

## Nonresidential Appendix NA2

# Appendix NA2 – Nonresidential Field Verification and Diagnostic Test Procedures

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### NA2.1 Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems

#### NA2.1.1 Purpose and Scope

1. NA2.1 contains procedures for field verification and diagnostic testing for air leakage in single zone, constant volume, nonresidential air distribution systems serving zones with 5000 ft<sup>2</sup> of conditioned floor area or less as required by Standards section 140.4(l).
2. NA2.1 procedures are applicable to new space conditioning systems in newly constructed buildings and to new or altered space conditioning systems in existing buildings.
3. NA2.1 procedures shall be used by installers, HERS Raters, and others who perform field verification of air distribution systems as required by Standards Section 140.4(l).
4. Table NA2.1-1 provides a summary of the duct leakage verification and diagnostic test protocols included in Section NA2.1, and the compliance criteria.

#### NA2.1.2 Instrumentation Specifications

The instrumentation for the air distribution diagnostic measurements shall conform to the following specifications:

##### **NA2.1.2.1 Pressure Measurements**

All pressure measurements shall be measured with measurement systems (i.e. sensor plus data acquisition system) having an accuracy of plus or minus 0.2 Pa. All pressure measurements within the duct system shall be made with static pressure probes, Dwyer A303 or equivalent.

##### **NA2.1.2.2 Duct Leakage Measurements**

All measurements of duct leakage airflow shall have an accuracy of plus or minus 3 percent of measured airflow or better using digital gauges.

##### **NA2.1.2.3 Calibration**

All instrumentation used for duct leakage diagnostic measurements shall be calibrated according to the manufacturer's calibration procedure to conform to the accuracy requirement specified in Section NA2.1.2.

## NA2.1.3 Diagnostic Apparatus

**NA2.1.3.1 Apparatus for Duct Pressurization and Leakage Flow Measurement**

The apparatus for duct system pressurization and duct system leakage measurements shall consist of a duct system pressurization and leakage airflow measurement device meeting the specifications in Section NA2.1.2.

**NA2.1.3.2 Apparatus for Smoke-Test of Accessible-Duct Sealing (Existing Duct Systems)**

The apparatus for determining leakage in and verifying sealing of all accessible leaks in existing duct systems provide means for introducing controllable amounts of non-toxic visual or theatrical smoke into the duct pressurization apparatus for identifying leaks in accessible portions of the duct system. The means for generating smoke shall have sufficient capacity to ensure that any accessible leaks will emit visibly identifiable smoke.

## NA2.1.4 Verification and Diagnostic Procedures

**NA2.1.4.1 Nominal Air Handler Airflow**

The nominal air handler airflow used to determine the target leakage rate for compliance for an air conditioner or heat pump shall be 400 cfm per rated ton of cooling capacity. Nominal air handler airflow for heating-only system furnaces shall be based on 21.7 cfm per kBtu/hr of rated heating output capacity.

**NA2.1.4.2 Diagnostic Duct Leakage**

Diagnostic duct leakage measurement shall be used by installers and HERS Raters to verify that duct leakage meets the compliance criteria for sealed duct systems for which field verification and diagnostic testing is required. Table NA2.1-1 summarizes the leakage criteria and the diagnostic test procedures that shall be used to demonstrate compliance.

*Table NA2.1-1 – Duct Leakage Verification and Diagnostic Test Protocols and Compliance Criteria*

Case	User and Application	Leakage Compliance Criteria, (% of Nominal Air Handler Airflow)	Procedure(s)
Sealed and tested new duct systems	Installer Testing HERS Rater Testing	6%	NA2.1.4.2.1
Sealed and tested altered existing duct systems	Installer Testing HERS Rater Testing	15%	NA2.1.4.2.1
Sealed and tested altered existing duct systems	Installer Testing and Inspection HERS Rater Testing and Verification	Fails Leakage Test but All Accessible Ducts are Sealed Inspection and Smoke Test with 100% Verification	NA2.1.4.2.2 NA2.1.4.2.3 NA2.1.4.2.4

**NA2.1.4.2.1 Diagnostic Duct Leakage from Fan Pressurization of Ducts**

The objective of this procedure is for an installer to determine and a HERS Rater to verify the leakage of a new or altered duct system. The duct leakage shall be determined by pressurizing the entire duct system ducts to 25 Pa (0.1 inches water) with respect to outside. The following procedure shall be used for the fan pressurization tests:

- (a) Verify that the air handler, supply and return plenums and all the connectors, transition pieces, duct boots, and registers are installed, and ensure the following locations have been sealed:

1. Connections to plenums and other connections to the air-handling unit.

2. Refrigerant line and other penetrations into the air-handling unit.
3. Air handler access door or panel (do not use permanent sealing material, metal tape is acceptable).

The entire duct system including the air- handler shall be included in the test.

- (b) For newly installed or altered ducts, verify that cloth backed rubber adhesive duct tape has not been used.
- (c) Temporarily seal all the supply registers and return grilles, except for one large centrally located return grille or the air handler cabinet access door or panel. Verify that all outside air dampers and/or economizers are sealed prior to pressurizing the system.
- (d) Attach the fan flowmeter device to the duct system at the unsealed return grille or the air handler cabinet access door or panel.
- (e) Install a static pressure probe at a supply register located close to the air handler, or at the supply plenum.
- (f) Adjust the fan flowmeter to produce a positive 25 Pa (0.1 inches water) pressure at the supply register or the supply plenum with respect to the outside or with respect to the building space with the entry door open to the outside.
- (g) Record the flow through the flowmeter, this is the duct leakage flow at 25 Pa (0.1 inches water).
- (h) Divide the duct leakage flow by the nominal air handler airflow determined by the procedure in Section NA2.1.4.1 and convert to a percentage. If the duct leakage flow percentage is equal to or less than the target compliance criterion from Table NA2.1-1, the system passes.

#### **NA2.1.4.2.2 Sealing of All Accessible Leaks**

For altered existing duct systems that are unable to pass the leakage test in Section NA2.1.4.2.1, the objective of this test is to verify that all accessible leaks are sealed. The following procedure shall be used:

- (a) Complete the leakage test specified in Section NA2.1.4.2.1.
- (b) Seal all accessible ducts.
- (c) After sealing is complete, again use the procedure in NA2.1.4.2.1 to measure the leakage after duct sealing.
- (d) Complete the Smoke Test as specified in NA2.1.4.2.3.
- (e) Complete the Visual Inspection as specified in NA2.1.4.2.4.

All duct systems that fail to pass the leakage test specified in Section NA2.1.4.2.1 shall be tested and inspected by a HERS Rater to verify that all accessible ducts have been sealed and damaged ducts have been replaced. Compliance with HERS verification requirements shall not utilize group sampling procedures when the installer used the Sealing of All Accessible Leaks procedure in Section NA2.1.4.2.2.

#### **NA2.1.4.2.3 Smoke-Test of Accessible-Duct Sealing**

For altered existing ducts that fail the leakage tests, the objective of the smoke test is to confirm that all accessible leaks have been sealed. The following procedure shall be used:

- (a) Inject either theatrical or other non-toxic smoke into a fan pressurization device that is maintaining a duct pressure difference of 25 Pa (0.1 inches water) relative to the duct surroundings, with all grilles and registers in the duct system sealed.
- (b) Visually inspect all accessible portions of the duct system during smoke injection.
- (c) The system shall pass the test if one of the following conditions is met:
  1. No visible smoke exits the accessible portions of the duct system.

2. Smoke only emanates from the furnace cabinet which is gasketed and sealed by the manufacturer and no visible smoke exits from the accessible portions of the duct system.

#### **NA2.1.4.2.4 Visual Inspection of Accessible Duct Sealing**

For altered existing duct systems that are unable to pass the leakage test in Section NA2.1.4.2.1, the objective of this inspection in conjunction with the smoke test (Section NA2.1.4.2.3) is to confirm that all accessible leaks have been sealed. Visually inspect to verify that the following locations have been sealed:

- (a) Connections to plenums and other connections to the air-handling unit.
- (b) Refrigerant line and other penetrations into the air-handling unit.
- (c) Air handler access door or panel (do not use permanent sealing material, metal tape is acceptable).
- (d) Register boots sealed to surrounding material.
- (e) Connections between lengths of duct, as well as connections to takeoffs, wyes, tees, and splitter boxes.