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## **Venting of Residential Viessmann Gas-Fired Condensing Heating Boilers**

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At present, there are industry discussions in regards to venting of gas-fired condensing heating boilers. The following represents the opinion and position of Viessmann Manufacturing in regards to venting Viessmann gas-fired condensing heating boilers, series Vitodens 200 and Vitodens 100.

Since the mid 80's, we manufacture and sell gas-fired condensing heating boilers; now sold in more than 30 countries, including North America. In almost all countries, PPS (polypropylene) is mostly used in coaxial vent-type applications or stainless steel for single wall venting systems. PPS is suitable for a steady flue gas temperature of 250° F (121° C) and for short-term exposure up to 280° F (138° C). Stainless steel vent pipe is suitable for 550° F (288° C); typically, an SA240 316 L material is used or the higher grade in North America AL29-4C.

Due to the fact that gas-fired condensing boilers are being vented, not only the temperature of the flue gas becomes an important factor but also, in combination with the extreme high moisture content, the associated acidity (pH level) of the flue gas condensate and the extreme temperature exposure to outdoor conditions need to be considered when selecting materials.

PPS, as well as stainless steel venting systems, have successfully been in use for many years and carry independent certifications for venting these types of heating boilers properly.

CPVC material is certified for 90° C (194° F) and PVC is certified for 65° C (149° F) according to ULC-S636 Standard for Type BH Gas Venting Systems. The Viessmann gas-fired condensing heating boiler Vitodens 200 and 100 series are approved for use with listed CPVC material.

IPEX (the manufacturer of CPVC venting systems) informed that this material is now readily available. Should there be supply issues, please contact your Viessmann sales representative or Viessmann directly – (in Canada at 1-800-387-7373 or in the U.S. at 1-800-288-0667).

The flue gas temperature exiting a gas-fired condensing heating boiler depends on a number of factors; some impact more than others:

- 1) The maximum allowable supply water temperature rating on the heating boiler or the maximum adjustable aquastat or limit settings.  
The Vitodens 200 is limited to a max. supply water temperature of 75° C (167° F) and the Viessmann Vitodens 100 series is limited to a max. water supply temperature of 80° C (176° F), plus cut in and cut off differential.
- 2) Venting with a coaxial vent pipe system, where fresh outside air moves around the PPS pipe, preheats the combustion air and cools flue gas temperature further.

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- 3) The heating boiler utilizing one separate vent pipe and a separate fresh air intake pipe.
- 4) Boiler utilizes standard room air for combustion air or outside air directly.
- 5) Flue gas velocity within vent system (vent length and restriction).
- 6) Possible vent restrictions (partial icing or blockage of vent terminal and/or air intake).
- 7) Excessive wind and pressure impact on terminations.
- 8) Possible partial heat exchanger flue gas passageway blockage.
- 9) Cycling frequency pending on control strategy, system water flow, zoning, etc.

After all of the above is considered, is there a safety margin left? After all, reliability and dependability for heating comfort are key factors in our opinion.

The main factor influencing flue gas temperature is however the return water temperature to the heating boiler. This is the primary influence on how high the flue gas temperature will go and exit into the actual flue pipe.

Both models of Viessmann heating boilers are certified to ANSI Z21.13 CSA 4.9 Low Pressure Steam and Hot Water Heating Boiler Standard by CSA. The test procedure within this particular standard calls for a boiler water supply temperature maintained until the limit control functions  $\pm 3^{\circ}\text{C}$  ( $\pm 5^{\circ}\text{F}$ ). When the boiler is tested under this criteria and a very low return temperature is selected (by the manufacturer), it will drive the flue gas temperature extremely low. Typically the flue gas temperature on both Viessmann heating boilers is between  $5^{\circ}\text{C}$  ( $9^{\circ}\text{F}$ ) and  $15^{\circ}\text{C}$  ( $27^{\circ}\text{F}$ ) above the return water temperature; therefore, for example, with a low return water temperature selection of  $27^{\circ}\text{C}$  ( $80^{\circ}\text{F}$ ) into the boiler, a flue gas temperature of  $42^{\circ}\text{C}$  ( $107^{\circ}\text{F}$ ) would be the net result. This flue gas temperature would not pose a problem in general for any type of PVC or ABS material; however, this test with a very large temperature differential of  $55^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ) between supply and return is not realistic. Also, at that temperature differential, the flow rate through the boiler would only be 20% of the actual required flow for a typical  $11^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ) hydronic system design temperature differential; again, not realistic in an everyday install.

Example under full input – design condition:

If the boiler water supply temperature would be  $82^{\circ}\text{C}$  ( $180^{\circ}\text{F}$ ), provided the boiler is certified to that temperature, then one would typically assume a temperature differential of  $11^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ) and therefore the return water temperature would return back at  $71^{\circ}\text{C}$  ( $160^{\circ}\text{F}$ ) to the heat exchanger. The dew point of natural gas is  $57^{\circ}\text{C}$  ( $135^{\circ}\text{F}$ ) at sea level.

The boiler would not condense anymore and the stack temperature would certainly be higher than the return water temperature of 71° C (160° F). It would probably reach the 85° C (185° F) to 88° C (190° F) mark.

This operating condition now clearly shows flue gas temperatures higher than what the limit is on standard PVC, CPVC and ABS. Even if the heating boiler has a limit at 71° C (160° F) set for the boiler water supply temperature and an 11° C (20° F) spread to the return water temperature, the return temperature would still be 60° C (140° F), the flue gas temperature could exceed the maximum listed temperature limits.

Especially when heating boilers are utilized to provide domestic hot water through an indirect-fired domestic hot water storage tank, return temperatures back to the boiler, when the tank temperature reaches 60° C (140° F), will rarely be less than 60° C (140° F) due to obvious reasons and higher flue gas temperatures will be the result again.

In our evaluation for suitable vent pipe material, we have looked at the following data:

**Present Status for Non-Metallic Gas Vent Material**

		<b>PVC (DWV) as Plumbing Material</b>	<b>PVC as Gas Vent Material</b>
<b>Canada</b>	Temperature rating	prohibited	149° F (65° C)
	Approvals	ASTM	ULC - S636
	Supplier	several	IPEX only (presently)
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<b>U.S.A.</b>	Temperature rating	158° F (70° C)	no listing
	Approvals	ANSI	UL 1738
	Supplier	several	

		<b>CPVC as Plumbing Material</b>	<b>CPVC as Gas Vent Material</b>
<b>Canada</b>	Temperature rating	prohibited	194° F (90° C)
	Approvals	ASTM	ULC - S636
	Supplier	several	IPEX only (presently)
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<b>U.S.A.</b>	Temperature rating	210° F (99° C)	no listing
	Approvals	ANSI	UL 1738
	Supplier	several	

		<b>ABS as Plumbing Material</b>	<b>ABS as Gas Vent Material</b>
<b>Canada</b>	Temperature rating	prohibited	prohibited
	Approvals	ASTM	failed the ULC test
	Supplier	several	none
<b>U.S.A.</b>	Temperature rating	180° F (82° C)	no listing
	Approvals	ANSI	UL 1738
	Supplier	several	

This, in our technical opinion, renders standard PVC, CPVC and ABS unfit for venting a Viessmann Vitodens 200 or Vitodens 100 series gas-fired condensing heating boiler. Also, the Canadian Gas Fired Equipment Installation Code CSA B149.1 has already prohibited the use of this material. Furthermore to our knowledge, no manufacturer of DWV (drains, waste, vent) PVC had it certified or recommends this material as a vent pipe for gas-fired condensing heating boilers.

DWV approved materials are mostly used in sewer and drainage applications within buildings or below ground. These materials are not subject to this type of temperature (erratic temperature changes) with constant pH levels between 3 and 4, and none of these materials are typically exposed to long periods of ultraviolet light or severe cold outdoor temperatures, when used in vent terminations where all the foregoing conditions occur at the same time. In addition, the expansion factor of the pipes has to be considered, possible change of support, including feasibility of adhesives and terminations.

As high limits and low water cutoffs are safety measures for the pressure vessels, so is venting the safety measure for disposing flue gas.

A venting system will become part of a home. It may get enclosed in a wall or a ceiling and therefore not be easily accessible in the future for inspection.

For the reasons mentioned above, Viessmann does not recommend and is not certified on the Vitodens 200 and Vitodens 100 series with DWV PVC, CPVC or ABS, even though our listed efficiencies are some of the highest in the industry.

PVC, CPVC and ABS may only be used for the combustion air intake side when a separate pipe is used for the combustion air intake system and the separate flue gas pipe is constructed utilizing stainless steel or CPVC ULC-S636.

We recommend, and are approved for, venting and combustion air intake with a coaxial PPS / aluminum venting system for combined venting and combustion air supply.

For separate flue gas venting, both heating boilers are approved with CPVC 90° C (194° F) according to ULC-S636 or AL29-4C stainless steel venting, in combination with DWV PVC, CPVC, ABS or even galvanized sheet metal ducting for the separate air intake for combustion air. Of course, CPVC, ULC-S636 or stainless steel may also be used for the air intake side.

We have opted not to employ a fixed flue gas temperature sensor, with manual reset, to avoid boiler lockout when high flue gas temperatures occur to protect a venting system, in order not to subject our customers to boiler lockouts in the main heating season when higher water temperatures are required to maintain the heating comfort. Instead, we have selected, in our opinion, the correct venting material for the Vitodens 200 and Vitodens 100 series.

For more information, please contact the technical department at Viessmann - in Waterloo 1-800-387-7373, Langley 1-877-853-3288 or Warwick 1-800-288-0667.

With best regards,

A handwritten signature in black ink, appearing to read 'H. Prell', written in a cursive style.

Harald Prell  
President  
Viessmann Manufacturing Company Inc.