

## Heating & Cooling

Your home's heating and cooling system should give you many years of service with proper maintenance. Preventive maintenance will lower your energy costs, prevent costly repairs and prolong the life of your system. Regular maintenance will ensure that your system is ready to heat and cool your home when needed.

There are a variety of systems for heating, ventilating and cooling your home. This chapter discusses the most common systems and their individual components. Review all sections that apply to your home. For specific information on how to maintain the system in your home, see the manufacturers' appliance manuals for the equipment in your home. If you are missing one or more original appliance manuals, contact the appliance manufacturer and ask for a replacement manual. Most manufacturers should replace missing manuals.

The suggestions listed below are a reminder that your home's system must be maintained regularly. Always follow the manufacturer's maintenance specifications.

### Professional Maintenance

Most heating and cooling systems should be serviced once a year by a professional heating or cooling contractor. The professional contractor has the tools, instruments and training necessary to maintain your system for dependable, trouble-free operation. The contractor should inspect your system, complete necessary maintenance tasks and adjust the entire system for optimal performance.

The contractor that installed your system or your local oil or gas distributor should be qualified to maintain your system. You also can look for heating and cooling contractors in the yellow pages of your local telephone book. You may want to consider purchasing a service contract for your system. Once you find a good contractor, reward the contractor's service by your continued patronage.

### Thermostats

Thermostats signal a demand for heat 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 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.

#### Maintenance

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.

## **Forced Air Heat**

Forced air heating systems warm many modern homes. First a furnace or electric heat pump 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.

Your forced air heating system requires comprehensive annual maintenance by a professional heating contractor at the beginning of each heating season. In addition, you should follow the simple maintenance suggestions discussed below to keep your system operating at peak performance.

### **Air Filters**

Dirty air filters restrict airflow and reduce the heating system's efficiency. Inspect your air filters once a month when the system is in use for heating or cooling. Clean or replace dirty air filters as necessary. The first step in inspecting your air filters is to locate and remove the metal panel covering the filter or filters. The cover panel should be located near the heating system's blower. Next, slide out the filters. Clean or replace the filters with new filters of the same size. Slide the new filters into position according to the air-flow directions on the filter. Finally, replace the cover panel. Regular inspection, cleaning and replacement of your furnace filters will reduce your heating bills and prolong the life of your heating unit.

### **Balancing The Heat**

If some rooms seem too hot or too cold, you can "balance" the heat distribution throughout your home. Open and close supply registers and duct dampers 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. If you have problems adjusting the heat to your satisfaction, consult your professional heating contractor.

### **Professional Maintenance**

Call your heating contractor early before the start of the heating season to schedule a service call. This way you will beat the winter rush. The contractor should do the following:

1. Thermostats. Clean and adjust all thermostats.
2. Blower Blades. Clean the furnace's blower blades.
3. Fan belts. Check fan belt tensions and adjust as necessary. Worn or faulty fan belts should be replaced.
4. Motors. The blower motor and any other motors should be oiled. Do not oil permanently lubricated motors.
5. Humidifier. Examine humidifier for water leaks and flush mineral deposits from unit.
6. Heat Source. Inspect and service the heat source.
7. Ducts. Examine supply ducts for gaps or leaks and repair as necessary.

## **Home Owner Maintenance**

Between maintenance calls, you should do the following once each month when your forced air system is in use for heating or cooling:

1. Filters. Inspect air filters and clean or replace as necessary.
2. Registers. Reduce dust in your home by vacuuming heat registers and the cold air return as part of your regular cleaning. Remove any objects or debris that may have fallen through the registers.
3. Obstructions. Remove any drapes, furniture or other objects blocking registers, interrupting airflow and lowering your system's efficiency.
4. Listen. 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.
5. 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.

## **Gravity Air Heat**

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. Gravity air system maintenance is similar to the forced air system maintenance discussed above. Gravity air systems, of course, do not have blowers to maintain. In addition, there are no filters to obstruct the slower moving air. Like forced air systems, gravity air systems require annual maintenance by a professional heating contractor.

## **Hot Water Heat**

Hot water heat is a common heating system. First, oil, gas, electricity or another 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. Distribution piping can be laid out in a variety of arrangements. Some combination of thermostats, aquastat controls (on/off control based on preset water temperatures), relays and manual controls will control the system. Some systems divide the home into separate heating areas or "zones." Your heating contractor or gas or oil supply representative can identify and explain the particular features of your hot water system.

Although the theory is simple, you have a complicated system. Your system must be inspected and serviced by a professional heating contractor annually. Careful operation and periodic home owner maintenance are also required for safe, trouble free operation.

If you have any questions or concerns regarding the operation of your hot water or steam heating system, call your professional heating contractor. Call immediately. Do not wait for the system to fail before consulting an expert.

## **Radiators & Convectors**

Radiators and convectors are the most common radiating devices. Radiators are large cast iron tubes. 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.

Dirt, dust and obstructions interfere with the heat transfer from the radiators or convectors to the room air. 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 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.

### **Balancing the 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, it can take several days of adjustments to balance the system.

### **Freezing**

Do not allow the water in your distribution pipes to freeze. Mechanical problems, extended power failure, fuel oil delivery problems, gas supply interruptions and other causes can shut down your system. If the system is to be off for several days, contact a heating professional to add anti-freeze to or drain water from the system. Leave the system running at a low temperature when you leave your home during the heating season.

### **Controls**

If your system has a constant running pump, turn the pump on at the beginning of the heating season. Turn the pump off after the heating system ends. This task does not apply to gravity systems or circulation pumps controlled by aqua-static or relay controls.

Your system heats water under pressure. An automatic pressure relief valve guards against excessive pressure. This safety control device will open, if needed, to release pressure and prevent serious damage.

### **Professional Maintenance**

Call a professional heating contractor or your local oil or gas distributor to schedule an annual inspection and service before the start of the heating season. The contractor should do the following:

1. Thermostats. Clean and adjust all thermostats.
2. Controls. Inspect all aquastats, relays and other controls.
3. Temperature Pressure Relief Valve. Check the temperature pressure relief valve by lifting the valve lever and allowing a small amount of water to flow into a bucket. Replace if no water flows from the valve.
4. Water Temperature. Inspect the water temperature gauge and adjust water temperature as necessary.
5. Water Pressure. Inspect the pressure temperature gauge, showing boiler water level, and make any necessary adjustments. Some systems have a pressure reducing valve that maintains the proper water level automatically.
6. Pumps & Motors. Oil all pumps and motors unless they have permanently lubricated bearings. Un-lubricated pumps are expensive to replace.
7. Radiators & Convectors. Bleed radiators and convectors if there is no automatic air valve.
8. Pipes. Inspect pipes for rust and leaks.
9. Heat Source. Inspect and service the heat source.

### **Home Owner Maintenance**

Between maintenance calls, you should do the following once each month during the heating season:

1. Radiators & Convectors. Clean radiators or convectors with a vacuum brush attachment.
2. Obstructions. Remove any drapes, furniture or other objects blocking radiators or convectors. These obstructions interrupt airflow and lower your system’s efficiency.
3. Temperature Pressure Relief Valve. Examine the temperature pressure relief valve. Call your contractor if you see signs of leaking or discharged water.

4. Pipes. Check exposed pipes for rust and leaks. If you discover a problem, contact a heating professional immediately, before the problem worsens and extensive repairs become necessary.
5. Listen. Listen to your heating system. If you hear unusual noises, review the appliance manual for the boiler and any separate manuals for the pumps and motors. Follow the manufacturer's directions or call your heating contractor.

## **Steam Heat**

Steam heat systems are similar to hot water systems. Boilers, pipes and radiators or convectors generate, distribute and radiate heat. The boiler heats cool water until it turns to steam. The steam then rises through the pipes to radiators or convectors. After the steam gives up its heat, it condenses back to water and runs back to the boiler to be heated again.

You should maintain your steam heat system similar to the hot water system discussed above. Steam systems must be serviced by a professional heating contractor. There are some differences between the two systems. Steam heat systems do not have pumps and pump controls to maintain. The steam boiler's water level should be monitored periodically. In addition the low-water cutoff should be flushed once a month to prevent buildup of sediment. Ask your contractor how to maintain your system throughout the heating season.

## **Gas Burner**

Gas burners are common in forced air, hot water and steam systems. The burners can be fueled by natural gas, manufactured gas or bottled liquid propane gas. Gas burners are generally reliable and require little maintenance.

In a gas system, an automatic gas valve opens when the thermostat calls for heat. Gas flows into a manifold and through venturi tubes where the gas mixes with air. A pilot light then ignites the air-gas mixture when it emerges from burner ports. The burning gas produces heat.

A thermocouple next to the pilot light closes the gas valve if the pilot light goes out. This prevents unburned natural gas from accumulating and creating a fire hazard. If the thermocouple is faulty, the pilot will not light.

Pilot lights can be electric or gas pilots. If you have problems with an electric pilot, call your professional heating contractor. You can clean and re-light a gas pilot by following the instructions printed on the front of the boiler or furnace.

Some home owners turn off their gas pilot lights during the non-heating months. This may save energy but can create other problems. Keep the pilot burning all year to reduce condensation within the system and prevent corrosion.

## **Professional Maintenance**

Your heating contractor should do the following during the service call:

1. Pilot. Clean the pilot orifice and adjust the pilot flame as needed.
2. Burners. Clean the burners and adjust as necessary.
3. Heat Exchanger. Clean heat exchanger surfaces. Inspect to ensure there is no deterioration allowing poisonous exhaust gases to mix with indoor air.
4. Flue. Clean flue passages to remove soot buildup and inspect for exhaust gas leaks.

## **Oil Burner**

Two types of oil burners usually heat air or water. The most common is the high pressure or gun-type burner. The other is a vaporizing or pot-type burner.

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.

### **Controls**

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.

### **Professional Maintenance**

All oil burners require an annual inspection by a professional heating contractor. A burner that is out of adjustment can waste up to 50% of your fuel dollars.

Your heating contractor should do the following:

1. Burners. Clean the burners and adjust as necessary.
2. Heat Exchanger. Clean heat exchanger surfaces. Inspect to ensure there is no deterioration allowing poisonous exhaust gases to mix with indoor air.
3. Flue. Clean flue passages and inspect for exhaust gas leaks.
4. Efficiency Testing. Test burner efficiency and adjust as necessary.

### **Electric Elements**

Electric resistance heating can be the heat source for your boiler or furnace. Electrical resistance coils are immersed directly into the furnace's flowing air or the boiler's water. It is a simple system. When a thermostat calls for heat, the resistance coils become warm and transmit their heat directly to the air or water. When the thermostat signals that the demand for heat has been satisfied, the coils are turned off. Have a qualified professional maintain your electric boiler or furnace once a year. Likewise, if you have any problems with the electric heating elements, call a qualified professional.

### **Heat Pump**

Heat pumps are another heat source for forced air heating systems. Electric heat pumps are more energy efficient than other electrical heating systems because they use electricity to move heat, instead of producing heat.

The most common heat pumps are air-to-air systems. They extract heat from the outside air and transfer it to the inside air. Other systems include solar-assisted, water-source and ground-source heat pumps.

The principles for air-to-air systems discussed below also apply to other types of heat pumps.

It may seem hard to believe that heat from outside air can heat your home during freezing weather. As long as the air temperature is greater than absolute zero, -460 degrees F., there is some heat in the air. At 32 degrees F., air possesses 88% of the heat that it has at 100 degrees F.

### **Operation**

Heat pumps move heat by moving a refrigerant with a boiling point around -20 degrees F., such as Freon, between indoor and outdoor coils or heat exchangers. The cold refrigerant, like any fluid, absorbs

heat when the outside air heats it to a boil.

A compressor then compresses the vaporized refrigerant and raises its temperature to over 100 degrees F. The heated refrigerant passes through a pipe to the inside heat exchanger, transfers its heat to the inside air and condenses to a warm liquid.

The warm liquid then, passes through an expansion valve, reducing the refrigerant's pressure, expanding its volume and lowering its temperature (the reverse of compression). The cold refrigerant is ready to absorb heat from the outside air again and repeat the cycle.

The air at your registers may seem cool during the heating cycle. This is because a heat pump does not deliver sudden bursts of hot air like conventional furnaces. Instead, it delivers a more constant flow of 85 to 90 degrees F. air at a higher velocity. The air feels cool because it is less than your body temperature. The air is sufficiently warm to keep you comfortable.

### **Air Conditioning**

Air conditioning is another advantage of heat pumps. A reversing valve reverses the refrigerant's flow for cooling so that the system extracts heat from the inside and discharges it outside.

### **Supplemental Heating**

Supplemental electric heating elements will help heat your home when cold outside air reduces the heat pump's heating capacity. Raising the thermostat setting by more than 2 degrees F. increments may also turn on the supplementary heating and increase your energy usage. For maximum efficiency, set the thermostat and leave it at that setting day and night.

### **Outdoor Unit**

It is normal for ice to build up on the outdoor coil, or heat exchanger, during winter heating. The heat pump defrosts the ice automatically to maintain efficient operation. Steam or fog may rise from the outdoor unit during the defrost cycle.

Do not allow snow, grass, clippings, vines, shrubs or other items to accumulate on or around the outdoor unit. Do not stack or store items on or around the unit. Maintain a minimum 12 inch clearance between the outdoor unit and snow banks and other obstructions. It is important to allow air to flow to the unit unrestricted.

Make sure that no one steps on the copper tubing between the indoor and outdoor units. Do not place or hang items on the tubing either. The heat pump may malfunction if kinks or dents in the tubing causes refrigerant to leak or restricts refrigerant flow. Repairing or replacing the copper tubing can be expensive.

### **Professional Maintenance**

Once a year, call a professional heating and cooling contractor to do the following:

1. Blower. Inspect, clean and oil the indoor blower motor and blower wheel. Permanently lubricated motors should not be oiled.
2. Coils. Inspect and clean indoor and outdoor coils.
3. Drains. Inspect and clean the indoor coil's primary and auxiliary drain pans and drain lines. Unplug if necessary.
4. Wiring. Inspect wiring for loose electrical connections, discolored contacts and terminals and bare or frayed wiring.
5. Performance. Check the system's performance and adjust as necessary.

### **Home Owner Maintenance**

Between maintenance calls, you should do the following:

1. Filters. As discussed in the forced air section, filters must be cleaned once a month when the system is in use. For a heat pump system, that means cleaning the indoor unit's filter (there is no filter in the outdoor unit) once a month, 12 months a year.

2. Indoor Coil. Periodically clean the indoor coil or heat exchanger with a vacuum cleaner's soft brush attachment. If this is insufficient to clean the coil, call your heating and cooling contractor.
3. Outdoor Coil. Clean around the outdoor coil unit. Remove any leaves, grass clippings or other debris from around the unit. Clean the outdoor coil or heat exchanger using a soft brush or the vacuum attachment discussed above. If the dirt is deeper in the coil than you can reach, call your heating and cooling contractor. Do not use a garden hose to clean the outdoor coil.
4. Listen. Listen to the outside unit and the rest of your system. If you hear unusual noises, follow the appliance manual's directions or consult with your professional heating contractor.
5. Winter Care. If it snows in your area, keep snow away from the coil surface. Clear the snow with a broom or soft brush.

## **Electric Baseboard Heat**

Electric baseboard heat is easy to control, requires little or no maintenance and provides clean, quiet, comfortable, draft-free heat. Unless you have a problem, the heating units require no professional maintenance.

Electric baseboard systems convert electricity to heat by forcing large amounts of electricity through a thin, highly resistant wire, causing the wire to become warm. The wire, or heating element, runs through a ceramic-lined metal tube surrounded by metal fins. A natural draft draws air through openings at the bottom of the baseboard unit's exterior housing. The air flows over the finned tube, picks up heat and rises through openings at the top of the housing to heat the room.

An alternate electric baseboard heating system uses fluid in a sealed tube. The heating element heats the fluid, which heats the tube and fins, which heats the passing air. The fluid retains heat and continues to warm passing air for a time after the thermostat turns off power to the heating element.

### **Controls**

Thermostats control the flow of electricity to the baseboard units. Each unit has its own thermostat built into the unit's housing or mounted on a wall. The individual thermostats allow rooms to be heated as needed. This "zone" heating is more efficient than heating rooms that are not being used.

Most electric baseboard units have a temperature cutoff control. This safety device prevents the heating element from burning out when obstructions block air flow to the unit.

### **Home Owner Maintenance**

Electric baseboard heaters require little maintenance. However, you should do the following once each month when your baseboard heaters are in use for heating:

1. Dust. For efficient heat transfer, remove the baseboard unit's cover and dust the inside surfaces, the heating element and the radiator fins with a soft brush.
2. Obstructions. Remove any drapes, furniture or other objects blocking baseboard units. An obstruction can interfere with the efficient flow of heated air and heat from the units can damage the obstructing item.
3. Problems. Electric baseboard heaters are very reliable. If you ever have a problem with a baseboard unit, call a professional electrician.

## **Electric Ceiling Heat**

Electric ceiling heat is a true maintenance free heating system. Only the thermostats controlling the heat require maintenance.

Your ceiling system converts electricity to heat by forcing large amounts of electricity through thin, highly resistant wires embedded in the ceiling. The wire becomes warm and radiates its heat to the room below.



Thermostats control the flow of electricity to the ceiling units. Each unit has its own thermostat mounted on a wall. The individual thermostats allow rooms to be heated as needed. This “zone” heating is more efficient than heating rooms that are not being used.

Do not drive nails, drill holes or screw hangers through the ceiling. This can sever the thin wires and damage your system. If you ever have a problem with a ceiling unit, call a professional electrician.

## **Air-Conditioning**

Central air-conditioning systems commonly use a forced air heating system’s duct work. The furnace’s blower forces cool air through ducts and vents into your home. If you do not have a forced air heating system, a separate duct system can carry the cooled air.

Cooling takes place when a cold liquid (-20 degrees F. boiling point), such as Freon, passes through an evaporator coil. The refrigerant absorbs heat from the inside air and begins to boil. An electric compressor pumps the vaporized refrigerant under pressure to a condenser coil in an outside unit. A fan cools the refrigerant in the condenser. The refrigerant passes through an expansion device. The rapidly expanding refrigerant then cools to form a cold liquid. The now cold refrigerant returns to the evaporator coil to repeat the cycle.

The cold evaporator coil will collect condensing moisture from the circulating air. A pan collects water dripping from the evaporator. The water then drains through a primary drain and possibly a second overflow drain.

### **Balancing**

As with heating, you can “balance” the distribution of air-conditioned air throughout your home. Adjust supply registers and duct dampers as necessary. Because hot air rises and cold air falls, you may want to increase the flow to upstairs rooms and decrease the flow to downstairs rooms. If the ducts also distribute heated air, remember to readjust the registers and duct dampers before the heating season.

### **Professional Maintenance**

Energy costs for most air-conditioning systems can be high. For that reason, it is important to maintain your system properly. Ask your professional heating and cooling contractor to inspect your air-conditioning system during the annual service call. The contractor should:

1. Refrigeration System. Inspect and service as necessary.
2. Coils. Inspect and clean condenser and evaporator coils.
3. Drains. Inspect and clean the evaporator coil’s primary and overflow drain pan and drain lines.

Unplug if necessary.

4. Wiring. Inspect wiring for loose electrical connections, discolored contacts and terminals and bare or frayed wiring.
5. Motors. Oil all motors unless they have permanently lubricated bearings.
6. Performance. Check the system’s performance and adjust as necessary.

### **Home Owner Maintenance**

Between maintenance calls, you should complete the maintenance tasks listed below once each month, or as necessary, during the cooling season.

1. Filters. As discussed in the forced air section above, air filters must be cleaned once a month when the system is in use.
2. Coils. Clean the condenser and evaporator coils with a vacuum cleaner’s soft brush attachment. If this is insufficient to clean the coil, call your heating and cooling contractor.
3. Listen. Listen to the outside unit and the rest of your system. If you hear unusual noises, follow the appliance manual’s directions or consult with your professional heating and cooling contractor.

The roof cannot be adequately evaluated during dry weather, especially during a hot, dry summer.

Consequently, roof problems might not be detected at the time of the inspection and might not be able to

be detected until a significant storm comes along. Roofs are particularly prone to leaking after extended dry periods due to weathering, drying, and shrinkage of the various components of the roof