

Building America Case Study Technology Solutions for New and Existing Homes

Combustion Safety for Appliances Using Indoor Air

PROJECT INFORMATION

Project Name: Combustion Safety for
Appliances Using Indoor Air

Partners:

American Gas Association

www.aga.org

Center of Energy and Environment

www.mncee.org

Building Performance Institute

www.bpi.org

NorthernSTAR Building America

Partnership

Partnership for Advanced
Residential Retrofit

www.gastechnology.org/PARR

Building Components: Gas Appliances

Application: Retrofit Single Family

Year Tested: 2013

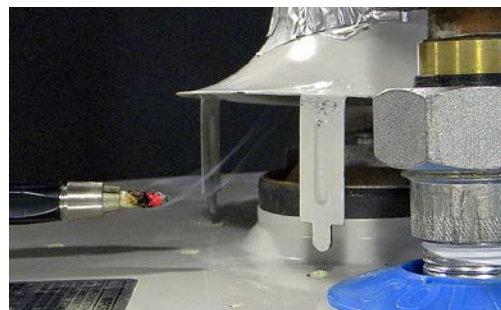
Applicable Climate Zone(s): All

In this research project, the U.S. Department of Energy Building America team, Partnership for Advanced Residential Retrofit, developed a method for evaluating safe installation and operation of combustion appliances in homes undergoing energy efficiency upgrades where indoor air is used for combustion and venting. Only appliances installed in the living space or in an area freely communicating with the living space, vented alone, or in tandem with another appliance were considered in this project. The result of this work is captured in a measure guideline that outlines steps for inspectors, auditors, and technicians to follow when working in homes where energy upgrades are being conducted, whether or not air infiltration control is included in the package of measures being applied.

“Following the code guidelines for combustion air and venting is important for the safe operation of gas appliances in high efficiency homes.”

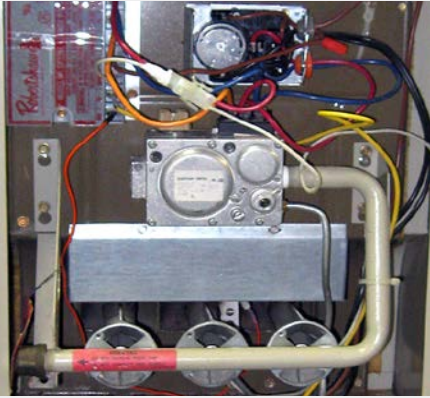
- Ted Williams,
American Gas Association

In this case, guidelines are based on language provided in several of the codes to establish minimum requirements for the space using simplified prescriptive measures. In addition, building performance testing procedures are provided by testing agencies. The codes, in combination with the test procedures, offer comprehensive combustion safety coverage to address safety concerns, allowing trained residential energy retrofit inspectors to effectively address combustion safety issues and allow energy retrofits to proceed.

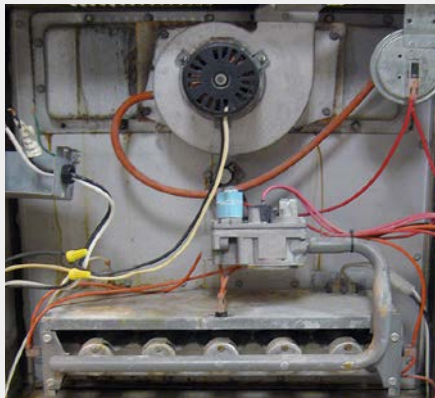


Smoke pen test of draft hood
equipped water heater

DESCRIPTION



Category I appliances require air for combustion and dilution of flue gases. A draft hood or draft diverter is provided with some of these appliances to decouple the burner operation from the outdoor weather conditions, primarily wind effects. Adequate air is needed for the burners and the draft hood to ensure good combustion and avoid nuisance outages. Dilution has the added advantage of reducing corrosion in the vent system.



For some Category I appliances, a draft inducer is used to improve efficiency. These appliances require air for only the burner operation. A vent safety switch is sometimes used to avoid unsafe operation.

For more information, see the Building America report, *Measure Guideline: Combustion Safety for Appliances Using Indoor Air* at, www.buildingamerica.gov

Image credit: All images were created by the PARR team.

Table 13.2(a) Type B Double-Wall Vent

Vent CONNECTOR Capacity

Connector Height ft (ft)	Appliances #	Type B Double-Wall Vent												
		3			4			5			6			
		Appliance Input Btu/hr			Appliance Input Btu/hr			Appliance Input Btu/hr			Appliance Input Btu/hr			
	FAN	NAT	FAN	NAT	FAN	NAT	FAN	NAT	FAN	NAT	FAN	NAT	FAN	
	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max
6	1	22	37	26	35	66	46	46	106	72	58	16		
	2	23	41	31	37	75	55	48	121	86	60	18		
	3	24	44	35	38	81	62	49	132	96	62	19		
8	1	22	40	27	35	72	48	49	114	76	64	17		
	2	23	44	32	36	80	57	51	128	90	66	19		
	3	24	47	36	37	87	64	53	139	101	67	21		
10	1	22	43	28	34	78	50	49	123	78	65	18		
	2	23	47	33	36	86	59	51	136	93	67	20		
	3	24	50	37	37	92	67	52	146	104	69	22		
15	1	21	50	30	33	89	53	47	132	83	64	22		
	2	22	53	35	35	96	63	49	143	99	66	23		
	3	24	55	40	36	102	71	51	153	111	68	24		
20	1	22	53	31	33	99	65	46	157	87	62	24		
	2	22	57	37	34	105	74	48	167	104	64	25		
	3	23	60	42	35	110	84	50	176	116	66	27		
30	1	20	62	33	31	113	59	45	181	93	60	28		
	2	21	64	39	33	118	70	47	190	110	62	29		

The National Fuel Gas Code provides sizing tables for vent connectors, vertical vents, and masonry chimneys for safe venting of gas appliances. In many cases in the field, the vent connector is not properly sized or an adjustment was made to the vent system, the number and type of appliances, or the appliance location that requires a fresh look at the vent design.

When using indoor air for combustion, the indoor space must meet volume requirements and freely communicate with the indoor environment to provide adequate combustion air.

Lessons Learned

Following are steps for evaluating safe installation and operation of combustion appliances in homes undergoing energy efficiency upgrades:

1. Start with a visual inspection of the appliances and vent systems.
2. Identify vent system design or installation flaws and have them addressed.
3. Calculate the required air volume for indoor combustion air using one of several methods provided in the code.
4. Test for adequate draft and high carbon monoxide levels in the flue or in the space.
5. Have a trained technician repair broken or damaged appliance components.
6. Perform remediation or replace unsafe appliances before or during the energy efficiency upgrade.
7. Conduct the upgrade and test the appliances again to ensure safe performance.
8. Perform additional remediation as needed.

Looking Ahead

As houses become tighter through energy upgrades, combustion safety test procedures and recommendations will evolve. Ensure that the latest code requirements are being followed in the field.