

Indiana WX Gas Appliance Inspection Procedure

1)

Gas Appliance Inspection Responsibilities

- The gas appliance inspection and associated tasks must be completed by qualified auditors or heating technicians, with internal furnace work performed by qualified heating technicians.
- The auditor and tech columns are both for the initial inspection. Both columns are not required to be filled out. Each task must be acknowledged in either the auditor or the tech column.
- The interim column is only completed to verify repairs or requested changes.
- The interim column must be completed by a qualified technician or auditor.
- Repairs or furnace replacement must be inspected and signed off before air sealing and insulating.
- Health and safety repairs should be listed on the last page of the form.

2)

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 cook stove.)
- 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.

3)

Initial Health and Safety Inspection:

This is important to ensure we have a safe working environment before we start the inspection process.

- Measure ambient carbon monoxide levels
- Look for fire hazards such as flammable products in the combustion appliance zone
- Inspect for mold or moisture issues
- If gas odor is detected, use electronic gas leak detector to search for major leak

4)

Equipment Information:

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. For more than one furnace or WH, document appropriate information in the “comments” section.

5)

New Furnace installations:

If the final inspection is of a job with a new furnace installation then only the CAZ Depressurization, Combustion Safety and Temp Rise sections need to be completed.

Other appropriate information will be entered on the New Furnace Installation Inspection form.

6)

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. These include but are not limited to piping, fittings, and valves and flex connectors.
- Inspect to make sure that flex connectors or soft copper tubing do not extend through a knockout hole in the furnace cabinet without appropriate protection.
- Make sure that flex connectors are entirely in the same room as the appliance it serves and there is a shut-off valve on the inlet of the connector and only one flex connector is used per appliance.
- Make sure that flex connectors used outdoors are rated for such use.
- Inspect for proper materials. Black iron pipe or CSST must be used as piping for natural gas systems.
- CSST (Corrugated Stainless Steel Tubing) must be grounded to the electrical service electrode grounding system at the point where the gas piping enters the building – the bonding jumper must be no smaller than 6 AWG copper or equivalent.
- Black iron pipe, CSST, 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.
- Understand pressure testing may be required to perform leak testing on inaccessible piping.

7)

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. Fuse size should be no larger than the size of the breaker or fuse feeding the furnace branch circuit.

- If the appliance has a fused switch, make sure the line/load designations are followed so the fuse is not “live” when being replaced by the client.
- Determine the polarity of the electrical supply and repair if necessary. Proper direction of current flow can be easily tested with a non-contact voltage tester.
- Make sure the appliance is properly grounded. This starts with a visual inspection to see if a ground wire has been run to the furnace. The ground must be tested to make sure it is connected at the electrical service panel. A proper ground must be provided if one does not exist.
- Repair any electrical safety problems.

8)

Heat exchanger:

Don't waste time doing more work than necessary on a bad furnace. A determination of the integrity of the heat exchanger needs to be made at this point in the process. Removal of the burners and blower assembly for inspection and cleaning often provides an opportunity to inspect the heat exchanger from the inside and outside. On condensing furnaces it may be necessary to remove the air conditioning coil or open the plenum to view the entire heat exchanger.

- Inspect the heat exchanger for holes or cracks visually or by any of a number of heat exchanger testing methods.
- A combustion analyzer may be useful for testing for heat exchanger integrity by monitoring oxygen changes during blower operation on non-condensing furnaces.
- On condensing furnaces, block the furnace vent outlet, turn blower on, check for pressure on the heat exchanger pressure switch tube or smoke the combustion air inlets or at the burners. Pressure in the tube or smoke blowing back from inlets may indicate a hole in the heat exchanger.
- 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.
- Clean the interior of the heat exchanger as necessary.
- Check the heat exchanger secondary coil and clean as necessary.

Burners:

- Remove and clean as required. Burners should be cleaned both inside and outside.
- Water is a good cleaning tool.
- Check for proper burner alignment
- Clean orifices as necessary.
- Remove and clean pilot assembly as necessary
- Clean flame sensor
- Adjust burner primary air openings as necessary.

Direct or Belt Drive Blowers:

- Disassemble the assembly and clean the blower wheel.
- Clean the blower housing.
- Brushes are typically insufficient for proper cleaning. Water and cleaners are recommended.
- Clean the air-cooled motor. A vacuum w/brushes and electrical motor cleaner are recommended.
- Oil the motor if required.
- Inspect and replace worn belts.
- Inspect the pulley alignment and adjust if required.

Air conditioning:

- Clean the indoor air conditioning coil as necessary

- While the blower is removed may be a good time for a visual inspection of the coil.
- Inspect condensate pan and drain piping – make necessary repairs.

Note: The clean and tune process is very much a preventative maintenance procedure. The burners and blower assemblies on almost every furnace should be pulled and cleaned. This may be the only clean and tune this furnace will ever see. With good client education, the goal is to keep the appliances running properly long after you are gone

9)

Vent system:

The vent system must be inspected before the appliances are operated for testing. A vent system installed to the minimum NFPA 54 venting guidelines is required to achieve as proper and predictable vent operation as possible. Venting problems, which would allow combustion by-products to enter the structure during appliance operation, must be repaired before testing can begin.

A vent system that is, at a minimum, installed to code is an important part of the Weatherization process. From a quality control perspective, a description of the final vent system gives Agency reviewers and Monitors a good idea of what was done at the home.

- Inspection of the entire vent system, including attics, chases...etc., is required.
- Make sure the vent system is free of obstructions.
- Inspect for chimney damage, corroded vents or connectors, gaps or sections of missing pipe.
- Make sure the chimney has a proper clean-out cover and that any unused holes have been 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 by itself, regardless of the configuration
- Condensing furnace vent systems must be installed per Manufacturers Installation Instructions.
- Condensing furnaces must obtain combustion air from outside if the unit is designed for direct vent (“two-pipe”) installation.
- Inspect for proper outside termination of plastic vent pipes.
- Inspect for proper slope of plastic vent pipe back to furnace for proper drainage of condensate.
- Inspect for proper condensate disposal system, clean if necessary.

10)

Combustion and Ventilation Air:

All combustion appliance zones are to be evaluated to determine whether proper combustion and ventilation air is available. If the volume or air leakage rate of the CAZ is determined to be insufficient, then combustion and ventilation air requirements are to be met per NFPA 54 or the IFGC.

- Follow the form procedure to determine the adequacy of the space to meet combustion and ventilation air requirements
- To use interior air for combustion and ventilation, the estimated natural air infiltration rate of the building must be no less than .4 ACH.
- If the volume needed is more than the volume available or the building is too tight, follow the guidance outlined in NFPA 54 or the IFGC.
- Never leave a CAZ without proper combustion and ventilation air.

11)

Filter:

During client education, discuss the savings potential of a clean filter and blower. Educate the client on location and maintenance of the filter.

- 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 a high pressure drop filter is used, make sure there is still proper airflow across the unit.

12)

Ducts:

Be aware that severe duct problems may cause a hazardous environment for testing the combustion appliances. Take appropriate precautions. CAZ depressurization testing should identify these issues.

- Seal any open returns in the CAZ.
- Supply and return ducts that extend outside the pressure and thermal boundary of the home are to be tightly sealed and insulated.
- Supply and return ducts that are inside the pressure and thermal boundary of the home are to be sealed if there is a pressure imbalance or air delivery issues.
- Return ducts in crawl spaces should be sealed for indoor air quality.
- Air distribution issues must be addressed – this would be either to provide enough airflow across the furnace for proper operation or to eliminate the use of a supplemental heat source in an area that can be serviced by the furnace.
- 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.

- After duct sealing, make sure there is sufficient airflow across the furnace heat exchanger to keep the unit operating within temperature rise specifications.
- Leaky supply and return ducts are sealed to address both safety and efficiency.
- Open dampers in supply duct runs.
- Address restrictions in the duct system such as blocked return grilles or crushed supply registers.
- 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.

13)

Thermostat:

During client education, discuss the savings potential of setting back the thermostat.

- Make sure the thermostat is level and secure.
- The thermostat location must be functional - away from heat sources, direct sunlight or outside walls.
- The hole behind the thermostat must be sealed to prevent drafts in the wall from affecting the stat.
- Measure the amperage of the control circuit and reset the heat anticipator if necessary.
- Digital thermostats should have the cycle rate set to match the furnace it is controlling. Refer to manufacturer instructions.
- If replacing a mercury based thermostat, remove safely and dispose of in accordance with EPA regulations.

14)

Water Heater Initial Check:

In order to be able to fire the water heater for operational testing, it may be necessary to put the water heater on “pilot” and run water to cool the heater. This is a good time to document the hot water temperature.

During client education, discuss the inefficiency and scalding potential of water hotter than 120 °F. If the water temperature has been adjusted down and the client wants 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 setting with a permanent marker.
- Measure the hot water temperature at the nearest location.
- Make sure that all water heaters have a properly installed pressure and temperature relief valve.
 - T&P must be installed in the water in the top 6” of the tank.
 - The drop must be a material suitable for water distribution. (PVC drain pipe not allowed)
 - Drop extends to within 6” of the floor
 - Cannot extend into a drain – must have an air gap
 - Drop cannot have a valve in the line and cannot terminate with a threaded end
- After draft and CO testing is complete, adjust the water temperature setting to approximately 120 ° Fahrenheit, if necessary.
- Repair or replace leaking water heaters.
- Install expansion tank when code requires (back flow preventer on water system)
- Inspect electric water heaters for safe wiring practices.

- Repair any problems with the electric or gas water heaters.

15)

CAZ Depressurization:

Depressurization testing is done to determine the configuration of the CAZ which is least likely to allow vented combustion appliances to establish a flow in the vent and adequately vent combustion by-products to the exterior of the building.

Base Line Test set up:

- Turn off the combustion appliances to be tested. Test the appliances with as cool of a vent as possible.
- Remove the furnace filter. Forced air systems must be able to move air if there is a depressurization problem to be found.
- Close exterior windows, doors and other openings. Be thorough; don't miss something like an attic hatch hidden in a closet.
- Close fireplace and wood stove dampers. Leaving these open will pressure relieve the house and affect depressurization testing.
- Set-up manometer to measure CAZ pressure with reference to outside.
- Record CAZ base line pressure.**

Depressurization set-up, blower off:

- Operate the clothes dryer and all building exhaust fans.
 - **Exception:** Do not operate whole house fans
 - Exhaust fans might be range hoods, down-draft cooking appliances, some microwave ovens, bath fans, radon fans, craft room fans...etc.
 - Operate working PAV's. (Power attic ventilators)
 - Clean the dryer lint trap and outlet if dirty. Recommend running the dryer on a "no-heat" setting.
- Open all the supply registers except any registers located in the CAZ. Closing registers in the CAZ would be "worst case" from a negative pressure perspective.
- Interior door position:
Close all interior room doors except to rooms that contain an exhaust fan or exhaust appliance. We need to see the effect of the fans in those rooms on the CAZ without the furnace fan operating.
- Smoke or pressure test any doors that separate stories or sections of the house to determine door position with CAZ at your back. Positive pressure (blows smoke toward you) close door. Negative pressure (sucks smoke under) open door.
- If needed, a blower door can be operated to exhaust 300 CFM from the building to simulate the flow of an operable fireplace/ or wood-stove vent. This can also be used to simulate the flow of exhaust fans that may not have been installed or connected yet. Typical flows might be:
 - Bath fan – 50 CFM
 - Range hood – 100 CFM
 - Clothes dryer – 150 CFM
 - Whatever CFM is calculated for occupant ventilation

"Worst Case" Depressurization Test, blower off:

- a) Document the CAZ pressure WRT outside with the CAZ door to the interior open.
- b) Document the CAZ pressure WRT outside with the CAZ door to the interior closed.

Blower on test set-up:

- c) Operate furnace blower and test the position of interior doors to rooms that have supplies and also have exhaust fans or returns.

With the furnace blower operating, it is necessary to evaluate the door position of the rooms with exhaust fans or returns. From the CAZ side of the door, smoke the doors to rooms with an exhaust fan or exhaust appliance 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. A digital pressure gauge can be used instead of smoke. Also retest any doors that separate stories or sections of the house to determine door position

“Worst Case” Depressurization Test, blower on:

- d) Document the CAZ pressure WRT outside with the CAZ door to the interior closed.
- e) Document the CAZ pressure WRT outside with the CAZ door to the interior open.

Determine the worst case depressurization. Adjust it from the baseline reading and record. Compare it to the Appliance Depressurization Limits Table found in the SWS detail **2.0299.1**. If negative pressure exceeds the limits for the appliance(s) in the CAZ determine corrective measures.

Appliance(s)	Tolerance rating
Atmospheric water heater only	-2 pa
Atmospheric water heater with atmospheric furnace	-3 pa
Atmospheric or fan assisted furnace or boiler only	-5 pa
Oil furnace	-5 pa
Closed controlled wood burning appliance	-7 pa
Direct vent sealed combustion	-15 pa

Important: This set-up procedure does not cover all houses. Understand the concepts and adapt them as needed. Common deviations from the set-up procedure deal with door closure issues. Examples would be having a bathroom with an exhaust fan located in a bedroom or a CAZ in a basement that has a door along with a door at the top of the basement stairs. Anytime there is a door where you are unsure of its position, smoke it with the furnace fan off to get the first two measurements and then smoke it again with the furnace fan on for the second two measurements. Use the smoking guidance under set-up item “g” listed above.

16)

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.
- If the technician finds the appliances cannot establish flow in the vent or will not work under “Worst Case” conditions, then continue testing under normal operating conditions and document in the “Health & Safety Issues to be Addressed” or “Comments” section of the guide.

- The final measurements documented in either the Auditor or Technician columns of the Gas Appliance Inspection Form must meet all standards for appliance operation before shell work can begin.

Appliance Firing and Testing Procedure Set up:

- a) Drill a test hole at the appropriate location in the vent pipe of the appliances to be tested.
 - a. Draft hood equipped – as far as possible, keep test hole away from the draft hood or turbulence created at elbows...etc. – in the longest, straightest pipe is preferred
 - b. 80% furnaces – away from the draft effect created by the inducer operation – preferably after an elbow from the inducer
 - c. 90% furnaces – CO can be tested at the outlet of the vent – only drill the pipe at the furnace if the hole can be sealed appropriately with a threaded plastic plug and silicone or located behind a rubber coupling that can be tightened over the test hole.
- 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) Re-create “worst case depressurization” of the CAZ.

Order of testing:

Test the lowest Btuh input appliance first. (Usually the water heater) This provision applies to all appliances that share combustion air.

17)

Water Heater Combustion Safety Test

- 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:

Outdoor Temperature	Minimum draft inches of W.C.	Minimum draft Pascals
Greater than 80°F	-.005” W.C.	-1 pa
Between 60° and 80°F	-.008” W.C.	-2 pa
Between 40° and 60°F	-.012” W.C.	-3 pa
Between 20° and 40°F	-.16” W.C.	-4 pa
Less than 20°F	-.02” W.C.	-5 pa

- 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.

18)

Furnace Combustion Safety Test

- For personal safety, measure CO in the ambient air as all appliances are operated.
- Fire the heating appliance.
- 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.
- There should be no spillage of flue products within two minutes of operation.
- After a draft hood heating appliance flow is established and spillage disappears, retest the smaller appliance for spillage and draft pressure. After an induced draft furnace fires and flue gas is flowing into the vent, immediately retest the smaller appliance for spillage, then draft.
- After 5 minutes, measure for adequate draft in the vent. Adequate draft pressure was previously listed in the water heater section.
- 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.
- After 5 minutes, measure temperature rise across the heat exchanger.

Note: When the blower comes on, check for flame interference if worst case set-up does not call for the blower on.

- 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. Verify heat exchanger integrity.
- 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.
- All appliances are checked for Carbon Monoxide (CO)

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.

19)

Combustion Analysis

Perform a combustion analysis with the furnace operating at steady state upon inspection. If a cleaning or any adjustments are made, also do a post tune and clean combustion analysis. Record the following readings from the analyzer:

- Carbon monoxide (as measured)
- Oxygen
- Carbon dioxide
- Excess air
- Steady state efficiency
- Stack temperature

20)

Furnace Operational Testing

Temperature Rise:

Measure the temperature rise across the heat exchanger after 5 minutes of operation. Adjust 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 to middle of the temperature rise range listed on the data plate if possible.
 - On a mid-efficiency 80% draft induced appliance –within the middle third of the temperature rise range listed on the data plate if possible. Mid-efficiency 80 % appliances are prone to condensation issues in the heat exchanger if they are under fired or have too much air flow.
 - 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.
- If the temperature rise is greater than the maximum temperature rise listed on the data plate after cleaning and adjustments have been made, static pressure testing must be performed to determine corrective measures.

Pilot Safety:

The pilot safety system can also easily be tested during the burner clean and tune procedure.

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

High Temperature Limit:

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

- The primary high temperature limit switches must shut down the burners if the unit overheats.
- The blower must continue to operate when the limit trips.
- The limit switch must reset and the burners re-ignite 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 and the burners should re-ignite before the thermostat is satisfied.

Fan Switch:

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

- With temperature actuated fan switches adjust the fan off temperature as close to 90° Fahrenheit as possible.
- With time on circuit board switches adjust the time off delay to achieve a fan off temperature of 20° F above the measured return air temperature if possible.
- If available, adjust the fan on time to make the blower come on as soon as possible.

20)

Clocking the gas meter:

This can be a vital piece of information in diagnosing furnace problems. Measure appliance input. If this is a propane furnace without a gas meter, measure the gas pressure and adjust to the manufacturers specifications and verify proper orifice size.

Procedure:

- Accurately time the number of seconds it takes for the smallest dial on the meter to flow two cubic feet, four revolutions of ½ cubic foot dial, 8 revolutions of the ¼ cubic foot dial.
- Divide by four to get seconds for ½ cubic foot.
- Refer to the “meter clocking card” or the last page of this form to find the number of cubic feet of gas/hour the appliance is using.
- Another option to finding the cubic feet of gas/hour is to calculate the flow. Divide the total seconds for two cubic feet of flow into 7200 to attain the cubic feet of gas/ hour.
- Multiply the cubic feet/hr. by the Btu 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.
- Gas manifold pressure must be within 10% of manufacturers listed nameplate pressure.
- Measured Btu/hr. input must be within 5% of manufacturers nameplate input rating.
- Heating appliances are not to be over-fired.

21)

Calculating air flow:

The information required to calculate the air flow has already been gathered in the inspection process.

The calculation is: $CFM = \text{Btuh output} \div (\text{Temp. rise} \times 1.08)$

- Convert the Btuh input to output. Multiply the input by the efficiency.
 - Example: 70,000 Btuh 90% furnace: $70,000 \times .9 = 63,000$ Btuh output
- Apply the correction factor (1.08) to the temperature rise.

- Example: 70° return, 125° supply = 55° temperature rise. $55 \times 1.08 = 59.4$
- Divide 63,000 by 59.4 = 1060 CFM

22)

Measuring Static Pressure

Measuring static pressure is a valuable diagnostic procedure when it is determined there is an airflow issue with the system. The volume of air an air handler can deliver is affected by *the Total External Static Pressure* the blower is working against.

Most gas furnaces state on the nameplate; *Maximum External Static Pressure: .5 inches of water column*. This means the maximum static pressure the furnace will deliver its rated air flow is .5 inches water column. Furnace manufacturers provide fan performance tables that will show what volume of airflow it will deliver at given static pressures. A gas furnace may work safely at static pressures greater than .5 inches if the temperature rise is still below the maximum rise listed on the nameplate. There are up to four common components that affect the total external static pressure:

- The supply duct static pressure
- The return duct static pressure
- The pressure drop across the coil
- The pressure drop across the filter

Static pressure shall be measured at four locations to gather the necessary information. Measure and record the four readings.

- Measure at the outlet of the coil, this is the *Supply Duct Static Pressure*.
- Measure at the supply outlet of the furnace, before the coil. This is the *Total Supply Static Pressure*. (if there is no coil, total supply static and supply duct static are the same)
- Measure at the blower compartment on the blower side of the filter. This is the *Total Return Static Pressure*.
- Measure in the return duct for the *Return Duct Static Pressure*.
 - Note: If the return system has a remote filter grille the static pressure drop across the filter will be measured by inserting the manometer probe through the filter and reading the pressure with reference to outside the filter. Subtracting this from the *Total Return Static Pressure* will give the *Return Duct Static Pressure*

Calculate and record the following on the form:

- Add the b) *Total Supply Static Pressure* to the c) *Total Return Static Pressure* disregarding the positive/negative. This sum is the *Total External Static Pressure*.
- Subtract the a) *Supply Duct Static Pressure* from the b) *Total Supply Static Pressure*. This sum is the *Pressure drop across the coil*.
- Subtract the d) Return duct static pressure from the c) Total return static pressure. This sum is the *Pressure drop across the filter*.

Note:

If airflow is low and *Total External Static Pressure* is high, look for the component(s) that have high static pressure and determine corrective action.

If airflow is low and *Total External Static Pressure* is low, the problem is internal to the furnace. (Dirty wheel, blocked secondary heat exchanger, weak blower motor)

23)

Additional Appliance or CAZ

- The Gas Appliance Inspection Form is formatted to allow for up to two appliances. 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 more than two appliances, use two forms or more...etc. The same thing applies to multiple Combustion Appliance Zones.
- All the testing on the Additional Appliance or CAZ pages is done in the same manner as previously outlined in this document.

24)

Issues to be addressed / Comments / Signatures

- Use this section to document needed/performed work on the building and any appropriate information that needs to be shared with the Auditor and Technician.
- 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.
- Appropriate names and dates must be on the form for proper review. It should be clear which person performed each task associated with the form.
- 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.

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.