

Until recently, all direct-vent space heaters were simple gas-fired units used to provide heat for additions, workshops, or seasonal homes. In the past few years, however, there have been dramatic technical improvements in direct-vent heaters, which now include kerosene-fueled models (see Figure 1, next page). These heaters have a relatively low initial cost, are fuel efficient, and perform well. Since they don't require a basement or utility room, direct-vent heaters are often chosen as the primary heating source for apartments and small homes.

Not Your Father's Oldsmobile

The older generation of direct-vent space heaters has gas-fired atmospheric burners with standing pilot lights. Most of them have no fan to distribute the heat, and require no electricity. Two U.S. manufacturers of this style of simple heater are Empire and Cozy. Their two chief overseas competitors, Eco-Therm and Orbis, are from Argentina.

by Martin Holladay

The newer generation of space heaters was developed in Japan, where homes are typically small and lack basements. These heaters use electronic ignition or glow plugs instead of pilot lights. They also have power burners, which use a motor and fan to provide forced-air combustion. This forces the vent gases through smaller tubes, improving heat transfer and fuel efficiency. All newer heaters are equipped with fans to blow heated air away from the heater. In some models, sophisticated electronic controls allow the burner to fire at different rates, limiting short cycling.

These newer heaters, like their predecessors, have sealed-combustion burners, which use outdoor make-up air ducted directly to the burner. Since they don't draw room air for combustion, these heaters are less likely than open-combustion heaters to encourage air infiltration through windows and doors.

INSTALLING Direct-Vent Space Heaters

These efficient heaters can provide reliable heat for room additions or even small houses



Direct-Vent Space Heaters with Power Burners

	Fuel	Input	Output	List
Toyotomi Laser 30	Kerosene	Not available	14,800 Btu/h	\$799
Toyotomi Laser 56	Kerosene	Not available	22,000 Btu/h	\$1,229
Toyotomi Laser 73	Kerosene	Not available	40,000 Btu/h	\$1,539
Monitor 441	Kerosene	43,000 Btu/h	40,400 Btu/h	\$1,550
Monitor 422	Kerosene	22,000 Btu/h	20,400 Btu/h	\$1,150
Monitor GF500	Natural gas / Propane	38,000 Btu/h	30,700 Btu/h	\$1,400
Monitor GF200	Natural gas / Propane	20,000 Btu/h	16,000 Btu/h	\$1,100
Rinnai RHFE-1004	Natural gas / Propane	38,400 Btu/h	30,720 Btu/h	\$2,175
Rinnai RHFE-556	Natural gas / Propane	21,500 Btu/h	17,420 Btu/h	\$1,765
Rinnai RHFE-431	Natural gas / Propane	16,700 Btu/h	13,400 Btu/h	\$1,678
Empire DV-20E	Natural gas / Propane	20,000 Btu/h	16,300 Btu/h	\$1,352
Empire DV-40E	Natural gas / Propane	40,000 Btu/h	32,600 Btu/h	\$1,716
Empire DV-550E	Natural gas / Propane	55,000 Btu/h	44,835 Btu/h	\$1,976

Note: Contractors' prices are generally 20% to 30% off list.

Figure 1. Direct-vent heaters are very compact, making them good choices for small houses without basements or utility rooms.



The two leading Japanese-made gas-fueled heaters sold in the U.S. are Rinnai and Monitor. When Empire Comfort Systems, headquartered in Belleville, Ill., saw Rinnai and Monitor take an increasing share of the market, the company realized that space heaters with power burners were the wave of the future. About two years ago, after briefly marketing a heater made by Mitsubishi, Empire began manufacturing its own power burner space heater, called the E-model.

Choosing the Fuel

In some areas of the country, including northern New England, there has been a sharp increase in the use of kerosene-fueled space heaters. "About 40,000 homes in Maine heat with Monitor heaters," according to Peter LaRose of Nelson and Small, a distributor of direct-vent heaters. There are only two brands of kerosene-fueled direct-vent heaters available in the U.S.: Monitor, which also makes gas-fueled heaters, and the lesser-known Toyotomi.

At first, some potential customers are reluctant to consider kerosene. "Some people, when they hear 'kerosene heater,' they go brain dead on you," says Bob Jobin, a Monitor installer from Manchester, Conn. "All they can think of is a smelly, smoky heater that can tip over. We have to explain that these are fuel-injected, sealed-combustion heaters." Once they see the equipment and understand the lower



Figure 2. The kerosene tank is best located on the north side of a house, where it is shaded from high temperatures. The tank must be installed on either concrete blocks or a slab, depending on local codes. In any case, it must be level (right).

operating cost of kerosene, the skeptics often come around. If operating cost is the most important consideration, then kerosene is the fuel of choice. Kerosene costs less per Btu than natural gas, and much less than propane.

Kerosene has an additional advantage over gas, according to Mark Hellen of Nelson and Small: The exhaust gases escaping from the sidewall vent are less likely to cause siding paint to peel. "Paint peeling is more of a problem with a gas-fired heater than a kerosene heater, because gas contains more moisture than kerosene," he says.

When choosing a fuel, it is important to consider the availability of kerosene (K-1) delivery. If the local fuel supplier delivers kerosene in the same truck used for other fuels, the kerosene can become contaminated with remnants of diesel or heating oil. Contaminated fuel can lead to burner problems, so it's best to find a fuel dealer with a dedicated kerosene truck. The popularity of kerosene as a fuel varies regionally, with the greatest use of kerosene centered in northern New England, the Carolinas, and the Pacific Northwest. Elsewhere, gas space heaters are much more common than kerosene heaters.

The disadvantage of kerosene is that unlike natural gas, it requires a fuel tank — usually a 275-gallon tank. If the tank can't be placed high enough to provide gravity feed to the heater, then there is the added cost of a lift pump. The combined cost can easily add \$1,000 to \$1,500 to the price of installing a direct-vent heater.

Since many customers balk at the expense of a fuel tank, natural gas is often the preferred fuel. If natural gas service is unavailable, propane can make sense, especially for a seasonal home, where the cost of operation is less critical than it would be in a year-round home.

High Efficiency

Direct-vent heaters can be very efficient. Rinnai claims its gas heaters are 81% efficient, while Monitor claims that its kerosene heaters are 88% efficient. Because space heaters have no

heat distribution system besides the fan, there are no efficiency losses from ductwork or pipes.

Some direct-vent heaters, including both Monitor and Rinnai, increase their efficiency with variable-rate burners. Rather than simply cycling on and off, these heaters can cycle down to the optimal burn rate to match the demand. For example, the Monitor burner has four different burn ranges, with the lowest range producing about 40% of the Btus of the highest range.

Installing a Direct-Vent Unit

As the photos show, most installations are fairly simple, taking two workers about three or four hours, including setting the fuel tank.

Fuel tank location. If the heater burns kerosene, choose a location for the fuel tank that will minimize condensation problems. When a 275-gallon tank is located in direct sunlight, on the south side of a house, wide temperature swings encourage frequent exchanges of the air in the tank. Moisture from that air condenses on cold tank surfaces at night, mixing with the fuel and possibly shutting down the heater. The fuel tank should be shaded from the noon sun, located on the

north side of the house or under a deck (Figure 2). If a tank has condensation problems, one solution is to raise the intake tube on the fuel line at least 2 inches above the bottom of the tank. Any water will then tend to settle to the bottom. Installer Bob Jobin uses a vacuum pump at every service call to suck up the water from the bottom of condensation-prone tanks.

Be sure you install your tank on an appropriate base. In some areas, local



Figure 3. When a direct-vent heater is located under an operable window, the vent pipe termination must be at least 12 inches below the window sill.



Figure 4. A cardboard installation template locates the vent pipe and fuel line holes. Before drilling the 2½-inch hole for the vent pipe, check for wiring, plumbing, and other obstructions by first drilling a small hole. The vent pipe assembly consists of two concentric pipes — a smaller vent pipe inside the larger air intake pipe.

codes permit the installation of a fuel tank on solid concrete blocks. Other jurisdictions require that a fuel tank be installed on a concrete slab. In any case, the tank should be installed level.

In many cases, the tank will be placed as high as possible to allow for gravity feed of the kerosene to the heater. Remember that most codes do not allow tank legs to be any higher

than 12 inches. If the fuel line is short, a gravity-feed fuel tank can be installed, with the bottom of the tank level with the floor of the room where the heater is located. In this case, the tank must be kept at least one-quarter full. If there is a long fuel line, it is better to have the bottom of the tank 16 inches above the floor of the room where the heater is located.



Figure 5. The sidewall vent terminations for the Rinnai and Monitor heaters are made of stainless steel. These fittings are equipped with a rubber boot that can conform to the irregular profiles of a wide variety of siding types, including clapboard. Some installers caulk the joint between the siding and the vent termination boot.



Heater location. In general, a direct-vent heater is installed on an outside wall to simplify venting (Figure 3, previous page). However, using a vent extension kit, the flue pipe (with one or two 90-degree elbows) can be extended up to 13 feet vertically or horizontally. This permits a heater to be installed in a basement, for instance, and vented through the rim joist. Consider the location of the flue pipe termination on the house exterior. It should be at least 24 inches below any overhanging obstruction, and at least 12 inches above grade — even higher in areas with deep snow.

Install the heater in a central location in the space to be heated. Sometimes a heater faces the door of an adjacent room. Since the fan directs air forward, both rooms are then easily heated.

Drilling the wall for the vent pipe. Once a location has been chosen, the next step is to locate the 2½-inch-diameter flue pipe hole. Examine the wall carefully to assess the location of any wiring or plumbing lines. It is best to drill a small diameter hole first, to check for possible obstructions (Figure 4, previous page). The flue pipe hole should tilt slightly toward the exterior, to allow any condensation in the exhaust gas to drain. The standard flue pipe kit is designed for up to an 8½-inch-thick wall, but kits are available for walls up to 20½ inches thick.

If the flue pipe has to go through a concrete wall, the hole can be drilled with a 2½-inch diameter carbide or diamond core bit, which costs about \$300. In most areas, a 2½-inch carbide core bit can be rented for about \$35 a day.

Once the hole is drilled, install the stainless steel flue pipe. The pipe consists of two concentric pipes, with the smaller flue pipe located inside the larger air intake pipe. Because of the cooling effect of the intake air, the pipe assembly can be installed with zero clearance to combustibles. The flue pipe fittings permit some adjustment in the location of the heater. The eccentric connection on the pipe can be rotated, allowing for right-to-left and up-and-down adjustment, up to about 4 inches. This allows the heater to be raised at a



Figure 6. A Firomatic safety valve, which shuts down the flow of fuel in the event of a fire, is installed in the ¾-inch copper fuel line behind the heater. The flexible air intake pipe (foreground, right-hand photo) is installed between the heater and the stainless steel vent pipe assembly.



later date, for the installation of new flooring, for example.

The rubber gasket that fits between the flue pipe flange and the siding is designed to conform to a wide variety of sidings, including clapboards and vinyl. In most cases, this allows the vent termination to be installed directly on the siding without a wood mounting block (Figure 5).

Install the fuel line. The fuel line for a kerosene heater is usually flexible $\frac{3}{8}$ -inch O.D. copper tubing, connected with flare fittings. Some installers use a fuel-approved Teflon paste on the flare fittings to reduce the chance of leaks. Drill a $\frac{7}{16}$ -inch hole for the fuel line in a location that leaves room behind the heater for a Firematic safety valve, which shuts off fuel flow in the case of a fire (Figure 6).

Before attaching the heater to the wall with a clip, a flexible air intake pipe is connected. The air intake pipe in the Monitor is equipped with a damper. If the heater is venting directly through an exterior wall, then this damper is used to cut down the size of the air intake opening from $1\frac{1}{2}$ inch diameter to $\frac{3}{4}$ inch diameter. For long vent pipe runs, the damper is not used.

Fire it up. If you plan ahead, you can schedule the first delivery of kerosene for halfway through the installation — after the fuel tank is installed, but in time to test the heater before you leave.

Cautions

The chief limitation to direct-vent space heaters for home heating is that they do not distribute heat through ductwork. Since the heat is distributed directly by fan, one of these heaters will generally heat the room in which it is located, and any adjacent rooms — as long as the doors are kept open.

Don't oversize. According to Mark Hellen, an engineer at Nelson and Small, a distributor of direct-vent heaters in Portland, Maine, one of the most common errors when installing Monitor heaters is oversizing. An oversized heater is more likely to cycle off, reducing its efficiency. On-off cycles also add thermal stresses to the burner

components, and can cause them to wear out prematurely.

Regular Maintenance Needed

In general, direct-vent space heaters are easily maintained. Most installers recommend a regular servicing at least every two years. At that time, the heater is checked and cleaned. If the heater is kerosene-fueled, the fuel filter should be changed. 

Martin Holladay is an assistant editor at the Journal of Light Construction. Special thanks to Monitor installer Weldon Pyorala for his assistance with this article.

Makers of Direct-Vent Heaters

Heaters with power burners

Empire Comfort Systems, Inc.

918 Freeburg Avenue
Belleville, IL 62222-0529
800/851-3153
www.empirecomfort.com

Monitor Products, Inc.

P.O. Box 3408
Princeton, NJ 08543
800/524-1102
www.monitorproducts.com

Perfection-Schwank

P.O. Box 749
Waynesboro, GA 30830-0749
877/446-3727
www.psheat.com

Rinnai America

1662 Lukken Industrial Drive West
La Grange, GA 30240
800/621-9419
www.rinnaiamerica.com

Toyotomi USA, Inc.

P. O. Box 176
Brookfield, CT 06804-0176
203/775-1909
www.toyotomiusa.com
Manufacturer of Toyostove kerosene heaters

Heaters that do not require electricity

Cozy Heaters

Louisville Tin & Stove Co., Inc.
P.O. Box 2767
Louisville, KY 40201-2767
502/589-5380
www.cozyheaters.com

EcoTherm

Distributed by Controlled Energy Corp.
340 Mad River Park
Waitsfield, VT 05673
800/642-3199
www.cehot.com/aquastar/ecotherm
Manufactured in Argentina by Rheem South America

Orbis Gas Heaters

1500 Airway Circle
New Smyrna Beach FL 32168
800/806-7247
www.orbisheat.com
Manufactured in Argentina