate the input of all four boilers to meet the needs of the heating system.

As the heating system temperature increases to the required system setpoint, the auxiliary contacts of the BMS will open. The opening of the Auxiliary contacts can be adjusted from the keyboard of the BMS. As the auxiliary contacts open, the CCP closes the motorized valve to isolate the domestic loop from the heating loop. The control of the combination boilers is also returned to their internal setpoint controls, and will only fire upon a signal for domestic water production. If the domestic tank aquastat closes while the motorized valve is open for heating, the CCP will automatically close the valve and return Combination Boilers #1 & #2 back to domestic recovery service. This internal feature provides priority to domestic water heating.

<table>
<thead>
<tr>
<th>CCP Panel Specifications:</th>
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<tbody>
<tr>
<td>Dimensions ............... 10&quot;x6-1/16&quot;x1-1.25&quot;</td>
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<tr>
<td>AC Voltage Input .......... 120/1/60</td>
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<tr>
<td>Maximum Current Draw ..... 5 amps</td>
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<tr>
<td>CCP Fuse Rating** .......... 5 amps</td>
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<tr>
<td>Motorized Valve Output ... 120/1/60 5 amps Max</td>
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<tr>
<td>Circ Pump Coil Output ... 120/1/60 5 amps Max</td>
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<tr>
<td>Aquastat/Temp Switch Output* .. 12 VDC</td>
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<tr>
<td>Valve End Switch Output* ... 12 VDC</td>
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<tr>
<td>Operating Ambient .......... 0 to 55C</td>
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<tr>
<td>* - These devices should be supplied with Dry Contacts</td>
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<tr>
<td>** - Littel Fuse Model #225005</td>
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Represented by:

HEAT EXCHANGERS • WATER HEATERS • BOILERS
CONTROL VALVES • STEAM GENERATORS

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