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The Bell Performance Guide To Taking Care of Your Home Heating System

Home heating systems burning fuel oil run third in number in the United States behind natural gas and electricity-driven units. 6.3 million of these home units exist in the US, with over 80% of these clustered in the North East. Home heating oil is quite similar, but not identical to, diesel fuel, and the two fuels together represent over 25% of the cut of the typical barrel of crude oil (gasoline obviously being the highest portion). We say diesel fuel is not identical to home heating oil because both of these fuels have different ASTM specifications they must meet in terms of fuel properties.

This resource guide from Bell Performance should give you all the background information you need to know how your system works and, more importantly, what you should be doing (and why) in order to keep the investment that is your heating system working properly for its longest life. We'll touch on subjects like

- How oil heating systems work
- Different types of heating systems and how they differ
- Maintenance going into the summer
- More maintenance going into the winter
- What happens during the annual service call

How The Typical Heating System Works

Home heating systems do not burn fuel oil by itself. For any substance, solid or liquid, to burn, it needs to be heating above its auto-ignition temperature and it has to be in the presence of a sufficient amount of oxygen to sustain and power the chemical reactions that make up combustion. So a home heating system has hardware in place to make this happen.

The mechanism for this is really the same for both a gas and an oil-fired furnace system. Fuel oil is sprayed by a pump into a combustion chamber where it mixes with air. The fuel-air mix is ignited by an electric spark to produce heat that heats up a sealed chamber. Fresh, filtered air blows across the outside of the hot chamber, and the hot air travels to the heating ducts. Alternatively, water may be heated by a boiler system, with the hot water travelling to radiators in the house that give off heat to the surrounding air. In each system, the left-over exhaust from combustion is vented to the outside of the house via a flue or chimney.

The key to the combustion process is the proper atomization and mixing of the fuel oil with the air in the combustion chamber. This is where the oxygen to sustain combustion comes from. The heat required to

start driving the combustion reactions comes both from the spark and from the ambient heat in the combustion chamber.

Forced Air vs Gravity Air vs Radiator Water Heat

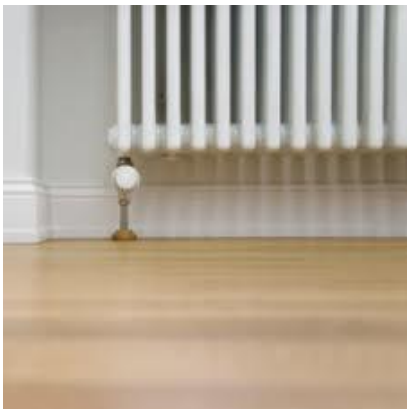
Regardless of the kind of fuel used to generate heat, there are three most common types of heating systems when it comes to how the heat gets distributed for the combustion chamber to the rest of the house.

Forced air heating systems warm many modern homes. First an oil furnace heats cool air. A blower then forces the heated air throughout your home. The heated air travels through ducts and registers into your home's living areas. Next cool air returns to the furnace by a separate register and duct known as the cold air return. Finally, the furnace heats the returning cool air and the cycle begins again.

A gravity air system is similar to a forced air system. Both systems use air to transfer heat from the furnace to the living areas. A gravity air system does not have a blower. Instead, the natural convection created by warm air rising circulates air throughout the system. These systems are a little simpler to maintain because they don't have blowers to maintains, nor do they use air filters.

Hot water heat or radiator heat is the third common heating system. First, oil fuel heats water in a boiler. Next, the heated water travels through pipes to radiators, convectors or radiant piping concealed in floors, walls or ceilings. Heat from the water then radiates throughout the living space. After giving up some of its heat, cooler water returns to the boiler to be heated again. Water can circulate through the system by gravity (lighter, heated water rises to displace heavier, cooler water) or by circulating pumps. The distribution piping for the hot water can be laid out in a variety of arrangement, with a combination of thermostats, aquastat controls (on/off control based on preset water temperatures), relays and manual controls controlling the system.

Forced Air Heating System



Hot Water/Radiator Heating System

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The Oil Burner

Oil-fired systems cannot work without some kind of mechanism to move the oil from a liquid state to a combustible state. The oil burner is what functions to accomplish this. The two types of oil burners are the high pressure or gun-type burner, and the vaporizing or pot-type burner.

During system operation, when the thermostat calls for heat, a high pressure or gun-type oil burner pumps oil through a nozzle, producing an oil mist. A blower mixes the oil mist with air and propels the air-oil mixture into a combustion chamber. A high-voltage spark created by two electrodes then ignites the air-oil mixture.

In a vaporizing or pot-type burner, an oil control valve opens to allow oil to pool in a pot. A blower or natural draft adds the air needed to support combustion. An electric spark then ignites the oil. The heat of the burning oil causes the oil in the pool to vaporize and mix with the air. The vaporized oil-air mixture then ignites and the cycle continues. The vaporizing burner requires a higher grade of oil that vaporizes easily for efficient operation.

Oil burners incorporate a safety mechanism in which, if the oil does not ignite in either type of burner, a safety control cuts off the flow of oil to the burner. This control may be a flame sensor in the burner or a heat sensor on a stack control attached to the flue. Without this safety device, the boiler or furnace could flood with flammable oil and put your home in danger.

A proper draft over the fire box is important for efficient operation of either oil burner. Most oil burners have a draft regulator mounted in the exhaust stack near the boiler or furnace. The regulator contains a small damper that opens and closes automatically to maintain the proper draft.

Heating Systems Require Maintenance

Like many things in life, home heating systems require regular maintenance if they are to provide the most efficient and trouble-free service for the length of their life. The recommendations for this service can be divided into “regular maintenance” performed by the home owner and “annual service” that is performed by a heating and cooling professional. In addition, these recommendations can vary from the spring (when you’re ‘summarizing’ your heating system to get it ready for the hot weather period when you won’t be using it) and the fall (when you’re ‘unpacking’ your system from dormancy and readying it for the upcoming heavy use of the cold weather months).

Getting Ready For The Summer

Before you stop using the system for the warm weather months, there are some things that you should do as you prepare your system to go back into heavy use around this time of the year.

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- ***Check Your Heating System Parts***

Just as you should be doing all year, check your pipes, boiler and tank for signs of damage or leaking. Catching those early will save you money and prevent a small repair for accelerating into a huge one.

- ***Have Your System Cleaned of Soot and Scale***

You may need to have this done professionally, depending on how dirty the system is. It is typically recommended to have a professional cleaning at least on a semi-regular basis. So it's especially important to have this done now if you neglected to have a service call before the previous winter.

Build-up of soot and scale deposits are pretty much the primary causes of system inefficiency. Inefficiency means money out of your pocket. Soot and scale will interfere with the efficiency of the system later on in the year. Soot also contains sulfur, and if this is allowed to sit over the spring and summer months, the sulfur will react with water in the system to form acid, which will eat away at metal surfaces and cause costly corrosion damage.

So have your system cleaned, whether professionally or by vacuuming out as much of the soot and scale as you can. This cleaning should include coils, filters and reflecting plates.

- ***Check and Fill Your Heating Oil Tank***

If you don't get your oil delivered automatically, you'll need to figure out when you need oil. So check your oil level before the winter starts and be sure to schedule a delivery before you get below ¼ of a tank. You don't want the level to drop below a quarter, as this will cause sediment and sludge on the bottom of the tank to be pumped into your fuel line and clog your filters and equipment.

Spring time is also the best time to re-fill your oil tank because the fuel demand is lowest and the prices are lowest, saving you money.

- ***Treating The Fuel Oil For Storage***

Any kind of petroleum that sits in storage for months at a time will oxidize and react with oxygen and water. These reactions degrade the quality of the fuel oil, producing long, heavy molecules that turn the fuel dark. These heavy molecules settle on the bottom of the tank as sludge. Treating the fuel oil for long term storage with a product like Bell Performance's ATX-942 interrupts these chemical reactions, stopping them in their tracks and ensuring that the fuel oil in storage burns the same in the upcoming falls as it did in the previous winter. It's been shown that fuel treated in such a manner makes the heating system easier to start the following winter with less black smoke. That's good for all of us.

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Home Improvements That May Benefit Your Heating System

In addition to system improvements to bring it out of summer hibernation, there are things you can do around your house to assist in bringing your heating system back to peak operation heading into the fall and winter.

- **Clean up your basement -** Down in Bell Performance's home state of Florida, they don't have basements due to the high water table. Not so everywhere else in the country. The basement has become a storage area and that's not good for your heating system, oil-powered or otherwise. Clean up your basement, especially if you have a lot of dust and line or even sawdust and pet hair. All of those can be drawn into your heating system and cause service problems over time.

- **Test your burner to make sure it still works properly -** Do this by turning up your thermostat above room temperature. That will turn on your boiler or furnace. Let them run for a few minutes. Hopefully you will have heat coming out and everything will then be in order.

- **Free your vents -** Remember, too, that you need to make sure your vents aren't blocked by furniture, carpets, wall hangings and other large items. Move those away from vents to ensure proper air flow and best efficiency for your house.

- **Clear out air registers -** If you have a Forced Air or Gravity Air system, clean out your air registers on a regular basis, but especially when winter just starts. A vacuum cleaner works quite satisfactorily to accomplish this. Check to make sure no foreign objects have fallen into the registers to obstruct the system.

- **Air filter maintenance -** Change your air filter on a regular basis. This improves system efficiency and helps keep the system cleaner longer. The air filter removes particulates from the air that is blown across the heating chamber. Without this pre-cleaning, the air blown out of the vents is now dirty and can contain any number of contaminants that you wouldn't want to be breathing in.

- **No leaky ducts -** Examine exposed supply ducts for gaps or leaks allowing heated air to escape. Look for gaps and run your hand along exposed supply ducts with the blower running to feel for escaping air. Seal any leaks with duct tape.

Finally, listen to your furnace and the rest of your system. If you hear unusual noises, follow the appliance manual's directions or consult with your professional heating contractor.

Proper Radiator Maintenance Tips

Those who don't have forced air/gravity air heating systems will typically have radiators and convectors, common radiating devices used to distribute heat. Radiators are large cast iron tubes while convectors are smaller copper or steel tubes surrounded by metal fins housed in grilled cabinets or baseboard units. The fins increase the convectors heated area.

Over time, dirt, dust and obstructions interfere with the heat transfer from the radiators or convectors to the room air. So it's important to clean the radiators or convectors with a vacuum brush attachment regularly. If a radiator cannot be cleaned with a vacuum brush attachment, spread damp newspapers

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under the radiator and clean with a radiator brush. Remove any drapes, furnishings or other objects obstructing air flow around your radiators or convectors. Do not place anything on top or in front of your radiators or convectors.

Air trapped inside a radiator or convector, can interfere with heat distribution. Some radiators and convectors have automatic air valves that bleed air from the units. If yours do not, they should be bled manually at the beginning of the heating season and after adding or removing water from the system. If a radiator or convector will not heat properly, bleeding the unit may solve the problem.

Getting Ready For Winter Use

Bringing your system out of hibernation and readying it for extended use after the summer entails a few other recommendations. Hopefully your startup issues will be minimal because you will have already taken the previously-recommended steps to take care of your system earlier in the year before the summer.

Balance The Heat In Your House

Before the winter cold gets cranked up is an excellent time to check if some rooms seem too hot or too cold. If so, this can be remedied by balancing the heat distribution throughout your home. This entails opening and closing supply registers and duct dampers in the rooms as necessary to control the flow of heated air.

If your system has duct dampers, they should be found where one duct branches from another. The damper handle shows the direction of the damper vane. A damper is fully open when the handle is parallel to the duct. It is fully closed when the handle is perpendicular to the duct. Increase air flow to cold rooms and reduce air flow to overheated rooms.

For those of you with radiator heat, you can “balance the heat” distribution when some rooms feel too hot or too cold. First, turn the system on and allow room temperatures to stabilize. Next, open or close the valve leading to the radiator or convector to be adjusted. Then wait for room temperatures to stabilize before making another adjustment. You may need patience as it can take several days of adjustments to balance the system.

A properly balanced heating system will save you money during the winter by keeping you from running it excessively when you’re in the rooms of your house that don’t seem to be getting enough heat; proper balance would make these rooms warmer and make you more comfortable.

Check Your Thermostat

The thermostat signals a demand for heat from the system at preset minimum temperatures. It is this signal that controls the rest of the heating system. When the air reaches the desired temperature, the thermostat turns the heating system off. Thermostats control cooling systems in the same manner at preset maximum temperatures.

Clock thermostats and multiple-setback thermostats can be adjusted to

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maintain different temperatures at different times of the day to conserve energy. You can set the units for lower temperatures during the work day if the house is empty and at night when you sleep.

Thermostats should be cleaned and, if necessary, adjusted once a year. Dust between contact points and improper alignment can affect a thermostat's operation. Your heating and cooling contractor should inspect all thermostats during the annual service call. If you prefer, you can maintain the thermostats yourself. This annual maintenance should include the following:

1. Dust. Remove the thermostat's cover and dust the inside surfaces and any metal coil with a soft brush.

2. Contact Points. Clean metal contact points by working a piece of heavy bond paper or thin card stock between the contact points and blowing the contacts clean.

3. Liquid Mercury Contacts. The previous step is not necessary if the unit has a liquid mercury contact enclosed in an airtight glass tube instead of contact points.

4. Switch Contacts. Clean any metal switch contacts along the top or edges of the unit with a cotton swab moistened with alcohol.

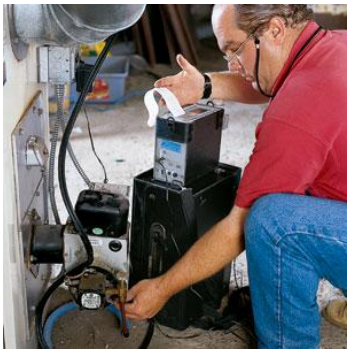
5. Alignment. Check alignment with a level and adjust as necessary.

6. Calibration. Check temperature readings for accuracy and adjust as necessary.

The thermostat is really the "gate keeper" for your heating system – without it, you can't control when you actually get heat. So it's important to keep it working properly.

Annual Heating System Tune-ups By The Professionals

It's highly recommended in the industry (and by the Department of Energy) to have an annual system service performed by a trained professional. For many homeowners, this annual service for their system is already built into their yearly system contract. But even for those who don't get it for free, an annual service and tune-up is an important part of maintaining the system so it works its best for the longest period of time.



Even though annual service calls may cost some money, it's less expensive in the long run to pay for such a visit each year than to pay for the consequences of not having one. Annual service calls help keep the service more efficient. Oil-fired heating systems produce soot and deposits that build up over the course of the year. These deposits on key system surfaces cut into the system's efficiency and make it more expensive to run the system. A new system might work at 85% combustion efficiency (the % of heat potential in the fuel oil that is actually turned into heat by the combustion system) at first. If you go more than a year without service, the efficiency can drop to 70%, and that means your heating bills go up 20%. That's not small change.

Furthermore, the longer you wait, the longer it takes to clean your system when you eventually have it done. That can turn a $100 service bill into a $400 service bill. And if you really wait, the soot buildup can become like cement, destroying the boiler and turning into a $7,000 bill to replace it.

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Given the three different types of heating systems powered by oil, there will be some variance in he steps performance during standard annual service calls, but they will commonly entail some or all of the following steps:

- ***Switching off the power supply and fuel supply to the system before starting.***

This is a safety measure. All homeowners should know where the cutoff switch for their system is.

- ***Cleaning of the Combustion Chamber***

Products of fuel oil combustion are mainly soot, water vapor and carbon dioxide. The soot is the non-carbon, heavy metal content in the fuel oil which has been oxidized during combustion and left behind. Since fuel oil contains sulfur, the soot will contain oxidized sulfur that reacts with water vapor and becomes acidic. Left in there too long, you'll get corrosive damage to all the metal surfaces that the ash typically accumulates on.

The technician will use a wire brush to scrap out and dislodge accumulated ash buildup, followed by removal of as much ash as possible with an industrial-strength vacuum system.

The technician will also inspect the combustion chamber surfaces for damage and holes that may need to be repaired. No amount of system optimizing can make up for mechanical damage.

- ***Flue Pipe Inspection***

The technician always checks for holes in the exhaust flue that could leak carbon monoxide, particularly where the pipe meets the furnace. This is important, as carbon monoxide is a silent killer and results from fuel oil burning without sufficient oxygen (the carbon turns into carbon monoxide, not carbon dioxide). Small holes can be patched with foil tape, but corroded flues must be replaced. The tech will also adjust the flue pipe's barometric damper, which moderates the chimney draw. A tall chimney in an old house tends to suck too much air, compromising efficiency. Making such adjustments to the damper will lessen the draw and improve efficiency, putting money back in your pocket.

- ***Replace The Oil Filter***

Just as in cars, the oil filter prevents small impurities from clogging the oil-burner nozzle (the part that injects the fuel spray into the combustion chamber). Clogged burner nozzles are bad news for systems because they could result in a misfire that shuts down the system. To change the filter, the tech will close the oil valve, remove the old filter and put a new filter on, setting aside the dirty filter to be disposed of according to local hazardous-waste regulations.

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- ***Changing of the Air Filter***

Homeowners can easily change the filter themselves (and should, about once a month). But the technician will check the filter anyway. He will also check the blower belt's wear and tension. The blower, driven by an electric motor, is what moves heated air from the furnace through ductwork to room vents. If the belt is loose, it can slow the blower and compromise system efficiency. If the belt deflects more than 3/4 inch when pressed firmly, it can be adjusted by sliding the motor backward slightly. The technician has the training and expertise to change these settings to make the system work its best.

- ***Adjustment of the Burner and Efficiency Testing***

Furnace efficiency can be tested by the technician using a combustion analyzer, which calculates furnace efficiency by measuring gasses in the exhaust flue. Through this testing, he/she can make sure that the burner's air gates are adjusted for the proper ratio of fuel to air – an essential element of optimal combustion. The oil nozzle will also be replaced, which atomizes the fuel just before it ignites, and the flame color and shape is checked by the technician to ensure the system is functioning its best. For any type of heating system, this is a key indicator of stable and complete combustion.

- ***Check the Blower, Motor and Humidifier***

These essential systems elements should have parts inspected and replaced as necessary. The service technician will clean the blower blades, check the fan belt tension (replacing worn belts) and lubricating the blower motor (unless it is permanently lubricated). There's also a humidifier element in the system that is checked for water leaks and mineral deposits.

- ***Cleaning of the Floor Vents***

The final job for system optimizing in forced air systems during the annual checkup is to remove floor registers and vacuum out the ducts, which are magnets for dust, pet hair, small toys, and food scraps. Any blocking of these registers reduces the system's efficiency by making it just a little bit harder for the system to push the heated air out into the room. Cleaning out of these registers also improves the air quality within the house.

As you can see, there's quite a bit of important work and expertise that goes into that annual checkup. The annual system tune-up can save you 10-15% on your heating bills and reduce your system's emissions. Industry data also shows that homeowners who have annual tune-ups on their systems have 80% fewer "no-heat" service calls in the winter. A typical tune-up will run $120-150 (unless it's included in your contract), but that money will definitely be money well spent.

Professional Maintenance of Radiator Systems

Beyond inspecting and servicing the oil and heating units, service technicians may perform some or all of these extra steps for hot water radiator heat systems.

- ***Thermostats***

As mentioned in this Guide, the service technician will undertake cleaning and adjusting all thermostats.

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- ***Inspect all aquastats, relays and other controls***
- ***Temperature Pressure Relief Valve***

The temperature pressure relief valve is checked by lifting the valve lever and allowing a small amount of water to flow into a bucket. If no water flows, the valve is faulty and will be replaced.

- ***Water Temperature and Pressure***

Water temperature is checked and adjusted as necessary. The tech will inspect the pressure temperature gauge, showing boiler water level, and make any necessary adjustments.

- ***Radiators & Convectors***

The radiators and convectors are bled if there is no automatic air valve.

- ***Inspect pipes for rust and leaks.***

This is self-explanatory, checking the pipe for rust and leaks to head off potentially costly problems.

Conclusion

Home heating systems are complex systems of engineering. Installed right and taken care of properly, they'll give you years of comfort during the cold weather months. Paying attention to the points covered in this Resource Guide should take you a long way toward preserving the investment you've made in your home heating system.

Bell Performance's goal is to educate consumers and equip them to make the best choices for them, their family and their budget. Bell Performance invented the first fuel additive for cars in 1909. Nobody else can claim that. Bell Performance has been manufacturing ATX-942 treatment for home heating fuel oil for almost twenty years.

For more information on these and other topics, visit the Bell Performance web sites at www.BellPerformance.com and www.WeFixFuel.com.