Applications and Piping Strategies for Condensing Boilers - *Introduction*
Applications and Piping Strategies for Condensing Boilers

Webinar Objectives:

1. Control objectives for hydronic systems
2. Review of hydronic fundamental principals
3. System control and piping strategy for condensing boilers
4. Introduction to NEW Vitodens 100 Application Guide
Applications and Piping Strategies for Condensing Boilers

Webinar Objectives:

1. Control objectives for hydronic systems
Control Objectives for Hydronic Systems

1. Maximize Occupant Comfort:
   - Maintain a constant room air temperature
   - Vary temperatures as occupants desire.

2. Minimize Energy Consumption:
   - Maximize boiler condensing efficiency
   - Minimize boiler on/off cycling
   - Minimize electrical consumption

3. Protect Equipment:
   - Prevent boiler short cycling
   - Prevent excessive temperature from damaging flooring, tubing, etc.
The Control Challenge

1. Maintain a constant room temperature, with constantly changing conditions.
The Control Challenge

2. Control a multiple function, multiple temperature system.
Applications and Piping Strategies for Condensing Boilers

Webinar Objectives:

2. Review of hydronic fundamental principals
Understanding Hydronic Fundamentals

The Universal Hydronics Formula

\[ \text{GPM} = \frac{\text{BTU/hr}}{\Delta T \times 500} \]

Why is this formula important to understand?

- Sizing pipes
- Sizing pumps
- Sizing Low loss headers, zone valve, air scoops, etc
- Trouble shooting systems
- Controlling heat transfer rates
Understanding Hydronic Fundamentals

The Universal Hydronics Formula

\[
GPM = \frac{BTU/hr}{(\Delta T \times 500)}
\]

WHERE:

\begin{align*}
GPM & \quad \text{Fluid flow rate in gallons per minute} \\
BTU/hr & \quad \text{Heat Loss at design temperature of area being heated} \\
\Delta T & \quad \text{Temperature drop across the piping circuit (Typically 10 - 20°F)} \\
500 & \quad 8.33 \text{ lb/gal} \times 60 \text{ min/hr} \times 1 \quad \text{(Specific heat or water - Btu/lb./°F)}
\end{align*}
Understanding Hydronic Fundamentals

The Universal Hydronics Formula

\[ \text{GPM} = \frac{\text{BTU/hr}}{\left( \Delta T \times 500 \right)} \]

Typical hydronic system: 20°F temperature drop

90,000 BTU/hr

160°F

180°F

GPM = \frac{90,000}{10,000} = 9 \text{ GPM}
Understanding Hydronic Fundamentals

The Universal Hydronics Formula

\[ \text{GPM} = \frac{\text{BTU/hr}}{\Delta T \times 500} \]

Controlling the Rate of Heat Output:
- Control the flow
- Control the water temperature
Understanding Hydronic Fundamentals

The Universal Hydronics Formula

\[ \text{GPM} = \frac{\text{BTU/hr}}{(\Delta T \times 500)} \]

Flow Controls:
- On-off (zone valves/pumps)
- Balancing

Water temperature controls
- Boiler outdoor reset
- Mixing valves
  - Thermostatic
  - Motorized

Rate of heat output

Outside air sensor

Room thermostat

MGPM = BTU/hr ÷ (ΔT x 500)
Outdoor Reset Control

Why use it?

1. Comfort
   - Consistent, even space temperatures
   - Constant heat output to match the load
   - Keep up vs Catch up

2. Efficiency
   - Eliminate overheating
   - Increases condensing in boiler
   - Longer boiler run times
   - Lower standby losses
Outdoor Reset Control

How does it work?

- Heat loss **changes continuously** with outdoor temperature
- Water temperature is **varied** based on outside air temperature
- Heat output of boiler (or mixing device) now **matches** heat loss of building
Outdoor Reset Control

Heating curve selection

- **High temp heating system**, eg Fin tube radiation, fan coils
- **Medium temp heating system**, eg Cast iron radiation, Staple-up RFH
- **Low temp heating system**, eg Radiant floor heating
Applications and Piping Strategies for Condensing Boilers

Webinar Objectives:

3. System control and piping strategy for condensing boilers
Control Strategy And Component Selection

Where do you start?

1. What are the system water temperature requirements?
   - Low, medium or high temp emitters
   - Multiple function, multiple temp systems
   - DHW heating requirements

2. What are the boilers requirements
   - High mass / Low mass construction
   - Minimum / Maximum flow rates
   - Maximizing condensing efficiency

3. What are the zoning requirements?
   - Areas experiencing solar gain or internal heat gains
   - Areas with different use patterns
   - Night or weekend temperature setback
Control Strategy And Component Selection

1. Typical hydronic emitters water temperature requirements

High temperature emitters:

- Finned tube baseboard: 140 - 190 °F
- Air heat fancoils: 140 - 180 °F
- Pool/spa heat exchangers: 160 - 180 °F
- DHW production: 150 - 190 °F

Medium temperature emitters:

- Cast iron radiators: 100 - 140 °F
- Low mass radiant floor: 100 - 150 °F
  ie: wood joist floors

Low temperature emitters:

- High mass radiant floor: 80 - 120 °F
  ie: concrete floors
- Snowmelting systems: 80 - 120 °F
Control Strategy And Component Selection

2. Boiler requirements – Temperature

How do you maximize the efficiency of condensing boiler?

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![Graph showing boiler efficiency vs. water temp](image)

- **Boiler efficiency %**
- **Boiler return water temp °F**
- **Condensing mode**
- **Non-Condensing mode**
- **130°F Dew Point of Natural Gas**
- **140°F**
- **120°F**
2. Boiler requirements – Construction

Vitodens 100 / 200 series:
- Low mass HX construction
- Low water content
- Minimum and Maximum flow rate requirements
- Higher friction loss through heat exchanger
- Maximum boiler temperature limitations (= 167°F or 176°F)

Vitocrossal 300, CU3A series:
- High mass HX construction
- High water content
- No Minimum flow rate requirements
- Lower friction loss through heat exchanger
- Maximum boiler temperature limitations (= 194°F)
2. Boiler requirements – Piping

Vitodens 100 / 200 series:
- To avoid short cycling, **flow must be** maintained
- Dedicated **boiler pump** usually required
- **Primary-secondary** piping usually required
  - Closely spaced tees *or*
  - Low loss header

Vitocrossal 300, CU3A series:
- **Not** flow sensitive
- Dedicated boiler pump **not** required
- **Primary secondary** **not** required
Control Strategy And Component Selection

2. Boiler requirements – Piping

Primary-Secondary piping

Piping directly to system
Control Strategy And Component Selection

2. Boiler requirements – Hydraulic separation with Primary-Secondary Piping

Option 1: Closely spaced Tees

Option 2: Low Loss Header
Control Strategy And Component Selection

2. Boiler requirements – Hydraulic separation with Primary-Secondary Piping

This pump only has to overcome the friction loss of the heat emitters and secondary loop piping.

Happy boiler:
- Always gets the flow it needs
- Less likely to short cycle
- Not affected by on/off zones

This pump only has to overcome the friction loss of the boiler and primary loop piping.
Control Strategy And Component Selection

2. Boiler requirements – Low Loss Header operation

*Mixing* occurs within the hydraulic separator.

*Primary flow higher than secondary flow*

*Secondary flow higher than primary flow*
Control Strategy And Component Selection

3. Zoning requirements

**Multiple zone pumps**

- Higher electrical consumption
- Flow balance with speed control

![Diagram showing multiple zone pumps and thermostatically controlled zone pumps]

Thermostatically controlled zone pumps

Multizone control
3. Zoning requirements

**Single pump, multiple zone valves**

- Lower electrical consumption
- Individual loop control for RFH
- With single speed pump use pressure bypass valve to balance flow
Control Strategy And Component Selection

3. Zoning requirements

**Single pump, multiple zone valves**

- Lower electrical consumption
- Individual loop control for RFH
- Variable speed pump to balance flow
Control Strategy And Component Selection

Time to start designing!

1. System water temperature requirements
   - Separate **heating circuits** by temperature
   - Use mixing valves to satisfy lower temperatures

2. Boilers requirements
   - Size boiler to match heating load
   - Pick **piping strategy** to meet boiler construction

3. What are the zoning requirements?
   - Add zone controls to meet **zoning demands** of building
Applications and Piping Strategies for Condensing Boilers

Webinar Objectives:

1. Overview of control objectives for hydronic systems
2. Review of hydronic fundamentals
3. System control and piping strategy for condensing boilers
4. Introduction to NEW Vitodens 100 Application Guide
Applications and Piping Strategies for Condensing Boilers

Application Guide

- First module for Vitodens 100 introduced in November 2015
- Installer / Designer assistance for:
  - Component selection
  - Hydronic piping layouts
  - Wiring diagrams
  - Control Programing / coding
  - Design tips
- Future modules – Vitodens 200, Vitodens 222-F
Applications and Piping Strategies for Condensing Boilers

Application Guide – Boiler Nomenclature
### Recommended Product Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Typical Supply Temperature</th>
<th>Vitodens 100 W101</th>
<th>Vitodens 200/220 W</th>
<th>Vitomax 200 CDAX</th>
<th>Vitomax 200 CDUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential / Fan Coil</td>
<td>High 160-190 °F</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>Core Health Hospital</td>
<td>Medium 140-170 °F</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
<td>🆘</td>
</tr>
<tr>
<td>Panel Radiator</td>
<td>Medium 120-150 °F</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
<td>🆘</td>
</tr>
<tr>
<td>Central Heating System</td>
<td>Low 95-120 °F</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>Internal Boiler</td>
<td>High 160-190 °F</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
<td>⚫</td>
</tr>
</tbody>
</table>

- **Key:**
  - ⚫: Recommended
  - 🆘: Not recommended
  - ⚫: Possible with limitations

1. Limited Maximum boiler supply water temperature.
2. Ensure boiler protection to prevent damage from return water temperature.

Refer to Technical Data Manual of each product for applicable certifications. Technical information subject to change without notice.
Applications and Piping Strategies for Condensing Boilers

Application Guide – Component Index
Applications and Piping Strategies for Condensing Boilers
Application Guide – Piping Layouts

Application Guide
Vitodens 100 WB1B

Vitodens 100 Application 3

Notes/Comments
1. A thermostatic mixing valve should be installed to protect the radiant floor heating from receiving excessive hot water.
2. Component Index on pages 5.
3. The circulator which is built into the Combipack module will also act as the boiler pump when in heating mode. Therefore an external/optional circulator is not required.

Pressure Drop

Application Code
VD1C 2HC2T2ZP01
Applications and Piping Strategies for Condensing Boilers
Application Guide – Wiring Layouts

Application Guide
Vitodens 100 WB1B
Applications and Piping Strategies for Condensing Boilers
Application Guide – Set-up and Programming

WB1B Boiler Setup

Similar to the previous application, this system incorporates a Viessmann CombiPLUS module. With an on demand domestic hot water, this offers an alternative solution to installing a storage type indirect water heater. The integrate circulator and diverting valve in the CombiPLUS are controlled via the Vitodens boiler. Just remember not to incorporate to steep of a return curve, as air handlers offer substantially less BTU’s into the dwelling at lower water temperatures. To setup the boiler for this application you will need to complete the following:

<table>
<thead>
<tr>
<th>Step #</th>
<th>Description</th>
<th>Dial Position / Setting</th>
<th>Resulting Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove the XI jumper from the Vitodens 100 Power Pump Module. (shown on previous page)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Program boiler for CombiPLUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A) Simultaneously turn rotary selectors 1 and 2 to their central position; “SERV = +” will appear on the screen. Note: One or both of the rotary selector dials are always in the central position, select the one out of the central position, then simultaneously turn both rotary selector dials to the central position. B) Turn the rotary selector 2 fully to the right; “X” will appear on the display. C) Adjust the control by turning the rotary selector 3. The display shows “0” or “1” flashing “1” boiler with no optional CombiPLUS, “0” boiler with optional CombiPLUS (factory default’s setting). Note: After programming the boiler control to accept the CombiPLUS, turn off the boiler, then switch the control on. D) Set the DHW to the desired Hot Water Temperature.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Set the DHW dial to the desired Hot Water Temperature.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Set the Space heating temperature to the desired supply temperature.</td>
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</tbody>
</table>

If outdoor sensor is connected, turn the dial to select the heat curve for your system. The boiler will then target system return temperature based on the outdoor ambient temperature.
Applications and Piping Strategies for Condensing Boilers
Application Guide – Application # 1
Applications and Piping Strategies for Condensing Boilers

Application Guide – Application # 2
Applications and Piping Strategies for Condensing Boilers

Application Guide – Application #3
Applications and Piping Strategies for Condensing Boilers

Application Guide – Application #4
Applications and Piping Strategies for Condensing Boilers

Application Guide – Application # 5
Applications and Piping Strategies for Condensing Boilers

Application Guide Phase 2 – Vitodens 200 piping

Motorized mixing valve
Applications and Piping Strategies for Condensing Boilers

Application Guide Phase 2 – Vitodens 200 piping

Motorized mixing valves
Applications and Piping Strategies for Condensing Boilers

Application Guide Phase 2 – Vitodens 200 piping
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3. **Get more training** at one of our in-depth 1 or 2-day Academy seminars. Go to the *Academy* section of the Viessmann website for the full schedule of all our in-house training.
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