Why Do Heat Exchangers Fail?

An open letter to you, our valued customer:

Dear Friend,

I’m sorry that your heat exchanger has been condemned. I know that you didn’t plan to have a broken furnace now.

You deserve the best trained and most professional service available. Our goal is to provide you with technicians that are on the cutting edge of current technology and diagnostic techniques.

Carbon Monoxide is highly toxic. Because of this danger, we have invested in new, patent pending technology that allows us to identify potentially hazardous furnaces much earlier and easier than ever before.

Diagnosing heat exchanger failures and other dangerous furnace conditions is part of the annual heating inspection that every industry organization and equipment manufacturer recommends.

We follow two industry guidelines when inspecting your heating system.

The first is the International Fuel Gas Code Annex H, it instructs us to “inspect the heat exchanger for cracks, openings, or excessive corrosion.”

The second is the American Gas Association, they state that “any visible crack or hole discovered during this step is reason to REQUIRE replacement of the heat exchanger or furnace.” Hopefully this guide will help you understand what was found during the inspection that was performed on your equipment.

Thank you very much for trusting your family’s safety and comfort to us. It is our primary concern at this time.

Heat Exchanger Q&A:

What is a Heat Exchanger?

What is a Chamber?  How do they fail?  Why do they fail?  How do you know?

What do they fail?

Holes / Corrosion:

Moisture that has mixed with exhaust gases becomes acidic. When it comes into contact with the heat exchanger it will corrode the metal, until eventually, it penetrates the heat exchanger.

The moisture that causes the corrosion can come from different sources. The moisture content of the fuel, relative humidity in the home, air conditioner coils leaking, etc.

Fact: (There is enough acidic moisture content in burning fuel to corrode bare metal quickly.)

Cracks:

Your heat exchanger cells are made out of very thin metal. When the burners ignite, the heat causes them to expand slightly in every direction. When cooling off, they shrink to their normal size and shape.

Fact: (You can literally hear the pinging noises as the metal in your system expands and contracts.)

The stresses of constantly expanding and contracting, bending and flexing are usually concentrated in a small area. This continuous flexing back and forth, like bending a paper clip, eventually causes the metal to crack and the heat exchanger to fail an inspection.

Cracks are usually caused by stresses that occur during the heating cycle.

Other defects include things like; defective draft diverters, front panels, gaskets, etc.

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How do you know?
There are many ways to inspect a heat exchanger, they include; Visual, Flame Disturbance, Dye Penetrant, and Tracer Gas.

Visual Inspection:
Inspecting the heat exchanger with a light and mirror.

Disadvantage: Some modern heat exchangers curve such that a visual inspection from the burner, and blower areas only reveals about 20% of the heat exchanger to inspection.

“Any visible crack or hole discovered during this step is reason for requiring replacement of the heat exchanger or furnace.”
American Gas Assoc. (AGA) (http://www.aga.org)

Flame Disturbance Test:
Inspect the burner box with a lit candle while the blower runs to check for any flame distortion that would indicate a hole or crack.

Disadvantage: The same as visual inspection. Some modern heat exchangers curve such that a candle inspection from the burner area, only reveals about 20% of the exchanger to inspection.

“Disturbance of the flame by the blower under this step is reason for requiring replacement of the heat exchanger or furnace.” (AGA)

Dye Penetrant Test:
A non-toxic fluorescent penetrating dye is sprayed on the “air side” of the heat exchanger. The inside or “combustion side” of the heat exchanger is then inspected, using an ultra violet flashlight for evidence of any leakage, seepage, or drips that would indicate a failure of the heat exchanger to separate the “air” and “combustion” sides of the heat exchanger.

Advantage: Allows cracks, holes, and defects, that cannot be seen by the naked eye, to be found by looking for the bright fluorescent dye penetrating inside of the heat exchanger.

Disadvantage: Much more difficult and time consuming than visual or flame disturbance test. Penetrating dye may cause furnace to smell slightly the next time it comes on.

Tracer Gas Test:
The heat exchanger cells are isolated and a tracer gas is discharged into the cell. A gas detector is then used to locate any tracer gas outside of the combustion chamber.

Advantage: Good for tubular type heat exchangers.

Disadvantage: Very time consuming, requires specialized and calibrated test equipment. Since tracer gas is lighter than air, it’s only useful for finding holes in top third of the heat exchanger.

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