# VISIBLE Defects HEAT EXCHANGER INSPECTION SYSTEM

A unique method of visually evaluating the integrity of a gas furnace heat exchanger. The Visible Defects System consists of a specially designed delivery of a penetrant for identifying the tiniest hairline cracks in the heat exchanger.



This picture shows Visible Defects Crack Finder illuminated by a black light flashlight. The penetrant makes the defect easy to find and verifies there is a breach from the air side to the combustion side of the heat exchanger.

# **INSTRUCTION BOOKLET**

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### CAUTION

While freeze resistant, Visible Defects Crack Finder Leak Detector Solution can freeze below 12 degrees Fahrenheit. While freezing will not damage the fluid, it can damage the sprayer and cause it to leak. When the outdoor temperature approaches freezing, bring the sprayer indoors to prevent freeze related problems with the assembly.

### WARRANTY

Your Visible Defects Heat Exchanger Inspection System comes with a one year limited warranty against defects in materials and workmanship.

## Introduction:

The Visible Defects Heat Exchanger Inspection System is a unique way to provide Service Technicians with an accurate, cost effective, non-destructive inspection processes to visually identify a potentially hazardous defect in a gas furnace.

## **Concept:**

Visible Defects utilizes a fluorescent based penetrant that is non-toxic, low-odor, and creates no smoke after application. The solution is applied to the entire heat exchanger through holes in the front panel as small as 1/8 inch on standard efficiency furnaces (non-condensing types). This can be accomplished by removing a sheet metal screw that positions the front panel, or it can be injected into the cells of tubular heat exchanger designs.

On natural draft and induced draft furnaces (with open combustion and sealed combustion furnaces with the burners at the bottom) spray the pentrant on the air side of the heat exchanger. After applying the spray, inspect the heat exchanger through the burner compartment.

On tubular heat exchangers, used typically in Nordyne, Amana, GMC, Coleman, Luxaire, and York equipment, inject it INTO the tubes at the combustion chamber by the burners. The penetrant can be applied with the spray wand and extender. Its design allows for it to be injected with enough force to get through the front bends in the tubes. After applying penetrant, inspect the heat exchanger from the air side through the plenum, insertion limit, or blower compartment.

Inspection is performed with the supplied LED UV flashlight to see if any of the solution has penetrated to the opposite side of the heat exchanger (air side or combustion side depending on its design).

**NOTE:** Visible Defects is just another tool in your toolbox, and should be used with all available tools at your disposal for a thorough diagnosis. It may not locate every defect in a heat exchanger, but you'll find more with it than without it.

# WARNING / CAUTION / ALERT: CRIMPED EDGE HEAT EXCHANGERS:

Some crimped style heat exchangers may weep a trace amount of dye into the crimped seams between the cell halves. This may be **NORMAL** and is NOT a reason for condemning a heat exchanger. In these circumstances, a small, barely visible amount of penetrant is seen.

# YOU MUST BE PREPARED TO VERIFY AND IDENTIFY ALL DEFECTS AND CRACKS TO YOUR CUSTOMER .

Failure to verify, identify, and show the customer 100% of the defects in the heat exchangers you condemn can affect the reputation of your organization.

We recommend that you follow the dye to the defect and be prepared to show the customer the defect. Then give your customers a copy of the *"Why Heat Exchangers Fail"* handout.

As an example, imagine you didn't verify a bad heat exchanger to the customer. They have only your word to go on. Your customer gets a second opinion from another contractor. The contractor states the heat exchanger is not defective and states your company is using tactics to sell furnaces that people don't need.

Then, the customer decides to get a third opinion and that contractor states that the heat exchanger "has only a small crack, but it is ok for now." This sequence of events places your company in a compromising position. Suddenly, through the negligence of others and through no fault of your own, you are viewed as an organization that uses tactics to sell furnaces that don't need to be replaced.

Protect your organization's reputation - VERIFY AND IDENTIFY THE DEFECTS IN ALL OF THE HEAT EXCHANGERS THAT YOU CONDEMN.

### **System Contents:**

- (1) Padded Carrying Case
- (1) 22" 90° Spray Wand (supplied a in protective clear plastic cylinder)
- (1) 12" Extension/Injector
- (1) Flexible Gooseneck UV Flashlight
- (1) Set of Instructions
- (1) AGA Heat Exchanger Leakage Test Hand-out

- (10) Customer Handouts on Why Heat Exchangers Fail
- (1) Plastic Sprayer with Flexible Hose
- (1) Pair of Yellow UV Blocker Safety Glasses
- (1) Break Resistant 11 x 1 inch Inspection Mirror
- (1) Quart of Visible Defects Crack Finder Solution

#### Natural Draft or Induced Draft Furnaces with Clamshell/Serpentine heat exchangers and burners on the bottom (not tubular styles):

**WARNING:** Wear UV Block safety glasses when working with this Visible Defects System.

**CAUTION:** Make sure furnace is cool before applying Visible Defects Crack Finder penetrant. Run blower for a minimum of 15 minutes, after the burners turn off before applying Visible Defects Crack Finder to the heat exchanger. Always have a clean towel available to clean up any Visible Defects Crack Finder drippage that could occur with handling the product.

- 1. Turn off power to the furnace.
- 2. Remove blower assembly from the furnace.
- 3. Place a clean towel in the blower compartment to absorb any Visible Defects Crack Finder that may drip out of furnace.
- 4. Remove the insertion limit from the front panel of the heat exchanger.
- On serpentine heat exchangers with retaining rings, inspect the blower wheel and blower deck for rings that may have popped off the heat exchanger.

Insert your hand around the side of the heat exchanger and feel the retaining rings for rough edges that could indicate cracking or missing rings. **Optional:** Inspect manually the blower compartment with a telescoping extension mirror to view rings and inspect for cracks or missing rings.

- Inspect the visible portions of the heat exchanger through the insertion limit hole and blower compartment using a flashlight and inspection mirrors.
- 7. Remove the burner shields and burners from each cell.
- 8. Visually inspect the visible portions of the heat exchanger from inside the combustion chamber.
- 9. Visible Defects Crack Finder is injected into the furnace cabinet through holes in the front panel and onto the heat exchanger cells using a 22 inch spray wand with the a straight injector. The holes, which need to be 1/8 inch in diameter, exist in the furnace cabinets and front panels of most furnaces. The most obvious examples are existing sheet metal screw holes and the insertion limit hole.
- 10. In addition to the insertion limit hole, locate existing holes in the furnace that occur between the cells of the heat exchanger. Good places to find them are to remove the screws around the perimeter of the inducer assembly and where the front panel screws to the furnace cabinet.
- 11. If enough factory provided holes are not available, consider the following:
  - A. Measure the distance between the centers of the heat exchanger cells.
  - B. Using the center of the insertion limit hole as a starting point, install sheet metal screws in a horizontal line at intervals equal to the distance between the cells of the heat exchanger. Ideally, a sheet metal screw hole is created between each cell of the heat exchanger at the same height as the insertion limit hole.
- 12. Remove cap from quart bottle and assemble sprayer head assembly to quart bottle. Insert the 22 inch spray wand from the Visible Defects Kit through the holes in the front panel. Spray to completely saturate the air side of the heat exchanger with Visible Defects Crack Finder.

Application considerations:

- A. Completely insert the 22 inch spray wand into holes in the front panel. After inserting, spin it between your fingers and slowly move it in and out as you pump the sprayer. Continue straying and slowly remove the spray-bar up to where the tip is almost out of the hole. Repeat between and alongside each cell.
- B. If the furnace is too deep for the 22 inch spray wand, the 12 inch extension/injector will saturate the rear half of the cell. Insert the extension/injector into a hole, move it up down and sideways, while spraying to completely saturate the cells.

- 13. Inspect the combustion side of each cell of the heat exchanger with the supplied black light flashlight and a mirror looking for any evidence of the Visible Defects Crack Finder that may have penetrated a crack or defect in the heat exchanger.
- 14. If no defects are found, reassemble the furnace, dry up any residual Visible Defects Crack Finder in the blower compartment and continue with your normal safety inspection.

**WARNING:** Wear UV Block safety glasses when working with this Visible Defects System.

**CAUTION:** Run blower for a minimum of 10 minutes after applying the penetrant to the heat exchanger before allowing the furnace to cycle again.

- 15. If any cracks or defects are suspected, they must be found, verified and PROVEN for the owner of the furnace. We recommend turning off the fuel valve, turning off the power at the disconnect switch and leaving a customer signed copy of a hazardous appliance tag with the customer.
- **16. IMPORTANT:** When finished with the inspection, dissemble the sprayer top from bottle, reassemble the quart bottle's original leak-proof cap. Pump sprayer dry to prevent a freeze related issue.

# WARNING / CAUTION / ALERT:

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Failure to verify, identify, and show the customer 100% of the defects in the heat exchangers you condemn can compromise your reputation.

We recommend that you follow the dye to the defect and be prepared to show the customer the defect. Then give your customers a copy of "*Why Heat Exchangers Fail*".

Protect your organization's reputation - VERIFY AND IDENTIFY THE DEFECTS IN ALL OF THE HEAT EXCHANGERS THAT YOU CONDEMN.

### Natural Draft or Induced Draft Furnaces with Tubular (exhaust pipe) heat exchangers residential and commercial

**WARNING:** Always wear appropriate eye protection when working with this or any other chemical.

**CAUTION:** Make sure furnace is cool before applying Visible Defects Crack Finder penetrant. Run blower for a minimum of 15 minutes, after the burners turn off before applying Visible Defects Crack Finder to the heat exchanger. Always have clean dry cloths available to clean up any Visible Defects Crack Finder that leaks out of the furnace.

- 1. Turn off power to the furnace.
- 2. Remove blower assembly from furnace.
- 3. Place some clean towels in the blower compartment to absorb any Visible Defects Crack Finder that may drip out of furnace.
- 4. Remove the insertion limit from the front panel of the heat exchanger.
- 5. Remove burner box cover and burners.
- 6. Visually inspect the visible portions of the heat exchanger through the insertion limit hole and blower compartment using a flashlight and inspection mirrors.
- 7. Visible Defects Crack Finder is injected into the combustion chambers of all the cells of the heat exchanger using the spray wand or the spray wand with 12 inch extension/injector or just the extension/injector.
- 8. The heat exchanger is then inspected from the air side with a black light flash-light to see if any Visible Defects Crack Finder penetrates the heat exchanger.
  - A. Look through the insertion limit hole with the supplied black light flashlight and mirrors for any visible detection solution.
  - B. Look up through the blower compartment for any visible detection solution.
  - C. Inspect the condensate system for any visible detection solution.
- 9. If no cracks or defects are found, reassemble the furnace, dry up any residual Visible Defects Crack Finder in the blower compartment and continue with your normal safety inspection.

**WARNING:** Wear UV Block safety glasses when working with this Visible Defects System.

**CAUTION:** Run blower for a minimum of 10 minutes after applying Visible Defects penetrant to the heat exchanger before allowing the furnace to cycle again.

- 10. If any cracks or defects are found they must be identified and shown to the owner of the furnace. We recommend turning off the fuel valve, turning off the power at the disconnect switch and leaving a customer signed copy of a hazardous appliance tag with the customer.
- **11. IMPORTANT:** When finished with inspection, remove the sprayer head from quart bottle and recap quart bottle with original leak-proof cap. Pump sprayer top to remove any chemical in assembly to prevent any potential of freeze damage.

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Below is the industry standard that defines when a heat exchanger or a furnace must be replaced. It was produced by the American Gas Association (AGA). The complete document can be found at www.aga.org using a keyword search for "heat exchanger leakage test".



- AMERICAN GAS ASSOCIATION

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The AGA's *industry standard* states that "The first step in the test procedure involves a visual examination of the heat exchanger." "*Any* visible crack or hole discovered in this step is reason for *requiring* replacement of the heat exchanger or furnace.



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