



## **Steam & Hot Water Boiler Systems**

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Made out of cast iron, boiler systems were made to withstand the test of time. Nicknamed after battleships for their similarity in material, strength, & durability, it is not uncommon to find an old boiler system still going strong 50 years down the road. A boiler's design can be overwhelming at first, but once you understand how they operate, inspecting a boiler system becomes a whole lot easier.

### **How They Work**

Each boiler comes in sectionals that are held together by cast nipples. Older styles stacked the sectionals one on top of the other, while more modern systems connect horizontally like a radiator. Around the sectionals are steel covers enclosing the unit. The base is open where the burner is located and the top has a diverter box to collect the flue gases before they exit up the flue pipe. As the burners heat the cast iron sectionals, the water inside becomes hot. The water or steam is then piped throughout the home to radiators in a 1-pipe or 2-pipe distribution system. Steam systems and the older hot water systems operate by convection, while the newer hot water systems rely on pumps.

### **Steam Boilers**

There are some general characteristics that distinguish these boilers from hot water systems. First, there is no circulation pump. Steam systems operate on convection and normally have gravity return. Second, there will be a sight glass mounted on the side of the boiler. This will not be present on a hot water system. The sight glass tells you how full the water level is in the boiler tank. The tank should be  $\frac{1}{2}$  full to no more than  $\frac{3}{4}$  full. There will be piping for makeup water usually indicated by a hand valve that enables the homeowner to add water to the tank if it is too low. Every 2 weeks during normal operation, the homeowner needs to open the drain valve on the tank and let out sediments. (You open the valve and let the water run until it appears clear then add more water accordingly.) If the sediments are allowed to build up, the base of the tank rises giving way to false readings on the sight glass. If you have too much sediment in the tank base, your sight glass may be telling you that there is the correct amount of water in the tank when it's too low. Operating a steam boiler with low amounts of water or no water (dry firing) will damage the unit. Third, there should be a Hartford Loop on the return side of piping just before it enters the tank. This piping helps maintain a constant water level inside the boiler and should enter the tank 2" below the water level.

### **Steam Boilers with 1-Pipe Distribution**

Found typically in homes dating back to the late 1800's through to the late 1920's, 1-pipe steam boilers utilize (just as the name implies) a single pipe to distribute steam heat throughout the

home. The steam rises throughout the distribution system on the higher portion of the pipe. As it cools, the steam condenses back to liquid form, and runs back down the bottom side of the pipe to the boiler. On the radiators, there will be only 1 pipe entering at the base and half way up will be an air vent. This 1-pipe system is very inefficient and not economically plausible to retrofit to a 2-pipe system. When the time comes, the homeowner is looking at having an entirely new system installed, whether it is a new boiler system or forced air furnace. Either decision will not be cheap as new piping or new ductwork will have to be run throughout the entire home.

### **Steam Boilers with 2-Pipe Distribution**

Found in homes typically after the late 1920's, 2-pipe steam boilers have supply piping and return piping. The steam rises through the supply side, condenses when it cools, and flows back down the return side back to the boiler to be reheated. The radiators will have 2 pipes, the supply line entering on one side at the top and the return exiting on the other side at the base. There will be a trap on the return side of the radiator right before the pipe. Unlike the 1-pipe system, if the boiler reaches the end of its life, it's rather easy and economical to replace the boiler. The piping does not have to be removed and replaced. They simply remove the older boiler, put the new boiler in its place, and reinstall the piping. 2-pipe steam systems can also be easily converted to hot water systems.

### **Steam System Defects**

In addition to the information above, pay extra attention to any discolored steel on the sectionals. This may indicate the system was "dry fired" or operated with no water in it. When this happens, the steel is heated to temperatures beyond its intended design and the steel will chemically change its composition and become weak. Steam systems are more susceptible to leaks. Look for leaks at the nipples that connect the sectionals, on top of the sectionals, and at the base. You may hear water dripping. Another indication that the unit is leaking is if you see white or yellow deposits in the form of stalagmites below the boiler usually forming on the burner. Caution: don't mistake leaks for condensation. Let the unit run for a minimum of 15 minutes before looking for leaks. Indications of dry firing or a leaky steam boiler will require an expert to review and if your concerns are confirmed, the unit will need to be replaced.

### **Hot Water Systems**

The older style hot water boilers were gravity flow, a.k.a.-convection and may take up to 4 hours to heat all the radiators in the home! You'll know these systems when you look in the attic or the highest living level and find an overflow tank. The overflow tank should be tapped into the sewer drain line or piped out to the gutter in case it ever exceeds its limits. (FYI-When these older systems are replaced, the overflow tank is removed. There is no longer a need for it.) The more modern hot water boilers have circulation pumps usually located on the return piping just before the water enters the boiler. The tank is full of water, unlike the steam boiler tank. These systems heat up the home rather efficiently and quietly. On the radiators, there is a supply pipe entering at the base of one side and a return pipe exiting at the bottom of the opposite side. There are shutoff valves on the supply sides for reducing the water flow or shutting the flow off completely. There are also air valves at the top of the radiators to let air out when filling with water. If air is not let out completely, however much air is left will block water flow to that portion of the radiator making it that much less efficient.

## **Operating Norms & Warranties**

Both steam & hot water systems should not have their aquastat gauges registering above 200 degrees F. Normal operating temperatures is between 140-180 degrees F. On a steam boiler, you want the water pressure to be as low as possible. The psi should not go past 4 and normally operates between 1-2 psi. On a hot water boiler, the gauge should read between 12-20 psi. For this system, the actual psi is determined by the height of the tallest radiator down to the base of the tank. Every 2.31' = 1 psi. Both steam & hot water systems have pressure relief valves also referred to as pop safety valves. A steam relief valve should not be rated for more than 15 psi and a hot water relief valve should not exceed 30 psi unless it's a large unit in which case it should not exceed 50 psi. These relief valves should be tested once a year (or at the time of the inspection.) If steam is not released when you pop it or if the valve does not reset, then it has to be replaced.

Note: Excessive rust at the burners, rust on the sectionals, or even if the unit is producing unsafe levels of CO gas DO NOT mean the unit is at the end of its life. Cleaning up the burners, scrubbing the sectionals, and replacing the steel diverter box are relatively easy and inexpensive repairs for boilers.

Newer steam boilers come with a 10-year warranty on the sectionals. This warranty is not tied to the owner if the property changes hands. Newer hot water boilers have a lifetime warranty on the sectionals reverting back to the original owner. If the property changes hands, the warranty reduces to 20-25 years depending on the manufacturer.

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