

Best Practice – Isolating the Combustion Appliance Zone (CAZ)

Date: Revised January 5, 2017

Subject: Isolating the Combustion Appliance Zone (CAZ)

Problem or Question #1: Don't combustion appliances inside the thermal boundary use conditioned air to burn and then send the combustion gases outside, adding to air infiltration and potential health and safety issues? When should I isolate the appliance?

Discussion: Yes, water heaters, furnaces, and vented space heaters that are located inside the thermal boundary often use conditioned air to burn. The combustion gases must vent to the outside. An open CAZ or leaky CAZ door can result in potential back-drafting of the appliance. Back-drafting occurs when a naturally vented appliance loses the chimney effect, which normally carries dangerous combustion by-products (carbon dioxide, nitrogen dioxide, and carbon monoxide) up the chimney, resulting in a Health & Safety issue. Running a furnace, clothes dryer, and bathroom or kitchen exhaust fans can cause negative indoor air pressure that leads to back-drafting as they move air out of the house. This air must be replaced by outside air. This is why we seal off and isolate the appliance from the conditioned space and add combustion air to a CAZ. However, combustion air that is brought into the CAZ (a mechanical room, for example) can also increase air infiltration into the conditioned space if the room is not effectively isolated from the living space. When 1 cubic foot of air is sent out of a building, one cubic foot of air must enter the building from somewhere else. Hi-low venting in an unsealed CAZ will have a huge negative impact on air infiltration. If the CAZ is not properly sealed and air from the combustion closet is able to interact with the air in the house, then there exists two 6"-8" diameter holes in the building envelope, simply because of the appliance combustion air supply. This unconditioned attic air must then be heated or cooled at some energy cost. This energy problem can also be solved by isolating or "zoning off" the area in which the appliance resides.

There are other times when the combustion appliance is located in a closet or area that does not draw combustion air from the thermal boundary. In these situations, simply weatherstrip and sweep the door and ensure the appliance has adequate access to unconditioned combustion air and that the appliance is vented properly through the flue.

Additionally, when trying to achieve CFM reduction—reducing CFM to the lowest possible reading possible – the leakage caused by the CAZ can be significant. One option that may be cost effective to reduce this type of leakage is to move the thermal boundary to surround the unit, thereby effectively "moving" the unit outside the thermal boundary. To successfully and completely accomplish this: (1) properly air seal around the appliance (combustion closet for example) and (2) insulate the surrounding walls. By having your air barrier and thermal barrier together, encapsulating the appliance, you have successfully isolated the appliance "outside."

SUMMARY:

Whenever possible, it should always be seriously considered to isolate the CAZ. The determining factors of when to isolate the CAZ can/should be driven by CAZ test results. Properly testing the combustion appliances for gas leaks, spillage, appropriate draft, etc., will inform you if the CAZ has to absolutely be isolated; if the appliances passed all the required tests, then follow the steps outlined below.

Whenever a Subrecipient pays to isolate the CAZ, at the final inspection, there should always be a zonal pressure diagnostic (ZPD) test to verify the effectiveness of that isolation work. For the ZPD test, with the blower door running at -50Pa: have one manometer hose accessing the isolated CAZ (EX: combustion closet – use the metal probe to slide in at the bottom corner of the CAZ door) and the other manometer port, on the same manometer channel, registering the pressure in the house (open port if you are standing in the house), you will be able to easily quantify how well that CAZ has been sealed/isolated. If the blower door is running at -50Pa, then the closer the reading is to -50Pa, the closer to the outside that CAZ is. If the ZPD reading for the CAZ reads -45Pa, that is very well sealed; if the ZPD reading is -24Pa, that closet is more inside the house than outside, and that isolation work is not effectively installed and must be re-addressed.

Question #2: What steps should I take when considering if it is appropriate to isolating the CAZ?

There are three categories to consider when evaluating a combustion appliance zone:

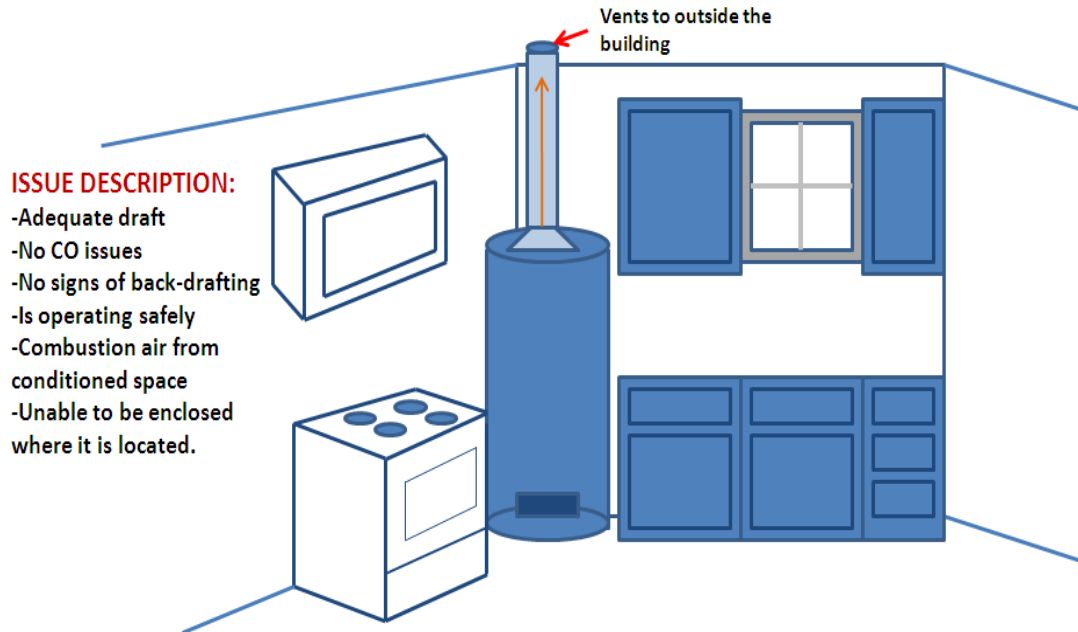
Category 1: Problems that pose an immediate threat to the occupants.

Category 2: Problems that potentially pose a future threat to the occupants.

Category 3: Problems or issues that do not appear to pose a future threat to the occupants.

The degree of air-sealing and isolation vary, depending on the above categories. The situational levels that you may encounter are described below from the least to most comprehensive actions:

PROBLEM #1: In this scenario the appliance is operating correctly and cannot be enclosed due to limited space. It presently poses no danger to the occupant; however, it is a **Category 2**, because it resides in a living space.



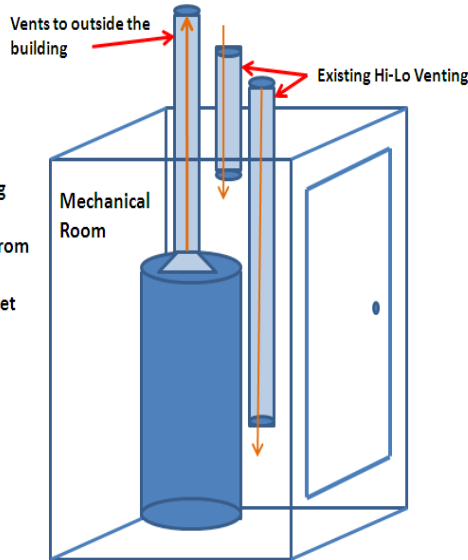
ACTION REQUIRED:

- The appliance passes 'worst case depressurization' testing and **does not show** any signs of back-drafting even though it is in conditioned space.
- Such a situation has the potential to cause a problem. At some point in the future, because the appliance is in a living area, a back-drafting situation may occur. As a safe-guard, a CO detector must be installed in the room and the client must be informed that if the CO alarm goes off then the appliance should be checked by a professional. Have the client sign off to this education.
- The cost of the CO detector is billed under Health & Safety.

PROBLEM #2: In this scenario the appliance is operating correctly, the mechanical room is set up well, and there is no danger (current or future) to the occupant. However, there is an issue of unwanted air-infiltration occurring at the CAZ door, as determined by a blower door test. It is a **Category 3**.

ISSUE DESCRIPTION:

- Adequate draft
- No CO issues
- No signs of back-drafting
- Is operating safely
- Combustion air supply from unconditioned space
- Air leakage through closet door



ACTION REQUIRED:

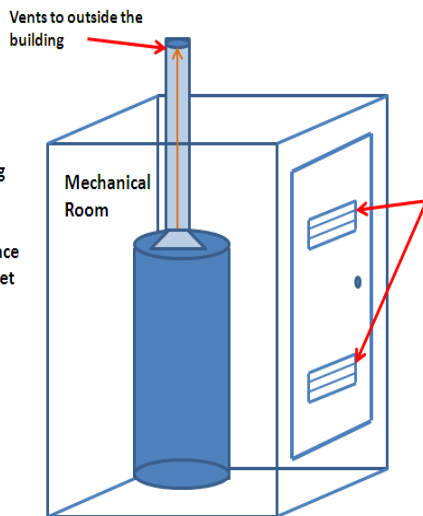
- Weatherstrip/jamb-up/door sweep the mechanical room door to stop air-infiltration.
- This, in essence, designates the mechanical room as a buffered space, between the conditioned space and non-conditioned space.
- The cost of air-sealing the CAZ door should be part of the air sealing/Infiltration Reduction dollars. This is not a health and safety measure. Complete a Zonal Pressure Diagnostic test to determine the effectiveness of the isolation attempt

Since the Subrecipient is paying to air seal this door, essentially isolating the CAZ, verification of the isolation should be done with a ZPD test during the final inspection, as outlined in Question 1 earlier in this Best Practice.

PROBLEM #3: In this scenario the appliance is operating correctly and there is no danger to the occupant, but it is drawing combustion air from conditioned space. It is a **Category 2**, since CO could potentially enter the home through the door vents if back-drafting ever occurred.

ISSUE DESCRIPTION:

- Adequate draft
- No CO issues
- No signs of back-drafting
- Is operating safely
- Drawing combustion air from the conditioned space
- Air leakage through closet door

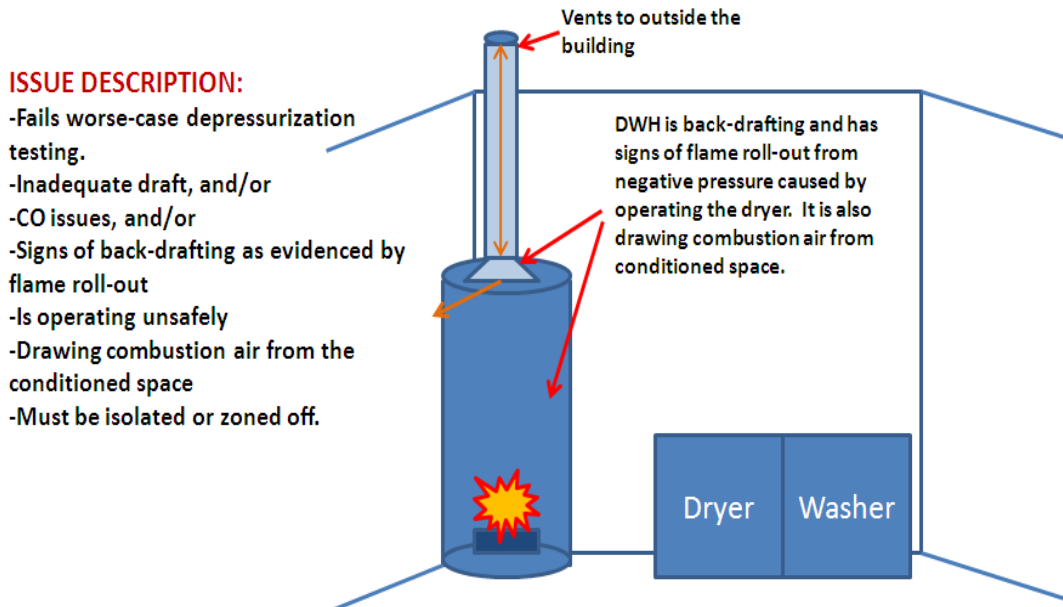


ACTION REQUIRED:

- Add high low venting to the mechanical room.
- Seal off door vents and insulate door with foam board.
- Weatherstrip/jamb-up/door sweep to seal the door from the conditioned space. This will also, prevent air infiltration and establish a buffered space between the conditioned space and the CAZ.
- Adding combustion air supply, as well as the air-sealing and insulation of the door (since it is using conditioned air for combustion), may be entered under Itemized Costs for Health and Safety reasons.

Since the Subrecipient is sealing off the door, isolating the CAZ, verification of the effectiveness of the isolation should be done with a ZPD test during the final inspection, as outlined in Question 1 earlier in this Best Practice.

PROBLEM # 4: In this scenario the appliance is in a conditioned space, such as a laundry room or kitchen, has room to be enclosed, but it is not operating properly which puts the occupant in danger. It is a **Category 1** and must be isolated.



ACTION REQUIRED:

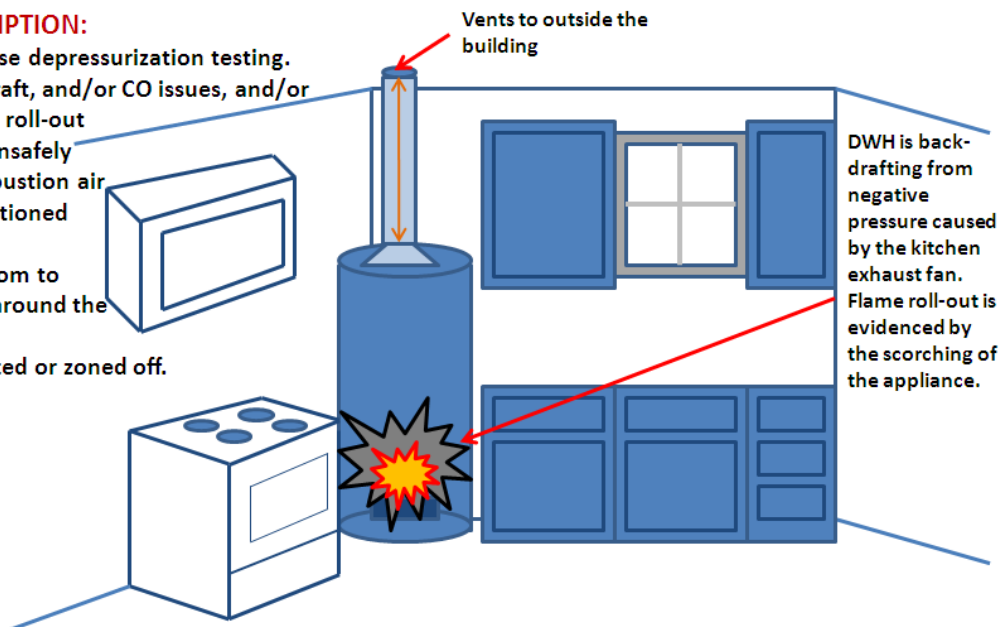
- This is the time to “isolate the CAZ” by building a mechanical closet for the appliance.
- Be sure to keep appropriate clearances as to local code or appliance installation guides.
- See “How to Isolate the CAZ” discussion later in this best practice for details.
- Add combustion air with high-low venting and air seal the mechanical closet, essentially making this a buffered space.
- All associated costs are assigned under Health and Safety.

Since the Subrecipient is creating a space around the appliance to isolate the CAZ, verification of the effectiveness of the isolation should be done with a ZPD test during the final inspection, as outlined in Question 1 earlier in this Best Practice.

PROBLEM #5: In this scenario the appliance is in a conditioned space, such as a laundry room or kitchen, and it is not possible to isolate the unit where it resides. It is not operating properly, putting the occupant in danger. It is a **Category 1** and must be isolated.

ISSUE DESCRIPTION:

- Fails worse-case depressurization testing.
- Inadequate draft, and/or CO issues, and/or
- Signs of flame roll-out
- Is operating unsafely
- Drawing combustion air from the conditioned space
- There is no room to build a closet around the DWH.
- Must be isolated or zoned off.



ACTION REQUIRED:

- There is insufficient room to “isolate the appliance (CAZ)” where it resides. This is a situation to evaluate moving the combustion appliance to outside the thermal boundary.
- The feasibility and costs associated with moving the appliance to a garage or outside the home to its own closet, moving plumbing and venting, adding combustion air and bringing the unit up to code must be evaluated. This may result in a deferral.
- This is a Health and Safety measure.

SUMMARY:

Whenever an appliance is drawing conditioned air for combustion air, fails ‘worst case depressurization’ testing, had uncorrectable high CO levels, or needs repair or replacement go through the levels and categories to determine action needed, keeping in mind the intent and scope of WAP. Isolating the combustion appliance zone can be too costly a measure and consequently some situations may need to result in a deferral.

Decisions, as to whether and how a CAZ should be “isolated,” require a systematic approach.

- Identify the situation and Category the CAZ falls under.
- Determine what degree of isolation and/or air-sealing must be performed.
- Use sound test data and assessment information to document your decision.
- Enter measure into appropriate category in the energy audit or Priority List.
- Remember CAZ isolation measures are not always a H&S cost, if the only concern is air-sealing.
- Consult with Department program staff if your problem cannot be addressed within the guidelines of this document.
- **If the cost of isolating the CAZ exceeds 30% of the total cost of the house, check your Health and Safety budget and consult with Department program staff before proceeding.**

How to Isolate the CAZ:

1. Depending upon the location of the CAZ:
 - a. As a general practice, if the combustion appliance(s) are located in an open conditioned space then building a closet around the appliance may be warranted. Be sure to keep appropriate clearances as to code or appliance installation guides. This means air sealing, insulating and placing interior 5/8" sheetrock (fireblock) on the walls. Fire tape the drywall.
 - b. If the unit must be moved outside the thermal boundary (such as the garage or literally outside the house) then use appropriate building materials, 5/8" sheetrock on the connecting house wall, fire tape, air seal and insulate the closet.
2. Weatherstrip (jamb up) the door and install a door sweep. If the door is vented, install a panel over the vent hole and insulate the door. Using foil faced foam board can easily take care of both insulating and sealing the surface of the door.
3. Ensure the plenums are air tight by using duct-board, insulation and mastic. Use mastic; even foiled tapes made for ductwork will often fail in time due to humidity. Be sure they are tight because the high pressures in these areas greatly contribute to leakage.
4. Provide combustion air source from outside the thermal boundary (not conditioned air). Outside air or non-conditioned attic air are both good sources of combustion air.
Combustion air can be supplied by one of the following methods:
 - The ceiling (if inside the thermal boundary) can actually be removed if a dam is installed to prevent insulation from falling in the CAZ. In this method, the appliance becomes part of the attic space, drawing air from the attic. OR
 - Install a high/low system. This can be accomplished by adding two vents to the outside, one within a foot of the ceiling and one within a foot of the floor. OR
 - If vertical ducts are used to bring combustion air to the appliance each vent should be sized at one square inch of free vent area per 4000 BTUH of the appliance *input* rating. NOTE: use code compliant vents. Too large a vent often leads to condensation and corrosion. Too small a vent can result in spillage. The wrong vent materials can corrode or deteriorate from heat.

The high and low vents allow heat to dissipate from the enclosure and they allow combusting gases to escape should there be any back-drafts. The hi-low venting permit a freer flow of combustion air to the heating appliance such as a furnace or gas fired water heater.

If the cost of isolating the CAZ exceeds 30% of the total cost of the house, check your Health and Safety budget and consult with Department program staff before proceeding.

As identified in Question 1 earlier in this Best Practice, whenever a Subrecipient pays to isolate the CAZ, at the final inspection, there should always be a ZPD test to verify the effectiveness of that isolation work. If the results of the ZPD are not -40Pa or better, then that isolation work is not effectively installed and must be re-addressed.

Energy Audit DATA ENTRY for Isolating the CAZ:

Isolating the CAZ is a Health & Safety measure: EXCEPT for when only air-sealing is involved. Air-sealing falls under "Infiltration Reduction" and is added into the dollars allowed within the NEAT. Below are sample entries:
ENTRY FOR RETROFITTING AN EXISTING CAZ CLOSET:

"Isolating the CAZ-Retrofit" is used when modifying an existing mechanical closet.

The screenshot shows a software interface for a 'Sample Setup Library'. The 'Measure Name' field is 'Isolating the CAZ-Retrofit', and the 'Energy Savings' dropdown is set to 'No EnergySavings'. The 'Materials/Labor Details' table has one row: #5, Health and Safety Item, Qty 1.00, Units+ Each, \$/Unit 350.00, and Comment L&M. A 'MEASURES' list at the bottom shows item 2 selected, with a 'Measure Comment' field containing: 'CAULK, INSULATE EXISTING CLOSET; WX STRIP, THRESHOLD, INSULATE EXISTING DOOR; ADD HI-LO VENTING'.

#	Type^	Copy Supply^	Description	Qty	Units+	\$/Unit	<Comment>
5	Health and Safety Item		Isolating the CAZ	1.00	Each	350.00	L&M

"Isolating the CAZ" is used when building a closet around an existing unit, or when moving the unit to another location and zoning it off. Be sure to enter COMMENTS for contractor directives and have documentation (photo and written) in the client file for these actions.

ENTRY FOR BUILDING A CLOSET AROUND EXISTING COMBUSTION APPLIANCES:

The screenshot shows a software interface for a 'Sample Setup Library'. The 'Measure Name' field is 'Isolating the CAZ', and the 'Energy Savings' dropdown is set to 'No EnergySavings'. The 'Materials/Labor Details' table has one row: #5, Health and Safety Item, Qty 1.00, Units+ Each, \$/Unit 950.00, and Comment L&M. A 'MEASURES' list at the bottom shows item 1 selected, with a 'Measure Comment' field containing: 'BUILD CAZ AROUND EXISTING APPLIANCES; FRAME OUT, SHEETROCK, CAULK, INSULATE WALLS; INSTALL EXTERIOR DOOR-WX STRIP, THRESHOLD, ADD HI-LO VENTING'.

#	Type^	Copy Supply^	Description	Qty	Units+	\$/Unit	<Comment>
5	Health and Safety Item		Isolating the CAZ	1.00	Each	950.00	L&M