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# Kerosene Heaters

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# Kerosene Heaters

L.R. Piercy, S.S. Holland, E.S. Holmes and D.G. Colliver

Many families are buying supplemental space heating units in an attempt to use heat only where it is needed and thus lower the total heating bill. If you turn down your central heat thermostat and place such a unit in a room where the family spends most of their waking hours, heating bills may be reduced. Such savings appear to be significant, but each family first needs to carefully consider the safety risks and their energy savings potential as well as the lifestyle changes that might be necessary.

Many kerosene heaters have been sold in the United States in the past few years. Their popularity has come as a result of Japanese research and an improved design with burning efficiencies of over 99 percent. Previous kerosene burners had been abandoned because of inefficiencies, odors and safety hazards, but the new unvented Japanese burners currently are being used by the millions in Japan.

In addition to their improved safety and efficiency, another advantage of these new kerosene heaters is that they can be easily moved from one area to another. They also have some serious disadvantages that need to be considered before purchasing one for your home. Disadvantages include: 1) the difficulty and cost of obtaining high quality, 1-K grade kerosene, 2) the inability to control heat output, 3) the inconvenience of fuel handling and wick maintenance, 4) the potential hazard of burns and fires, and 5) the effects upon indoor air quality by venting burner emissions into the room.

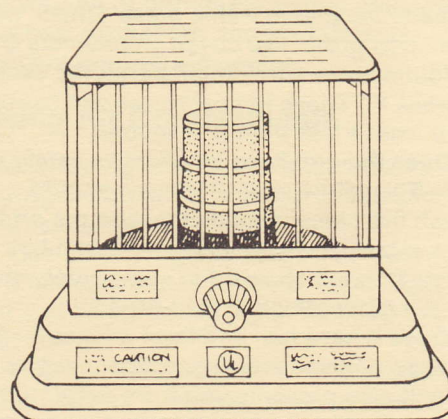
The economics as well as the advantages and disadvantages all need to be carefully evaluated when considering the purchase of a kerosene heater. Safety often has been the subject of greatest discussion and fuel cost savings the area of greatest claims. While many safety improvements have been made, it is wise to remember that safety still depends upon the operator's willingness to observe and practice all safety precautions. Whether you save money on fuel costs will depend on your present heating system and fuel costs, and how well you follow sound energy management practices.

## Purchasing

Your first consideration when selecting a unit should be the heater's suitability for your particular requirements.

1) **Is the unit sized to fit the room to be heated?**—These heaters are constructed for a specific BTU (heat) output and cannot be regulated. One rule of thumb is to select a unit by measuring the square footage of the room and multiplying by 28. As an example, a room 18 feet by 20 feet will need a 10,000 BTU heater (18 feet x 20 feet x 28 = 10,080 BTU).

2) **Is ventilation possible in the space to be heated?**—Manufacturers of unvented heaters specify ventilation of 1 to 4 square inches of opening to fresh air for each 1000 BTU/hour of heater capacity. Cracking a window or leaving doors open to other areas is necessary to accomplish this and can cause serious heat losses. Ventilation is essential as any combustion process consumes oxygen and gives off emissions of carbon dioxide, water vapor, carbon monoxide, nitrogen dioxide and sometimes sulfur



dioxide. A buildup of these undesirable emissions can occur in homes which do not have the necessary ventilation rates.

3) **Is the unit designed for spot heating or uniform heating?**—Kerosene heaters are available in two basic types. The radiant type has polished reflective shields to direct the heat to a specific area for spot heating. The convection heaters release the heat uniformly in all directions. Most of the larger units are the convection type and provide more uniform heating over larger areas. The radiant heaters however release less nitrogen dioxide which is the most critical element in meeting indoor air quality standards.

4) **Is the unit U.L. listed?**—Look for the Underwriters Laboratory (UL) seal on the unit. This certifies that the model has met minimum safety standards which includes such things as warnings and instructions, stability tests, tip-over tests of the flame extinguishing system, maximum surface temperatures and carbon monoxide emissions.

5) **Do local codes and your insurance carrier permit its use?**—Portable heaters are legal for use in Kentucky but may be restricted by some local codes. In addition, the use of kerosene heaters may increase your insurance rates. You should check these out before buying a unit.

6) **Is it of durable construction?**—The durability of any heater can be checked by observation and comparing its materials with other units.

7) **Does it have double walls or protective grills to minimize contact burns?**—Contact burns, especially to children, are a serious concern with any space heater located in traffic areas. Check the unit out for a good protective cover. Consumers Union testing found some surface temperatures exceeding 500 degrees F.<sup>1</sup> These temperatures can cause serious burns in less than one second.

8) **Does the unit have an effective safety shut-off device?**—The safety shut-off device should extinguish the flame immediately and cut off the fuel without a significant spill in case the unit tips over. *Consumer Reports* shows that some safety shut-off devices are more effective than others.<sup>1</sup>

9) **Does it have fuel and level gauges?**—A fuel gauge helps prevent over-filling or any unnecessary refueling. It also prevents you from running the heater dry which can damage cotton type wicks. The level gauge assists in leveling the heater for uniform burning of the wick.

10) **Is it designed to prevent burner flooding?**—Make sure that the fuel tank inlet or wick pan is below the level of the burner unit to prevent flooding.

11) **Is the correct type of kerosene available locally?**—Heaters require a 1-K grade kerosene with less than 0.04 percent sulphur by weight. Few suppliers have this grade and it is often expensive and only available in small containers. You should find a dependable source of 1-K kerosene before purchasing a unit.

## Fuel

Only top quality water clear 1-K kerosene is recommended for use in the heaters. The 1-K grade has a lower sulfur content, less than 0.04 percent by weight, which minimizes the sulfur dioxide emissions from the heaters. The more common 2-K grade kerosene, which may also be water clear, can contain up to 0.30 percent sulfur by weight. This sulfur content would increase the sulfur dioxide emissions by a factor of seven. The higher sulfur content of lower grade fuels can restrict fuel flow. This creates the need for frequent wick cleaning and maintenance. Poor wick maintenance can also lead to increased emissions from the heater.

Always keep burner wicks clean by following the manufacturer's instructions. Never use lower quality fuels such as diesel or No. 1 fuel oil. Using gasoline or other highly flammable fuels can cause serious fire hazards.

Kerosene should be stored in approved metal containers that are clearly marked "Kerosene" and have a distinctive color. Never store it in red containers that could be confused with gasoline or other fuels. Never store it inside the home where it presents a fire hazard to the residents and an added risk to fire fighters. Kerosene should be stored in a cool, well ventilated area to maintain quality. Exposure to direct sunlight or heat can lower the quality of the kerosene and cause yellowing. Avoid using any kerosene stored over the summer or for any long period of time. Also, remember to store it out of the reach of small children.

Kerosene is a Class II combustible liquid, with a flash point of approximately 110 degrees F and an ignition temperature of 410 degrees F, and it must be handled with respect. Since heater surfaces may exceed 500 degrees F, always allow the heaters to cool before refueling. Because of fire hazards, always refuel outside away from hot surfaces and open flames. Refueling indoors creates unnecessary fire hazards, and drips and spills can damage floors and other objects. Using a siphon pump helps reduce spillage during refueling.

## Emissions

Although the combustion process for the new portable kerosene heaters is highly efficient, oxygen

<sup>1</sup>*Consumer Reports*, October 1982.

is consumed and byproducts of combustion are released into the air. The most common are carbon dioxide and water vapors. Other emissions include carbon monoxide, nitrogen dioxide and sulfur dioxide. The health effect of these gases is still a point of controversy. Research has indicated that there is a potential for the level of gases produced by unvented heaters in an enclosed area to exceed the generally accepted indoor air quality standards. Some high risk health groups such as pregnant women, asthmatics, people with heart and lung disease, children and the elderly may be more adversely affected by these gases at much lower concentrations than the general public.

Many older, drafty homes allow air infiltration rates of 2 to 4 air changes per hour or greater. At these infiltration rates, the concentration of these gases is minimal. Newer, more energy efficient homes have an infiltration rate of 1/2 to 3/4 air changes per hour. In these homes, dangerous burner emissions can build up quickly.

**Carbon monoxide** is very dangerous as it is colorless, odorless, non-irritating, hard to detect and toxic. It accumulates in the blood and combines with hemoglobin more than 200 times faster than oxygen. It robs the blood of oxygen and prevents the disposal of waste and carbon dioxide from the blood. Exposure to concentrations as low as 0.05 percent (500 parts per million (ppm) ) for three hours is life-threatening. Exposure to levels of 35 ppm can affect healthy people temporarily by impairing their visual perception and ability to perform tasks. Symptoms in humans include headaches, dizziness, pain and tightening in the chest, blurred vision, nausea and unconsciousness. The group with the highest risk from carbon monoxide exposures are pregnant women, newborn infants and those with heart and lung disease.

Excess **carbon dioxide** is less dangerous but high levels lead to a number of different illnesses including an increased occurrence of headaches, dizziness and nausea.

**Sulfur dioxide** constricts the airways leading to the lungs, making breathing difficult. People with allergies are quite sensitive to sulfur dioxide which may impair their breathing. It poses a special threat to people with asthma and can lead to asthma attacks at concentrations of only 5 ppm.

**Nitrogen dioxide**, along with other nitrogen oxides, can cause unpleasant respiratory effects, such as throat irritation and a feeling of dryness, at low levels. Increased nitrogen dioxide levels can impair breathing. The long-term health effects are not well known but could be cause of concern, especially with children.

Both the Consumer's Union and the Consumer Product Safety Commission have published information concerning emission levels from unvented kerosene heaters. They indicated the pollutant levels created a clear hazard to the high risk health groups and a less certain but possible hazard for healthy individuals. In both cases, the high concentration was based upon continuous operation in a restricted area with low rates of ventilation as might be found in an energy efficient home. The calculated emission rates under these conditions exceeded the generally accepted indoor and outdoor air quality standards. These standards are aimed at providing a safe environment for the entire population, including the high risk health groups. However, with the exception of carbon dioxide, the emission levels did not exceed the maximum levels considered acceptable for an industrial work environment. (Standards for the work environment assume a maximum exposure of 40 hours per week and are not intended to protect the high risk health group.) The sulfur dioxide level would have exceeded the acceptable level for work environment if 2-K grade kerosene had been used.

The effects of kerosene heater emissions are not restricted to humans. High levels of nitrogen dioxide and sulfur dioxide are harmful to pets and can damage plants and furnishings after only a few days of exposure. When both of these gases exist, they can be particularly potent in their effect on fabric dyes.

At least one manufacturer is currently marketing a room kerosene heater with a fresh air intake and outside venting of burner emissions. Because of the use of a heat exchanger, the manufacturer indicates a 90 percent burning efficiency.

## Reducing Air Contaminants

The following are recommendations for minimizing the build-up of these combustion gases from kerosene heaters:

1) Use only 1-K grade kerosene. Never use 2-K or other substitutes which contain higher sulfur content and can produce seven times as much sulfur dioxide.

2) Use the manufacturer's recommended ventilation rate as minimum levels of ventilation. Never use heaters in smaller rooms unless the door is open to adjacent areas and/or a window is opened as specified by the manufacturers.

NOTE—The overall heating efficiency of the heater is lowered as the outside ventilation is increased and can result in heat lost from the home at lower outside temperatures.

3) Use the heaters in large open areas of the home so gases can dissipate over a larger area and natural ventilation through cracks and air leaks can reduce concentrations.

4) Avoid use in highly energy efficient or earth sheltered housing which have very low natural ventilation rates. Only use if outside air is provided.

5) Use the heater sparingly and reduce the length of exposure to emission gases. The longer the heater operates, the greater the output of pollutants and the greater the exposure. The homemaker, pre-school age children or elderly who spend all day in the home may have the longest exposure if heaters are operated all day. Always turn the units off at night.

6) Follow proper maintenance and operating procedures to insure maximum burning efficiency for the unit. Keep the wick clean of carbon deposits and the wick burning height adjusted according to the manufacturers recommendations.

Do not leave the heater burning unattended for extended periods of time. Turn the heater off before leaving the home, going to bed or taking a nap.

## Fire and Contact Burns

Because of potential fire hazards, always maintain a 3-foot clearance between the heater and all flammable materials such as curtains, draperies and chairs. This clearance includes the space above the heater. One exception is with the radiant heaters. Since heat is reflected toward the front, some manufacturers reduce the required clearance behind the heater. Check the instructions for your heater and follow all the manufacturer's recommendations.

Never use the heaters in areas where flammable liquids are stored or being used such as garages or workshops. Never use other flammable materials such as aerosol sprays or lacquers in an area where a heater is in operation. Because of the risk of fire, smoke detectors should be installed in your home and all family members should be aware of the proper escape procedures.

While clearances from combustible materials must be maintained, avoid placing heaters in traffic areas where they could be bumped or knocked over by children, pets or normal activities. Careful

placement of the heaters will also reduce the chance for contact burns which can occur instantly on high temperature surfaces. Children should be warned about the hazards of playing near the heaters, and if small children are present, barricades should be erected to prevent contact.

## Cost Savings

Because it has a high fuel efficiency, the kerosene heater is often considered for its energy saving potential. While savings are possible, they primarily occur when you reduce the thermostat setting for your home's central heating system, and use the heater for supplemental heat in the area of the home being used at the time. (By reducing the thermostat setting on the central heating system 15 degrees F, your central heating systems fuel cost could be reduced by 50 percent.) Your savings will depend upon the efficiency of your home's primary central heating system and fuel prices. Heating systems using resistance electric and fuel oil will provide the greatest potential for savings because of their higher fuel costs. Remember that this approach also requires a commitment to a change in lifestyle.

Other factors that may offset fuel cost savings from kerosene heaters are the relative high price of 1-K grade kerosene and the need for outside ventilation air to reduce the concentration of heater emissions. At the present time, bulk supplies of 1-K grade kerosene are not readily available and the price of smaller packaged containers may be two or more times higher than the price of bulk supplies of lower grade kerosene fuels. Such prices eliminate any potential for fuel cost savings.

The net efficiency of the kerosene heaters is also reduced when sufficient outside ventilation is provided to meet indoor air quality standards. While outside ventilation is recommended and essential, this cooler air must be heated to room temperature. As the outdoor temperature drops, the heater's efficiency also drops because it takes more of the heater's energy to heat the incoming outside air. At cold temperatures, more energy may be required to heat the necessary ventilation air than the unit can produce. In these cases, the heater actually has a negative efficiency.

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