

AHRI Guideline X

2023 Guideline for

Induced Draft Furnace Heat Exchanger Inspection



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IMPORTANT

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AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk.

Note:

This guideline supersedes AHRI Guideline X-2009.

AHRI CERTIFICATION PROGRAM DISCLAIMER

AHRI Standards are developed independently of AHRI Certification activities and can have scopes that include products that are not part of the AHRI Certification Program. The scope of the applicable AHRI Certification Program can be found on AHRI's website at <http://www.ahrinet.org>.

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, contractors, and trained and qualified technicians.

Review and Amendment

This guideline is subject to review and amendment as technology advances.

2023 Edition

This edition of AHRI Guideline X, *Induced Draft Furnace Heat Exchanger Inspection*, was prepared by the Furnaces Standards Technical Committee. The guideline was approved by the Unitary Standards Subcommittee in June 2023.

Origin and Development of AHRI Guideline X

The initial publication was AHRI Guideline X-2009, *Induced Draft Furnace Heat Exchanger Inspection*.

Summary of Changes

AHRI Guideline X-2023 contains the following update(s) to the previous edition:

- Update to intent
- Update definitions to align with the current ASHRAE definitions
- Revisions to OSHA guidelines to align with current OSHA regulations.
- Update to Section [4.2](#)

Committee Personnel
Furnaces Standards Technical Committee

Participant	Interest Category	Voting Role	State / Province / Country
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Madan Baral Revcor, Inc.	Product Manufacturer	Primary	IL, USA
Doug Bennett CSA America Testing & Certificate LLC	Testing Laboratory	Primary	OH, USA
Scott Creamer Rheem Manufacturing Company	Product Manufacturer	Primary	AR, USA
Robert Glass Daikin Comfort Technologies	Product Manufacturer	Primary	AL, USA
Thomas Gort Trane Technologies	Product Manufacturer	Primary	TX, USA
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Aniruddh Roy Energy Solutions	Product Manufacturer	Primary	AB, Canada
Phillip Stephens WM Technologies, LLC	Product Manufacturer	Primary	IN, USA
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Judd Smith CSA America Testing & Certificate LLC	Testing Laboratory	Alternate to Doug Bennett	OH, USA
Mark Swanson WM Technologies, LLC	Product Manufacturer	Alternate to Phillip Stephens	IN, USA
Antonio Romeo	AHRI Staff Liaison		

Furnaces Standards Technical Committee Scope:

The Furnace Standards Technical Committee is responsible for the development and maintenance of AHRI standards and guidelines pertaining to Induced Draft Furnace Heat Exchanger Inspection.

The following product types are out of scope for this STC: Unitary Small Equipment, Packaged Terminal AC/HP, Commercial or Industrial AC/HP, Variable Refrigerant Systems (VRF), Geothermal and Water Source HP, Single Package Vertical Unit (SPVU), and Performance Rating of Zoning products.

For product definitions refer to the AHRI website sector pages.

Unitary Standards Subcommittee

Name	Interest Category	Voting Role	Country
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Dana Fischer Mitsubishi Electric Cooling & Heating	Product Manufacturer	Primary	GA, USA
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Unitary Standards Subcommittee Scope:

The scope of the Unitary Standards Subcommittee is standards and guidelines related to the end products that are part of the AHRI Unitary Industry Sector. (The definition of and list of products associated with each sector are found on the AHRI website sector pages.

These lists represent the membership at the time the Standards Technical Committee and Standards Subcommittee were balloted on the final text of this edition. Since that time, changes in the membership may have occurred. Membership on these committees shall not in and of itself constitute an endorsement by the committee members or their employers of any document developed by the committee on which the member serves.

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INDUCED DRAFT FURNACE HEAT EXCHANGER INSPECTION

Section 1. Purpose

This guideline outlines a test procedure for the inspection of *induced draft furnace heat exchangers*.

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 ASHRAE Terminology website unless otherwise defined in this section.

3.1 Expression of Provisions

Terms that provide clear distinctions between requirements, recommendations, permissions, options, and capabilities.

3.1.1 “Can” or “cannot”

Express an option or capability.

3.1.2 “May”

Signifies a permission expressed by the document.

3.1.3 “Must”

Indication of unavoidable situations and does not mean that an external constraint referred to is a requirement of the document.

3.1.4 “Should” or “should not”

Indication of recommendations rather than requirements. In the negative form, a recommendation is the expression of potential choices or courses of action that is not preferred but not prohibited.

3.2 Guideline Specific Definitions

3.2.1 Circulating Air Blower

A device for moving air using an impeller attached to a rotating shaft.

3.2.2 Burner

Part of a *furnace* where flame is produced.

3.2.3 Flue Gas

All gases in a flue during combustion in the combustion chamber, including reacting products such as carbon dioxide, carbon monoxide, oxygen, water vapor, nitrogen, and other inert gases.

3.2.4 Furnace

An appliance where heat is produced, as by burning fuel, and circulated throughout a building through a ducted distribution system for space heating.

3.2.5 Heat Exchanger

A device to transfer heat between two physically separated fluids.

3.2.6 Induced Draft

Fan exhaust of hot gases from the heat absorbing equipment.

3.2.7 PPM

Parts per million.

3.2.8 Return Air

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

3.2.9 Static Pressure

Pressure exerted by a fluid at rest.

3.2.10 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 working condition and calibrated. 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 can indicate one or more of the following conditions: 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 *circulating air blower* comes on can be an indication that a *heat exchanger* problem exists.

Other air leaks in the vicinity of the *burners* can cause flame disturbances and should be corrected. If these disturbances cannot be corrected by eliminating the air leaks near the *burners*, refer to Section [4.5](#) for physical inspection of the *heat exchanger*. If no flame disturbances are observed, proceed to Section [4.2](#).

4.2 Measure CO Levels in the Airstream

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

- 1) Start the measuring equipment in accordance with the test equipment manufacturer's instructions.
- 2) Take an ambient air measurement inside the conditioned space for comparison purposes to the *return air* measurements.
- 3) Take the *return air* measurement after and the *supply air* measurement before any fresh air, ventilation, humidification, or dehumidification connections.
- 4) Take more than one reading and average the results to obtain the CO level.

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. For example, 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.

- 1) If there is no measurable difference in the CO in the *return air* and *supply air*, this indicates that the *furnace* is not leaking CO into the air stream. If the measured value is below 9 *ppm* proceed to Section [4.3](#).
- 2) 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 a dislodged or blocked vent, proceed to Section [4.4](#).
- 3) 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*, and there is not a dislodged or blocked vent look for 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 potential sources with the homeowner.

- 4) If the CO in the *supply air* is less than the CO in the *return air*, there can be an error in the measurement or that the measurement is being diluted by a ventilation or fresh air intake. Repeat Section [4.2](#) with a different gas analyzer if possible.
- 5) If the CO in the *supply air* is greater than the CO in the *return air*, although unlikely, the *furnace* can generate the CO that is leaking into the airstream. Proceed to Section [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 calibrated combustion analyzer. If the CO reading is less than 200 *ppm*, no further action is needed. If the CO reading is 200 *ppm* or higher, proceed to Section [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 minimum 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 if needed 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 Section [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 is visible to the naked eye. Do not use water, cameras, or smoking agents to check for leaks. *Furnace heat exchangers* joints are not hermetically sealed, so a small amount of leakage can occur. Replace the *heat exchanger* or the *furnace* if there are any splits, cracks or holes.

Note: If the inspection described in Section [4.5](#) does not show holes, cracks or separated seams, further investigation is advised to determine the source of the CO contamination.

APPENDIX A. REFERENCES - INFORMATIVE

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 the guideline.

- A.1. ASHRAE Terminology. ASHRAE. Accessed September 8, 2022. <https://www.ashrae.org/technical-resources/authoring-tools/terminology>.