KBSI KANSAS BUILDING SCIENCE INSTITUTE

KBSI Field Guide - Worst Case Depressurization Test

1. Zero your ambient CO meter outdoors and record the outside temperature.
2. Prepare the house with windows, exterior doors, and fireplace damper closed, interior doors open, and begin with all combustion devices and ventilation fans off. Remove or replace all dirty air filters. Record the ambient CO in the Combustion Appliance Zone (CAZ). Test all gas lines, fittings, and valves for leaks with a gas sniffer moving one inch per second. Inspect the flue vents for minimum ¼"per foot slope.
3. Record the baseline pressure in the CAZ with reference to outside. (can be set to zero)
4. Turn on all devices that exhaust air, including the clothes dryer with a clean filter.
5. Turn on forced air system fan. Check and record CAZ ΔP with system on.
6. Start at the farthest room from the CAZ. Close all doors that cause the CAZ to go more negative, and leave all doors in a position that increases the depressurization of the CAZ. Check each room with a manometer hose under the door. If a room is pressurized by closing a door, leave that door closed. If the room is negative with reference to the rest of the house and the CAZ, open that door. The last door to close is the door to the CAZ. Position that door to depressurize the CAZ and record ΔP depressurized. Calculate ΔP_{worst} = $\Delta P_{depressurized}$ - $\Delta P_{CAZbaseline}$ = _____ Pa
   Compare to CAZ Depressurization Limits.
7. Begin with the smallest BTU appliance and follow the basic combustion appliance test **PROCEDURE** on the reverse side of this page. Monitor the ambient CO. Allow the flue vent to cool after the smallest appliance is tested. (see flowchart below)
8. Fire all other combustion appliances connected to the common flue vent simultaneously and test for spillage of each device. Test the draft and undiluted CO at steady state (up to 10 minutes) for each combustion appliance. If any fail, test under natural conditions. If all pass, there's no need to test under natural conditions.
9. Generate recommendations / work order in accordance with BPI standards.

$T_{outside}$ ___ °F

Ambient CO ___ ppm

$\Delta P_{CAZbaseline}$ = ___ Pa

$\Delta P_{w\ system\ on}$ = ___ Pa
(If system fan causes house pressurization due to dominant return duct leakage to outside, the worst case ΔP may be with system fan off).

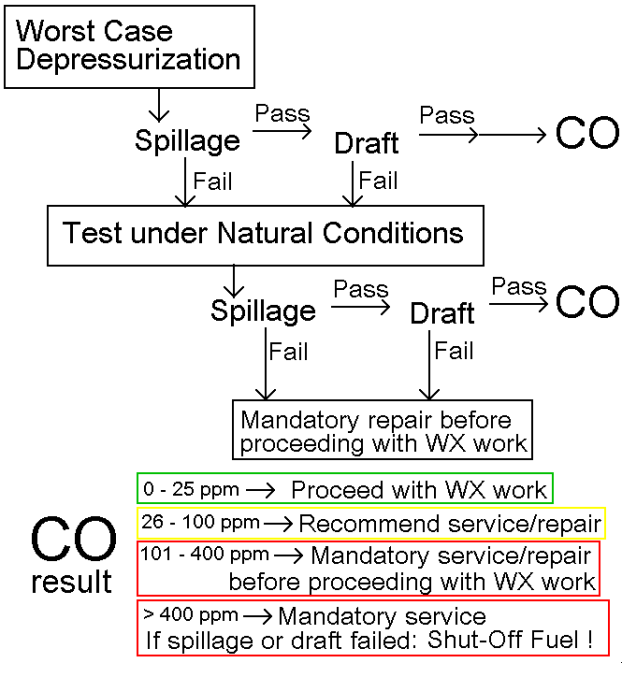
$\Delta P_{depressurized}$ = ___ Pa

ΔP_{worst} = _____ Pa

Actions / work order recommendations in accordance with BPI standards:

CAZ Depressurization Limits

Venting Condition	Limit (Pascals)
Orphan natural draft water heater (including outside chimneys)	-2 Pa
Natural draft boiler or furnace vented with water heater	-3 Pa
Natural draft boiler or furnace with vent damper vented with water heater	-5 Pa
Individual natural draft boiler or furnace	-5 Pa
Mechanically assisted draft boiler or furnace vented with water heater	-5 Pa
Mechanically assisted draft boiler or furnace alone, or fan assisted DHW alone	-15 Pa
Exhaust to chimney-top draft inducer; High static pressure flame retention head oil burner; Sealed combustion appliances;	-50 Pa



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KBSI Field Guide - Combustion Appliance Test Procedure

Under **Natural Conditions** Using: ambient CO monitor, spillage mirror, combustible gas sniffer, draft gauge, and flue gas CO meter

1. Zero your ambient CO meter outdoors. Prepare the house to test the combustion appliances with exterior windows and doors closed, interior doors open, and all ventilation fans off. This is the preparation for "natural conditions".
   The basic combustion appliance test **PROCEDURE** follows:
2. Begin with the smallest BTU appliance. Inspect the appliance and record Make, Model, Date of manufacture, and general condition. Check the supply line for combustible gas leaks. Check the flue for minimum ¼ inch per foot slope.
3. If there are no safety hazards, proceed. Prepare to test the combustion products spillage, flue draft, and CO production in undiluted flue gasses at steady state. Drill a hole in the flue vent about one foot (away from elbows) and from the draft diverter for measuring the draft. *Do not drill double walled, stainless steel or PVC flue vents*, (measure those vent types at the flue exit when safely possible).
4. Begin tests. Monitor ambient CO, if ambient CO > 35 ppm, ventilate area and evacuate. Turn on the smallest appliance first and test for spillage with the mirror or smoke pen. Note the time required for spillage to stop, and if *more than 60 seconds, it fails*, turn off the appliance. Test the larger BTU appliances. For the furnace, observe the flame shape, color, and for interference when the fan starts.
5. If spillage passes, wait up to 5 minutes and test the draft. Compare to the *Minimum Acceptable Draft*, and if draft is not a larger negative value, the appliance fails draft.
6. At steady state (after up to 10 minutes), measure the CO in undiluted flue gasses. Compare the measured level to the CO Action Levels.

Spillage: 60 seconds or less passes, more than one minute fails

Draft: requires negative pressure at flue vent with reference to inside

BPI Minimum Acceptable Draft = (T_{out}/40) - 2.75 Pa									
°F (out)	19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90
Pa Pascals	-2.3	-2.28	-2	-1.75	-1.5	-1.25	-1	-0.75	-0.5
inches H_20	-0.009	-0.009	-0.008	-0.007	-0.006	-0.005	-0.004	-0.003	-0.002

If less than 10 °F, the minimum draft is -2.5 Pa, If greater than 90 °F, the minimum draft is -0.5 Pa

CO Action Levels:

CO Test Result	Combined with And / Or	Spillage and Draft Results	Action
0-25 ppm	And	Passes	Proceed
26-100 ppm	And	Passes	Recommend CO be fixed
26-100 ppm	And	Fails Worst Case only	Recommend service/repair call
100-400 ppm	Or	Fails Natural Conditions	No work or air-sealing until repaired
> 400 ppm	And	Passes	No work or air-sealing until repaired
> 400 ppm	And	Fails either	**Emergency**: Shut off fuel / service

Device:
Make:_____
Model:_____
Age/condition:_____

Gas line leaks? ___
Flue vent slope:___

Comments:

Ambient CO: ____

Spill time: ____ (sec)
Pass___ / Fail___

Steady State Time:
_____ (min)

Undiluted CO:
_____ (ppm)

Draft: -___ Pa
Pass ___ / Fail___

Actions / work order recommendations in accordance with BPI standards: