# Heating Your Shop

## For every shop and climate, there's an efficient solution

BY ANDY ENGEL

My first woodworking shop was in a garage in northern New Jersey. I cobbled together some insulation, weatherstripping, and an old woodstove to make the shop mostly habitable—for me. For my tools and projects, though, I suspect it was a hostile environment. Morning often found the shop below freezing, which precluded storing glue or waterborne finishes there. Stoking the stove quickly launched the mercury into the 80s, a fluctuation in temperature and humidity that did my lumber no good. And, if the shop remained unused for any length of time during the winter, rust bloomed on my tools.

Better insulation and a heater I was comfortable burning in my absence would have fixed the problems. I think 50°F is good for an empty shop, and with decent insulation and air sealing, it's a temperature that shouldn't cost an arm and a leg to maintain in most climates.

### Dust and fumes can be a hazard

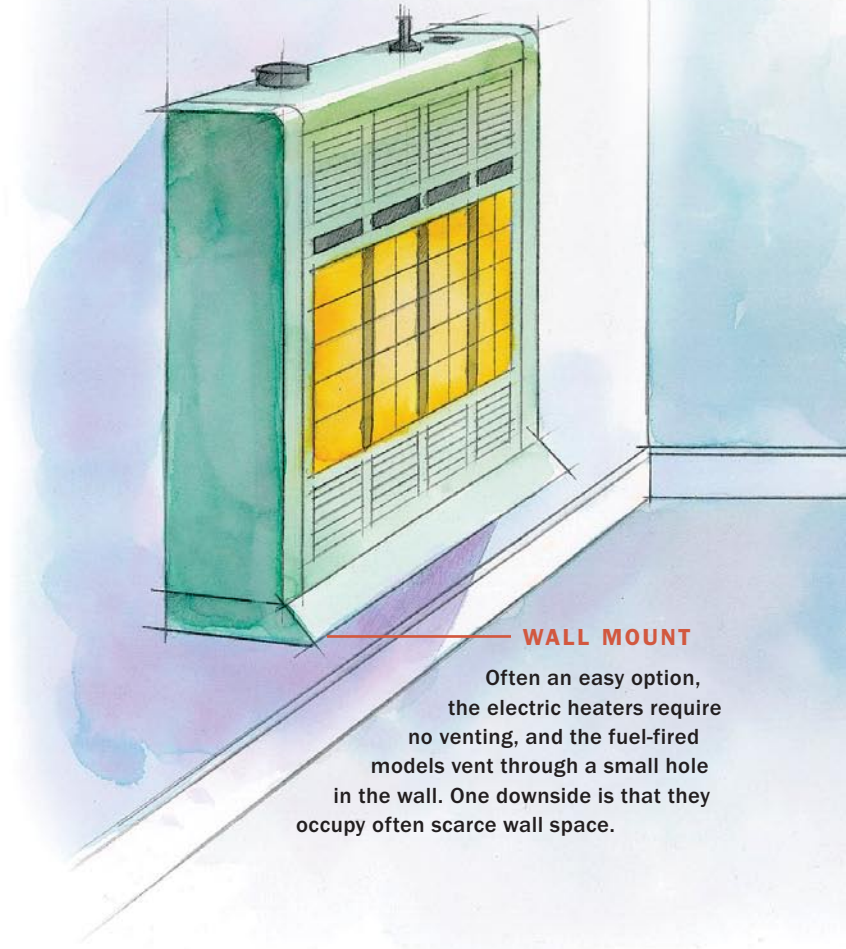
Wood dust will burn at 500°F or less, and clouds of dust can ignite if they're exposed to hot surfaces or an open flame. Aside from the fire risk, even relatively minor shop dust encrusting any type of heater will make it less efficient.

There are two types of fuel-burning appliances. Open-combustion appliances, such as woodstoves or gas heaters with pilot lights, feed the flame with air from inside the room and are potential ignition sources in dusty environments. Sealed-combustion appliances, such as most direct-vent kerosene heaters and many gas heaters, have no connection between the combustion chamber and the inside air. Rather, a supply duct brings air from outside into the chamber to support the flame. These are safer.

As a practical matter, a woodworker who installs a decent dust-collection system probably will never create enough airborne dust to make the atmosphere truly risky. Most types of heaters should be safe to use in a shop as long as you collect the dust, don't allow flammable fumes to build up, and clean off the heater on a regular basis. To limit the risk, ask the manufacturer if the surface temperature of the heater

### LOCATING YOUR HEAT SOURCE

**A heater must be safe, unobtrusive, close enough to warm you, but not so close as to roast you. Locating it between you and a door or window often works, because the heater can warm the cold air these openings admit.**

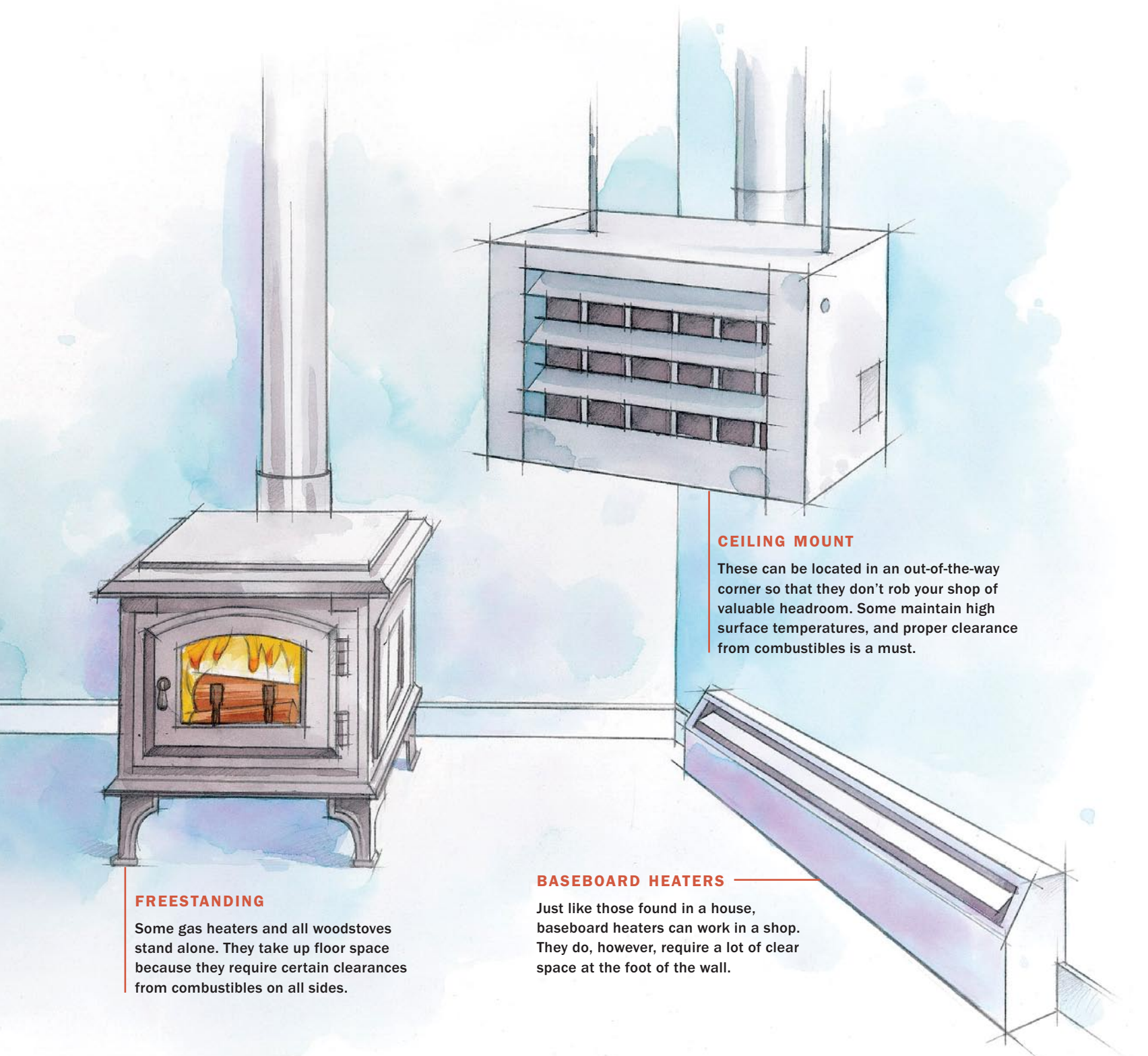


**WALL MOUNT**

**Often an easy option, the electric heaters require no venting, and the fuel-fired models vent through a small hole in the wall. One downside is that they occupy often scarce wall space.**



Photo, this page: Michael Pekovich



**CEILING MOUNT**

These can be located in an out-of-the-way corner so that they don't rob your shop of valuable headroom. Some maintain high surface temperatures, and proper clearance from combustibles is a must.

**FREESTANDING**

Some gas heaters and all woodstoves stand alone. They take up floor space because they require certain clearances from combustibles on all sides.

**BASEBOARD HEATERS**

Just like those found in a house, baseboard heaters can work in a shop. They do, however, require a lot of clear space at the foot of the wall.

will exceed 500°F or if there's an open flame. It's a good idea to check with your building inspector and your property-insurance agent before you install heat in a shop.

Although their simplicity may be tempting, avoid any unvented fuel-burning appliance in the shop. Unvented kerosene heaters in particular don't work well when their wicks become contaminated with wood dust. And when they aren't burning efficiently, kerosene heaters produce carbon monoxide, which can cause health problems even at low concentrations. Lacking a wick, gas burners aren't as sensitive to dust as kerosene heaters. Both types produce water as a by-product, which means an unvented fuel-burning heater will increase the moisture in your shop. If the heater stays off in your absence, this moisture is likely to condense, and no doubt will rust the costliest tool in your arsenal.

## Buy insulation once, save fuel forever

The first step to heating a shop is matching the insulation level to the climate. Remember, you buy insulation once, but fuel costs go on forever. Do it right. That said, the details of shop insulation are beyond the scope of this article. Your local building code will specify the minimum insulation values for residential construction, and these are a good place to start. You can always add more insulation than code requires; doing so will increase your

Drawings: Brian Jensen

# Fuel for thought

**The type of fuel that's most convenient is a big factor in choosing a heater. Fuel prices are volatile, so the discussion of price here, although based on history, is quite general.**

### NATURAL GAS

Natural gas, piped under city streets, is a good choice, particularly if your house is hooked up already. Gas is usually moderately priced, although it's a commodity, so the price fluctuates with demand. You buy it as you use it, so you can't stockpile fuel in the summer, when prices tend to drop. Because gas burns very cleanly, heater maintenance is minimal. And because it's supplied from a pipeline, you never run out.

### PROPANE

Propane burns in the same appliances as natural gas. However, because propane contains more Btu per given volume, it's critical that your heater is set up to burn it. With most heaters, that's a simple matter. Propane is delivered to a tank outside that you either buy or rent from the supplier. It's generally more expensive per Btu than natural gas, and rarely is used where natural gas is available. Filling up at cheaper summer prices can save money. Propane heaters are also low maintenance.

### KEROSENE AND FUEL OIL

Kerosene and #1 and #2 fuel oil are readily available in the Northeast and Northwest, less so in other parts of the country. Their cost per Btu generally ends up the cheapest. Like propane, they're stored on site in a tank that you own. Prices are often lower in the summer. Unlike gas, kerosene- and oil-burning heaters need a cleaning and a tune-up every year or so, a cost that should be factored in. In a cold climate, oil may still be cheapest. In more moderate climates, this cost might give gas the edge.

### ELECTRICITY

Electricity is simple: Pay the bill every month and it keeps on coming. With no flue or piping to run, electric heaters are cheap to install and don't require regular maintenance. Depending on your electricity rates, however, they can be the most expensive to run.

### WOOD

Wood is tempting. After all, most of us have scrap that sure looks like free heat. The amount of wood it takes to get through a winter can be surprising, though. If you spend any serious time in the shop, you likely will need to lay in some cordwood. And if you are not in the shop every day to fire it up, keeping minimal heat going with a woodstove is dicey.

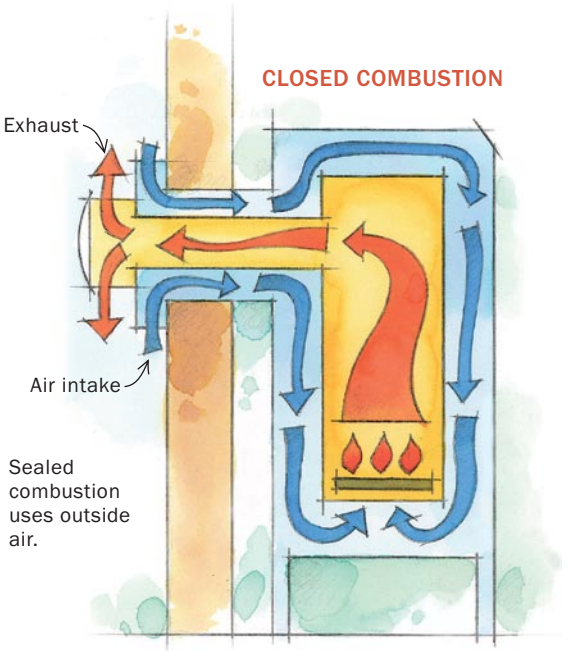
comfort and decrease your energy usage. However, it will probably take a long time to recoup the cost of extra insulation if you go far beyond the code requirements.

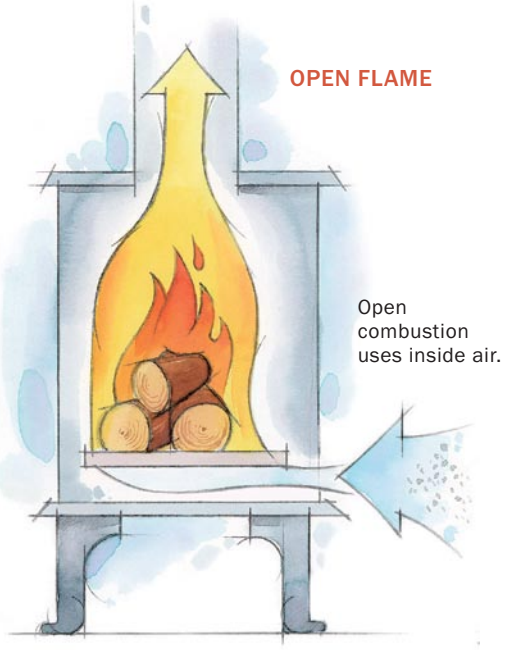
Air sealing is at least as important as the R-value (resistance to heat flow) of your insulation. In a drafty cavity, most insulation has an R-value of close to zero. Any breach in the building envelope—be it a door without weatherstripping, a leaky attic hatch, or a hole in a wall—will cost you heat and money all out of proportion to the hole size. Pay particular attention to the ceiling and the tops of the wall framing. Because warm air rises, you can almost watch the dollar bills floating out of the smallest holes in these areas. Garage doors need close attention as well.

After insulating your shop, figure out just how much heat you need. Here's where a knowledgeable supplier can be a great help. Heater size depends on the climate, the size and insulation level of the shop, and how warm you want to be. For example, a two-car garage shop insulated to residential standards in southern Connecticut

### CLOSED COMBUSTION IS SAFE AND EFFICIENT

In a closed-combustion heater, air for combustion is drawn in from the outside, rather than from the heated space. This offers several advantages, the first of which is safety. Because there is no flame exposed to the shop air, the chance of flammable vapors, say from a lacquer-thinner spill, encountering an ignition source is greatly reduced.



would require about 30,000 Btu of heat per hour on an average winter day.

The downside of an undersize heating system is obvious—you'll be cold. Oversize systems aren't good, either, because they don't deliver consistent heat. They kick on at the right temperature, but quickly make it hotter than the thermostat setting, causing big swings in temperature. This is called short cycling, and it's not only uncomfortable, but the constant starts and stops are bad for the equipment's longevity and efficiency. And bigger equipment costs more. Forced to choose between undersizing and oversizing, I'd undersize, and get through the coldest days with a portable electric heater.

### Two ways to feel warm: convection vs. radiant heat

Heat reaches the occupants of a building in one of two main ways: convection, which for this purpose is the movement of warm air; or radiation, the kind of heat you feel when standing next to a campfire. Forced-air heaters work by convection. Most other heaters work mainly by radiation or a combination of the two mechanisms.

Forced-air heat warms a space quickly, but because it warms the entire space, it might cost more to run. Radiant heaters can be set up to warm specific areas, such as your workbench, leaving the rest of your shop cooler. That said, as the radiant heat warms solid objects such as your bench and tablesaw, they in turn warm the air. The effectiveness of radiant heat varies with the surface area of the radiant source, the temperature of the source, and the distance from the source.

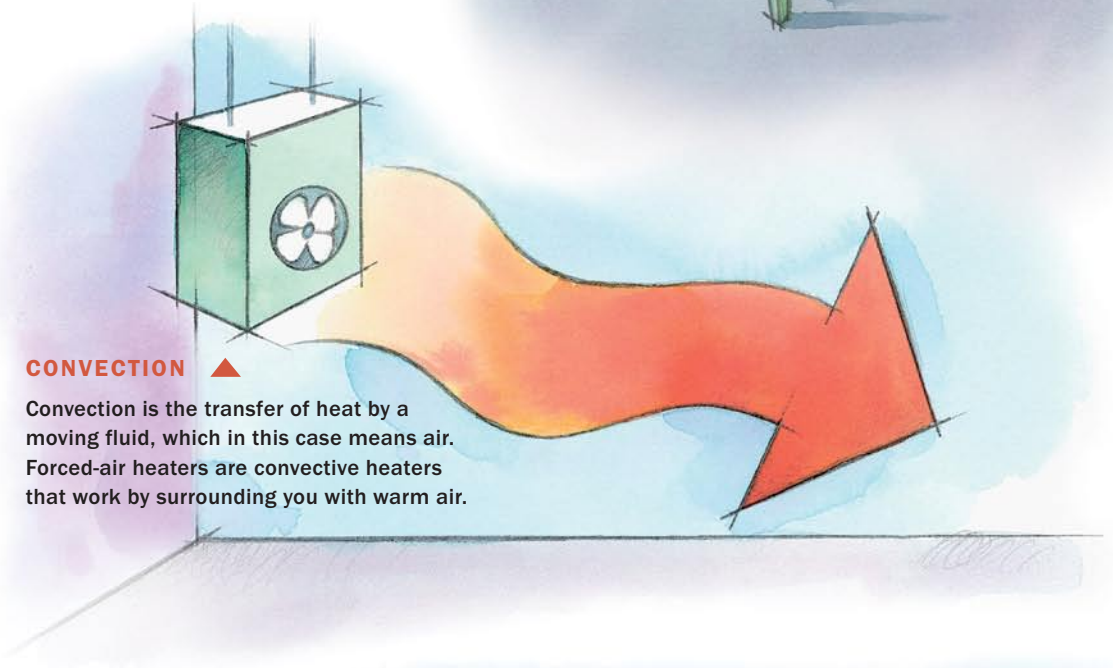
*Andy Engel is a senior editor.*

# How heat moves

**Heat warms a building by radiation and convection. Neither is inherently better, and neither works alone. Convection heaters radiate some heat, and radiant heaters create convective loops.**

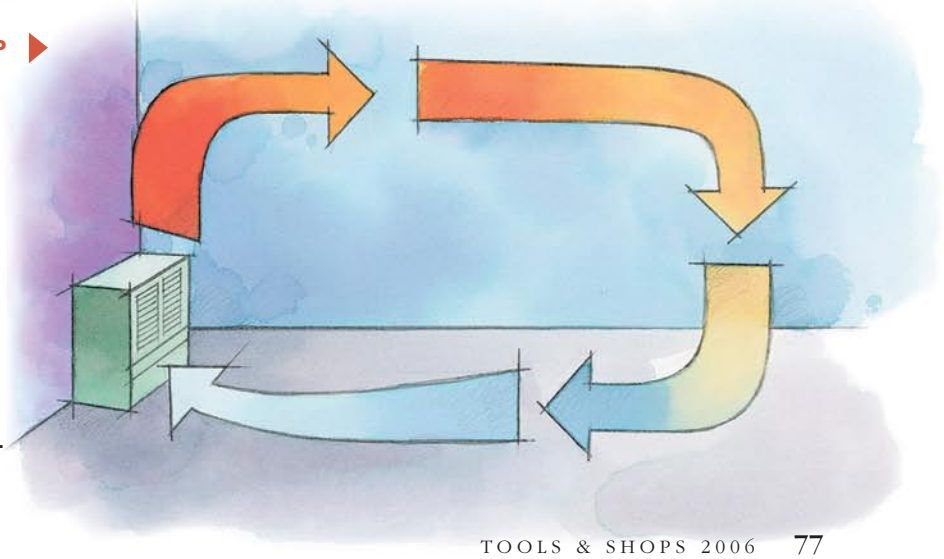
**RADIANT HEAT**

Radiation is the transfer of heat via electromagnetic waves, such as the infrared waves radiated by a woodstove. Radiation travels through the air, but doesn't warm it much. Rather, it transfers its heat to solid bodies, such as you or your tablesaw. As these solid bodies warm, they will heat the surrounding air, creating some convection. However, most of the warmth you feel from a radiant source is infrared, and has nothing to do with air temperature.



**CONVECTION**

Convection is the transfer of heat by a moving fluid, which in this case means air. Forced-air heaters are convective heaters that work by surrounding you with warm air.



**CONVECTIVE LOOP**

As air warmed by a heat source rises, it sucks in cool air from below to replace it, forming a loop of gently moving air. To heat a large area, the heater needs a big surface area, such as a baseboard. Where space is tight, passive radiant heaters may not be the best choice.

# A shopper's guide

**The heater you choose will be determined by some combination of where you can put it, the fuel, and how the heat moves. Shown here are some common types with their pros, cons, and costs. When considering cost, don't forget installation. An extreme do-it-yourselfer could install any of these heaters, but most of us would hire a pro for at least part of the job.**

## GAS-FIRED HEATERS

LOCATION: wall, floor
FUEL: natural gas, propane
COMBUSTION: sealed
HEAT TYPE: convection

Most wall heaters are surface mounted, and vent outside through the wall via a horizontal flue. Gravity furnaces are one type: Tall and thin, they suck in cold air from the floor level and vent it out the top. An optional blower can improve airflow. These heaters come in sizes from 10,000 Btu to 50,000 Btu, and cost in the range of $400 to $800.

Counterflow furnaces are similar, except that an internal fan reverses the natural upward flow of heated air within the furnace, blowing warm air out of a louvre near the floor. Priced between $800 and $1,200, these are available up to 65,000 Btu.

Console-type heaters are lower and wider, similar in size to a woodstove, with an output of 20,000 to 70,000 Btu. Their price range is $500 to $900.

Manufacturers include Louisville Tin and Stove Co. (www.cozyheaters.com), Empire Comfort Systems (www.empirecomfort.com), and Rinnai (www.rinnai.us). Major furnace manufacturers such as Trane and York also make counterflow furnaces.

## ELECTRIC HEATERS

LOCATION: wall
FUEL: electricty
COMBUSTION: none
HEAT TYPE: radiant, convection

Probably the simplest heater to install and the least expensive to buy is the wall-mount electric heater. There are two types: those that use a fan to force air over electric resistance coils and into the shop, and those that heat by radiation or by creating a natural convective current (think baseboard heat). They're available in small sizes (500 watts) that would easily take the chill off a Florida shop, or in larger units (8,000 watts) that would warm a small Maine shop, if Yankee parsimony didn't object to the electric bill. The small ones run on 120v, the larger on 240v. Expect to pay as little as $100 for a small heater and as much as $800 for a large one. Installation is relatively simple, requiring mainly a dedicated electrical circuit. The downside is that even the larger models produce only the equivalent of about 24,000 Btu, suitable for a one-car garage in a cold climate. Manufacturers include: TPI Corp. (www.tpicorp.com), Marley Engineered Products (www.marleymeh.com), Cadet (www.cadetco.com), and Empire Comfort (www.empirecomfort.com).*

## OIL-FIRED HEATERS

LOCATION: wall, floor
FUEL: kerosene, heating oil
COMBUSTION: sealed
HEAT TYPE: convection

Another through-the-wall option is a unit that burns kerosene or stove oil (#1 low-sulphur heating oil). Units that burn #2 home heating oil are available, but need more regular maintenance. Oil-fired heaters claim high efficiencies and the lowest cost per Btu, but require an outside fuel tank. Outside tanks can be problematic in really cold weather, because cold fuel oil can gel. Additives are available to prevent this problem, but you have to remember to add them. The only wall penetrations are a small hole for the flue and the outside combustion-air intake, and an even smaller hole for the fuel line. Sizes range from 15,000 Btu to 43,000 Btu, prices from $750 to $1,600.

Manufacturers include Monitor Products (www.monitorproducts.com), and Toyotomi; (www.toyostove.net).



Photos, this page: Courtesy of Louisville Tin and Stove, Empire Comfort Systems, Toyotomi

## FAN-FORCED HEATERS

LOCATION: ceiling
FUEL: multi
COMBUSTION: varies
HEAT TYPE: convection

Options abound with ceiling-mounted heaters. Several manufacturers make fan-forced, gas-fired units that hang from above. The cost hovers around $500, and the Btu range is from 30,000 to 75,000. You'll need to add the cost for the flue and the electric and gas hookup.

Fan-forced hot-water (hydronic) heaters are also available. Because no part of the heater ever gets hotter than the water, there is no fire danger. The downside is the need for a hot-water source. In a shop attached to a house with hot-water heat, you might tap into the existing system. If you go this route, you'll have to keep the shop above freezing or run a special antifreeze through the heating system. These heaters start at around $350, but piping will add to the cost. If you have to add a boiler, the cost will run into the thousands. Sizes range from 18,000 Btu to close to a million Btu. Manufacturers include Modine (www.modine.com), Marley Engineered Products (www.marleymeh.com), Cadet (www.cadetco.com), and Beacon-Morris (www.beacon-morris.com).


## INFRARED HEATERS

LOCATION: ceiling
FUEL: gas, electric
COMBUSTION: sealed
HEAT TYPE: radiant

Often called infrared heaters, these are either gas-fired or electric. Smaller units can provide spot heating over a workbench; several can heat an entire shop. By locating one where you usually work, you might leave the rest of the shop at a cooler temperature, saving energy.

The smallest gas-fired model is 25,000 Btu and costs about $650. Be sure you get a model certified for residential use, such as Detroit Radiant's LS or LD series (www.reverberray.com), or Schwank's STR 45-10 (www.schwankheaters.com) if you're heating an attached garage. A downside of this type of heater is the high surface temperature. You need at least an 8-ft. ceiling for a gas-fired radiant heater. And you need to maintain the clearances to combustible materials specified by the manufacturer.

Because they don't get as hot, electric radiant heaters don't suffer from the same clearance constraints as gas units. One manufacturer, Ennerjoy (www.sshcinc.com) targets the woodshop market by selling panels with slight cosmetic defects for $250 for a 1,000-watt unit, several of which would be required in a northern shop.

## WOOD STOVES

LOCATION: floor
FUEL: wood, pellets
COMBUSTION: open
HEAT TYPE: radiant

Wood stoves can be the ultimate in cheap heat, or a nuisance. Because there's always an open flame, the danger of fire never really goes away. Building codes require at least 3 ft. of clearance to combustibles and a non-combustible hearth that extends at least 18 in. from the stove. Stoves require an annual chimney sweeping and regular ash cleanout. A big advantage to a woodworker is that they also get rid of scrap. And woodstoves are the only option mentioned here that don't release greenhouse gases. They can emit substantial particulate matter, however. Check if your town regulates such emissions before installation. Pellet stoves are a costlier option. A thermostatically controlled hopper feeds cellulose pellets into the stove as needed. Pellets aren't free, but the convenience is a valuable consideration.

## HEAT PUMPS

LOCATION: wall
FUEL: electric
COMBUSTION: none
HEAT TYPE: convection

A through-the-wall heat pump is another electrically powered option. Commonly used in hotel rooms, heat pumps work like refrigerators or air conditioners, extracting the heat from the air and moving it somewhere else. The chief advantage of heat pumps is that they can be set to cool the air as well. (The industry name for these units is PTAC, or packaged terminal air conditioner.) They're available in sizes from about 7,000 Btu to 15,000 Btu, and are best suited to moderate climates. For cold weather, many heat pumps have auxiliary electric coils that kick in and produce heat. Costs run from $500 to $1,000. Manufacturers include most major HVAC suppliers.

Photos, this page: Courtesy of Empire Comfort Systems, Vermont Castings, Schwank Heaters, Friedrich

## *Correction

The photo on p. 78 misidentifies a heating device. The heater featured under the headline "Electric Heaters" is a gas-powered, vent-free unit made by Empire.