

Indiana WX Gas Appliance Inspection Information

Client Interview:

This is important because it gives the inspector an idea of how the appliances are operating, lets the client know what you will be doing and gets the client involved which helps make client education easier.

- Let the client know that access will be needed to the entire house.
- Ask if the appliances currently operate.
- Ask if there are any problems with the system.
- Ask if there are any uncomfortable areas of the home.
- Would the addition of a supply run benefit an area of the house heated by a supplemental heat source? (An example would be a kitchen with no supply run and is being heated with the cookstove.)
- Ask the client if there are any resident illnesses.
- Ask if the client sets back the thermostat.
- Find out when would be a good time to discuss client education issues.
- Document any problems or pertinent information in the “Comments” section of the inspection form.

Comments / Billing Information:

This would be a good place for contractors to document any repairs that may require billing above the cost of a standard inspection or clean and tune. Document any pertinent information about the appliances being inspected keeping in mind that the form will be reviewed by a third party. The Inspection form should contain sufficient information for competent review.

Follow-up:

Document any emergency or otherwise situations that will require follow-up work to bring the situation within safety or efficiency specifications. Anything documented in the Follow-up section should have been remedied before the completion of the Wx work performed on the structure.

Furnace and Water Heater:

Determine fuel type, whether the heating system is a forced air, and types of appliances. List furnace Make, Model and Serial numbers, inputs and locations. Briefly describe the final configuration of the vent systems. For more than one furnace or WH, document appropriate information in the “comments” section.

New Furnace installations:

In the Inspector column on the form, a new furnace installation would only require that the CAZ depressurization and “5 minute” tests be performed on the final inspection. Other appropriate information will have been documented in the New Furnace Installation Inspection Form.

Gas Leaks and Piping Problems:

Gas piping is checked at the beginning of the inspection process to ensure inspector and client safety before the appliances are run for testing. The inspection process is stopped if a hazardous leak is found. A hazardous leak is one that can be easily smelled or sets off the alarm on a calibrated electronic gas leak detector. Hazardous leaks are repaired before the inspection process can resume. Non-hazardous leaks can be repaired at a later date.

- Test **ALL** gas piping in the home for leaks using a U-tube manometer or another pressure testing procedure, or an electronic leak detector and/or soap bubbles.
- No leaks allowed.
- Brass flex connectors manufactured in 1973 or earlier are to be replaced.
- Only AGA approved materials should be used in the gas piping system. This includes but is not limited to piping, fittings, valves and flex connectors.

- Inspect to make sure that flex connectors or soft copper tubing do not extend through a knockout hole into the cabinet of an appliance.
- Make sure that flex connectors are entirely in the same room as the appliance it serves and have a shut off valve on the inlet of the connector.
- Make sure that flex connectors used outdoors are rated for such use.
- Inspect for proper materials. Black iron pipe should be used as piping for natural gas systems.
- Black iron pipe, galvanized pipe or copper tubing can be used on L.P. systems.
- Check to make sure the appliance shut off valve is user friendly and operable.
- Install missing sediment traps if the piping system will be altered in any way.
- Make sure gas piping is properly supported.
- Compression fittings are not allowed on any fuel line.
- Inspect the gas piping system for any potential hazards.

Note: Program and Certification specs require that all the gas piping in the home is to be checked for gas leaks. Use of an electronic leak detector backed up with soap bubbles to gauge the severity of the leak is a good way to do this. If the alarm on your detector is used to gauge the severity of a leak, make sure you can show the unit is calibrated correctly. Be prepared to relate how to perform leak testing on inaccessible piping.

Electrical Safety:

The electrical system is checked at the beginning of the inspection process to ensure inspector and client safety before the appliances are run for testing or cleaning.

- Inspect to make sure the appliance has an operational shut-off switch in a usable location.
- If the appliance has a fused switch, make sure the fuse is of the appropriate amperage rating.
- Determine the polarity of the electrical supply and repair if necessary.
- Make sure the appliance is properly grounded.
- Repair any electrical safety problems.

Note: Program and Certification specs require that all furnaces are to be checked for proper polarity and grounding. Not all furnaces will have an SSU for polarity testing. Grounding starts with an initial visual inspection. Testing beyond that requires an understanding of how to check whether a ground wire is actually connected at the service panel.

Pilot Safety:

The pilot safety system is checked at the beginning of the inspection process to ensure inspector and client safety before the appliances are run for testing.

- Test for correct operation of all standing pilot safety systems and repair as necessary.
- Make sure L.P. gas appliances have an operational 100% shut-off pilot safety system.

Heat exchanger:

While the pilot safety system is being checked and the burners are about to be inspected and cleaned is a good time to check the integrity of the heat exchanger. Don't waste time doing more work than necessary on a bad furnace.

- Inspect the interior of the heat exchanger using lights and mirrors for holes or cracks.
- If there is reason to suspect that the heat exchanger may not be in good condition, then perform a Hetkit heat exchanger test on the appliance before going any further.
- If the furnace is found to be beyond repair and is to be replaced, the technician must continue the inspection process and complete all other appropriate sections of the Inspection form.

Note: Inspectors should be able to perform a tracer gas heat exchanger test. Understand how to calibrate and use the equipment.

Burners:

This point in the inspection process is a good time to inspect the burners for cleanliness, alignment and primary air adjustment.

- Inspect the burners. Remove and clean as required.
- Inspect and clean the heat exchanger if necessary.
- Open primary air openings as necessary.

Note: The clean and tune process is very much a preventative maintenance procedure. The burners on almost every furnace should be pulled and cleaned. This allows a good look at the heat exchanger and helps to keep them operating properly much longer after you leave. Water is a good cleaning tool. Burners should be cleaned both inside and outside.

Vent system:

Checking the vent system at this point in the inspection process ensures inspector and client safety before the appliances are operated for testing. A vent system installed to the NFPA 54 guidelines is desirable for proper and predictable operation. Venting problems, which would allow combustion by-products to enter the structure during appliance operation, are repaired before testing can begin.

- Inspect the entire vent system to be sure it is free of obstructions.
- Inspect the entire vent system for corroded pipe or a deteriorated chimney.
- Make sure there are no gaps in the piping or sections of missing pipe.
- Make sure the chimney has a proper clean-out cover and have any unused holes repaired.
- Make sure the chimney or vent has a proper cap or appropriate bird screen.
- Inspect the termination for proper height and location or obstructions.
- Make sure the vent system has proper support and is screwed together.
- Inspect for proper clearances to combustibles.
- Inspect for proper gauge of pipe for the vent connectors.
- Check for proper size of the vent and vent connectors.
- Make sure the vent and vent connectors have proper upward slope to the exterior of the structure.
- Remove thermally operated vent dampers and replace them with the appropriate pipe.
- Reasons for relining existing masonry chimneys with a new listed chimney lining system:
 - Bad chimney – Not Class A – deteriorated – plain brick and mortar chimney
 - Too large – violates the 7X rule – this pertains to “orphaned” water heaters
 - Insufficient draft
 - Exterior chimney with a new appliance installation
 - Mid-efficiency 80% furnace regardless of the configuration
- Repair any problems with the vent system. If possible, bring all vent systems up to meet NFPA 54 requirements.

Note: Program and Certification specs require that the entire vent system be inspected. It is difficult to make an evaluation of the vent system without a complete visual inspection.

Combustion and Ventilation Air:

All combustion appliance zones are to be measured to determine whether proper combustion and ventilation air is available. If the air to a CAZ is determined to be insufficient, then combustion and ventilation air openings are to be provided per NFPA 54 requirements.

- Procedure:
 - a) Total the BTUH input of all the vented appliances in the CAZ.
 - b) Divide the total input BTUH of the appliances by 20. The result is the volume, in cubic feet, required for the CAZ to be large enough based on an infiltration rate not less than .4 ACH.
 - c) Measure the actual volume of the CAZ.

- d) If the volume measured is less than the volume required, then provide adequate combustion and ventilation air openings into the CAZ per the National Fuel Gas Code (NFPA-54).
 - e) If the CAZ has previously been determined to be insufficient and combustion air openings have already been provided, measure the net free area, in square inches, of the existing openings and compare that measurement with the required net free area per NFPA-54.
 - f) If the net free area measured is less than the net free area required, then provide adequate combustion and ventilation air openings into the CAZ per the National Fuel Gas Code (NFPA-54).
 - g) If the infiltration rate of the building is less than .4 ACH, consult the NFPA-54 for the appropriate recommendations.
- Never leave a CAZ without the proper amount of combustion and ventilation air.

Filter:

A clean filter is required for properly testing the appliance. During client education, discuss the savings potential of a clean filter and blower.

- Replace the existing dirty filter or clean the existing dirty washable filter.
- If possible or appropriate, move the filter to a user friendly location. It is a good idea to put them someplace other than inside the blower housing.
- Add support to filters to prevent them from being sucked into the blower.
- Make sure the opening in the cabinet is larger enough to allow the proper airflow to the blower.
- Inspect to make sure the filter covers the entire opening in the return duct.
- When a remote filter such as a filter grille is used, the entire return system must be tightly sealed all the way back to the furnace casing.
- Make sure exposed filter slot openings have been covered with a removable, marked cover, if needed.

Direct or Belt Drive Blowers:

A clean blower is required for properly testing the appliance.

- Clean the blower wheel.
- Clean the blower housing.
- Oil the motor oiled if required.
- Clean the air-cooled motor.
- Inspect and replace worn belts.
- Inspect the pulley alignment and adjust if required.
- Increase the motor speed if required.
- Adjust the motor speed so the temperature rise across the heat exchanger is as follows:
 - On a draft hood equipped appliance – toward the low end of the temperature rise range listed on the nameplate
 - On a draft induced appliance – toward the high end of the temperature rise range listed on the nameplate
 - If there is no nameplate, try to move as much air as possible and always keep the temperature rise below 90 degrees F.
- If the motor speed has been increased by adjusting the pulley on a belt drive blower assembly, or by increasing pulley diameter, then the amperage of the motor must be measured and must be within nameplate specifications.

Note: The clean and tune process is very much a preventative maintenance procedure. The blowers on almost every furnace should be pulled and cleaned. The entire assembly should be disassembled for adequate cleaning and servicing of the wheel, motor and housing. Vacuum cleaners and brushes are often inadequate for cleaning. Water and cleaners are typically more appropriate. Be thorough in your cleaning process as this may be the one and only time this blower gets cleaned. It is a good idea to understand the efficiency relationships between fan switch settings, blower speeds and temperature rise.

Heat Exchanger:

While the blower assembly is removed for cleaning is a good time to inspect the exterior of the heat exchanger. A tracer gas test may be required for more accuracy.

- Inspect the exterior of the heat exchanger using lights and mirrors for holes or cracks.
- If the furnace is found to be beyond repair and is to be replaced, the technician must continue the inspection process and complete all other appropriate sections of the Inspection form.

Air conditioning:

While the blower assembly is removed for cleaning is a good time to inspect the A/C coil. A dirty indoor A/C coil will not allow proper airflow across the furnace heat exchanger.

- Clean the indoor air conditioning coil if necessary.

Ducts:

The duct system is checked at this point in the inspection process to ensure inspector and client safety before the appliances are run for testing.

- Inspect to make sure there are no open returns in the CAZ.
- Leaky supply and return ducts are to be sealed for safety and efficiency reasons.
- Open dampers in supply ducts.
- Remove or repair restrictions in the duct system such as blocked return grilles or crushed supply registers.
- Make sure that once the ducts are sealed that there is still sufficient airflow across the furnace heat exchanger to keep the furnace from cycling on the limit switch and meet temperature rise specifications.
- Existing duct-board or flex duct returns that have the potential to be future open returns should be replaced with metal duct – in particular, those that are located in the CAZ.
- Interior rooms are to be pressure relieved if necessary.
- Pressure pan numbers are documented on WX audit paperwork.
- Repair any problems with the duct system.

Note: A good visual inspection would include all accessible ducts. Pay particular attention to dangerous versus inefficient leakage. Inspectors and contractors should be familiar with testing of ducts that are inaccessible.

Water Heater Initial Check:

In order to be able to fire the water heater for future testing, it may be necessary to put the water heater on “pilot” and run water to cool the heater. Mark the dial at the original setting with a permanent marker. During client education, discuss the inefficiency and scalding potential of water that is hotter than 120 degrees F. If the water temperature has been adjusted down and the clients want it hotter, instruct the client not to turn it back up higher than where you marked it.

- Mark the temperature dial on the water heater at its current temperature setting with a permanent marker.
- Measure the hot water temperature at the nearest location.
- Inspect to make sure that all water heaters have a properly installed pressure and temperature rated relief valve.
- After draft and CO testing is complete, adjust the water temperature setting to approximately 120 degrees Fahrenheit, if necessary.
- Repair or replace leaking water heaters.
- Inspect electric water heaters for safe wiring practices.
- Repair any problems with the electric or gas water heaters.

CAZ Depressurization:

The CAZ depressurization test is done to determine the most negative conditions under which the appliances can be expected to operate.

Set up:

- a) Turn off the combustion appliances to be tested. Try and test the appliances with as cool of a vent as possible.
- b) Clean or remove the furnace filter. Forced air systems must be able to move air if there is a depressurization problem to be found.
- c) Close all exterior windows and doors. Make sure top sashes are closed also.
- d) Close fireplace and wood stove dampers. Leaving these open will pressure relieve the house and affect depressurization testing.
- e) Operate clothes dryer and all building exhaust fans except whole house fans. Clean the dryer lint trap.
- f) Close all interior doors. Do not close doors that contain JUST and exhaust fan and no supply register. If you are not sure about whether a door should be open or closed, smoke the door to see the direction of the flow of smoke. If the smoke gets sucked under the door, leave it open. If the smoke blows back at you, close the door.
- g) Open all the supply registers except any registers located in the CAZ.
- h) If needed, a blower door can be operated to exhaust 300 CFM from the building to simulate the flow of an operable fireplace/wood-stove vent.
- i) Set up a magnehelic gauge or digital manometer to measure the CAZ pressure with reference to the outside.

Note: Be thorough in your set-up. Look into rooms and open doors to make sure you don't miss anything.

“Worst Case” Depressurization Test:

- a) Measure the CAZ pressure WRT outside with the CAZ door to the interior open.
 - b) Measure the CAZ pressure WRT outside with the CAZ door to the interior closed.
 - c) Operate furnace blower.
 - d) Measure the CAZ pressure WRT outside with the CAZ door to the interior closed.
 - e) Measure the CAZ pressure WRT outside with the CAZ door to the interior open.
- *Note: Depending on the location and type of appliance, all four pressure measurements may not be necessary.*
 - Test the appliances under the most negative pressure documented. This would be considered “worst case depressurization” conditions of the CAZ.
 - **Make necessary repairs to the CAZ or appliances if:**
 - a) The appliance cannot establish flow in the vent under “worst case depressurization” conditions.
 - b) The appliance does not meet minimum draft pressure or spillage standards.
 - The measurements documented in the Technician and Inspector columns of the Gas Appliance Inspection Form must meet all standards for appliance operation.
 - If the technician finds the appliances cannot establish flow in the vent or will not work under “Worst Case” conditions, then “lose worst case” and continue testing under normal operating conditions and document in the “Follow-up” section of the guide. The health and safety and efficiency testing and repairs must be completed.

Appliance Firing and Testing Procedure Set up:

- a) Drill a test hole in the vent pipes of the appliances to be tested.
- b) Drill holes in supply and return ducts for temperature testing.
- c) Turn on (preferably outside) a digital CO tester. Monitor CO in the ambient air for the entire test.
- d) Create “worst case depressurization” of the CAZ.

Order of testing:

- a) Test the lowest Btu/hr appliance first. (Usually the water heater) This provision applies to all appliances that share combustion air. It is important to understand that the reason we can do this is because this appliance will be re-tested for draft after other appliances in the CAZ are fired.

Water Heater “5 Minute” Test Procedure:

- a) For personal safety, measure CO in the ambient air as all appliances are operated.
 - b) Fire the water heater.
 - c) The water heater should be able to initially establish flow in the vent. That is to say, flow has started up the vent (vent is getting warm), and there is not complete back-drafting of the appliance. It should be noted that initial flow can be established while still having minor spillage.
 - d) There should be no spillage of flue products within two minutes of operation.
 - e) After 5 minutes, measure for adequate draft in the vent. Adequate draft pressure is:
-.005” of W.C. @ greater than 80° F. **or** -1Pa @ greater than 80° F.
-.008” of W.C. @ between 60° and 80° F. -2Pa @ between 60° and 80° F.
-.012” of W.C. @ between 40° and 60° F. -3Pa @ between 40° and 60° F.
-.016” of W.C. @ between 20° and 40° F. -4Pa @ between 20° and 40° F.
-.02” of W.C. @ less than 20° F. -5Pa @ less than 20° F.
 - f) After 5 minutes, measure for carbon monoxide on both sides of the baffle in the undiluted flue products under the draft hood. The acceptable amount of CO is a stable measurement of less than 50 PPM as measured.
- Initial draft pressure measurements of the water heater **MUST** be taken at steady state efficiency. This way there is a valid number to compare to when retesting. Operate and test the other vented combustion appliances in the CAZ and re-test the water heater draft. The draft pressure should not decrease.
 - If an appliance cannot establish initial flow in the vent or still has spillage after two minutes, the appliance should be considered hazardous and should not be operated until repairs are made.
 - An appliance not meeting draft or CO standards is to be repaired before WX work is completed.

Note: It is a good idea to have the CO meter between your nose and the draft hood when measuring ambient CO on start-up of an appliance. Think safety. Understand the concept of establishing flow. The unit has to start a flow up the vent or you must abort the test for your own safety. If the unit cannot establish flow, lose the “worst case” conditions and try again. Initial combustion safety testing must be completed. Think of the test as a 5 second, 2 minute, 5-minute test. Leave the water heater operating when moving on to the furnace – it will need to be retested for spillage and draft after the furnace has been started.

Heating Appliance “5 Minute” Test:

- a) For personal safety, measure CO in the ambient air as all appliances are operated.
- b) Fire the heating appliance.
- c) The heating appliance should be able to establish flow in the vent. That is to say, flow has started up the vent (vent is getting warm), and there is not complete back-drafting of the appliance. It should be noted that initial flow can be established while still having minor spillage.
- d) There should be no spillage of flue products within two minutes of operation.

- e) After the operation of the heating appliance is stable, retest the smaller appliance for spillage and draft pressure.
 - f) When the blower comes on, check for flame interference.
 - g) After 5 minutes, measure for adequate draft in the vent. Adequate draft pressure was previously listed in the water heater section.
 - h) After 5 minutes, measure for carbon monoxide in the undiluted flue products at the outlet of the heat exchanger cells or in the vent as applicable. The acceptable amount of carbon monoxide is a stable measurement of less than 50 PPM per cell as measured.
 - i) After 5 minutes, measure temperature rise across the heat exchanger.
- Operation of the heating appliance should not cause spillage at the draft hood or a reduction in draft at any other appliance.
 - If an appliance cannot establish initial flow or still has spillage after two minutes, the appliance should be considered hazardous and should not be operated until repairs are made.
 - An appliance not meeting draft or CO standards is to be repaired before WX work is completed.
 - All Category 1 appliances are checked for draft pressure.
 - Flame interference indicates a hole in the heat exchanger. Perform a heat exchanger tracer gas test.
 - Category 3 and 4 appliances are not checked for draft pressure, as they are positive pressure vents.
 - Sealed combustion appliances are not checked for vent pressure.

Note: It is a good idea to have the CO meter between your nose and the draft hood when measuring ambient CO on start-up of an appliance. Think safety. Understand the concept of establishing flow. The unit has to start a flow up the vent or you must abort the test for your own safety. If the unit cannot establish flow, lose the “worst case” conditions and try again. Initial combustion safety testing must be completed. Think of the test as a 5 second, 2 minute, 5-minute test.

Fan Switch:

For efficiency reasons, the fan switch is adjusted to get the blower to come on sooner and stay on longer.

- Adjust the fan off temperature as close to 90° Fahrenheit as possible.
- Adjust the fan on time to make the blower come on as soon as possible.

High Temperature Limit:

This test must be performed on the primary limit control of all heating appliances that have them.

- All primary high temperature limit switches must operate correctly.
- The blower must continue to operate when the limit trips.
- The limit switch must reset before turning down the thermostat.
- Abort the test if the temperature in the limit testing location exceeds 225° Fahrenheit.
- Test can be done by disabling the blower or by “starving” the return air to the furnace.

Note: Think of this as a three part test. First, the limit should shut the gas off when the unit overheats. Second, the blower must be proved to see that it still operates when the gas shuts off. Third, the limit must reset as the unit cools off.

Thermostat:

The thermostat is checked at this point of the inspection process to ensure proper operation during furnace testing and for future client comfort. During client education, discuss the savings potential of setting back the thermostat.

- Make sure the thermostat is level and secure.
- The hole behind the thermostat should be sealed.
- Measure the amperage of the control circuit and reset the heat anticipator if necessary.

Client Education:

Client education is an important aspect of the process to try to ensure that measures taken during the Wx process will continue to provide comfort, safety and efficiency long after we leave.

- Discuss energy savings potentials of setting back the thermostat, changing the air filter and turning down the water heater temperature.
- Fire the appliance during client education to make sure it cycles properly before you leave.

Agency Review:

Ideally, all technical forms should undergo review by a competent Agency person before they are filed away upon completion of the jobs. This helps to make sure nothing is missed and quality is assured.

Optional:

Clocking the gas meter – This can be a vital piece of information in diagnosing furnace problems.

Measure appliance input if you are having temperature rise, high temperature limit, draft or CO problems.

Procedure:

- Accurately time the number of seconds it takes for the smallest dial on the meter to make four revolutions.
- Divide by four to get “seconds for one revolution”.
- Refer to the “meter clocking card” to find the number of cubic feet of gas/hour the appliance is using.
- Multiply the cubic feet/hr by the btuh content per cubic foot of the gas in your area to get btuh input.
- Compare to nameplate input.
- Use a manometer to adjust gas pressure to achieve correct input rating

Note: Technicians should have the skills required to connect a manometer to the unit and be able to adjust gas pressure.

Certification note: It is recommended that HT-1 certification candidates bring or use tools and equipment that you are familiar and comfortable with using during the certification assessment. As an example, INCAA will provide a Sensit Gas Leak detector when the candidate may be used to using a different piece of equipment. If the candidate decides not to use their own tools, INCAA will have all necessary tools and equipment on site to complete the assessment.

Additional Appliance or Additional CAZ page:

- This page would not have to be a permanent fixture in the Gas Appliance Inspection Form. Page 7 could be added to the Form or Client file as needed.
- The Gas Appliance Inspection Form is formatted to allow for multiple appliances in multiple locations. Use the form as appropriate. Most situations will have just two appliances located in the same CAZ. There may be times when there are more than two appliances in the same CAZ or appliances that are isolated from each other in a different CAZ. If there are three appliances, use the additional page 7. If there are four appliances, use two forms. Five appliances, two forms and the additional page....etc. The same thing applies to multiple Combustion Appliance Zones.
- All the testing on the Additional Appliance page is done in the same manner as previously outlined in this document.