



A DIVISION OF A. O. SMITH CORPORATION



Technical Bulletin A.O. Smith Tech Services

Subject: Pilot Outage of Flammable Vapor Ignition resistant equipped atmospherically vented heaters.

A clean heater, and heater environment, is the first thing that should be considered when troubleshooting a water heater. Higher efficiency water heaters and new government regulations for flammable vapor ignition resistance have changed the design of water heaters. Dirty environments can take their toll on a water heater. Take time to make sure that the area around, and under the heater is clean and obstruction free. Make sure that the air intake screen (LDO screen) located on the base ring of the heater is clean and properly installed; this is where all of the combustion air enters the heater. Cleaning the screen and under the heater can improve the performance of the heater and save a costly service call. Please visit www.hotwater.com for cleaning instructions and other service related material.

Venting systems are very important to the safe operation of the water heater. For example, a 90° elbow on the top of the heater's draft hood can reduce the vent efficiency by up to 50%. There should be a rise of ten vent diameters off of the top of the heater before the first elbow. On a heater that has a three inch vent that would be 30 inches before an elbow. A poorly designed vent can render the heater useless and could lead to serious injury or death. A good vent is a vent that rises straight up from the heater to the termination on the roof and continues outside for at least another two feet straight up. However, horizontal vent runs are acceptable as long as a few rules are followed.

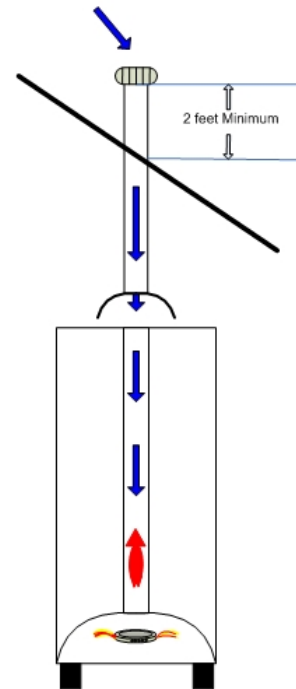
- The horizontal vent run (any angle less than 45° from horizontal) should not exceed 75% of the vent height. (The distance from the top of the heater straight up to the altitude of the vent termination).
- The vent must have a minimum of ¼" inch per foot rise on the horizontal run meaning that every four foot continuous run of a horizontal pipe must rise at least one inch.
- Must not be vented with a power vented (fan assisted) appliance per the National Fuel Gas Code.
- 10 vent diameters off of the top of the heater before the first elbow.
- The vent must be sized to handle the total BTU input of all the appliances connected.

If there is more than one appliance connected to the vent system and you suspect a problem, call a local plumber or venting specialist. Rust forming on the heater jacket as well as burnt gas are signs that the vent is not working properly. An improper vent may spill flue products out of the top of the heater which could cause the heater and vent pipe to rust.

As the water heater in most new homes has been banished to the garage, basement, closet or attic, simple needs of water heaters have been forgotten or overlooked. The most common is the availability of needed combustion air. Gas burning appliances must have air (Oxygen) to sustain a flame, and water heaters in garages and attic or utility closets have plenty of air around them; right? As we will explain that is not always the case. There are three major reasons for pilot outage; Capping, High ambient temperature and decompression. Though the outcome is the same, the causes of "Pilot Snuff" are quite different. "Pilot Snuff" is the lack of buoyancy in the gases causing them to lie in the bottom of the heater until the flame runs out of oxygen and goes out. Let's look at the cause and effect of these three different types of pilot outage. Let start with "Capping."

"Capping" takes place when a downward force equal to or greater than the pilot draft is present in the vent. Because of a poorly designed vent, wind outside the structure, will push down the vent and cause the flue to stall. This is most evident in high wind situations but can happen in much calmer atmospheric conditions, or in combination with one of the other two pilot outage reasons. When the flue stalls, the draft from the pilot flame stops rising up the flue, all the oxygen is used up and the pilot flame goes out. It takes less than 1/500th of an inch water column pressure to stall the flue. This can be caused by an improperly designed or installed vent termination, a vent termination that does not extend two feet above anything within a ten foot radius horizontally on the roof, a vent with no termination on it, or a vent that is too big for the heater.

(See Figure to right)



"Capping"
pressure from wind or other source will
stop flue gasses from exiting
the heater.

The second reason that contributes to pilot outage is high ambient temperatures. This effects heaters that are installed in attics, garages, unconditioned spaces or heaters that draw makeup air from an attic spaces. Soaring temps in the attic can peak at 160°F or higher in the summer months. If the tank temperature is set at 135° F, and the air in the attic is a sweltering 160° F, the heat generated by the pilot is not enough to heat the surrounding air adequately enough to start a draft (upward air movement) and the pilot will burn up all the available oxygen and extinguish. Atmospheric water heaters depend on heated flue gas to carry the products of combustion up and out due to the buoyancy of the flue gasses. Ventilation of the attic becomes a big issue. The hotter the air is the more it wants to rise. If the heater is getting combustion air from the attic, the hot air in the attic does not come down the makeup air vents to feed the burner and the pilot goes out from lack of oxygen. (see figure 2)

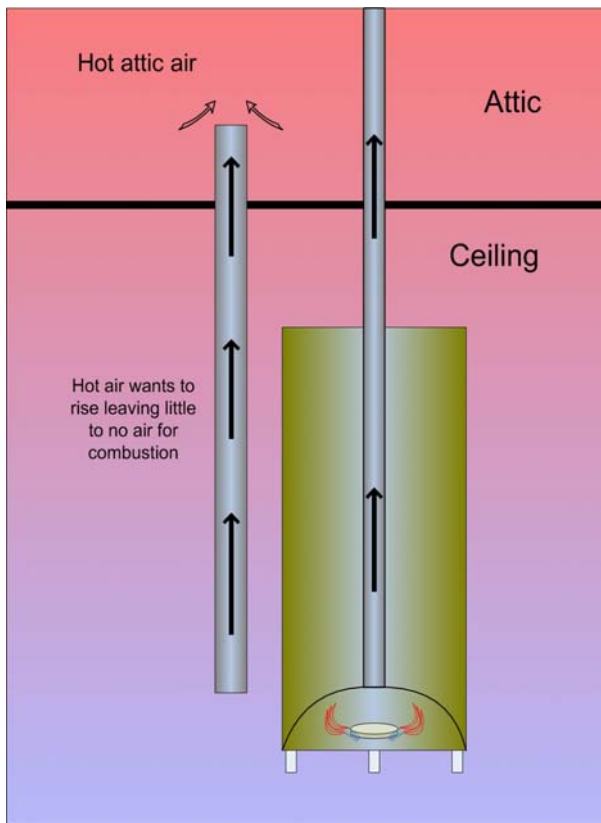


Figure 2

Decompression is the third reason that the pilot flame will fail. Decompression happens when the air pressure inside the structure where the water heater is located, drops below the outside air pressure. If air can not enter the structure as fast as it is being used then the building will go “negative.” If the room pressure is negative, then the air pressure outside will push down the vent to equalize the pressure. The effect is much like “capping”, the combustion products from the pilot stall in the heater flue pipe, and the pilot runs out of oxygen because there is no draft (upward air movement) to replace the oxygen. Reasons for a room or building to go negative are a closed room (no make up air vents) without much, or no foot traffic, a room that is too small to support the needs of the heater, an attic or kitchen fan that exhaust air out of the structure without bringing in its own makeup air, or combustion air shared by two or more gas burning appliances.

If it is a garage installation then try this as a test. Place a small 2”x 4” block of wood under each end of the garage door (or if the heater is in a utility closet, try opening a window). This will leave a gap for more air, equalizing the pressure and the outage problems may go away. Then simple vents can be placed in the garage door or exterior wall to help with ventilation. Most homes have no air conditioning ducts in the garage (to meet energy ratings) supplying air in the garage; which would normally be a source of combustion air.

Attic installations can be exceedingly hostile. The Constant high temperatures and little to no traffic along with poor ventilation take there toll. Attic design and materials are very important to proper combustion. Soffits and roof ventilation devices are very important to good attic ventilation necessities heater operation. Soffit vents are usually blocked during the construction of the home when the insulation is blown into the attic. The insulation should not cover the soffits. If the soffits are covered, then a leaf blower can be used from the outside to blow into the vent. This comes with a warning that all gas appliances must be turned off and any valuables need to be covered prior to clearing the vents. The insulation dust can take several hours to settle. Vents, and vent placement, are very important as well. Ridge vents work the best and can cool the attic by up to 35°F in the summer by cooling the underside of the roof deck as it is heated by the sun. There are also fewer pockets of dead air with the roof vents. Attics with no venting devices have no air flow in them except the heated air escaping from the soffits due to expansion, which leads to insufficient air. One way to determine if there is enough available air in the attic is to stand in the attic with the door closed and shut off the attic light during daytime hours (10am to 4pm).

If no light can be seen from the soffit areas, then chances are that the heater will never have the required air to support combustion. (See Figure 3)

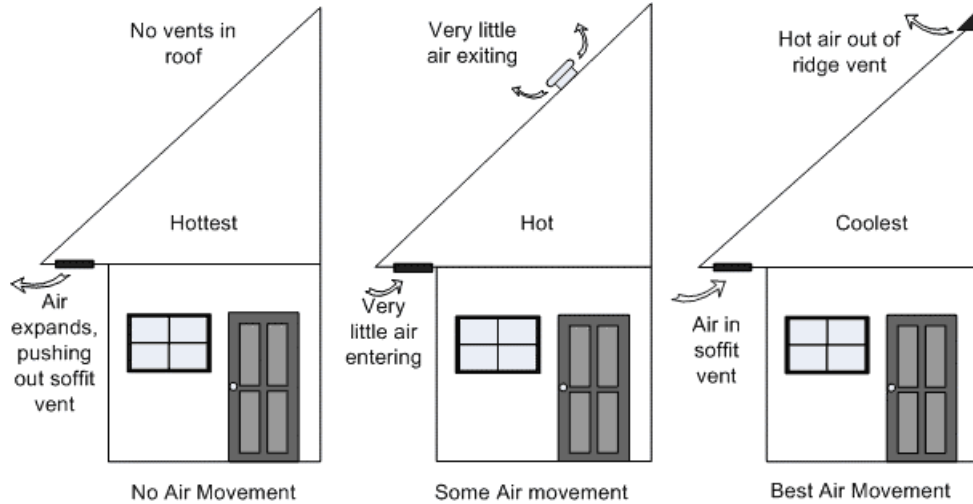


Figure 3

A lack of combustion air will cause the main burner to have an unstable yellow flame pattern in the combustion chamber. As the Flame “looks” for oxygen, it will change its color and flame pattern and flatten out in an effort to find an oxygen supply. This will increase the temperature in the bottom of the combustion chamber and cause the heater to shutdown.



Available air for combustion is essential to a heater. Properly vented heaters and installation conditions play a huge part in the operation of the heater because without enough air, the heater cannot operate properly and will shut down. The drafting characteristics of the heater depend upon the heat of the pilot, main flame and tank temperature to generate draft. **WARNING**, hotter water temperatures can lead to scalding. Safety always comes first. Keeping this in mind, an increase of tank temperature 10° F may help or even solve the problem. A simple mixing valve installed in the hot water outlet of the heater, will allow much hotter tank temperatures while providing a worry free solution to scalding.

In conclusion, remember that a heater that is not properly installed will not operate properly. Proper maintenance and cleaning of the heater and the surrounding area can play a major role as well. For more information on the operation of you heater you can call 800-527-1953 for technical assistance or visit the technical bulletin section under the technical literature section of our web site at www.hotwater.com. There you will find information on everything from water conditions to noises encountered in your water heater. With proper installation you're A.O. Smith water heater will give you many years of worry free hot water.