

**2009 Guideline for
Induced Draft Furnace Heat
Exchanger Inspection**



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FOREWORD

Gas Furnaces are known for their safety, performance and longevity. This is largely due to their certification to nationally recognized safety standards and the building standards and codes that require equipment be installed according to the manufacturers' installation instructions.

AHRI recognizes that despite the excellent safety record of gas furnaces, there have been infrequent reports of gas furnace heat exchanger problems. To address these situations, an industry-accepted procedure known as the "Three-Step Method for Detecting Unacceptable Flue Gas Leakage from Furnace Heat Exchangers" has been used since the early 1980's to conduct field inspections of gas-fired furnace Heat Exchangers. Though this procedure has been effective for testing Heat Exchangers in natural draft Furnaces, its effectiveness for testing Heat Exchangers on induced draft Furnaces that maintain a significant negative pressure within the Heat Exchanger has been questioned. Though it is unlikely for an induced draft Furnace to leak flue products from the Heat Exchanger to the circulated airstream, this guideline outlines a new test procedure to enhance the existing three-step methodology to make it more applicable, reliable and repeatable for the inspection of induced draft furnace Heat Exchangers.

Note:

This is a new AHRI Guideline.

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INDUCED DRAFT FURNACE HEAT EXCHANGER INSPECTION

Section 1. Purpose

1.1 Purpose. The purpose of this guideline is to outline a test procedure for the inspection of induced draft furnace heat exchangers.

1.1.1 Intent. This guideline is intended for the guidance of the industry, including gas utility companies, government authorities, manufacturers, engineers, building inspectors, building code officials, installers, and contractors.

1.1.2 Review and Amendment. This guideline is subject to review and amendment.

Section 2. Scope

This guideline applies to the inspection of induced draft furnace heat exchangers.

Section 3. Definitions

All terms in this document follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, and Refrigeration* unless otherwise defined in this section.

3.1 Blower. A device for moving air by two or more blades or vanes attached to a rotating shaft.

3.2 Burner. Part of a furnace where flame is produced.

3.3 Flue Gas. All gases in a flue during combustion in the combustion chamber, including reacting products such as excess air, carbon dioxide, carbon monoxide, oxygen, water vapor, nitrogen, and other inerts.

3.4 Furnace. An enclosed chamber or structure in which heat is produced, as by burning fuel.

3.5 Heat Exchanger. A device to transfer heat between two physically separated fluids.

3.6 Induced Draft. Fan exhaust of hot gases from the heat absorbing equipment.

3.7 PPM. Parts per million.

3.8 Return Air. Air extracted from a space, and totally or partially returned to an air-conditioning, heating or ventilating apparatus.

3.9 Should. . “Should” is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.10 Static Pressure. Pressure exerted by a fluid at rest.

3.11 Supply Air. Air entering a space from an air-conditioning, heating, or ventilating apparatus.

Section 4. Five-Step Method

This procedure is intended for use by qualified individuals trained and experienced in the servicing of an induced draft Furnace. All instrumentation used in the execution of this procedure must be in good working condition and calibrated appropriately. A gas analyzer capable of measuring carbon monoxide (CO) concentration with 1 ppm resolution is required for this procedure.

4.1 *Look for Flame Disturbances.* Start the Furnace and observe any changes in the flame pattern as the circulating air blower starts operating. Look for 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. Flame disturbance that occurs after the Blower comes on is a good indication that a Heat Exchanger problem may exist.

Other air leaks in the vicinity of the Burners may also cause flame disturbances and should be corrected. If these disturbances are significant and cannot be corrected by eliminating the air leaks near the Burners, refer to 4.5 for physical inspection of the Heat Exchanger. If no flame disturbances are observed, proceed to 4.2.

4.2 *Measure CO levels in the Airstream¹.* After the Furnace has run for at least five minutes, measure the CO level in the return airstream near the Furnace and record the value. Then measure the CO level in the supply airstream at a location in the system where the air is well mixed. Generally, a location downstream of one or more bends in the ductwork is a good place to take the sample for this measurement. Record this value.

- a) If there is no measurable difference in the CO in the Return and Supply Air, it is likely the Furnace is not leaking CO into the air stream. If the measured value is below 9 ppm, the Occupational Health and Safety Act (OHSA) acceptable maximum, proceed to 4.3.
- b) If there is no difference in the CO concentration between the Return and Supply Air, but there is CO detected in the air stream above 9 ppm, there may be another source of CO in the home such as other gas-fired appliances, an automobile operating in a garage, or a fireplace in operation. Discuss the elevated CO levels and the possible sources with the home owner.
- c) If the CO in the Supply Air is less than the CO in the Return Air, it is possible that there is an error in the measurement or that the measurement is being diluted by a ventilation or fresh air intake. Repeat 4.2 with a different gas analyzer if possible.
- d) If the CO in the Supply Air is greater than the CO in the return air, it is possible that the Furnace is generating the CO that is leaking into the airstream. Proceed to 4.5.

4.3 *Measuring CO levels in Flue Pipe.* Allow the Furnace to run for at least five minutes. Then measure the CO in the flue pipe, using a properly calibrated combustion analyzer. If the CO reading is less than 200 ppm, no further action is necessary. If the CO reading is 200 ppm or higher, proceed to 4.4.

4.4 *Verifying Proper Installation.* Verify that the furnace installation complies with the manufacturer's requirements and any applicable codes. Refer to the manufacturer's installation instructions if available. Verify the gas orifice size, pressure switch settings, gas input rate and manifold pressure, proper conversion for fuel type and altitude (if applicable), vent lengths, duct static pressure and the provision for adequate combustion air to the Furnace. Check the Furnace for any damaged or disconnected wires or hoses. Check for misaligned Burners. Inspect the vent system and combustion air pipe (if applicable) to check for holes or blockage.

Make corrections as necessary and then re-check CO in a flue gas sample. If the CO is still at 200 ppm or higher in the Flue Gas, proceed to 4.5.

4.5 *Visually Inspect Heat Exchanger.* Disassemble the Furnace until you can visually inspect all heat exchanger exterior surfaces. Any crack or hole that is big enough to affect combustion will be easily visible to the naked eye. Do not use water,

¹ NOTE: To ensure accuracy of the measurements, take the following precautions:

- 1. Take the Return Air measurement after and the Supply Air measurement before any fresh air, ventilation, humidification and/or dehumidification connections.
- 2. Take more than one reading and average the results to obtain the CO level.

cameras or smoking agents to check for leaks. Furnace heat exchangers joints are not hermetically sealed, so a small amount of leakage is normal. If there are any abnormal splits, cracks or holes, the heat exchanger must be replaced.

Note: If the inspection described in 4.5 does not show holes, cracks or separated seams, further investigation is necessary to determine the source of the CO contamination.

APPENDIX A. REFERENCES - NORMATIVE

None.

APPENDIX B. REFERENCES - INFORMATIVE

B1 Listed here are standards, handbooks, and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of this guideline.

B1.1 *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, and Refrigeration*, Second Edition, 1991, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.