

Combustion Safety Reference Sheet

1	Perform Visual Inspection
	<ul style="list-style-type: none"> • Corroded flue pipes? • Metal tape used to establish a permanent connection on flue pipes or vent connectors? • Flue pipes or vent connectors should fit well into one another having at least 3 sheet metal screws at each connection. • Flue pipes must have at least a ¼ inch rise per foot of towards exhaust termination. • Chimney and Vent connectors and Wall Penetrations: A chimney or vent connector shall not pass through any floor or ceiling. A chimney connector or vent connector shall not pass through a wall or partition unless the connector is listed and labeled for wall pass-through, or is routed through a device listed and labeled for wall pass-through and is installed in accordance with the conditions of its listing and label. • Do vent connectors or flue pipes have proper clearance to combustibles? • Can HVAC unit benefit from a clean & tune? • Was a clean & tune done satisfactory? • DHW draft diverter mounted properly? (Legs not bent & horizontal to top of tank.) • Is the flue pipe properly attached to the appliance? • When two vent connectors connect to a single chimney, the vent connector servicing the smaller appliance should enter the chimney above the vent for the larger appliance. • Chimney terminations should have vent caps. Masonry or manufactured chimneys should have adequate clearance from nearby building components. • Heat producing devices or chimneys in attics need to have damming to keep insulation away at least 3 inches and extend at least 4 inches above the insulation. • Insulation blankets cannot be installed on top of gas DHW tanks, combustion air inlets or over temperature & pressure relief valve. • Is high temperature caulking, or masonry cement and non-combustible materials being used to air seal around heat producing devices or chimneys? • Appliance combustion air floor grilles of mobile homes must not be accidentally sealed. • Are Carbon Monoxide alarms being installed according to the manufacture specifications outside of each sleeping area in the immediate vicinity of the bedrooms regardless of fuel source? • Are Smoke Alarms being installed according to the manufacture specifications in each sleeping room and outside each separate sleeping area in the immediate vicinity of the bedrooms and on each additional story of the dwelling, including basements and habitable attics but not including crawlspaces and uninhabitable attics? • Are Smoke Alarms being tested to verify they are operational? Replacement is necessary if not functioning properly.
2	Are all appliances set to pilot or thermostat turned down all the way or off prior to testing?
	<ul style="list-style-type: none"> • Combustion flue pipe needs to be cool to perform an accurate test. • If turning down appliance from thermostat, be sure to note initial settings to put back when testing is completed.
3	Is home set into <i>winter-time</i> conditions correctly?

	<ul style="list-style-type: none"> • All exterior windows and doors need to be closed. Open all interior doors to building envelope. • Turn off all mechanical air moving devices. (Clothes Dryer, Exhaust Fans, Air Handler, etc.)
	<ul style="list-style-type: none"> • Damper on fireplace needs to be closed. If damper is missing or unable to be closed, temporarily seal up.
	<ul style="list-style-type: none"> • Any large holes should be temporarily sealed. For example: use a garbage bag and painters tape for a missing pane of glass.
4	Is the Combustion Analyzers and Combustible Gas Leak Detectors being calibrated or started up outside the home?
	<ul style="list-style-type: none"> • Correct fuel source has been selected in the Combustion Analyzer settings. • Is the Combustion Analyzer within manufacturer's calibration date?
5	Is the Combustion Analyzer running when entering the Combustion Appliance Zone (CAZ)?
6	Is ambient CO being recorded?
	<ul style="list-style-type: none"> • <i>Abort testing:</i> <ul style="list-style-type: none"> ◦ Over 35 ppm CO inside the home or work space. ◦ Appropriate solutions will be suggested to client. <p>* Suggestions may include: Disable the appliance, open windows or doors and turn on exhaust fans to ventilate, shut-off gas to appliance and leave building.</p>
7	Are all gas lines (natural & propane), connections, shut-offs and fittings being tested for leaks?
	<ul style="list-style-type: none"> • Testing includes: vented or unvented space heaters, gas dryers, furnaces, DHW tanks, propane tanks, oven/ranges, any active gas line. • If a leak is found, the client should be informed as to the severity. If the gas leak is significant, the gas should be shut-off to the appliance and the area vented. Call gas service provider. • If a leak is present, the issue needs to be documented. Mark the location with a ribbon or string for easy identification and take a photo. • Flexible gas lines that are: kinked, corroded, have excessive wear, soldered connections on the line or that were manufactured before 1973 must be replaced.
8	Is the house being set up correctly to establish the Worst Case Depressurization of the CAZ?
	<ul style="list-style-type: none"> • Is the manometer correctly set up to establish a baseline? <ul style="list-style-type: none"> ◦ Is the manometer within manufacturer's calibration date? ◦ Referencing inside the CAZ to outdoors. ◦ Hose not pinched. ◦ Hoses connected correctly (input tap/reference tap). <ul style="list-style-type: none"> ◦ The steel tube that is provided with the manometer or automotive brake-line tubing should be used to avoid pinching the hose when wedged under a door or in between weather-stripping or elsewhere. ◦ If a door or a window is used to pass the tubing/hose through, make sure that it is closed as tightly as possible. ◦ Record baseline number. • Are <i>all</i> exhausting appliances turned on? <ul style="list-style-type: none"> ◦ Includes: Oven/range hood, clothes dryer (clean dryer screen for maximum air flow), bath fans, central vacuum and all supply registers should be opened with the HVAC system off. Do not turn on the Air Handler at this time. ◦ Do not turn on attic whole house fan if present. If there is an attic whole-house fan, be sure to inform the home owner that windows need to be opened to allow make up air to come into the home when it is in use.

	<ul style="list-style-type: none"> • Are doors being opened and closed to create the most negative pressure in the CAZ? <ul style="list-style-type: none"> ◦ If using a smoke stick: Close the door to a room or keep it slightly opened and see if smoke gets sucked in or not. If the smoke gets sucked into the room, then leave the door open. If the smoke blows out, leave the door closed. If nothing happens, leave the door closed. ◦ If using a manometer: You will need to go back and forth to check the manometer to determine if door positioning is making the reading more negative or not. It is best to have a helper read the manometer and communicate with the other person about the door positioning readings. • When the CAZ has been configured to be most negative at this point, then turn on the Air Handler and see if the CAZ becomes more negative. If it becomes more negative, leave the Air Handler running and re-check door positions to try to make the CAZ more negative. • Once the CAZ has been configured to be as negative as it can get, then the Base Pressure needs to be subtracted from the Gross reading. (Depressurization test will include exhaust fans, interior door closure, or duct leakage, or a combination thereof, and will not be more negative than -3 pascals accounting fo base pressure.) • This number needs to be checked against the BPI CAZ Depressurization Limits Chart to determine if the test passed or failed. Document results. • The correct table needs to be used. Correct appliance type and venting conditions needs to be determined. • If the test failed, the situation needs to be looked into to determine what can be done to remediate the problem. • The home MUST be kept in this set-up for rest of the entire combustion safety testing. <ul style="list-style-type: none"> ◦ Client <i>needs</i> to be informed not to turn off any fans and to leave door positions as they are throughout the entire testing process. ◦ After all testing has been completed the home needs to be returned to its previous state as upon arrival.
9	<p>Combustion Safety Testing <u>MUST</u> be done at the:</p> <ul style="list-style-type: none"> • Initial Assessment. • End of the work day. <ul style="list-style-type: none"> ◦ If any changes were made to the pressure boundary, another combustion safety test needs to be performed. This would include dense-pack wall insulation, air sealing, exhaust appliances installed and existing appliances were properly vented to the outside, etc. • Installation of new appliances. <ul style="list-style-type: none"> ◦ Furnace ◦ Gas DHW tank ◦ Vented space heater ◦ Oven/range • Remedial work on any combustion appliances. <ul style="list-style-type: none"> ◦ New flue pipe ◦ Clean & Tune ◦ New internal parts
10	<p>Appliance Testing:</p> <ul style="list-style-type: none"> • Smallest Btu/hr. appliance tested first. Remaining appliances tested in order of increasing input rating. • Was flue pipe allowed to <i>cool</i> to the touch before testing began? • Was a timing device used to measure spillage time? • Was a mirror or smoke stick used to verify spilling of the appliance?

	<ul style="list-style-type: none"> • Was a test hole drilled into the flue pipe at the proper location? <ul style="list-style-type: none"> ◦ Test hole should be about 1-2' down-stream of the draft diverter or first elbow. • CO Tests taken at steady-state? (Temperature will max out and stay steady at this point.) • Mechanically assisted furnaces commonly vented with a gas DHW tank need to be tested for spillage at the draft hood of the DHW tank. • Was the Combustion Analyzer probe in the correct location for accurate CO testing? <ul style="list-style-type: none"> ◦ When testing for CO in gas atmospheric DHW tanks, the probe should go down into the throat of the flue pipe to ensure sampling of undiluted flue gases. ◦ A curved piece of tubing fitting snug over the testing probe will allow easy access to the flue pipe throat without having to drill a hole into the draft diverter. • Drilling and patching vents for combustion testing: <ul style="list-style-type: none"> ◦ Single-wall metal vents, drill hole large enough for testing probe and patch it with high temperature silicone caulking or similar high temperature sealant. An appropriate plug can also be used. ◦ Double-wall metal vents, drill hole through both pipes large enough for testing probe and seal up with a bolt of same diameter and seal outside pipe with high temperature caulking or similar high temperature sealant. ◦ Do not drill into vent pipe on sealed combustion appliances. Test for CO at the end of the vent pipe if accessible. • Was the oven/range tested properly? <ul style="list-style-type: none"> ◦ Visual inspection of flame: discoloration, impingement; Burners: dirty, corroded, bent; Specify clean/tune. ◦ Foil needs to be removed from under burners on stove top and inside oven. ◦ Turn oven up as high as it will go without putting it into self-cleaning mode. • Probe inserted into throat of vent for oven. Tested at steady state (about 5-10 minutes). Reference current combustion safety test sheet for up to date testing protocols. <ul style="list-style-type: none"> ◦ Oven exhaust hood should be turned on while testing the appliance.
11	<p>Are Action Level Charts being used correctly? Are the results being documented and used to determine corrective measures that are needed?</p> <ul style="list-style-type: none"> • CAZ Depressurization Limits • CO Combustion Safety Test Action Levels • Spillage • Reference current combustion safety test sheet for up to date testing protocols.
12	<p>IF ANY TEST FAILS under Worst Case it MUST be tested under natural conditions.</p> <ul style="list-style-type: none"> • Home needs to be set into natural conditions. Open all interior doors. • Flue pipes need to be allowed to cool. • All testing needs to be conducted AGAIN under these natural conditions. • Use a separate Combustion Safety Test Sheet.
13	<p>Is the GEFA Combustion Safety Test Sheet being used?</p> <ul style="list-style-type: none"> • One needs to be used for each set of tests (before, during and after weatherization work). • Must be kept in client file.
14	<p>Is the CAZ being figured as confined or non-confined correctly?</p> <ul style="list-style-type: none"> • Measurements of the CAZ being taken to determine if it is confined or not? • Is the Total BTUs/hr. input for all appliances in CAZ taken? • Minimum required:

◦ *Standard Method*: 1000 Btu/hr. per 50 cubic feet. If minimum required volume is less than the measured CAZ it is a confined space. Remediation will be needed.

◦ *1/20 rule*. Divide total input by 20. If volume of CAZ is below it is a confined space. If above it is an unconfined space.

15 Is the need for Combustion Air being calculated correctly? (Reference current SWS)

• Connection to another indoor space:

◦ On same story. Each opening shall have a net free area of 1 sq. in. per 1,000 Btu/hr. of total input appliances in space. Not less than 100 sq. in. NOTE: If home is tight, outdoor combustion air will need to be brought in.

◦ One opening within 12 inches of top and one within 12 inches of bottom of enclosure. Minimum dimension of air openings shall not be less than 3 inches.

◦ Combining spaces in different stories. Total minimum net free area of 2 sq. in. per 1,000 Btu/hr. of total input of appliances.

• Outdoor combustion air. NOTE: When communicating with an attic or a crawlspace these spaces need to *freely* communicate with the outdoors. Attic and crawlspace areas must have sufficient venting to allow for this. If there is no venting in these spaces, then venting will need to be added to establish a connection to the outdoors.

◦ *Two-permanent openings (high/low)*.

▪ High within 12 in. of top and low within 12 in. of bottom.

▪ Ducts shall not be screened where terminating in an attic.

▪ Vertical duct openings shall have net free area of at least 1 sq. in. per 4,000 Btu/hr. of total appliances input.

▪ Horizontal duct openings shall have at least a net free area of 1 sq. in. per 2,000 Btu/hr. total appliances input.

▪ Ducts shall be constructed of galvanized steel or of a material having equivalent corrosion resistance, strength and rigidity.

▪ Ducts shall terminate in an unobstructed space allowing free movement of combustion air to the appliance.

◦ *One-permanent opening*.

▪ Minimum net free area of 1 sq. in. per 3,000 Btu/hr. and not less than the sum of the areas of all vent connectors in the CAZ.

▪ Ducts shall not be screened where terminating in an attic.

▪ Ducts shall be constructed of galvanized steel or of a material having equivalent corrosion resistance, strength and rigidity.

▪ Ducts shall terminate in an unobstructed space allowing free movement of combustion air to the appliance.

◦ *Louvers and grilles*.

▪ Where the design and net free area of louvers and grilles are not know the following shall be used:

▪ Assume wood louvers will have 25 percent net free area.

▪ Metal louvers and grilles will have 75 percent net free area.

▪ Screens shall not have a mesh size of less than a ¼ in.

16 Was a sealed CAZ created?

• Was it all sealed up correctly?

• Was combustion air introduced properly?

17	Was an unvented space heater left in the home for emergency back-up heat? (Reference current SWS)
	<ul style="list-style-type: none"> • Mobile homes <i>cannot</i> have any unvented space heaters under any circumstances.
	<ul style="list-style-type: none"> • DOE will not permit any DOE-funded weatherization work where the completed dwelling unit is heated with an unvented gas- and/or liquid-fueled space heater as the primary heat source. This policy applies to unvented natural gas-fired space heaters, unvented propane-fired space heaters, and unvented kerosene space heaters. This policy is consistent with the IRC and the IFGC.
	<ul style="list-style-type: none"> • <u>DOE strongly encourages removal of all unvented gas- and liquid-fueled space heaters and replacement with vented, code-compliant heating systems as a prerequisite to weatherization.</u> However, DOE will allow unvented gas- or liquid-fueled space heaters to remain as secondary heat sources in single-family houses provided they comply with the IRC and the IFGC. DOE is allowing this flexibility primarily to provide low-income clients an emergency back-up source of heat in the event of electrical power outages. Therefore, preference should be given to code-compliant units that do not require electricity.
	<ul style="list-style-type: none"> • Unvented Space Heater, removal required, except as secondary heat <ul style="list-style-type: none"> ◦ Unit must conform to ANSI Z21.11.2.
	<ul style="list-style-type: none"> • Was the client informed the unvented space heater is only to be used in the event of emergency heating only in the event of electrical power outages?
	<ul style="list-style-type: none"> • Recommend a sign-off sheet with client signature acknowledging unvented space heater will only be used for emergency heating only, in the event of electrical power outages.
	<ul style="list-style-type: none"> • Unvented space heater needs to be tested for CO levels and documented. (200 ppm CO max) If over allowed CO limit, a clean& tune needs to be performed.
18	Wood heating and venting and safety check?
	<ul style="list-style-type: none"> • Inspect stove, vent connector, and chimney for correct clearance. (Reference current SWS)
	<ul style="list-style-type: none"> • Does vent connector have any leaks? If so seal with high-temperature sealant designed for use with metal or masonry.
	<ul style="list-style-type: none"> • Is soot present on horizontal surfaces? Check gasket on door.
	<ul style="list-style-type: none"> • Inspect stack damper and/or combustion air intake.
	<ul style="list-style-type: none"> • If possible, have client light stove and test for ambient CO around stove.
	<ul style="list-style-type: none"> • If home is tight, wood stove should be equipped with outdoor combustion air.
	<ul style="list-style-type: none"> • If chimney or vent connector has creosote build-up, recommend a chimney cleaning.
19	Solid Fuel Burning Appliances in mobile homes. (Reference current SWS)
	<ul style="list-style-type: none"> • In mobile homes, solid fuel heating systems must be <i>UL-listed</i>. If replacement is not feasible or reasonable, see below.
	<ul style="list-style-type: none"> • In mobile homes, solid fuel heating systems must be rendered inoperable or removed before weatherization work may proceed.” Fireplaces should be removed, or if removal is not feasible, it should be permanently disabled to include: <ul style="list-style-type: none"> ◦ Disconnecting and capping the fireplace’s fuel supply line. ◦ Sealing/blocking the fire box with permanent construction materials (insulate opening then cap with wood, wall board). ◦ Removal of the chimney and capping the vent. ◦ If the fireplace or wood stove cannot be removed or disabled, the home will need to be deferred.