

Combustion Safety and Orphaned Water Heaters: An Overview for Home Inspectors
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The domestic water heater we are most likely to see when inspecting a home in Central New York is a gas-fired, atmospherically vented appliance. These heaters rely upon thermal buoyancy (warm air rising) to exhaust their combustion gases.

In the *best* case, exhaust gases include a large amount of water vapor and CO₂ along with lesser amounts of unwholesome combustion byproducts. There are also a number of conditions that can result in high levels of CO in the flue gases. Combustion gases belong outside the house, not inside.

Atmospheric venting for indoor combustion appliances is an early 20th century technology. In the old days, the furnace was also vented the same way, and it frequently had a pilot light.

Venting by thermal buoyancy requires that the weight of the plug of cold air in the chimney be overcome by the ability of the warm exhaust gas to rise. Another way of visualizing the process is that the cold air around the warm gas must push it up safely up the chimney.

If a large pilot light like the one shown here were operating, the chimney would stay reasonably warm and the water heater might well draft.

Now remember that early to mid 20th century technology *also* gave us cars that had no air bags, no seat belts, no collapsible steering columns, and really, really hard steel dashboards.



Remember too that older houses were light on insulation and the windows were drafty. If the chimney failed to draw, the spilled combustion gases would be diluted by high natural air changes resulting from building leakage rates, and the threat from high levels of moisture or from CO would diminish accordingly.

Now let's fast-forward to the 21st century. Houses are tighter. The *least* expensive furnace you can buy has electronic ignition instead of a standing pilot. Better furnaces don't vent up the chimney at all. People adore super-sized exhaust fans for their commercial ranges. Families use dryers rather than clotheslines for laundry.

“Orphaned” water heaters are created when an atmospheric furnace is replaced by a power vented or sealed combustion furnace. The water heater is the last appliance venting (or not!) up the chimney. Home Inspectors need to be aware of the potential hazards of orphaned water heaters. Heating or Building Performance Contractors trained by The Building Performance Institute, The National Comfort Institute, or another training organization should follow a combustion safety protocol and test to verify that the orphaned water heater is safe. If it is not, it should be corrected or replaced with an appliance engineered with non-atmospheric venting.

A number of conditions can keep the water heater from venting properly. Most likely is that a negative pressure in the basement with respect to the outside can cause the water heater to spill. These pressure differentials are measured in Pascals, a unit equal to 1/250th of an inch of water column (gas pressure should usually be delivered to the furnace at 3.5 inches of water column, or 3500 PA).

What's needed is a “worst case depressurization” test. This entails configuring the house in “wintertime” conditions: all windows, storm windows, and doors are closed. All interior doors should be open, and all fans off. The baseline pressure in the combustion appliance zone (CAZ) with respect to the outside is measured and recorded using a micromanometer, like this DG700 from the Energy Conservatory.



Then the house is reconfigured, often by closing interior doors that do not isolate fans, and by turning on all the fans that blow air out of the house. Bath fans, kitchen exhausts, the dryer, and so on are included. Finally, the air handler (the big fan in the furnace) is turned on. Once everything that sucks air out of the house is running, the technician measures and records the new pressure difference between the CAZ and the outside. Subtracting the baseline from the worst case gives the figure for the worst case depressurization. (There can be some experimentation involved in finding the worst case configuration of interior doors, depending on such questions as where cold air returns are located.)

You can find a table of depressurization limits in the Auditor Standards section on the contractor page at www.BPL.org. For example, if the CAZ depressurization is more than -2 PA when the water heater is an orphan, action is required.

If the water heater spills for more than one minute at worst case, it should be retested under normal conditions. If it spills for more than one minute under natural conditions, it must be corrected. The best correction is replacement with a power vented or direct vented appliance.

The technician also checks the flue pressure and compares it to standards, and he or she tests for CO. There are standards for that as well.

Home Inspectors may choose not to be trained and equipped to conduct this vital testing, but they can and should refer their clients to technicians who can verify the safety of orphaned water heaters. They should also educate their clients that any time a change is made to combustion appliances or to any other significant system in the house (air sealing and insulation, new windows, new kitchen range hood), combustion safety testing should be included as part of the scope of work. Consider advising the replacement of an orphaned water heater—even a new one—as an upgrade. Doing so is in the best interest of your client.