

# Home Inspection Data



By: Jeffrey Pelton  
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The information enclosed is meant to provide insight into some of the items home inspectors look for during a home inspection. This is not meant to be a how to perform a home inspection booklet, as no process data is provided. It is filled with items that are common issues seen with the homes major systems and appliances. Always follow appropriate safety guidelines and when in doubt, contact a professional.

The topics covered in the technical document are:

Asphalt roofs

Electrical panels

Furnaces

Water Heaters

Attics

# Asphalt Roofs

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**General information** – Asphalt roofs have grown in popularity and are the roofing material of choice for most homes. Asphalt composition shingles are manufactured with a layer of fiberglass matting sandwiched between two layers of asphalt. The tops of the shingles are covered with small granules. These little rocks help provide UV protection for the asphalt.

**The styles of shingles** – Asphalt roofing comes in two popular styles: Architectural (or laminated) shingles and three-tab shingles. There are a few other styles, but they are not as common or popular. These shingles are typically about 3 feet long. Architectural shingles are made by laminating material together to give the roof some texture and depth. Three-tab shingles are a single layer of roofing and cut into three tabs. Usually, each tab is about a foot long. When installed the cuts making the tabs are staggered, and the shingle below provides the roofing coverage for the cut.



Architectural Shingles



Three-Tab Shingles

Architectural shingles usually last longer than three-tab shingles. The extra materials of the laminated shingle proved extra protection, and the lack of individual tabs can provide better protection from wind damage as the roof ages. There are large variations in the quality of shingles produced, even by the same manufacturer.



Missing tab from Three-tab shingles, Note the black adhesive strip on the lower shingle

**Look for missing shingles** - The tabs on three-tab shingles are prone to breaking off when the shingles become old and brittle. Each tab is held down with an adhesive strip from the shingle below. The adhesive strip failure can cause the tab to be lifted by wind or other forces. When adhesive strips start failing, it's a sign that the roof is nearing the end of its useful life. Some items to look for are damaged or missing shingles, shingles held into place with fasteners going directly through the roofing materials, and cupping or bowing of tabs.



CA cut Open valley

**Look at the valleys** – Roofing valleys are common areas of concern for roofs. Water collects in the valley and is a common source of leaks. Not all valleys have exposed flashing. With a closed valley, the roofing material is run right through the valley. The photo is of a California (CA) cut open valley. In a CA cut valley, shingles are laid lengthwise along the valley edge making a nice straight line. This type of valley can save installation time over cutting the end of each

shingle to make the valley edge. Some common things to look for in valleys are where roofing tar may have been added to seal leaks, large collections of debris that should be removed, and damage to the flashing or the shingles in the valley.



CA Cut Closed Valley

**Check roofing penetrations** - Roofing penetrations are areas that should be checked. All roofing penetrations must still seal out water, this is most often accomplished with a flashing. Flashings come in different styles and materials, but have one goal, to protect areas of the roof or home from moisture intrusion. Plumbing vents typically have rubber flashings. Skylights and chimneys usually have metal flashings. Inspect the flashings around plumbing vents. They typically crack with age. Cracks shaped like a V can be seen along where the flashings are stretched over the plumbing vent.



Plumbing vent flashing



Roof anchor missing its protective cap

Most are replaceable by a good roofer. Some even a competent DIY

homeowner can replace. Flashings around skylights and chimneys should be in good condition and debris and roofing tar free. There are several styles of fall arresting anchor systems built into homes. Some of the designs require caps. These caps are often missing. The flashing is designed to shed water, but the caps provide better long-term weather protection. Roofing tar should not be used as a flashing, if a penetration is covered in tar, it's time to call a roofer.



Roofing with missing granules

**Look for missing granules** – As roofs age the granules protecting the roof surface can become dislodged. Some of this is normal, and some is caused by wear, aging, or mechanical damage. The granules provide UV protection to the asphalt and can reflect some of the heat from the sun. They also provide some shingle protection, as well as providing the surface view improving the aesthetics.

**Installation Pattern** – Typically Asphalt roofing is installed in a stair step shingling pattern. The shingles are staggered as they are installed making diagonal rows of shingles. The other method of installation is called racking. When the racking method is used, the shingles are

staged back and forth installed in vertical rows. Seams of every other course will be aligned, increasing the chances of leakage. Some manufacturers allow racking as an alternate method for installation, but the stair step shingling method is typically the preferred installation.



Installation from the racking method, the seams can be seen aligning, and is usually not the preferred method of installation



The typical stair style installation pattern, visible here because a batch of shingles had a manufacturing defect



The kickout flashing shown diverting water from the edge of the home into the gutter

**Are proper flashings in place?** – A kickout flashing will divert water running down a roof to the house intersection away from the home and into the gutter. A drip edge flashing installed at the rake edges of the roof can stop water from running beneath the shingles and damaging the roof sheathing. This small metal drip edge flashing should divert the water from the roof directly into the gutter protecting the roof deck below.



The drip edge flashing can be seen below the roofing materials and in front of the gutter



Continuous ridge vent

These vents allow air to escape through the vent. Both systems are effective as long as they are sized and installed properly. Lower roof venting should also be installed as well. Lower vents are usually located in the eaves, commonly called bird blocks, but sometimes are installed on lower edges of the



Bird block style lower roof vents, an electrical outlet for Christmas lights can be seen.

**Check roof ventilation** – Roof Ventilation is one of the most often overlooked areas of the home and plays a vital role in overall air quality and comfort. Roofing materials can get very hot during the summer months. Some of this heat is transferred to the attic. Attic vents aid in letting heat and moisture out. Common roof ventilation types are a continuous ridge vent where the ridge singles are installed over a vent, allowing the center of the roof to vent. The other method is roof vents, also called jacks. Roof vents are placed near the ridge of the roof.



Roof vents

roofing with roof

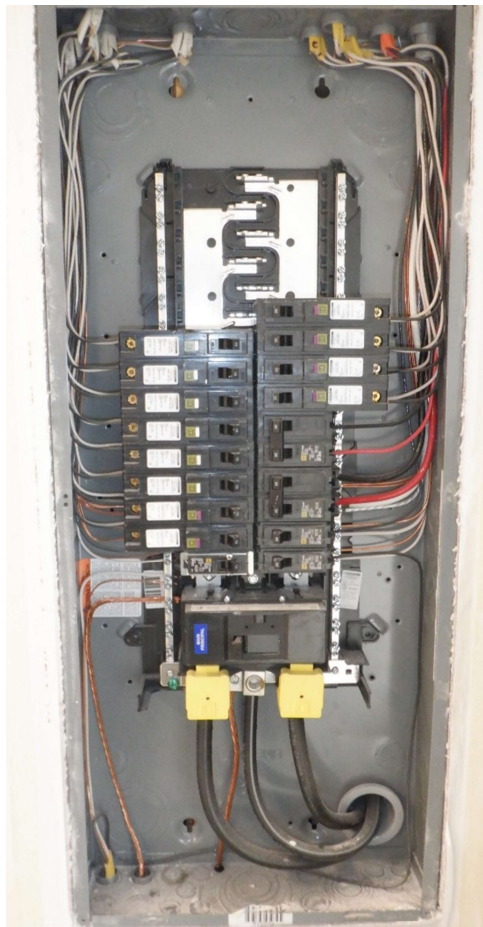
vents. The combination of upper vents and lower vents are what allows them to function properly. When warm air flows out the top vents, cool air is brought in from the lower vents keeping the attic cool. This cycle of flowing air also aids in removing moisture from the attic. Roof venting requirements are constantly changing as building methods and our lifestyles change. Proper vent area calculation is best left to a professional, but ensuring the vents are present and unobstructed will go a long way.

# Electrical Panels

By Jeffrey Pelton - E3 Home Inspections

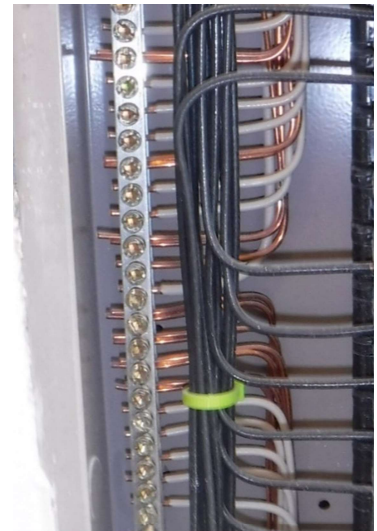


**General information** - The electrical panel is the home's main distribution point for the electricity supplied to the home. The electrical panels condition, age, and style along with features play a large role in the safety of the home electrical system.



A main service panel

**The Main Service panel** – The main service panel is the first location where power enters the home. In some multi-family dwellings, this may be outside in one central location for all the units in the building. One of the items to note for a main service panel is there are only 3 wires entering from the street, Two hot (ungrounded) conductors, and one neutral (grounded) conductor. A main service panel should have a main service disconnect (except split bus panels). This allows you to disconnect power to the entire home. The main service panel is the only place where a (grounding) bare wire and neutral (grounded) white conductors can be connected to the same bus bar. There is typically a bus bar on each side of the panel for convenient connection of the grounds and neutral wires. This bus bar should also be bonded to the panel box and grounded.



Neutral and ground bus bar in a main service panel

**The cover should not have any openings into the panel** - The electrical panel cover (dead front) should be in place and there should not be any open spots to allow access into the inside of



An improper, pointed panel cover screw cut the insulation on a live wire and caused an arc, note the back staining on the wall of the panel

the panel. The screws holding the panel cover in place should be fine thread, blunt point, electrical panel screws. The screws enter directly into the interior of the panel and can damage the insulation of wires or energize the panel cover.



A proper fitting electrical panel dead front cover in place

**The Split-bus panel** - The Electric code requires the power to be disconnected from the entire home using 6 or less breaker movements. Based on this rule, some manufacturers were able to save costs by eliminating the large main breaker at the top of the panel. Locating the larger double pole breakers for water heaters, ranges, furnaces, etc. on a separate bus section at the top of the panel. A lower section of the panel was fed by a main breaker in one of the top six positions. A common defect is seven breakers at the top of the panel (pictured). The lower section would be where the lights, outlets, and small appliances would be located. The split bus panel design is outdated. Most were made between roughly 1975 and 1985. Opinions vary on if they should be replaced when they are still in serviceable condition and configured properly.

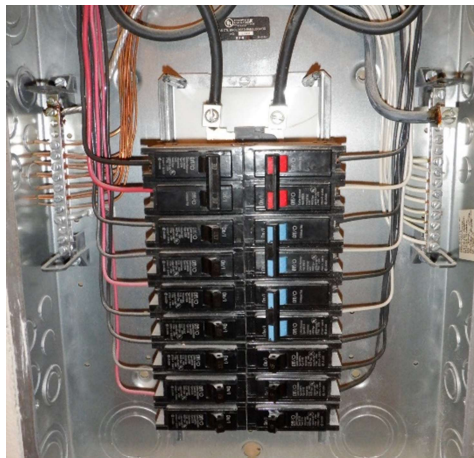
When in doubt its best to have an electrical contractor evaluate the panel.



A split bus electrical panel, note in this panel there are 7 breaker handles in the top live section of the panel, this is a defect



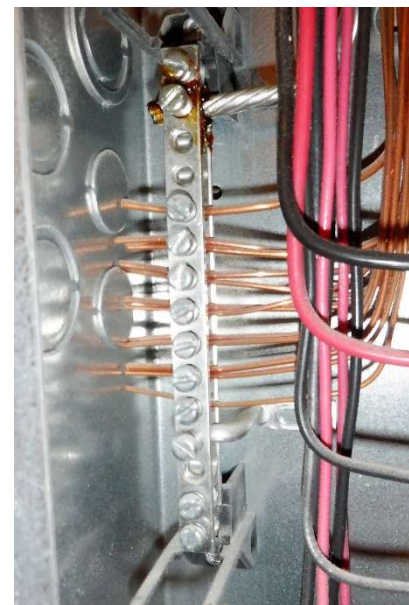
**Electrical panel brand** – Some electrical panel brands are known to have issues and should be replaced to protect the occupants or the structure. With an older panel, it's always best to have a professional evaluate the panel. Some of the brands, styles, or panels that I recommend replacing: Federal Pacific, FPE, Stab-lok, Zinsco, Bulldog, Sylvania, and Pumatic. The problems with the panels range from failing to trip, to arcing inside the panel.



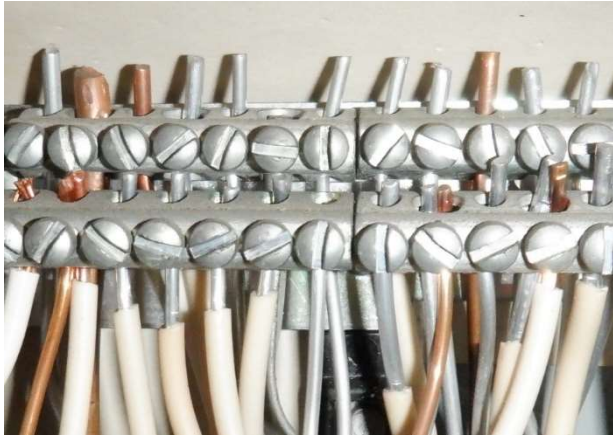
A distribution sub panel, note that all white wires go to one bus bar (right), and the bare wires go to a separate bus bar (left)

The ground (bare or green) wire must be kept separate from the neutral (white). Each conductor will typically feed their own bus bar. The ground bar should be bonded to the panel box, and the neutral bar should be isolated. Typically bonding and isolating are done by removing or installing either a strap or green screw. Check that they are in the proper configuration based on the panels use

**Distribution sub panels** – A distribution sub panel is an electrical panel that is NOT the first point of entry from the utility company or an electrical meter. There are some specific differences to look for in a distribution sub panel than in a main service panel. A distribution panel should be fed by four conductors: Two hot conductors, usually black (For most panels, 240v), one white neutral conductor, and one green or bare grounding conductor.



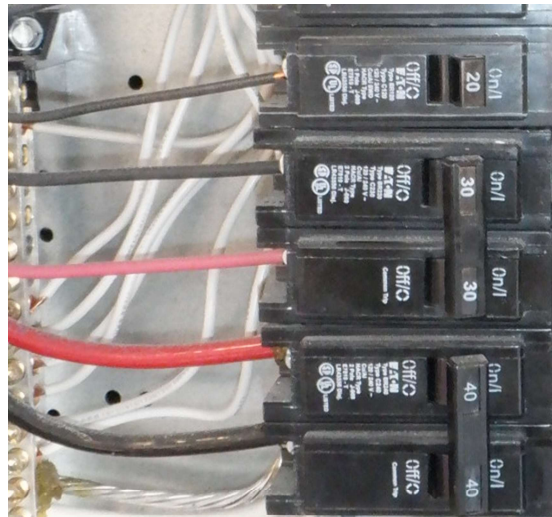
In this panel, the ground bus bar is properly configured, with a bare grounding conductor (top), grounding wires, and a bonding strap screw at the (bottom)



Single strand aluminum wiring in a panel, note the color difference from the copper wire

**Electrical conductor materials** – The electrical conductors material used in the home can affect the electrical system. During the 70s some homes were wired with Aluminum single strand wiring. Multi strand aluminum wiring is still used today and does not necessarily represent a problem. Single strand aluminum wiring expands and contracts more than copper wire. This expansion and contraction can cause loosening of the connections resulting in arcing and excessive heat. Various methods have been used to correct aluminum wire connections. I recommend that homes with single strand aluminum wiring, be evaluated by an electrician and corrected as directed.

**Electrical conductor sizing** – The electrical breakers should be sized by the conductors they are feeding. Breakers are designed to prevent wires from overheating. A larger wire can handle more electricity, therefore can be used with a larger breaker. A common defect seen is a larger breaker feeding a smaller wire. This condition can cause the wiring in the home to overheat. Wire sizing can be complicated. Refer to your local building code or contact an electrician. Conducting an internet search to see what sizes, wire types, and breakers should be used together can also be used to gain some information on proper wire size.



Note the size of each wire connected to the 40, 30, and, 20 amp breakers

# Gas Furnaces

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**General information** - The heating system in the home is a common area of concern for clients during the inspection. A gas furnace can be installed in a garage, attic or even a hallway closet.

Heating systems can be made in a variety of efficiencies, and other systems, such as an air conditioning or ventilation system, can be installed as well. Furnaces can have a big impact on the comfort of your home. Understanding furnaces can help you identify what you are getting along with its pros and cons.



A high efficiency furnace, note the back plastic area around the induction fan and the plastic exhaust flue pipes

intake as well as an exhaust flue, but it's not required in all installations. They will also have a condensation drainage system as well. These models will typically be between 90-98% efficiency. An extra condensing heat exchanger is added to increase the furnace's efficiency.

**Furnace efficiency and system installation** – Gas furnaces come in several styles based on the efficiency of the furnace. Mid-efficiency furnaces will have a metal draft pipe and a fan powered induction system. Typically, furnaces of this style will have about 80% efficiency. This type of furnace has been around for a while and can be easy to work on and relatively robust.

High efficiency furnaces can have plastic flue pipes. Some models will have an



A mid efficiency furnace, note the metal flue pipe

**High efficiency furnaces and AC systems need to have a condensation drain** – As systems become more efficient, condensation is produced, and the condensation moisture needs to be removed from the furnace.



A condensation catch pan and sensor under a high efficiency furnace

Typically, the water will be collected and pumped out. An overflow pan and water sensor should be installed under the



A condensation pump for an air conditioning system in a catch pan.

equipment in case of pump failure.



The draft induction fan motor, the motor is centered in the back circle.

**The furnace startup sequence** – On a mid or high efficiency furnace, the ignition sequence will begin with the draft inducing fan running. This draft fan pulls air, either from the intake pipe in a sealed unit, or in through the burner jet openings in a conventional unit. Once airflow is established the ignition system will start. Most units have a spark system, or a glow ignitor. With a glow ignitor once the ignitor draws the required number of amps of electricity, the gas valve opens. The gas is ignited by the glowing hot ignitor.

The fumes and heat produced are pulled through the furnace heat exchanger(s) and pushed out an exhaust flue. Once the heat exchanger has heated, the air handler system will start. The air handler system of the furnace moves the house interior air, drawing heat from the heat exchanger as it passes by. Normal temperature rise from a gas furnace is in the 30-60 deg. F range and will be listed on the furnaces data plate.



A furnace air handler

**Heat exchanger condition** – During most inspections, only a small part of the heat exchanger will be visible. The heat exchanger is usually a metal pipe or similar device that separates the combustion gases from the home's interior air. Any



The heat exchanger inside a furnace

cracks or leaks in the heat exchanger could be allowing carbon monoxide or other gases into the home. When the air handler turns on during the ignition sequence, observe the flames entering the heat exchanger. There should be no movement of the flames or changes in the color. This can be an indication of damage. The flames entering the burner compartment should have a nice blue color and not be dancing or deformed from a nice cone shape.

**Gas lines and flue pipes** – For gas (and LP) furnaces, the gas line running to the unit should have a shut off valve. The gas line should also have a drip leg (or sediment trap) and be flexible. The drip leg allows condensation that forms on the gas piping to run down and drip outside of the furnace body. The pipe entering the steel body of the furnace should be made of rigid metal, Flexible pipe can be cut by the sharp edges of the furnace body. The flue pipe from the furnace varies in material depending on the efficiency of the furnace.



A properly configured gas line, shut off valve, and drip leg



An older mid efficiency furnace

**Age and condition of the furnace** – Some furnaces can have long lifespans. It's not uncommon to see furnaces still in service that are 20+ years old. Most in that age range are mid-efficiency. A furnace can lose efficiency over time, so a newer furnace of the same design and rating would be more efficient, but also comes with a significant investment. Some may choose to upgrade to a more efficient model, others may keep a furnace in service until its condition warrants replacement.

**Air Conditioners and Heat Pumps** – Some furnaces can have a heat pump or air conditioner installed. An air conditioner can only be used for cooling while a heat pump can be used for heating and cooling. In most cases when a heat pump is installed, the heat pump will be the primary source of heat, and the furnace will be used as supplementary heat during periods of cooler temperatures where a heat pump is not efficient or cannot produce enough heat. A typical Air Condition system consists of an evaporator within the air handler system of the home and a condenser and compressor unit outside of the home. They are connected by two copper lines.



An evaporator unit for an air conditioner



Insulation around the low pressure gas line of the A/C system

**Air Conditioners and Heat Pump insulation** – As Air conditioners and heat pumps transfer heat, the refrigerant passes through an evaporator usually located inside the air handler system and a condenser usually located outside with the compressor. When the refrigerant is in the gas form, it travels through a larger, low pressure gas line. In its liquid form, it travels through a small high pressure liquid line.

Heat is transferred through the copper low pressure gas line. This line should be insulated to improve the efficiency of the heat transfer and reduce condensation buildup. Look for damaged or missing insulation.



An evaporator, located inside the air handler system

# Water Heaters

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**General information** - The water heating system is one of the most common areas where defects and safety hazards are seen during a home inspection. The water heater has a relatively short lifespan in comparison with other appliances; the typical lifespan of a water heater is 10-12 years. Occasionally I will see them as old as 20 years. The two most popular energy sources for water heaters are electricity and natural gas (LP – liquid propane).



An elevated FVIR water heater

**Gas water heaters should be elevated when installed in a garage** – Gas water heaters installed in garages should be elevated off the ground. There should not be an ignition source within 18 inches of the ground in garages. Typically, flammable vapors such as gasoline fumes will stay within 12 inches of the ground, giving a 6-inch margin for safety with an 18-inch-high ignition source. Newer water heaters are made to be flammable vapor ignition resistant (FVIR) and may not need to be elevated.

**The water heater should be strapped in place** - The straps are meant to hold the water heater in place in the event of an earthquake. The current standard for water heater strapping consists of a strap in the upper 1/3<sup>rd</sup> of the tank and a strap in the lower 1/3<sup>rd</sup> of the tank (the bottom one is at least 4 inches above the controls). The straps should be held in with bolts, not screws. All connections to the water heater should be flexible connectors (gas, water, and electricity).



A properly strapped water heater



Water heater temperature pressure relief valve

**The TPRV piping should be properly configured** - The temperature pressure relief valve (TPRV) is another safety item that is commonly not configured properly. The TPRV is the water heater's emergency release valve and is designed to open in an over-pressure, or over-temperature situation. The pipe connected to the TPRV must be approved for hot water use. Some examples are copper, CPVC, and PEX. The piping must not be smaller than the initial size, which for residential water heaters is usually  $\frac{3}{4}$  inch. Flex connectors can bend and kink, causing a restriction and should not be used. The pipe should drain by gravity. The typical installations have the pipe terminating within 6 inches of the ground to the exterior of the home or, as seen in newer

homes, terminate into an air gap drain system. Premade sections of pipe specifically designed for TPRVs can be purchased at hardware stores and typically come in 3 sizes depending on water heater configuration. The TPRV valve should not drip or discharge water under normal circumstances. If you do see water dripping from the TPRV, it may be time to have a plumber check the valve and tank.



A CPVC TPRV discharge pipe draining into an ABS waste pipe



A thermal expansion tank

**Is an expansion tank installed?** – A thermal expansion tank should be installed with a conventional tank style water heater. When a hot water tank is filled with cold water, the heating system brings the water up to temperature. When the water is heated, it expands. The expansion tank has a rubber baffle and an air chamber, giving a place for the expanded water to go and relieving the excessive pressure on the plumbing system, fixtures, and appliances.



**Gas lines and flue pipes** – For gas (and LP) water heaters, the gas line running to the unit should have a shut-off valve. The gas line should also have a drip leg (or sediment trap). The flue pipe at the top of the water heater should be fully installed in place, and the flue pipe should not have any combustibles next to it.



A flexible gas line with drip leg and shut off valve



Armored cable run to an electric water heater

**Electrical lines should be armored cable, or run in conduit.** – The electrical supply lines to the water heater should be protected from damage. The electrical connection area should be fully sealed and screwed in place.

**Tankless water heaters** – Tankless water heaters are becoming more prevalent due to their increased efficiency. Tankless water heaters have most of the same requirements as tank style water heaters. Tankless water heaters typically do not need to be strapped in place. High efficiency tankless water heaters will have a condensate drain or pump system in place. Tankless water heaters need to be serviced. The manufacturers recommend annually. During a typical service, the heat exchanger is flushed out and cleaned, and any adjustments or calibrations needed are made. The water quality and characteristics play a big role in how much buildup forms in the heat exchanger. The process of inspecting a tankless water heater is the same as a tank water heater. One item to note is making sure the TPRV is rated for the BTU produced by the tankless water heater. A typical tank water heater will be 40k BTU's, whereas a tankless model will vary between 120K and 200K BTU's.



Typical tankless water heater installation

# Attics

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**General information** - The attic can play a critical role in keeping a home healthy and efficient. Large amounts of heat loss can occur through improperly insulated attics. Moisture from the home can migrate to the attic and must be removed to prevent condensation within the attic. Attics can also give you some clues about the condition of the roofing above including signs of leakage.



Attic insulation next to a depth measuring strip

**Check the level of insulation** – The insulation in the attic can improve the efficiency of the home by keeping warm air inside the home. The insulation during the summertime can keep the excessive heat in the attic out of the cool home. The insulation also reduces condensation by keeping the attic area a similar temperature to the outside temperature. With blown in fiberglass insulation, anything less than about 8 inches is deficient and needs updating to a more modern level.

needs both lower vents; bird block or soffit vents and upper vents. Typically roof vents or a ridge vent. As warm air rises out the upper vents, cool air is drawn in from the lower vents. Moisture from the warm air inside the home can also make its way into the attic. This moisture is removed from the attic through the vents. A properly vented attic will keep the temperature down in the summer as well



Bird block style lower attic vents

**Look for attic ventilation** – To ventilate properly an attic needs both lower vents; bird block or soffit vents and upper vents. Typically roof vents or a ridge vent. As warm air rises out the upper vents, cool air is drawn in from the lower vents. Moisture from the warm air inside the home can also make its way into the attic. This moisture is removed from the attic through the vents. A properly vented attic will keep the temperature down in the summer as well as in the winter. Keeping the attic cool can reduce condensation forming on the underside of the roof deck. This condensation can damage the roof deck or cause organic growth and mold on the sheathing. Look closely at the color of the roof sheathing, organic staining will cause the wood to darken in color or have a blackened look to it.



Attic roof vent

**Check the roofing penetrations** – Roofing penetrations are common areas that can develop leaks. The rubber around plumbing vents gets brittle and crack with age.

Missing caps for roofer tie-off locations are another common leak area. Even some skylights, roof vents, or solar panel connections can leak. Taking a good look around the underside of the roof can provide a lot of good information. Areas that are exposed to moisture usually appear darker in color and can have a spongy feel.



This tie off penetration is a common areas roof leaks are seen



Vent penetrations through a roof

**Verify the ventilation fans are connected to the exterior of the home** – The home’s bathroom and laundry room exhaust fans are designed to remove moist air from the home. If this air enters the attic area, it can quickly raise the temperature and moisture level in the attic creating conditions right for organic growth and deterioration of the roof deck.

**Check the condition of the roof sheathing** – The roof sheathing is one of the first things to alert you if there is a ventilation problem. The roof sheathing should look like it’s in almost new and clean condition. It should not be sagging or have any moisture damage. Most roofing manufacturers specify that the fasteners must fully penetrate the roof deck for proper adhesion, so you should see fasteners sticking through the roof deck.



*Moisture-stained roof sheathing, dark spots can be seen on the wood*



Good condition roof sheathing

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