

Appendix A: Combustion Appliance Protocols

Clean, Tune & Evaluation Requirements

Primary Heating System		
<p>For each home a primary heating appliance must be determined by the energy auditor. The clean and tune requirements for the primary heating system are two-fold; based on the elapsed time period since the previous CTE was performed <u>and</u> results of diagnostic testing during the energy audit.</p>		
Oil Fired	V.	Gas Fired
<p>A primary oil fired heating appliance shall be cleaned, tuned and evaluated by a qualified technician unless this task has been completed within the past 9 months from the date of the energy audit <u>and</u> the results of all combustion, spillage and draft testing conducted during the energy audit are acceptable.</p>		<p>A primary gas fired heating appliances shall be cleaned, tuned and evaluated by a qualified technician unless this task has been completed within the past 18 months from the date of the energy audit <u>and</u> the results of all combustion, spillage and draft testing conducted during the energy audit are acceptable.</p>
Secondary Heating Systems & Domestic Hot Water Systems		
<p>A secondary heating appliance or water heater shall be cleaned, tuned and evaluated by a qualified technician whenever results of diagnostic testing performed by WAP are not acceptable. The date of the last CTE has no bearing on whether or not a WAP agency must order a CTE for this category of appliances.</p>		

Solid Fuel Burning Appliances
Shall be visually inspected for safe operation
If system appears unsafe then a qualified technician must perform a system CTE.
Note that installation of optional, factory issued, combustion air kits that are not already installed on solid fuel burning appliances is allowable utilizing WAP funding.



Appendix A: Combustion Appliance Protocols

Determining Primary v. Secondary Heating Appliances

The energy auditor has discretion in determining the primary fuel source and which appliance is to be deemed the primary heating system for each project.

Determining the primary heating fuel and appliance is not limited exclusively to historical energy consumption records.

When making this determination the auditor must talk with the client to ensure all of the following variables are considered:

1. If there is more than one heating appliance, how often are they run at the same time or are they only used one at a time?
2. Which heating appliance would the client prefer to use if they had to make a choice between the multiple heating system options currently in the home? Why?
3. If a fuel assistance benefit is received, what fuel source is the benefit associated with?
4. What condition are each of the heating appliances in?
5. What is the projected cost to get each heating appliance operating in a safe and reliable manner?

WAP Purchasing Fuel for a Client Because the Client is out of Fuel During Project

Fuel can be provided by the WAP if there is no fuel onsite and fuel is needed to get a heating appliance operational so it can be evaluated/tested.

- ✚ **During the Energy Audit | This is important to ensure good decisions can be made when developing the workscope for heating systems.**
- ✚ **During the QCI | This is important to help ensure the home is being left in a safe condition at the conclusion of the project and that any work performed on the heating system was effective.**
- ✓ An example where the WAP may need to purchase fuel for a client to help determine the primary heating system is when a household is burning wood while the auditor is working through a project evaluation, the fuel tank for the furnace is empty and an informed decision is needed about whether to put a more significant investment into the wood stove or the furnace.



Appendix A: Combustion Appliance Protocols

Investment Allowances for Primary v. Secondary Heating Appliances


It is allowable to invest more weatherization funding into the primary heating system than into those deemed as secondary heating appliances. Improvement expenses shall be capped at \$500.00 for secondary heating appliances unless written permission to exceed this amount is granted by OEO. This written permission must be requested using the “Atypical Project Approval Form” and all approvals must be uploaded to the HES job file.

Required Order of Operations

Combustion Appliances Vs. Building Shell

Under no circumstances shall any airsealing or insulation improvements to the building shell be performed before all conditions outlined below are met.

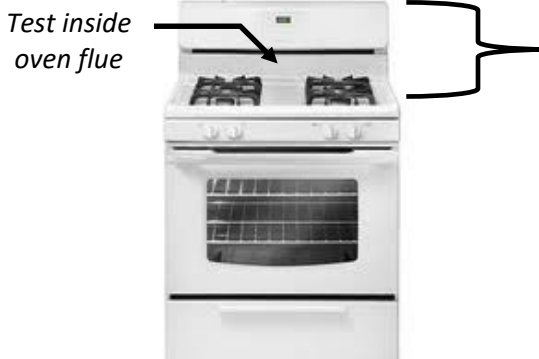
Required Prerequisites to Building Shell Improvement Measures

1. Initial spillage, draft and combustion testing shall be completed by an energy auditor
2. All applicable CTE requirements must be performed by a qualified technician
3. Any repairs—or replacements—that are necessary to ensure all combustion appliances are in safe working order must be completed
 -  This policy includes ovens and ranges



Appendix A: Combustion Appliance Protocols

Clean, Tune & Evaluation Requirements

Domestic Cooking Appliances	
Gas Ovens	v. Gas Range Tops
All gas ovens <u>shall</u> be tested at the energy audit. Turn the oven up to the highest possible bake setting (<i>not broil</i>).	All gas stove top burners <u>shall</u> be tested at the energy audit.
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> <p>For consistency testing shall be done well down inside the exhaust vent prior to the introduction of dilution air.</p> </div>	<div style="text-align: center;">  </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto;"> <p>For consistency testing shall be done 12" above the center of each individual burner.</p> </div>
<p>Action Levels If CO concentrations in the flue are lower than 200 ppm after 5 minutes document the measurement. The oven has passed the test. If CO levels are greater than 200 ppm after 5 minutes document the measurement and retest at the 10-minute mark.</p> <p>Repairs <u>must</u> be attempted if CO concentrations are still greater than 200 ppm at the 10-minute mark.</p> <p>If a CO concentration lower than 200 ppm is attained between the 5 and 10-minute marks, the owner (<i>and occupant, if applicable</i>) shall be made aware of the condition and the risks of CO exposure. Repairs are allowed but not required in these cases.</p>	<p>Action Levels If the measured CO level is between 35 -100 ppm at the test location after 2 minutes, the owner (<i>and occupant, if applicable</i>) shall be made aware of this condition and repairs should be attempted.</p> <p>Repairs <u>must</u> be attempted if CO concentrations are greater than 100 ppm at the test location after 2 minutes of operation.</p>
<p>Record Keeping Requirements All CO test results must be recorded in HES for each project.</p>	
<p>Oven Replacements Replacing ovens with DOE funding is not allowed. Oven replacements are allowable in some cases using Non-DOE Weatherization Funding. However, all oven replacement requests must be submitted to OEO for approval prior to ordering the new oven.</p>	
QCI Testing Requirements – Ovens & Range Tops	
<p>Testing the CO levels for Ovens & Range Top burners during the QCI is required whenever a CO problem was identified during the audit or at any other point during the project.</p>	<p>Testing the CO levels for Oven & Range Top burners during the QCI is recommended (not required) when no CO problems were identified during the audit or at any other point during the project.</p>



Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures

Ambient CO Monitoring Requirement

Ambient levels of carbon monoxide must be continuously monitored whenever performing draft and/or combustion testing. If ambient CO levels exceed 35 ppm the testing shall be aborted, the appliance turned off, the CAZ ventilated, and a qualified technician must be contacted immediately to schedule a system evaluation. Ambient levels shall be monitored 10 feet away from the flue opening of a combustion source.



When to Perform Combustion Testing

At minimum combustion testing is required two separate times during the course of every weatherization project.

1. At the Energy Audit
2. At the Final Quality Control Inspection

Many appliances will require a third combustion test.

Another combustion test must be performed every time a heating technician provides services during a weatherization project, even if the scope of work performed is limited to a system clean, tune and evaluation.

Written results of this combustion test must be provided by the heating technician to both the weatherization agency and to the homeowner.

Diagnostic Equipment

An approved combustion analyzer must be utilized.



Above are some of the many combustion analyzers available to weatherization professionals.



Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures

Test Location Protocols

A combustion test must always be completed prior to the introduction of dilution air. Various combustion, spillage and draft test locations are specified throughout this section.

Smoke Testing

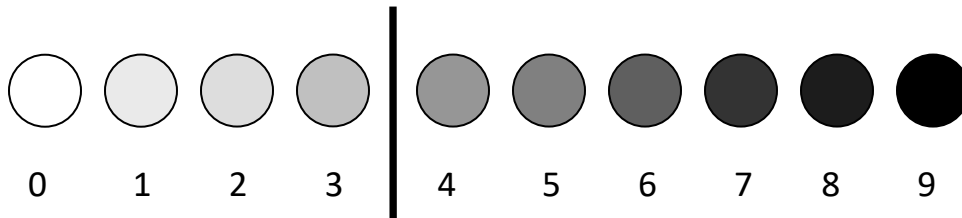
All Combustion Appliances



Smoke Tester

It is always recommended to pull a smoke reading prior to inserting the probe of a combustion analyzer into the flue of a combustion appliance.

High smoke production can damage the combustion analyzer.



0 1 2 3

Proceed

4 5 6 7 8 9

Abort Testing Procedures

A system clean, tune, & evaluation is mandatory whenever there is a smoke reading higher than zero.

This CTE requirement applies to all combustion appliances

Appendix A: Combustion Appliance Protocols

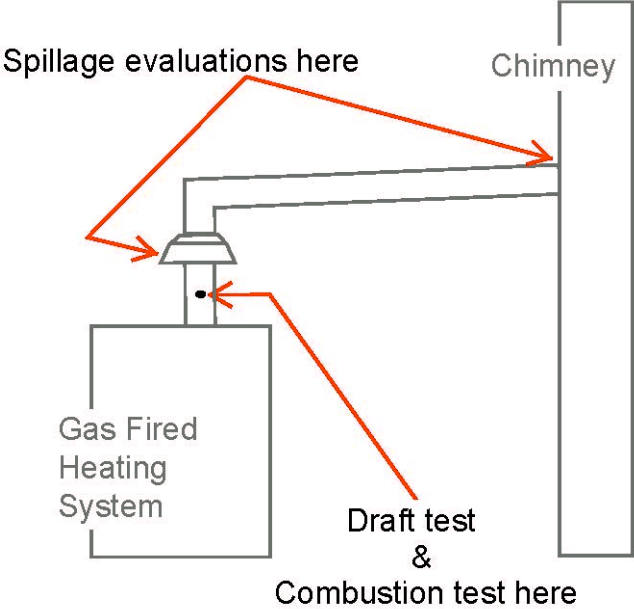
Combustion Appliance Testing Procedures

Test Location Protocols

Category 1 Appliances Include:

- ✓ Atmospheric Draft Appliances
- ✓ Induced Draft Appliances

Category 1: Atmospheric Draft Appliances

Gas Fired Equipment		
<p>For atmospheric drafting gas fired equipment, with a bell shaped dilution hood installed in the vent run at a point where sections of the flue pipe are located on each side of the bell hood, the combustion test and draft test shall be completed by drilling an opening in the flue pipe as shown in the diagram to the right. This method applies to some boilers and furnaces.</p>		
System Details	Minimum Distance: Test Hole to Elbow	Minimum Distance: Test Hole to Dilution Hood
W/ Bell Shaped Dilution Hood	6"	6"

All Category 1 Appliances:

- ✓ Are designed to have a negative draft pressure
- ✓ Are not designed to produce condensate

Appendix A: Combustion Appliance Protocols

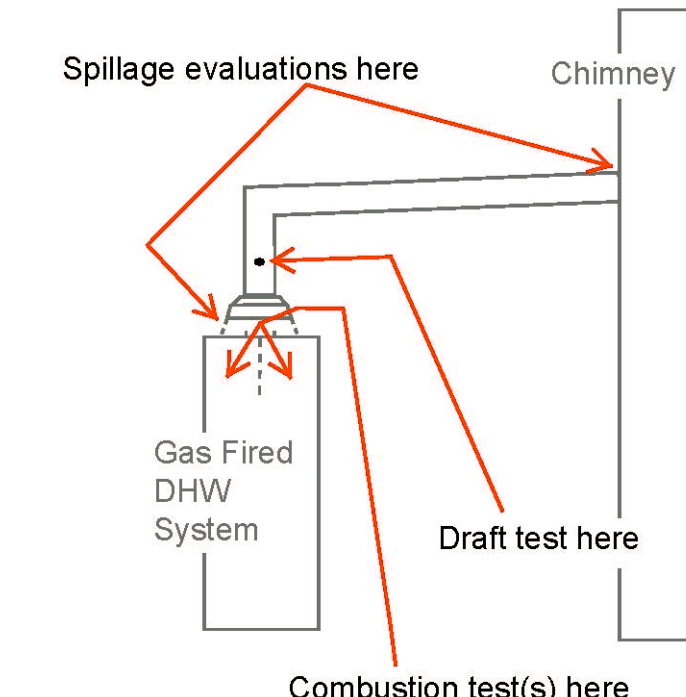
Combustion Appliance Testing Procedures

Test Location Protocols

Multiple Combustion Ports:

- ✓ Many water heaters have a baffle separating the combustion ports
- ✓ It is important to perform combustion analysis on both sides

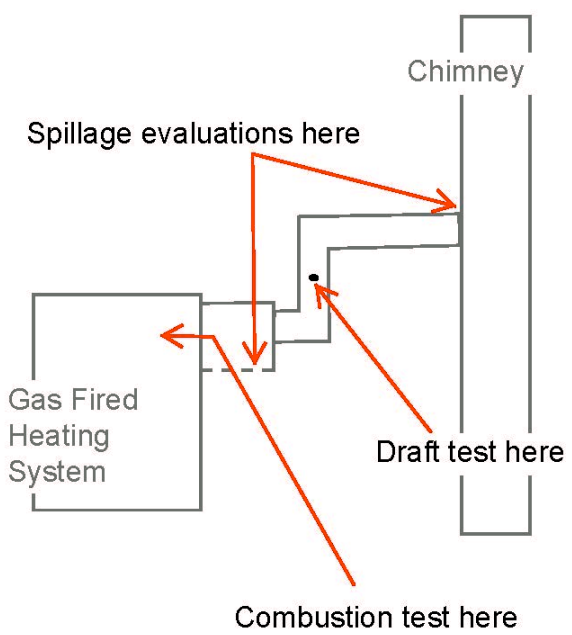
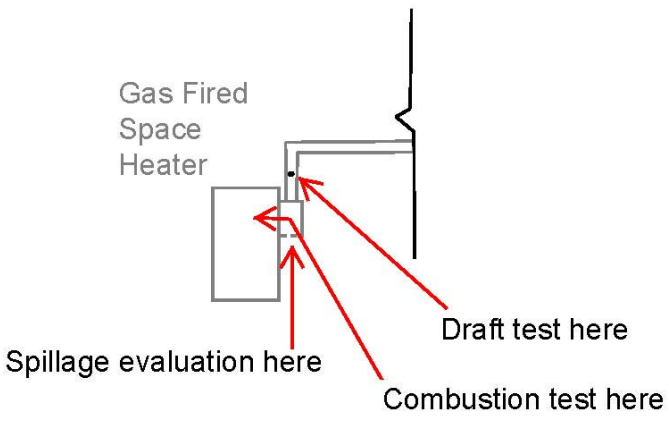
Category 1: Atmospheric Draft Appliances *(continued)*

Gas Fired Equipment		
<p>For atmospheric drafting gas fired equipment, with a bell shaped dilution hood located atop the appliance and before the beginning of the flue pipe run, the combustion test(s) and draft test shall be completed in separate locations as shown in the diagram to the right. This method applies primarily to water heaters.</p>		
System Details	Minimum Distance: Test Hole to Elbow	Minimum Distance: Test Hole to Dilution Hood
W/ Bell Shaped Dilution Hood	6"	6"

Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures

Category 1: Atmospheric Draft Appliances *(continued)*

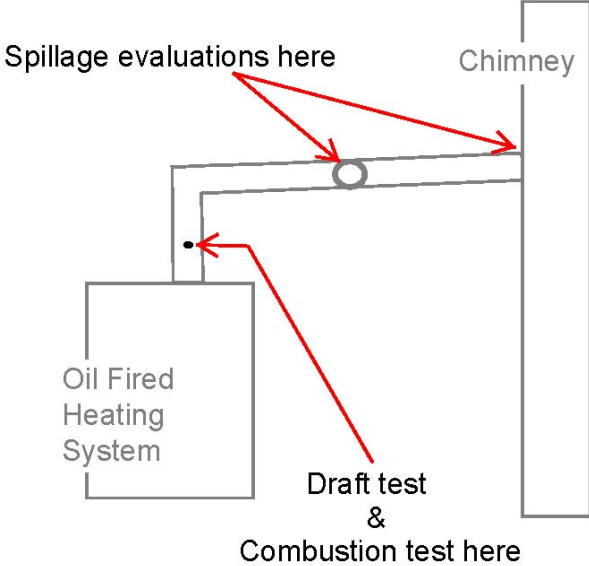
Gas Fired Equipment		
<p>For atmospheric drafting gas fired equipment, with a box shaped dilution hood located before the beginning of the flue pipe run, the combustion test and draft test shall be completed in separate locations as shown in the diagram to the right. This method applies to some boilers and furnaces.</p>		
System Details	Minimum Distance: Test Hole to Elbow	Minimum Distance: Test Hole to Dilution Box
W/ Box Shaped Dilution Hood	6"	6"
<p>Space heaters shall be tested in the same manner as an equivalent central heating system.</p> <p style="text-align: center;">~</p> <p>In the example shown, a spillage evaluation is conducted at the dilution box, a test hole is drilled to measure appliance draft, and combustion testing is done inside each combustion port prior to the introduction of dilution air.</p>		

Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures

Test Location Protocols

Category 1: Atmospheric Draft Appliances *(continued)*

Oil Fired Equipment		
<p>On many appliances, particularly oil fired appliances, the same test hole used for a combustion test can also be used for the draft test.</p> <p>~</p> <p>For atmospheric drafting oil fired equipment the combustion test and draft test shall be completed by drilling an opening in the flue pipe as shown in the diagram to the right. This method applies to boilers, furnaces, and stand-alone water heaters.</p>		
System Details	Minimum Distance: Test Hole to Elbow	Minimum Distance: Test Hole to Barometric Control
W/ Barometric Damper	6"	6"
Without Barometric Damper	6"	-NA-

Providing Combustion Air and/or CAZ Pressure Relief

Installation of combustion air products such as AirBoots, FurnaceBoots, Fan in a Can, etc., is allowed and encouraged to assist Category 1 appliances establish and maintain acceptable draft levels in efficient housing stock.

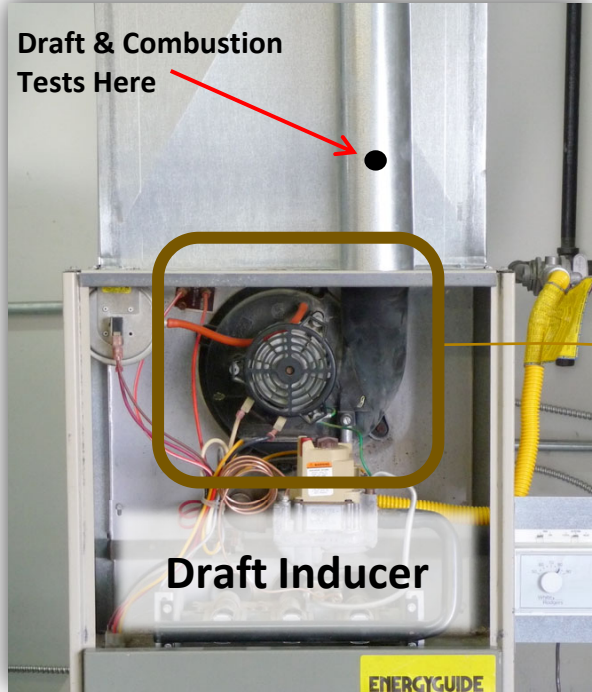
Installing combustion air devices will not change the category of an appliance nor will the appliance become "sealed-combustion" after system modifications are complete. However, these modifications will help an appliance operate more safely in efficient housing stock.

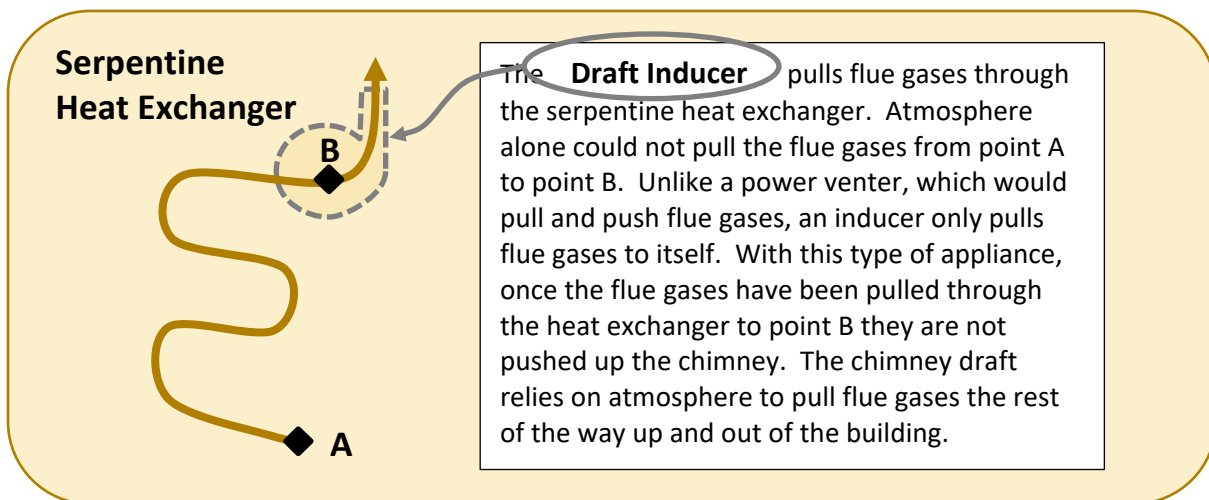
Installation of passive air inlets is allowable only when factory issued combustion air devices are not compatible with a specific appliance. If a passive air inlet is necessary to establish and maintain acceptable appliance draft, the inlet shall be located as close to the appliance as possible.

Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures

Category 1: Induced Draft Appliances


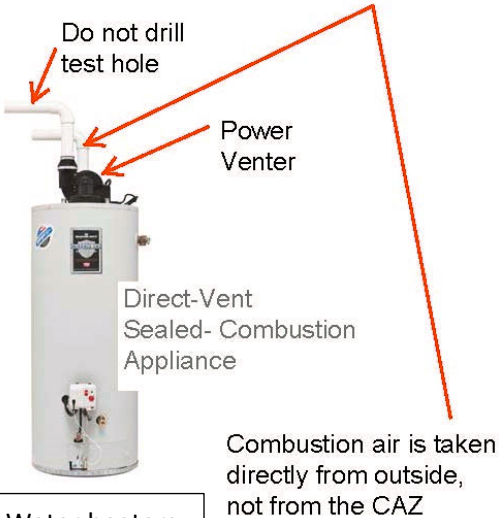
Gas Fired Equipment		
<p>Induced draft appliances are often confused with power vented appliances. But induced draft appliances are still Category 1 appliances. They have a negative draft pressure and they are not designed to produce condensate. The combustion test and draft test shall be completed by drilling an opening in the flue pipe as shown in the diagram to the right. This method applies to all induced draft combustion appliances.</p>		
System Details	Minimum Distance: Breach to Test Hole	Maximum Distance: Breach to Test Hole
Induced Draft	6"	10"



Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures

Category 3 & 4: Positive Pressure Draft Appliances

Gas & Oil Fired Equipment	
<p>All category 3 & 4 appliances have positive pressure draft. They are differentiated by whether or not they are designed to produce condensate in the flue. Category 3 appliances are not designed to produce condensate. Category 4 appliances are designed to produce condensate. Either category type of appliance may or may not be direct vented and sealed-combustion.</p>	
Power Vented	v. Direct-Vent Sealed-Combustion
	
<p>Both appliances shown above are Category 3 Water heaters</p>	
<p>Combustion air provided from CAZ</p>	<p>Combustion air piped in directly from outdoors</p>
<p>These are positive pressure draft systems.</p>	
<p>For all category 3 & category 4 appliances, regardless of whether or not the appliance is direct-vent and/or sealed-combustion, the combustion test shall be completed at the terminus of the vent piping by inserting the probe of a combustion analyzer as far into the vent opening as is possible from outdoors.</p>	
<p>Do not drill a test hole in the flue!</p>	
<p>Modified spillage evaluations are still required for these appliance types.</p> <p>-----</p> <p>See Appendix D for additional spillage evaluation protocols for positive-pressure draft systems.</p>	



Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures

Drilling Test Holes in Different Types of Venting Materials

Frequently Asked Question:

If an atmospheric drafting gas appliance is vented with “B” vent should I still drill a test hole in the flue?

Answer: Yes / No

- **“B” Vent** is a double wall pipe with an outer layer of galvanized steel and an inner layer made of aluminum. It is commonly used to vent gas fired appliances (with negative pressure draft) and it is acceptable practice to drill a test hole in this type of flue pipe to perform combustion and/or draft testing.
- **L” Vent** is another type of double wall pipe which is used to vent oil fired appliances. The inner layer of “L” vent is stainless steel rather than aluminum. It is also acceptable practice to drill a test hole in this type of flue pipe to perform combustion and drafting

Sealing Test Holes in Various Types of Venting Materials

Flue Type	Required Materials/Methods	Encouraged Materials/Methods
Single Wall	Aluminized tape applied over test hole	Insert a metal plug then seal with aluminized tape
“B” Vent	A tight fitting bolt with high-temp caulking applied to threads inserted into the test hole	Aluminized tape over the bolt after it’s threaded into place
“L” Vent	A tight fitting bolt with high-temp caulking applied to threads inserted into the test hole	Aluminized tape over the bolt after it’s threaded into place



Appendix A: Combustion Appliance Protocols

Combustion Appliance Testing Procedures Carbon Monoxide Action Levels & WAP Expectations

The previous pages in this section outline when, where and how to perform a variety of testing procedures on different appliance types. The table below emphasizes important action levels regarding measured carbon monoxide readings and expectations for WAP agencies.

Carbon Monoxide Level (in the stack)	WAP Expectations		
	Auditor or Inspector on site	Local WAP Agency	Qualified Service Technician
100 ppm(+)	Inform client & WAP office before leaving the site. Prior to leaving the site, install a CO detector on the same floor of the building where the problematic combustion appliance is located.	Immediately coordinate service for the combustion appliance.	After repairs have been performed, contact the local WAP office as soon as possible during regular business hours. Include written appliance diagnosis, scope of repairs and combustion test results along with invoice for services.
400 ppm(+) -AND- Appliance Spillage is Identified	Same actions as above. -AND- Disabling the appliance before leaving the site is required.	Same actions as above. -AND- Coordinate for provision of temporary space heating as needed until safety issue is fully resolved.	Same actions as above.

~Required Follow up & Verification: From the beginning of October through the end of April, an auditor or inspector employed by the local WAP (*not a subcontractor/vendor*) is required to complete a site visit and perform a combustion test after the repairs are completed to verify the safety issue was resolved. **This onsite follow up must be completed within two weeks of the service call date.** Note that this seasonal requirement is applicable for heating appliances only.

~Recommended Follow up & Verification: For the remainder of the year, this onsite follow up by a WAP employee is recommended for heating appliances. For non-heating appliances this onsite follow up is recommended throughout the calendar year.

