

## Appendix B: Worst-Case Draft Testing Procedures

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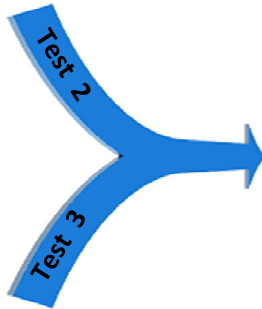
### Frequency of Testing | Minimum Requirements

Worst-case draft testing is required a minimum of three separate times during every weatherization project\*.

Required Test 1 | Energy Audit

Required Test 2 | Final Day of the Weatherization Installation Phase

Required Test 3 | Quality Control Inspection



**\*Acceptable Test Consolidation** | When a BPI Certified Quality Control Inspector is present on the project site during the final day of the weatherization installation phase, the certified inspector can perform final worst-case draft testing with the WAP installation team as they finish up their work.

This is only allowable if the certified inspector has not been involved in the installation of any of the weatherization measures and is not the supervisor of any installation team members.



This is the only scenario where the required tests from the final day of the weatherization installation phase and from the quality control inspection can be combined.

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**Note that conducting worst case draft testing is allowable and encouraged at the end of each day during the weatherization installation phase when the measures installed are anticipated to have a significant airsealing benefit.**

### Frequency of Testing | Additional Requirements Based on ACH50 Results

Worst-case draft testing is required every day of the weatherization project whenever the infiltration level in the building is below the ACH50 thresholds listed below:

-  **Site-Built Homes** | Daily testing is required whenever the ACH50 is 5 or less.
-  **Mobile homes (*single wide & double wide*)** | Daily testing is required whenever the ACH50 is 10 or less.

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### Worst-Case Testing Requirements by Appliance Type

Appliances Designed to Operate with Negative Draft Pressure in the Flue			
Appliance Type	Measure Worst-Case CAZ Depressurization	Must Pass Spillage Test within 2 Minutes	Measure Worst-Case Draft in Flue
Category 1 -Atmospheric Draft -Does not provide DHW	Yes	Yes <i>at Worst-Case</i>	No
Category 1 -Atmospheric Draft -Provides DHW	Yes	Yes <i>at Worst-Case</i>	Yes
Category 1 -Induced Draft -Does not provide DHW	Yes	Yes <i>at Worst-Case</i>	No
Category 1 -Induced Draft -Provides DHW	Yes	Yes <i>at Worst-Case</i>	Yes

Appliances Designed to Operate with Positive Draft Pressure in the Flue			
Appliance Type	Measure Worst-Case CAZ Depressurization	Must Evaluate for Spillage	Measure Worst-Case Draft in Flue
Category 3 -Positive Draft Pressure -Non-Condensate	No	Yes <i>at Natural Conditions</i> - no spillage for any amount of time is acceptable-	No
Category 4 -Positive Draft Pressure -Produces Condensate	No	Yes <i>at Natural Conditions</i> - no spillage for any amount of time is acceptable-	No



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### Establishing & Measuring Worst-Case Depressurization in the Combustion Appliance Zone

Please note that this testing is only required for combustion appliances designed to operate with negative draft pressure in the flue.

#### Step 1: Measure the Baseline Pressure

Set up the pressure gauge to measure the pressure difference between the combustion appliance zone (CAZ) and the outdoors. The gauge should be setup to read the CAZ pressure with reference to (WRT) outside pressure. The house should be set up with all windows and exterior doors closed, all exhaust appliances off, all combustion appliances off or in pilot mode, any fireplace dampers closed and all interior doors opened.

#### Step 2: Establish the Worst-Case Depressurization



**Remember, the goal is for you to find the worst-case scenario and then evaluate the draft of the combustion appliances while the CAZ is in that “worst-case” condition.**

Doing this correctly could potentially save lives. Take your time. If you are not sure about the correct way to establish the worst-case depressurization in a particular CAZ, please do ask for assistance.

These guidelines are intended to assist weatherization staff establish worst-case depressurization in the CAZ so one can test the draft of a combustion appliance with confidence that the CAZ is set up in a true “worst-case” condition. The specific order of steps taken to get from the baseline condition into the worst-case condition can be done in more than one way.

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**When trying to get to worst-case depressurization watch your pressure gauge as you turn on any clothes dryers, exhaust fans, central vacuum systems, HRVs/ERVs and furnace air handlers. Continue to watch the gauge as you open and close interior doors.**  
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**Whatever combination of running appliances and door configurations creates the greatest negative pressure reading in the CAZ (WRT) is the Worst-Case Depressurization.**  
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-  Always make sure that the dryer lint trap is clean or removed.
-  Always make sure that the furnace filter is clean or removed.



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### Spillage Testing | General Requirements

A spillage evaluation must be completed for all heating systems and water heaters unless the appliance burns a solid fuel, e.g., cord wood or pellets.

**Spillage shall be checked with smoke pencils, powder puffers and/or mirrors.**

For appliances vented into a chimney, spillage shall be checked where the flue pipe connects into the chimney/chimney liner, at every barometric damper/control and at each diverter hood/box. For more information about spillage evaluations refer to Appendix A, Combustion Appliance Protocols.

### Spillage Testing | Appliances Designed to Operate with Negative Draft Pressure in the Flue

Every combustion appliance that is designed to operate with a negative draft pressure in the flue shall be tested for spillage under worst-case depressurization conditions. This requirement applies to all Category 1-Atmospheric Drafting Appliances and all Category 1-Induced Draft Appliances. This requirement applies to appliances that provide the domestic hot water supply and to appliances that do not provide the domestic hot water supply. This requirement also applies to any appliances that are designed to have negative draft pressure in the flue even if those appliances are direct-vented and/or sealed-combustion units. If the appliance is designed to have a negative draft pressure in the flue it must be tested for spillage under worst-case conditions.

**The combustion appliance shall pass the spillage test within two minutes.**

Corrective action must be taken by the WAP whenever an appliance fails to pass the spillage test within two minutes.

### Spillage Testing | Appliances Designed to Operate with Positive Draft Pressure in the Flue

No spillage for any length of time is acceptable for these types of combustion appliances. A visual inspection of the entire length of the vent run between the appliance and the building exterior must be performed while the appliance is running.

If there are any signs of spillage at any seam/joint/connection along the vent run, corrective actions must be performed to prevent spillage of flue gases into the building.



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### Draft Testing | Appliances Designed to Operate with Negative Draft Pressure in the Flue

When a combustion appliance designed to operate with negative draft pressure in the flue passes the spillage test, the next step to take in the worst-case testing process depends on whether or not the appliance provides domestic hot water (DHW). The table below outlines the next step of the worst-case testing process for negative draft pressure appliances.

Appliance Provides DHW	Appliance Does Not Provide DHW
	
<p>The appliance has passed the spillage test.</p> <p>Next, wait for the appliance to reach steady state and then test the strength of draft.</p> <p>Record the strength of draft and compare it to the “minimum acceptable worst-case draft levels” table.</p> <p>These appliances must pass both the spillage test <u>and</u> the strength of draft test or corrective action must be taken by the WAP.</p>	<p>The appliance has passed all required steps of the worst-case draft testing process.</p> <p>Record the worst-case depressurization level and document that the appliance has passed the spillage test.</p> <p>Note that it is allowable for a WAP technician to perform additional testing (e.g. measure the strength of draft at steady state) but additional testing is not required by the WAP.</p>

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### Minimum Acceptable Worst-Case Draft Levels (at various outdoor temperatures)

<b>Appliances Designed to Operate with Negative Draft Pressure in the Flue &amp; that also do provide DHW</b>											
Degrees F	<10	10	20	30	40	50	60	70	80	90	>90
Pascals	-2.5	-2.5	-2.25	-2	-1.75	-1.5	-1.25	-1	-0.75	-0.5	-0.5

The table above provides the minimum acceptable draft levels for combustion appliances at various outdoor temperatures.

- ✚ When the temperature is less than 10 degrees Fahrenheit, the minimum draft level is always -2.5 Pascals.
- ✚ When the temperature is greater than 90 degrees Fahrenheit, the minimum draft level is always -0.5 Pascals.
- ✚ Whenever the outdoor temperature is between 10 – 90 degrees Fahrenheit, the minimum draft level is calculated using the formula below:

$$(T_{out} \div 40) - 2.75$$

The results of this calculation for a sampling of outdoor temperatures is included in the table above for reference.

**Corrective action must be taken by the WAP whenever the minimum acceptable worst-case draft level outlined here is not achieved when the appliance reaches steady state.**



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### Testing Appliance Draft

<b>Category 1: Atmospheric or Induced Draft Appliances</b> "In The Flue" Draft Testing Location by Venting Configuration & Fuel Type:		
System Details	Minimum Distance: Test Hole to Elbow	Minimum Distance: Test Hole to Barometric Control**
Oil Fired	6"	NA
Oil Fired w/ barometric damper	6"	6"
Gas Fired w/ diverter (bell or box type)	6"	NA
Gas Fired w/ barometric control	6"	6"

*\*\*Whenever there is a barometric control, the test hole shall be located at the appliance side of the barometric control, not on the chimney side of the barometric control.*

**Common Scenario:** An oil-fired appliance equipped with an AFG Series Beckett burner and a barometric damper.

**FAQs About Draft Testing Locations For this Common Scenario:**

When is testing the strength of draft in the section of flue pipe located on the chimney side of a barometric control needed? Is it allowable?

**Guidance:** Drilling a draft test hole in the section of flue pipe on the chimney side of the barometric control is never required in this scenario. This draft test location could only be used in addition to the required spillage and draft testing location which is located on the appliance side of the barometric damper. It is allowable as a secondary testing location and could potentially be a valuable test to perform when trouble shooting a draft problem.

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 For more detailed information on Combustion, Draft & Spillage Test Locations  
 refer to Appendix A, Combustion Appliance Protocols  
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**Do not drill holes in the flue pipe for appliances with positive draft pressures = Category 3 & 4.**



## Appendix B: Worst-Case Draft Testing Procedures

### Frequently Asked Questions

*Question:* If I turn on the dryer and all the exhaust fans and then test the appliance draft am I doing a worst case draft test correctly?

**Answer:** This is...

True / **False**

...but why?

**Clarifying Example:** If an appliance—a fan, a dryer, etc.—is turned on and the CAZ pressure gets more positive, then any doors separating that appliance and the CAZ should be opened and closed. If that appliance is still making the CAZ more positive, with the door both opened and closed, then it should be turned off. The appliance is not contributing to worst-case depressurization and should not be running when the worst-case draft measurement is taken.

**If an exhaust appliance makes the CAZ more negative, but only with an interior door in one position but not another, then the appliance should be left on and the door should be left in whichever position makes the CAZ go the most negative while the appliance is running.**

*Question:* If a furnace air handler cannot be engaged with a button on the fan limit control do I still need to try and include the air handler in the worst case depressurization measurement?

**Answer:** Yes, but this is tricky and there are **three common scenarios** that require different approaches.

**Scenario 1 of 3:**

**House w/ an oil or gas furnace & an electric water heater**

*To test the worst-case draft of the furnace:*

Turn up the T-stat to get the furnace to engage. Measure the draft in the flue after the burner turns on—with a cold chimney and before the air handler engages—and then measure the draft again immediately after the air handler engages. Document the lower of the two draft readings. Also monitor the CAZ depressurization while the furnace is running and determine if the CAZ goes more negative after the air handler kicks in. Document the largest negative number in the CAZ as the worst-case depressurization.

**If the CAZ goes significantly more negative when the air handler turns on and/or the draft in the flue pipe gets significantly weaker check for leaky return ducts. It is possible for a furnace to back draft itself if the returns are leaky enough! This is one of many good reasons to seal the return side of the distribution system with duct mastic.**





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### Frequently Asked Questions

*Question (from previous page):* If a furnace air handler cannot be engaged with a button on the fan limit control do I still need to try and include the air handler in the worst case depressurization measurement?

**Answer:** Yes, but this is tricky and there are **three common scenarios** that require different approaches.

#### *Scenario 2 of 3:*

**House w/ an oil or gas furnace & an oil or gas water heater vented into separate chimneys**

*To test the worst-case draft of the furnace:*

Follow all of the steps listed previously in scenario 1.

*To test the worst-case draft of the water heater:*

**If the CAZ was more negative with the furnace (*more specifically the air handler*) running during the furnace testing procedures then leave the furnace running while testing the water heater draft. Otherwise, turn the furnace off (*and wait for the air handler to shut off*) before testing the water heater draft.**

#### *Scenario 3 of 3:*

**House w/ an oil furnace and a gas water heater vented into a shared flue**

*To test the worst-case draft of the furnace:* Follow all steps listed previously in scenario 1.

*To test the worst-case draft of the water heater:*

**Turn up the T-stat to get the furnace to engage. Wait for the air handler to engage. Monitor the CAZ depressurization while the furnace is running and determine if the CAZ goes more negative after the air handler kicks in. If the air handler does not make the CAZ more negative it is not contributing to worst case depressurization. Turn off the furnace, wait a few moments for the chimney to cool and then fire up the water heater and test the draft.**

**If the air handler does make the CAZ more negative it needs to be on when testing the draft of the water heater. This is counter intuitive because the furnace will have preheated the chimney which will likely strengthen the draft of the water heater that shares the same flue. Because of this, the timing for when to fire the water heater is important. Wait for the furnace to meet the T-stat setting in the home. This will shut off the burner but the air handler will continue to operate for a few minutes until shutting off on the low limit of the fan control. Allow the chimney to cool down as much as possible within the time frame allowed by the low limit setting of the fan control and then fire the water heater and test the draft. This will be the worst-case scenario for the water heater draft test; highest level of CAZ depressurization with the coolest chimney/flue temperature possible after the furnace's burner shuts off.**

