December, 1986

FACT SHEET

FURNACE HEAT EXCHANGER LEAKAGE TEST

Gas furnaces are known for their safety, performance and longevity. This is due in no small part to their certification testing under nationally recognized standards and their proper installation in accordance with the manufacturer's installation instructions, as required by those standards, and local codes. There have been infrequent reports, however, of gas furnace heat exchanger problems with the potential for flue products to leak into the conditioned space by way of the circulating air ducts.

Until recently there was no really reliable, standardized test procedure for detecting unacceptable heat exchanger leaks that might occur in the field. A number of techniques, including visual examination and detection through the use of smoke bombs, odor tracing and salt spray, were used with partial success but most had undesirable side effects. Some were too sensitive and detected minute, inconsequential openings; some used chemicals that, when entered into the circulating air stream, could stain paint, furniture, draperies, etc.; some were too destructive; some used chemicals that could be left on the heat exchanger surface and accelerate heat exchanger corrosion; and some used gases which, when burned, could produce other gases that have hazardous health effects. In all, the older procedures used to detect heat exchanger openings were too subjective and unreliable, and at times resulted in an unnecessary replacement of the heat exchanger or furnace.

A test procedure was needed that was objective, consistent, simple, accurate, reliable, not harmful to the structure, and capable of being conducted under realistic operating conditions. To develop such a procedure the Gas Appliance Manufacturers Association (GAMA) initiated a research project in 1980 that was continued with support from the Gas Research Institute (GRI). The research work was conducted by the American Gas Association Laboratories in Cleveland, Ohio, and resulted in the "Recommended Three-Step Method for Detecting Unacceptable Flue Gas Leakage From Furnace Heat Exchangers."

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The equipment needed for this procedure includes:

- A tracer gas mixture of 14.3% non-odorized methane in nitrogen. This mixture is available from specialty gas distributors and should be obtained in a cylinder size that can easily be carried by a service person.
- A single stage regulator/flowmeter (O-30 cfh) for the gas cylinder.
- A suitably calibrated combustible gas detector.
- Calibration gas for the gas detector, 200 ppm CO in nitrogen, or combustible gas detector manufacturer's recommendation of equivalent methane and nitrogen mixture.
- Stainless steel tubing for the injection probe, ¼ inch diameter, 12 inches long.

The first step in the test procedure involves a visual examination of the heat exchanger. Loose particles that may have built up on surfaces of the heat exchanger are cleaned away. Using a mirror and a flashlight, the internal sections are inspected for signs of split seams, open cracks and severe deteriorations. Joints between the flue gas passageways of the heat exchanger and other parts of the furnace are examined. If construction is such that a portion of the heat exchanger or flue gas passageway is in the cold air return compartment, special care is taken in examination of these parts.

Since access for visual inspection of the heat exchanger is frequently limited by evaporator coils and the like, a removable inspection plate, access panel or heat register on the plenum is helpful in viewing the heat exchanger from the circulating air side. Any visible crack or hole discovered in this step is reason for requiring replacement of the heat exchanger or furnace.

The second step involves igniting the pilot and main burner and observing the flame pattern before and after the blower is turned on: specifically for any floating flames, flame roll-out or flame distortion. These conditions indicate a possible split seam, open crack, severe deterioration of the heat exchanger or gasketing material, or physical separation of the connected parts. Disturbance of the flame by the blower under this step

is reason for requiring repair or replacement of the heat exchanger or furnace. (Repairs must be limited to regasketing or tightening of parts.)

In preparation for the third step of the method, conducting the methane (CH_4) tracer procedure, access to the circulating air side of the system is needed. Either a warm air register in the plenum of the furnace is used or a suitable size hole is made in the plenum approximately 3 inches above the top of the heat exchanger. If it is not possible to achieve the 3-inch clearance, any opening as close to the heat exchanger as possible is acceptable; however, if the opening is located at 'a higher level, more time is allowed for a reaction. If there is an air conditioning cooling coil, the hole is located on the heat exchanger side of the coil. If not practical, the hole is to be located as close to the top of the coil as possible. Care is to be taken in making this hole to avoid damaging the cooling coil. In the case of downflow furnaces, the blower compartment must be accessible. For horizontal furnaces, either the blower compartment or warm air outlet may be used depending on the duct configuration.

With the access opening prepared, the third step of the procedure is carried out as follows:

1. The furnace is allowed to operate at least 5 minutes.

2. The vent connector is checked for any blockage.

3. Next the main burner, pilot and power supply to the unit are turned off and the balance of the procedure is conducted quickly while the heat exchanger is warm.

4. The gas detector probe is inserted into the selected access opening in the plenum and any background disturbance is nulled out.

5. The injector probe for the tracer gas is placed in the bottom of a heat exchanger section. The flow rate of the tracer gas is adjusted to 7 cubic feet per hour (cfh). This flow rate is maintained throughout the testing. For multiple section heat exchangers, the flow rate is adjusted to 7 cfh per section, and all systems are tested simultaneously.

6. As the heat exchanger is flooded, the gas detector probe is moved back and forth across the top of the heat exchanger section for a minimum of 2 minutes.

7. If an unacceptable leak is present, the calibrated indicator light will come on.

   - If the frequency of ticking of the detector increases during the probing period, but the indicator light does not go on, the heat exchanger is acceptable.

   - If the indicator light goes on, the leakage rate is unacceptable and the source of the leak should be confirmed by further probing. Repair or replacement of the heat exchanger or furnace is necessary. (Repairs must be limited to regasketing or tightening of parts.)

8. The above procedures (Nos. 5 through 7) are repeated with the remaining heat exchanger sections.

9. If no reason for corrective action is indicated, the pilot is relighted and the furnace is returned to a ready condition in accordance with the manufacturer's instructions. Any access opening made in the furnace plenum to conduct the test must then be sealed properly.

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The procedure above is based upon GRI topical report 84/0162 available from GRI, 8600 Bryn Mawr Avenue, Chicago, Illinois 60631 (312/399-810).

The above procedure was field tested by 7 major gas utilities during the 1982-83 heating season and was reported by them to be a major improvement over other methods.