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Home Tips

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Furnace Red Flags

By: Greg Wayman, ASHI Certified Inspector

The most important aspect of a home inspection is bringing to light major issues and safety hazards. When I find a cracked heat exchanger on a furnace, I'm surfacing a high-dollar problem and a major safety concern of carbon monoxide poisoning. Finding a crack makes most Listing Agents and Sellers cringe, however, my clients are truly grateful. Having the professional HVAC training, the high-tech equipment, and the years of experience allows me to find a high percentage of the heat exchangers that are cracked. In the 8 years of doing invasive testing on furnaces, I've found over 500 furnaces with cracked heat exchangers. For the price of an inspection, my clients are landing an awesome return on their investment. Below are red flags to look for on your furnace, pointers on preventing a crack heat exchanger, and tips on how to know if your HVAC Tech is checking for cracks properly:

Red Flags for High-Efficiency Condensing Forced Air Furnaces

In 2007, one of my clients had a high-efficiency furnace that was leaking low-levels of carbon monoxide into their child's bedroom unbeknownst to them. During the inspection, I found the leak and asked them if their child was having headaches, has been sick a lot, was light-headed, etc. We hadn't talked about the child's health, so the shocked look on the parent's face, and the fear-stricken follow-up question of "How did you know?" gave me my answer. I found the leak because there were stains in the drop ceiling in the bedroom closet. I pushed up the ceiling piece and found liquid leaking out of a flue connection. Come to find out, their child had been experiencing carbon monoxide poisoning symptoms for 3 years!

Leaking high-efficiency flue pipe

The common red flags to watch for on high-efficiency furnaces are:

1. Any drips leaking out of the PVC exhaust piping at any connection from the furnace to the exterior – If the condensate can leak out, so can the flue gases.
2. Any drips/staining below the exhaust fan located behind the panel cover
3. Any sloshing around of liquid coming from the exhaust fan
4. During extreme cold exterior temperatures, look for ice build-up and ice clogging the exhaust pipe
5. During heavy snowfall, make sure the exhaust pipe doesn't become buried and blocked
6. A dirty filter – the primary heat exchanger will crack very quickly if its airflow is restricted, so please change it often
7. Inadequate combustion air – there are some models that don't have the combustion air drawn in from the outside. For these, I've found too many where the homeowner had finished the basement and the furnace simply didn't have enough square footage to draw oxygen from.

Snow buried flue pipe

Red Flags for 80% Efficiency Forced Air Furnaces

The common red flags to watch for on 80% or less efficiency furnaces are:

1. Flame rollout – If the flue pipe is blocked, you'll actually see the burner flames roll out at you or roll under the burner. Flames should be vertical and mostly blue. If you see this after the furnace has been running for a few minutes, turn it off and call a licensed HVAC Company immediately.
2. Wafting or slanted flame – If the burner flame appears to dance or slants off to the side, there's a strong chance there's a crack in the heat exchanger or an opening where the faceplate meets the exchanger. Either

way, there's a strong potential for carbon monoxide and other flue gases to leak into the supply air and be blown throughout the home. Call a licensed HVAC Company immediately for this too.

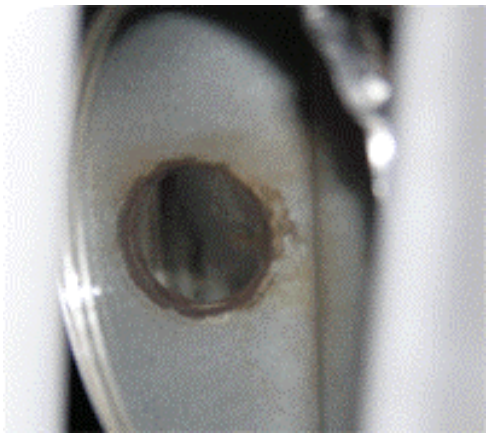
3. Rusting out of the flue pipe – Many older furnaces will have a metal flue pipe with lots of tiny holes rusting through it. This is a potential for flue gases to leak into the home and needs to be addressed immediately.
4. Inadequate combustion air – 80% (or less) efficient furnaces normally draw combustion air from the basement. Make sure there are either properly sized wall vents or louvered doors installed to the utility room/closet and also at the stairs. Vent sizing rule of thumb is 1 square inch per 1,000 BTU's minus 25% if you use a metal vent or minus 75% if you use a wood vent.
5. No opening in the cold air return ductwork within 10' of the burners – The blower is strong enough to draw flue gases from the burner opening into the supply air and throughout the home. Check to make sure the filter opening is sealed and that there are no vent openings cut into the cold air return near the furnace.
6. Solid separation between bedrooms and gas appliances - Basement bedrooms need to have solid doors separating them from the gas appliances. These furnaces can draw the oxygen for combustion air out of a bedroom when someone is asleep.
7. Solid separation between gas appliances and basement bathroom vent fans - When basement bathrooms are added, make sure the furnace and water heater are not in the same room as the bathroom vent fan for the shower. Turning the vent fan on can lead to the flue gases back-drafting.
8. Inadequate flue pipe clearance to combustibles - 80% (or less) efficient furnaces will have single-wall or double-wall flue stacks. There needs to be 6" and 1" respectively minimum clearance to combustibles.


Breached Clay-Tile Chimney Liner

9. Unlined or breached chimneys -The '60's homes and older will typically have the furnace and water heater discharging into a chimney. 21.3% of the homes I inspected in 2009 had either an unlined chimney or one with a breached liner. A breached liner or no liner at all poses a threat of carbon monoxide poisoning from the flue gases leaking through the chimney into the interior of the home AND a potential for a fire from the hot flue gases making their way to flammable materials surrounding the chimney. Remember, every time the chimney heats up and cools down, the lower the ignition temperature becomes of the surrounding wood.
10. Furnace cabinet is too hot to touch – Yesterday's inspection had a furnace like this. There was heavy charring up the front of the cabinet at the controls, the wires inside the control box were melted, and the side of the furnace was about 120 F. The high-limit control switch was faulty causing the insides of the heat exchanger to overheat. This can lead to metal fatigue, cracks, and a fire.

Where Heat Exchangers Normally Crack

Most natural gas forced air furnaces in use today will typically have 1 of 3 heat exchanger types: clam shell, Serpentine, or tubular. The clamshell type is found on the older furnaces to about the early 90's. This type normally forms a crack near the rear seam, but cracks can be found in other areas. The Serpentine and tubular shells are found on today's newer models. The Serpentine consists of 2 pieces of sheet metal held together by rivets or eyelets. Carrier utilizes a rivet design that I rarely find any issues with. Inversely, any time I see an eyelet design, I'm surprised if I don't find a crack shortly after the 10-year mark. Cracks normally occur around the eyelets or where there's metal fatigue on the sides. I've found cracks in the eyelet design of furnaces only 3 years old! The tubular heat exchanger is, in my opinion, the best. It tends to last longer and doesn't seam to crack out as fast. Cracks normally can be found at the bends, at the seams, or where the exchanger meets the faceplate at the burner opening.


Cracked Serpentine heat exchanger
The eyelet fell out.

Common Causes Of A Cracked Heat Exchanger

1. Failing to change the filter regularly
2. Inadequate combustion air
3. Installing high MERV rating filters when the duct system wasn't designed for such an air flow restriction
4. Leaky A-coil from the A/C unit down on top of the furnace
5. Leaky built-in humidifier

6. Installation error usually involving old undersized ductwork combined with a newer furnace
7. Poor design of heat exchanger from manufacturer


Cracked horizontal furnace

Pay Attention To What Your HVAC Tech Is Doing

Some pointers on how to know if the HVAC Tech is checking for cracks properly:

1. On clamshell exchangers, the ONLY definitive test is the hydro test. That consists of the HVAC Tech removing the blower, spraying the outside of the heat exchanger with a surfactant solution, and looking on the inside of the exchanger to see if it bleeds through. To do this test, the HVAC Tech needs a lawn & garden sprayer. When he's done, you'll see soapy water leaking out the bottom of the furnace.
2. On Serpentine & Tubular exchangers, the ONLY definitive way is for the HVAC Tech to look at every square inch of the outside of the heat exchanger. If a crack is found, then the HVAC Tech doesn't need to look any further. To do this, the HVAC Tech will need to remove the blower, physically slide up inside the blower cavity, and check the exchanger with a mirror and flashlight. Some times the blower cavity is smaller than the Tech so they are forced to disconnect the gas line, remove the burners, and then slide the heat exchanger out. This is much more time consuming. This is true also of high-efficiency furnaces as the secondary heat exchanger blocks access from the blower cavity.
3. If an HVAC Tech pulls out a sprayer on a Serpentine with eyelets or Tubular exchanger, then politely ask them to leave. A Serpentine exchanger will bleed every time, even brand new ones. They aren't cracked. Their design has a small gap between the eyelet and sheet metal. The metal becomes airtight when it's heated up.
4. If the HVAC Tech pulls out a fancy furnace camera and shoves it inside the burner opening without doing the above mentioned tests, then they haven't effectively looked for a crack. You can shove a high-end camera into a Serpentine and tubular design only up to about the first bend before you risk ruining the fiber optic wires of the camera. Not to mention, today's cameras don't allow you to see the cracks unless you know exactly where they are already. I know. I own the cameras and have tried to find the cracks this way. You can't! On clamshells, if a camera is used, it also needs to verify that the crack goes all the way through. Simply looking at a rust mark, scratch, or crack without spraying it will not give you the definitive answer. I've had countless furnaces where I thought I saw a crack, but they didn't bleed through when sprayed. I don't call out a crack if I can't verify it and neither should the licensed HVAC Companies. There are furnace companies in Omaha that pull out the cameras to WOW the customer and don't perform any definitive tests to confirm the cracks exist. I've seen ads on TV and heard them on the radio of local HVAC companies touting their furnace cameras and how they are able to find cracks. If the HVAC Tech doesn't have the proper training and fails to perform the definitive tests, then the cameras are useless. Unfortunately, the public doesn't know any better and is easily duped into buying a new furnace when they may have nothing wrong with the one they have.

Install Those Carbon Monoxide Detectors

In the fall of 2003, I was messing around with the CO detector that I had placed in my baby's bedroom. To my surprise, the peak level button indicated that the carbon monoxide level in his room had reached 15 ppm since the last time I reset the detector. At first I guessed we had left the car in the garage too long and it had trickled up to his room. I investigated further and found that our furnace was leaking 600 ppm of CO into our basement!!! I thanked God that I found it, because our entire family could have been killed. We installed a new furnace immediately. What I was shocked about was the fact that the new CO detector failed to go off! Upon doing further research, I found out that the manufacturers of CO detectors set the calibration so they go off when the CO level reaches 50-70 ppm. Long-term exposure of just 8 ppm of carbon monoxide can kill a person. To the responsible parents out there, please install CO detectors that have peak level buttons on them AND check them regularly. If you've installed CO detectors with only a test button, then you have no way of periodically checking the actual levels of CO in your home and I would strongly recommend upgrading them. The CO detectors should be installed on every floor and one in the utility room.

Improve Your Heating Efficiency By Up To 600%

Alleviate the threat of carbon monoxide poisoning by installing a heat pump. When you actually compare apples to apples, an air-source heat pump is 200%-350% efficient depending on the exterior air temperature compared to the highest high-efficiency natural gas forced air furnace at only 95%-96% efficient. There are even sub-zero air source heat pumps that operate down to –32 F taking away the need for a backup furnace. Geothermal heat pumps can also

alleviate your need for a backup furnace and can reach efficiencies of 400%-600%! If you're going to be in your home for the long haul, the geothermal systems are the way to go. Even Omaha Public Schools are getting in on the action. Many of their schools are being converted to geothermal systems. They make long-term financial sense and are one of the best eco-friendly designs in use today.

Greg Wayman is a Certified Inspector of The American Society of Home Inspectors, Inc., has been inspecting full-time for over 8 years, and has personally inspected over 1,900 properties. Greg is Heat Exchanger Experts Certified and is a NE Radon Measurement Specialist. He is a member of the Go-ASHI Chapter in Omaha. He is the past Nebraska Chapter of NAHI President from '03-'07, past Board member of NAHI from '07-'08, and past national Secretary/Treasurer of NAHI '08.

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