



## HOW-TO BOOKLET #3109

# CHOOSE AND INSTALL A THERMOSTAT



### TOOL & MATERIAL CHECKLIST

- Phillips Screwdriver
- Masking Tape
- Level
- Wire Connectors
- Rubber-soled Shoes
- Foam Insulation or Putty
- Putty Knife
- Slotted Screwdriver
- Wire Cutter/Stripper or Sharp Knife
- Drill
- Electrician's Tape
- Eye Protection
- Molly Screws
- Voltmeter

**Fig. 1**

Mon	Tue	Wed	Thu	Fri	Sat	Sun
6:00 <sup>AM</sup>	6:00 <sup>AM</sup>	6:00 <sup>AM</sup>	6:00 <sup>AM</sup>	6:00 <sup>AM</sup>	8:00 <sup>AM</sup>	8:00 <sup>AM</sup>
68°F	68°F	68°F	68°F	68°F	68°F	68°F
7:30 <sup>AM</sup>	7:30 <sup>AM</sup>	7:30 <sup>AM</sup>	7:30 <sup>AM</sup>	7:30 <sup>AM</sup>	—	—
60°F	60°F	60°F	60°F	60°F	—	—
5:00 <sup>PM</sup>	5:00 <sup>PM</sup>	5:00 <sup>PM</sup>	5:00 <sup>PM</sup>	5:00 <sup>PM</sup>	—	—
68°F	68°F	68°F	68°F	68°F	—	—
10:00 <sup>PM</sup>	10:00 <sup>PM</sup>	10:00 <sup>PM</sup>	10:00 <sup>PM</sup>	10:00 <sup>PM</sup>	10:30 <sup>PM</sup>	10:30 <sup>PM</sup>
62°F	62°F	62°F	62°F	62°F	62°F	62°F

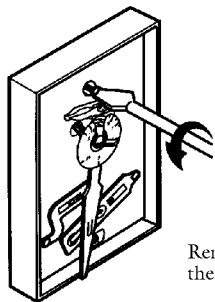
Chart your typical weekly schedule.

*Read This Entire How-To Booklet for Specific Tools and Materials Not Noted in The Basics Listed Above*

The purpose of a thermostat is to turn a furnace boiler or air conditioner on and off at the appropriate times to provide comfort in a home or business. Most thermostats work on the principle of something inside the thermostat changing when the temperature changes, which then switches the heating and/or cooling system either on or off.

ASHRAE (American Society of Heating, Air Conditioning and Refrigeration Engineers) standards for thermostat performance call for no more than a 2°F temperature swing (i.e., the thermostat will control the temperature within 2°F of the setpoint). Thermostats that meet this standard provide optimum comfort in a home or business.

**Fig. 2**



Remove old low voltage thermostat.

### THERMOSTAT VOLTAGE

Make sure you choose the correct model for your needs.

The first thing you need to know before choosing your new thermostat is whether you are replacing a **low voltage**, **millivoltage** or **high voltage** (also called line voltage) model. You must choose your new thermostat to be the same voltage as the old one.

**Low voltage** is a 6 to 30 volt system that is stepped down or transformed from house voltage that is usually 120 volts and associated with central heating/air. These thermostats usually have three basic parts—a heat anticipator, a heat sensor and a switch. The heat anticipator produces heat, raising the temperature of the sensor. The heat sensor most commonly used is a metal coil that responds by expanding/contracting as it is warmed/cooled. At a certain point it trips the

switch to turn the furnace either on or off. The switch is usually either a mercury bulb, a magnetic switch or an electronic switch. To function properly, mercury bulb thermostats must be mounted level and the anticipator setting must be matched to the furnace ampere rating.

Some low voltage thermostats are specifically designed for use with heat pump systems. Many of these heat pump thermostats are designed for single-state heat pumps, while others are designed for heat pumps with auxiliary heat. The auxiliary heat models require connection of seven or more wires and warrant professional installation.

**Millivoltage** systems are self-powered by devices called thermopiles that produce direct current ranging from 250 millivolts to 750 millivolts. A thermostat specifically designed for millivoltage systems is required.

**High voltage** refers to 120 to 240 volt systems, and is typically associated with baseboard, space and other noncentral type heaters. A thermostat specifically designed for high voltage systems is required. Power flows through a coil to the elements and generates heat. Since a high voltage thermostat must withstand these greater voltages, it is less sensitive to temperature changes than is a low voltage thermostat.

A high voltage thermostat has a temperature reaction range of up to seven degrees. The room may get very warm or very cool before the coil can change enough to turn the thermostat either on or off.

A high voltage thermostat is either a single-pole (two-wire) or double pole (four-wire) device. The double-pole thermostats have an OFF position that completely shuts off power to the baseboard or space heater. You can hear a click sound when you turn the thermostat OFF.

You can usually find the voltage listed on the inside cover of your old thermostat or on the rating cover plate to your furnace. This is your first clue when

determining whether or not your thermostat is low, millivoltage or high voltage. Another clue would be to check the thickness of the thermostat wires. High voltage wiring is usually as thick as a wooden pencil lead (12 gauge)—thicker than low voltage or millivoltage wiring (14 to 18 gauge).

## CHOOSE YOUR THERMOSTAT

After you have determined whether your system is low voltage, millivoltage or high voltage, you will need to think about and answer the following questions before you go to the store to choose your thermostat:

**Compatibility.** To choose the correct thermostat and to determine your system type, answer the following questions. Most thermostat manufacturers include a cross reference table on each thermostat package that indicates the compatible systems for that thermostat.

- 🏠 Is your system a heating only, central air conditioning only or heating and central air conditioning system?
- 🏠 How many wires are connected to your old thermostat?

- 🏠 Is your heating system: forced air gas or oil? hot water gas or oil? gravity hot air/water? electric forced air? electric heat pump? zoned? multistage?
- 🏠 Does your system have a pilot light or automatic (spark) ignition?

In some cases, automatic ignition systems may send a variable signal that confuses the thermostat. To solve this potential problem, choose either a battery-powered thermostat, or install a separate isolation relay to maintain consistent power to the thermostat. Many thermostat manufacturers offer battery-powered thermostats that work on almost all low voltage systems.

It will help to write down any information that is on your heating/cooling equipment and thermostat (i.e., model numbers, brand names, descriptions) and bring it along to the store.

The table below may help you determine compatibility by matching the system type with the number of wires and voltage.

## Programming

- 🏠 Do you want a programmable thermostat for energy savings?
- 🏠 Do you want a clock or digital display with clock?

System/Type	Number of Wires	Voltage	Characteristics
Gas-Standing Pilot	2,3,4* or 5*	24 Vac	Pilot, forced air
Gas-Electronic Ignition	2,3,4* or 5*	24 Vac	Pilotless, forced air
Gas-Fired Boiler	2 or 3	24 Vac	Hot water
Gas-Millivolt	2	750 mV	Gravity air (no fan)
Oil-Fired Boiler	2 or 3	24 or 120 Vac	Hot water
Oil-Fired Furnace	2, 4* or 5*	24 Vac	Forced air
Electric Furnace	2, 4* or 5*	24 Vac	Forced air
Electric Air Conditioning	4 or 5	24 Vac	Outdoor condenser
Baseboard Electric	2 or 4	24 or 120/240 Vac	Thermostat in each room
Heat Pump-Single Stage	4 or 5	24 Vac	Outdoor unit marked heat pump
Heat Pump-Multistage	7 or more	24 Vac	

🏠 What program capability should the thermostat have to meet your schedule (i.e., how many programs per day)?

🏠 Do you need capability to set different programs for weekends?

After you arrive at the store and narrow down your choices, consider the following:

### Ease of Installation and Programming

🏠 Does the thermostat you are considering appear easy to install?

🏠 Are clear instructions included?

🏠 Does the thermostat you are considering appear easy to program? Are permanent programming instructions included inside the thermostat door or cover?

🏠 Do the instructions include a toll-free phone number to call when you have questions?

### Comfort

🏠 Does the thermostat you are considering feature low (2°F) temperature swings for maximum comfort?

### Reliability

🏠 Does the thermostat (if electronic) include low battery indication?

🏠 If the thermostat has a door or cover, do the hinges appear sturdy?

🏠 If an electronic thermostat, are the electronic components covered to prevent damage from static electricity?

🏠 If an electronic thermostat, are interconnects between subbase and thermostat made of silver or gold to assure reliable operation?

The best choice is a thermostat that will provide good temperature control along with the features you want. And remember that a programmable thermostat will automatically set back the temperature and save money. It will usually pay for itself within a year.

## INSTALL YOUR THERMOSTAT

After you have chosen your thermostat, you can plan your installation.

If your new low voltage thermostat is a setback model, it will require programming either before or after installation. The principle of programmable thermostats is simple. It takes less energy to bring the house up/down to the proper temperature than to maintain a constant temperature all day/night. A setback thermostat can easily pay for itself in energy savings in the first year of installation!

Setback thermostats are either mechanical or electronic.

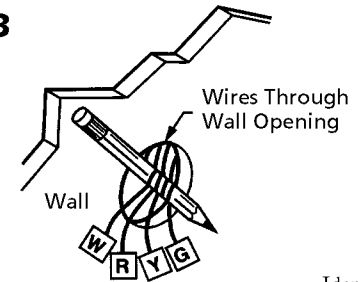
**Mechanical models** have internal programming wheels that track the time of day and night. You place programming pins in the wheel at the times you want to have the temperature set up or set back, which then turns the furnace on or off at programmed times of the day or night. You must check periodically that the timer is maintaining the proper time, unless the thermostat has a battery for backup in case of power outages.

**Electronic models** can be programmed with keys or buttons, in many cases with different programs for weekends and for each day of the week. One or more batteries may be required to power the thermostat or for backup to maintain programming in case of power outage.

Following are typical steps for programming a setback thermostat:

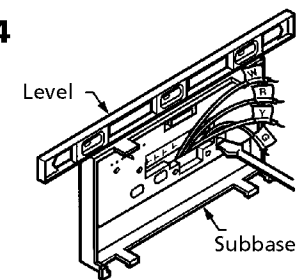
- 1 🏠 Chart your weekly habits such as your wake-up time, departure time for school/work, return home time, and last one to bed for each day. See **Fig 1**.
- 2 🏠 Choose your temperature settings for your times at home, away from home and at night.
- 3 🏠 Set the clock and day of the week.
- 4 🏠 Set programs according to instructions included with your thermostat. You may be able to set different programs for: weekdays/weekends,

**Fig. 3**



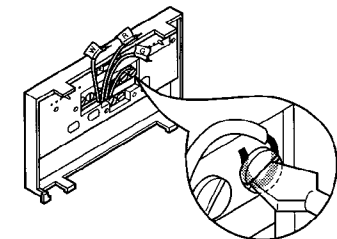
Identify wires.

**Fig. 4**



Attach base to wall.

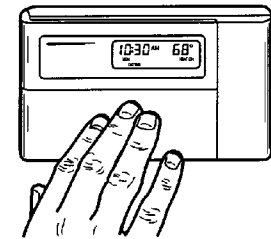
**Fig. 5**



Match wires to correct terminals.

**Fig. 6**

Note:  
This thermostat  
snaps on.



weekdays/Sat/Sun; or 7 days a week, depending on the thermostat capabilities. You should also be able to set the thermostat to raise/ lower the temperature a number of times each day. Again, your thermostat programming instructions will guide you.

- 5 Check your program to determine if you need to make any changes to your routine. Most programmable thermostats allow you to review your programs and make changes at any time.

## ELECTRICAL PRECAUTIONS

Now you are ready to install your thermostat. But first, take the time to note some safety precautions before working on any electric thermostat.

Electricians like to use the left-hand rule—keep your left hand in your pocket, or only on insulated tools and materials. The reason is simple. An electrical charge starting on one hand passes through your heart to escape out the other hand. Since the left hand is closer to the heart than is the right hand, electricians like to work with this rule in mind as a safety precaution.

Other precautions include the following:

- 1 Turn off the electricity before you remove the thermostat cover.
- 2 Remove your jewelry and watches.
- 3 Use your right hand to work on wires and use your left hand only on insulated tools/materials.
- 4 Always stand on insulated materials such as rubber-soled shoes.

## ELECTRICAL PRECAUTIONS

- 1 **TURN THE POWER OFF!** Some thermostats have switches near the furnace to turn the thermostat power off; otherwise, you can trip the breaker on the service panel. As an extra precaution, use an electrical tester to make sure the power is off.
- 2 Remove thermostat cover; loosen screws holding the thermostat, and lift away from the base or wall. See **Fig 2**.

- 3 Disconnect wires from old thermostat. When the thermostat has more than two wires, as you disconnect each wire, tape the end and label it with the letter of the terminal designation for correct reconnection to the new thermostat. Wrap the wires around a pencil so they do not fall back into the wall. Keep the wires separate from each other at all times and tape the ends for safety. See **Fig 3**.

- 4 Separate the new thermostat from the base, if there is a separate base. If necessary, install a decorative cover plate to cover the old hole. Pull the wires through the new base, keeping them separate. Level and attach the base to the wall. See **Fig 4**.

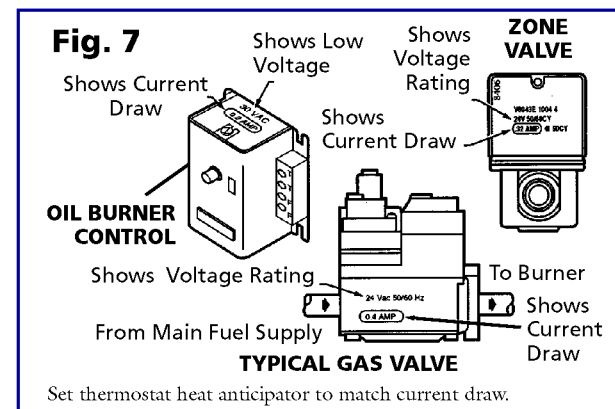
- 5 Match and connect the wires as labeled to the correct terminals on the base or the back of the new thermostat. See **Fig 5**. If you have only two terminals on your thermostat and only two wires, it does not matter which wire goes to which terminal.

- 6 Fill the hole in the wall with insulation or putty to protect the thermostat from drafts inside the wall that could adversely affect the thermostat operation.

- 7 Attach the thermostat to the base or wall. It should either snap on or attach with screws that are included. See **Fig 6**.

- 8 When the thermostat has an adjustable anticipator, set the anticipator to the same setting found on your old thermostat. The setting may also be found on the gas valve, oil burner control or zone valve located near your furnace. See **Fig 7** and your owner's manual. Note for hot water systems: set the anticipator to 1.4 times the current rating found on the zone valve.

- 9 Attach the cover, turn the power back on, and test your new thermostat according to instructions in your owner's manual.



**NOTE:** If you have a new baseboard heater, you should hear the elements expanding, and may smell some burning oil, which is the packaging oil applied at the factory. This is normal. If the heater does not come on, recheck the owner's manual.

## TROUBLESHOOTING TIPS

The suggestions below will correct many problems. Please refer to your thermostat owner's manual for more details.

Symptom	Possible Solution
No heat	<ul style="list-style-type: none"> <li>• Replace fuse or reset circuit breaker</li> <li>• Clean thermostat by removing cover and gently brushing off dust build-up in the parts</li> <li>• Replace batteries on battery-powered model</li> </ul>
Heating exceeds or does not reach desired temperature.	<ul style="list-style-type: none"> <li>• Be sure thermostat is mounted level</li> <li>• Be sure heat anticipator is set correctly</li> </ul>
Heating system short-cycles (turns on and off repeatedly).	<ul style="list-style-type: none"> <li>• Clean thermostat by removing cover and gently brushing off built-up dust</li> <li>• Be sure heat anticipator is set correctly</li> </ul>
Cooling system does not turn on.	<ul style="list-style-type: none"> <li>• Replace fuse or reset circuit breaker</li> <li>• Clean thermostat by removing cover and gently brushing off built-up dust</li> <li>• On battery-powered model, replace batteries</li> </ul>