



Setting the Standards for
Home Energy Efficiency

Results of RESNET Board Ballot on Adopting Amendments to RESNET Gas Leakage Testing Provisions of Chapter 8

March 15, 2013

Shall the RESNET Board adopt the amendments to the RESNET Gas Leakage Testing provisions of Chapter 8 (Attachment A)?

Yes (19)

No (0)

Abstain (0)

Not Voting (1)

Ben Adams
Jacob Atalla
David Beam
Dave Bell
Steve Byers
Dennis Creech
Brett Dillon
Philip Fairey
David Goldstein
Andy Gordon
Roy Honican
Mark Jansen
Lee O'Neal
Jim Petersen
Nancy St. Hilaire
Paul Stalknecht
Dennis Stroer
Joseph Triolo
Barb Yankie

Greg Thomas

The amendments were adopted.

Attachment A

Proposed Amendment: Revisions to Chapter 8 Sections 806-808

Proponent: RESNET Technical Committee

Applies to: Mortgage Industry National Home Energy Rating Systems Standards

Proposed Amendment:

806 GAS LEAKAGE TEST

The Auditor shall use a gas detector upon entry into the home to detect the presence of natural gas.

806.1 If there is a noticeable odor indicating gas buildup within the home, or the LEL exceeds 10%, the occupants and Auditor shall leave the house and the appropriate authorities and utility providers shall be notified from outside the home.

~~**806.2** The Auditor should use a gas detector upon entry into the home to detect the presence of natural gas. If gas is suspected or confirmed, ensure that switches are not operated while exiting and no ignition concerns are present.~~ The audit shall not proceed until the proper authorities have deemed it safe to re-enter the home. If there is no noticeable odor indicating gas buildup within the home, the Auditor shall determine if there are gas leaks in the fittings and connections of natural gas appliances within the home and natural gas/liquid propane supply lines as follows~~following these protocols.~~

806.1 Equipment needed

- Combustible gas detector
 - Must be intrinsically safe. It is essential that the instrument being used to detect gas leaks will not cause a spark.
 - Must have an adjustable tick rate. The tick rate provides the indication of concentration.
 - Gas leak detectors are prone to false positive signals from humidity and it is essential to have the ability to zero ambient conditions to trace the location of a leak.
 - Must provide an alarm when detecting the LEL exceeds 10%.
 - Must be calibrated in accordance with the manufacturers recommendations, or at least annually, whichever is the greater frequency.
 - Must be labeled with a calibration sticker, noting at a minimum the date of last calibration.
- Leak detection fluid (non-corrosive)
- MSDS Sheet for the leak detection fluid

3

806.2 Leak Inspection

Inspect all fittings and joints in supply lines and appliance connectors and confirm suspected leaks with leak-detection fluid. Identify for ~~repair or~~ replacement any kinked, corroded or visibly worn flexible gas lines and any flexible connectors manufactured prior to 1973~~1974~~.

806.2.1 When entering a confined space containing LP gas distribution pipes, test the ambient air at or near (within 6 inches of) the floor level.

807 CARBON MONOXIDE (CO) TESTING

807.1 CO testing of ambient air shall be performed when initially entering a property, when first entering any CAZ, and while performing a Worst Case Depressurization Test and/or under natural conditions, the tests as required by paragraph 807.14 sections 806 through 808.

807.2 Equipment required

806.4 Equipment needed

Combustible gas detector

807.2.1 Equipment used for testing ambient air for carbon monoxide (CO) shall:

- Be capable of measuring carbon monoxide (CO) levels from 0 to at least 50020 ppm (parts per million)
- Leak detection fluid (non-corrosive)
- Have a resolution of 1 ppm
- Have an accuracy rate of +/- 5 ppm
- Have an audible alarm at 35 ppm
- Be calibrated in accordance with the manufacturers recommendations or annually whichever is the greater frequency and evidence of the calibration shall be submitted to the Rating Provider Quality Assurance Designee
- Must be labeled with a calibration sticker indicating at a minimum the date of last calibration.
- A combustion analyzer may NOT be used for personal safety unless it is certified by the manufacturer as suitable for personal protection.

807.2.2 Equipment used for testing CO in the flue of combustion appliances

- Must be suitable for combustion gas analysis
- Have a resolution of 1 ppm
- Have an accuracy rate of +/- 5 ppm or better
- Have an operating range of at least 0 – 2000 ppm
- Be calibrated in accordance with the manufacturers recommendations or annually whichever is the greater frequency and evidence of the calibration shall be submitted to the Rating Provider Quality Assurance Designee
- Must be labeled with a calibration sticker indicating at a minimum the date of last calibration

807.3 Zero all carbon monoxide detectors outside the building away from any combustion outlets or automobile traffic areas, or in accordance with manufacturer's instructions.

807.4 If ambient CO levels exceed 35 ppm at any time during combustion appliance testing, stop any testing and turn off combustion appliances. Open all the exterior doors and windows. No one should enter the home until the CO levels drop below 35 ppm. The combustion

appliance causing the increase in CO levels must be repaired by a qualified technician prior to completing the combustion appliance tests, unless there is proposed work that calls for replacement of the appliance(s).

807.5 All CO measurements, with the exception of ambient air measurements, shall be adjusted to air free values either using the built-in capabilities of the test equipment or using the following equation and O₂ measurement (in ppm).

$$\text{CO Air Free} = \text{CO} \times \frac{20.9}{20.9 - \text{O}_2}$$

Equation (807.1)

-Worst Case

808 APPLIANCE VENTING (STANDARDIZED DEPRESSURIZATION) TEST

This test procedure measures the pressure in the Combustion Appliance Zones (CAZ) and provides visual evidence of venting potential. A CAZ is an enclosed space inside or outside the building envelope that contains a combustion device that uses air from the CAZ for combustion and shares a common wall, floor, ceiling or duct system with the conditioned space. Combustion devices include (but

if there are not limited to): furnaces, boilers, water heaters, solid fuel stoves and fireplaces.

Vented any vented combustion appliances that use air from inside the conditioned space boundary and/or air to vent combustion gases and which are not classified as a Category I or II according to NFPA standard 54 58, and 31 (i.e., an appliance that operates with, then a nonpositive vent static pressure) worst case depressurization test shall require an Appliance Venting (Standardized Depressurization) test to be performed using the following protocol in Section 808.

807

808.1 Equipment Needed

- one or more manometer(s) with a resolution of 0.1 Pa or better and an accuracy of +/- 0.2 Pa or better
- smoke pencils or other smoke visualization equipment
- an exhaust fan and flow meter system that can control exhaust flows with an accuracy of +/- 10 cfm or better (only required for homes with fireplaces and/or solid fuel stoves)

Check

808.2 Visually inspect the CAZ combustion appliance zone for the presence of flammable or explosive material near a combustion source. If present, remove these materials.

~~808.3 Inspect the heating system and 807.2 Visually inspect~~ venting system for proper vent type, size and horizontal pitch following the requirements of NFPA-54, 58 and 31. Determine and determine there is no blockage or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition. If an unsafe condition exists the Auditor shall not complete the other combustion safety tests.

~~807.2.1 Inspect burners and crossovers for blockage and corrosion.~~

~~807.2.808.4~~ Begin to measure the CO level in the CAZ using the equipment and test procedures of Section 807. Continue to measure the CO level for the remainder of this test procedure and halt the test procedure if CO rises above 35 ppm in the CAZ.

808.5 Put the home into BASELINE conditions by:

~~2 Inspect furnace heat exchangers for cracks, openings or excessive corrosion.~~

807.3 Close

808.5.1 Closing all the exterior doors and windows of the home.

808.5.2 Closing~~807.4 Close~~ fireplace damper(s) if fireplace is present.

~~808807.5.3~~ Opening all~~Close any~~ interior doors ~~between the CAZ and the remainder of the house~~, ensuring that all vented appliances and exhaust fans have been turned off. Close the door to the CAZ unless the combustion appliance is located in the conditioned space. If the CAZ is in an enclosed utility room or is in a closet the door shall be closed. Turn off all forced air system blowers.

~~808807.6~~ Measure the BASELINE~~baseline~~ pressure difference for~~between~~ the CAZ with respect to (WRT) outside. ~~_(ambient) and baseline CO levels. Set the gauge to read pressure and record the baseline pressure.~~

~~808807.7~~ Turn on all exhaust fans in the home¹ (kitchen range hood, bath exhaust, clothes dryer, etc.) that exhaust air outside the building envelope.

808.8 If one or more fireplaces or solid fuel stoves are present that are not direct vent appliances use the formulas or the tables shown below to determine the CAZ pressure adjustments.

~~807.8 Record pressure in CAZ with respect to Outside.~~

~~807.9 Turn on the air handler. Record pressure in CAZ with respect to outside. If air handler makes the CAZ more positive (or less negative), turn it off. If the air handler is kept on, close interior doors to any rooms that have no return registers.~~

¹ Excluding whole house exhaust fans used for cooling

807.10 If fireplace is present install blower door and set to exhaust 300 CFM to simulate fireplace in operation.

807.11 Record net change in pressure difference within the

808.8.1 For an open hearth fireplace the pressure adjustment P_{adj} shall either be calculated using Equation 808.1 or determined using Table 808.1, where the CFM50 value is the envelope leakage determined from Section 802 of this standard.

$$P_{adj} = 330,000 \times CFM50^{-1.54} \quad \text{Equation 808.1}$$

Table 808.1 CAZ Pressure Adjustments for open hearth fireplaces²

CFM50	P_{adj} (Pa)
500	23
1000	7.8
1500	4.3
2000	2.7
2500	1.9
3000	1.4
3500	1.1
4000	0.9
4500	0.8
5000	0.7

808.8.2.1 For a solid fuel stove or fireplace with glass doors the pressure adjustment P_{adj} shall either be calculated using Equation 808.2 or determined using Table 808.2, where the CFM50 value is the envelope leakage determined from Section 802 of this standard.

$$P_{adj} = 60,000 \times CFM50^{-1.54} \quad \text{Equation 808.2}$$

Table 808.2 CAZ Pressure Adjustments for solid fuel stoves or fireplaces with glass doors

CFM50	P_{adj} (Pa)
500	4.2
1000	1.4
1500	0.8
2000	0.5

² In the shaded areas of Table 807.2 the home fails the CAZ test and no further testing is required.

<u>2500</u>	<u>0.4</u>
<u>3000</u>	<u>0.3</u>
<u>3500</u>	<u>0.2</u>
<u>4000</u>	<u>0.2</u>
<u>4500</u>	<u>0.1</u>
<u>5000</u>	<u>0.1</u>

808.8.3 For an EPA listed airtight stove the pressure adjustment P_{adj} shall either be calculated using Equation 808.3 or determined using Table 808.3, where the CFM50 value is the envelope leakage determined from Section 802 of this standard.

$$P_{adj} = 9400 \times CFM50^{-1.54} \quad \text{Equation 808.3}$$

Table 808.3 CAZ Pressure Adjustments EPA listed airtight stoves

<u>CFM50</u>	<u>P_{adj} (Pa)</u>
<u>500</u>	<u>0.6</u>
<u>1000</u>	<u>0.2</u>
<u>1500</u>	<u>0.1</u>
<u>> 1500</u>	<u>zero</u>

808.9 Close the interior door of all rooms except those that meet any of the following conditions:

- the room has an exhaust fan,
- the room is ~~WRT~~ outside between an exhaust fan and the CAZ. For example, for a master suite with a connected bathroom that has an exhaust fan, do not close either the door to the bathroom or the door to the master suite,
- the room has a forced air system (FAS) return.

808.9.1 Measure the CAZ ~~baseline and worst case~~ depressurization for each CAZ.

808.10 Turn on all forced air system blowers and measure the CAZ depressurization for each CAZ.

808.11 The Appliance Venting (Standardized Depressurization) Test pressure difference is the largest negative pressure of the CAZ with respect to (WRT) outside from 808.9 and 808.10.

808.12 ~~conditions.~~ Record the position of all doors (open or closed), the condition (on or off) ~~doors and conditions~~ of fans (including the FAS) and vented combustion appliances. For each CAZ, subtract the BASELINE pressure from the Appliance Venting

(Standardized Depressurization) Test depressurization pressure from 808.11 to determine the net change in CAZ pressure. ~~air handler.~~ When the net change in CAZ pressure is lower (more negative) than the CAZ depressurization limit given in Equation 808.4, the required remediation limits specified below, the work scope shall specify ~~remediation through~~ pressure balancing, duct sealing, and/or other pressure-relief measures, or replacement of all equipment in the CAZ with direct-vent equipment as applicable.

$$\text{CAZ depressurization limit} = -5\text{Pa} + P_{\text{adj}} \quad \text{Equation 808.4}$$

808.13 With the doors and FAS in the configuration that gives the greatest CAZ depressurization turn on the ~~807.12 Turn on~~ vented combustion appliance with the smallest Btu capacity, operate. ~~Operate appliance~~ for 5 minutes.

808.13.1 ~~Check then measure CO levels according to the carbon monoxide test procedure below, and check~~ appliance draft using a smoke pencil all the way around ~~at~~ the draft diverter's perimeter.

808.13.2 ~~diverter.~~ If the smoke is not fully drawn up the flue, the appliance has spillage under depressurized conditions.

808.13.3 Install probe to measure CO levels in the appliance's flue gasses upstream of (before they reach) the draft diverter.

808.13.4 Measure the appliance CO after at least 5 minutes of operation or per manufacturer's specification.

808.13.5 ~~worst case depressurization.~~ Record the results of their there is any spillage test and the highest observed ~~record~~ CO level.

808.13.6 When spillage occurs or flue gas CO exceeds manufacturers specifications or the limits specified ~~below~~ in section 808.159, the required remediation work scope shall specify remediation, including equipment repair, ~~equipment or~~ replacement, and/or building pressure remediation, as applicable. If both spillage and high CO are found during the test, the homeowner ~~shall~~ should be notified of the recorded result ~~conditions~~ and need for ~~that it needs~~ immediate remediation.

808.14 Testing additional ~~807.13 Turn on all the other~~ combustion appliances.

808.14.1 Turn on each additional appliance, one at a time, in order of increasing capacity, within the CAZ and repeat section 808.13.1 through 808.13.6 for every appliance that is on. Note that once an appliance is turned on, it shall remain on until the spillage testing is complete ~~step 1.12 on each of them.~~

808.15807.14 If spillage or ~~high~~-CO greater than 200 ppm occurs in any appliance(s) under ~~CAZ worst-case~~ depressurization testing, retest that appliance(s) under natural conditions, as follows:-

808.15807.14.1 Turn off the combustion appliances.

808.15807.14.2 Turn off the exhaust fans.

808.15.3 Turn off air handler (if it's on).

808.15807.14.3 Open allthe interior doors.

808.15807.14.4 Let the vent cool.

808.16807.14.5 Test CO and spillage under natural conditions. If the test failed under worst-case, but passes under natural conditions, the required remediation work scope shall specify building pressure remediation, or replacement of all equipment in the CAZ with direct-vent equipment as applicable.

NOTE: 807.14.6 If an appliance fails under natural conditions, the Auditor shall immediately inform the homeowner of the problem, and the required remediation work scope shall specify remediation, including equipment or vent system repair or replacement and/or pressure remediation. Other proposed work on, as applicable.

CAZ Pressure Limits

~~-15 Pa for pellet stoves with exhaust fans and sealed vents~~

~~-5 Pa for Atmospheric vented oil or gas system (classified as a category 1 or 2 according to NFPA standard 54, such as oil power burner; fan-assisted or induced-draft gas; solid-fuel-burning appliance other than pellet stoves with exhaust fans and sealed vents)~~

~~If ambient CO levels exceed 35 ppm at any time, stop any testing and turn the combustion appliances off. Open all the exterior doors and windows. No one should enter the home until the CO levels drop below 35 ppm. The combustion appliance causing the increase in CO levels must be repaired by a qualified technician prior to completing the combustion appliance tests, unless the work scope calls for replacement of the appliance(s).~~

100.1—808 CARBON MONOXIDE TESTING

~~Test all spaces (including attached garages, crawlspaces, basements) containing combustion appliances for carbon monoxide using the following protocols.~~

~~**808.1** CO testing of ambient air shall be performed continuously while performing a Worst Case Depressurization Test and/or under natural conditions, as required by paragraph 807.14.~~

~~808.2~~ Equipment used shall:

- ~~• Be capable of measuring carbon monoxide (CO) levels from 0 to 2,000 ppm (parts per million)~~
 - ~~• Have a resolution of 1 ppm~~
- ~~• Have an accuracy rate of + 5 ppm~~
- ~~• Be calibrated annually by the manufacturer (or using manufacturer's instructions) and evidence of the calibration shall be submitted to the Rating Provider Quality Assurance Designee~~

~~808.3~~ property ~~3~~ Zero the carbon monoxide meter outside the building away from any combustion outlets or automobile traffic areas.

~~808.4~~ Take a measurement of CO levels within the home upon entering to establish a baseline. Do not measure near combustion appliances while they are operating. If ambient CO levels are higher than 35 ppm during normal appliance operation, turn off the appliance, ventilate the space, and evacuate the building. The building may not commence until the problem is remediated. ~~be reentered once ambient CO levels have gone below 35 ppm.~~

~~808.5~~ For atmospherically vented appliances:

~~808.5.1~~ Take a measurement of vent gases upstream of (before they reach) the draft diverter.

~~808.5.2~~ Appliance must operate for at least 5 minutes before taking sample.

~~808.5.3~~ Take sample during worst case depressurization test and/or under natural conditions, as required by paragraph 1.14. Record the CO level.

~~808.6~~ For direct or power vented appliances:

~~808.6.1~~ Sample must be taken at vent termination.

~~808.6.2~~ Appliance must operate for at least 5 minutes before taking sample.

~~808.6.3~~ Take sample during worst case depressurization test and/or under natural conditions, as required by paragraph 1.14. Record the CO level.

~~808.~~

809 CO MEASUREMENTS FOR 7 ~~For LP or~~ NATURAL GAS OVENS:

809~~808.7.1~~ Open a window or door to the outside.

[809808.7.2](#) Remove any foil or cooking utensils within the oven.

[809808.7.3](#) Verify that the oven is not in self-cleaning mode.

[809808.7.4](#) Turn oven on to highest temperature setting.

[809808.7.5](#) Close the oven door and begin monitoring the CO levels in the kitchen, 5 feet from the oven at countertop height. Record CO levels.

[809808.7.6](#) Measure the CO levels within the oven vent.

[809808.7.6.1](#) Samples must be taken while burner is firing.

[809808.7.6.2](#) Operate burner for at least 5 minutes while sampling [oven ventflue](#) gases.

[809808.7.6.3](#) If CO levels are higher than [200+00](#) ppm, repeat the [oven ventflue](#) gas sampling until the CO levels stop falling.

[809808.7.6.4](#) Record the steady state CO reading in ppm and turn off oven.

[809.7808.8](#) If measured CO levels are higher than [400+00](#) ppm (~~200 for oven~~), or an appliance fails to meet manufacturer's specifications for CO production (whichever is higher), the [required remediation work scope](#) shall specify replacement or repair of the appliance, and the homeowner shall be notified of the need for service by a qualified technician.

[Definition: DIRECT VENT APPLIANCE -- Method of venting appliance whereby all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged directly to the outside atmosphere.](#)

~~[808.9](#) If ambient CO levels exceed 35 ppm at any time, stop any testing and turn the combustion appliances off. Open all the exterior doors and windows. No one should enter the home until the CO levels drop below 35 ppm. The combustion appliance causing the increase in CO levels must be repaired by a qualified technician prior to completing the combustion appliance tests, unless the work scope calls for replacement of the appliance(s).~~

Proposed Effective Date:

The proposed amendment will go into effect thirty days after the adoption by the RESNET Board of Directors

Justification:

To improve the clarity and repeatability of combustion safety testing and to bring testing more in line with other industry standards.