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Space Heaters: Safe or Unsafe?

This NebGuide discusses safety problems associated with using space heaters, and provides precautions for use and recommendations on what to look for when purchasing one.

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Space heaters or portable heaters--no matter what they are called--must be used correctly to avoid personal injury. Anyone using these heating devices should know about their wide range of safety problems.

Background

The wick type heater has been used extensively for supplemental heat. Not until the advent of central, vented furnace heating systems in the early 1950s did it really go out of favor. Shortly thereafter, a new type of portable fuel-burning supplemental heater came on the market. This was the fuel oil or kerosene burning space heater, sometimes referred to as the "salamander." This style heater, patterned after the oil burning furnace, caused problems such as fires and the suffocation of people and livestock. Gases and moisture from these unvented heaters were discharged to the interior building atmosphere and not up a chimney as with a home fuel oil furnace.

Electric space heaters have been used for many years. In numerous instances, such units were responsible for electrocutions, clothing fires and fires in parts of homes where the heater malfunctioned, combustible products got too hot, or improperly installed and overloaded electrical wiring overheated. There are now arguments concerning the high temperature quartz type electric heater and regular electric elements as to which is better.

Solid fuel auxiliary heating units also have caused problems, typically where charcoal was burned in a grill or hibachi. Carbon monoxide given off by the burning charcoal caused unsuspecting humans or animals to collapse when the oxygen content got too low.

The catalytic space heater has caused problems, too--especially for campers. The manufacturers list the units as being clean burning. However, when the oxygen in a tightly closed camper is consumed, the occupants die from oxygen starvation and/or carbon monoxide poisoning.

Present Day Space Heaters

Most people who buy kerosene heaters do not have safety as a primary concern. They are looking at the perceived and claimed economics as a way to hopefully save fuel and money on the heating system built into their home. They should, however, use a safety checklist before making an investment.

One major safety question is, how dangerous are they in a home? Shortly after the craze began in 1979, the number of people hospitalized because of kerosene heater accidents increased four times over the previous year. According to the National Fire Protection Association (NFPA), most of the 2,400 injuries involved children who drank the kerosene or inhaled the fumes. Keep in mind that youngsters may be more vulnerable than adults to problems inherent with unvented heaters since they are usually kept in the house during cold weather, whereas adults have an opportunity to get out into the open air. Also, the tolerance level for air-borne contaminants often is lower for children than adults. Caution is required with elderly persons for the same reasons.

Another hazard is the reduction in air quality. One form is the lowering of the amount of oxygen in the air. Gases from kerosene, fuel oil or natural gas, if not properly vented, can cause headaches and irritate chronic respiratory ailments. Carbon monoxide is more readily attached to the hemoglobin of the blood than oxygen. Hence, carbon monoxide reduces the blood's ability to transport life-giving oxygen to the body's cells. A person who inhales carbon monoxide will not likely recover immediately when moved to good air. It may still be a long time (frequently 24 to 48 hours) before the carbon monoxide is completely removed from the blood.

There is also the threat of burns. Kerosene heaters have an open flame. A fire can occur if fuel is spilled. Also, flammable vapors of many types from many sources can occur within a home or building. Few people realize the vapors from tile cement can be very explosive. It is not inconceivable for someone to use a space heater where tile cement is being put down or lacquers are being applied. Other sources include cleaning agents, adhesives, and some aerosol products. Any product using a solvent other than water is a potential source of fire or an explosion. There are other fire hazards, such as curtains, paper, carpets or anything in the home that is combustible.

Carbon monoxide poisoning deserves the most attention. Carbon monoxide is referred to as the silent killer. People overcome by carbon monoxide usually have no warning. Some may notice a slight tightness in the chest, but this may not be a major factor since the brain is being dulled by the absence of oxygen-rich blood and the warning is easily ignored or misunderstood. The typical signs and reactions of acute carbon monoxide poisoning are headache, dizziness, drowsiness, nausea, vomiting, collapse, coma and death. Initially, the victim is pale; later the skin and mucous membranes become a cherry red color (this is most noticeable on light-skinned people). Loss of consciousness occurs at about 50 percent carboxyhemoglobin level. The precise moment depends on the duration of the exposure, ambient temperature, and the health and metabolism of the individual. Recovery is usually without permanent damage unless tissue hypoxia was severe enough to result in brain degeneration. Use of barbiturates and alcohol increases susceptibility and the possibility of harm.

Some kerosene heater manufacturers claim 100 percent fuel combustion efficiency. This is inaccurate. Chemically, 94 percent combustion is the best that can be obtained. From the standpoint of all the heat released by the combustion process staying in a room, this "100 percent efficiency" could be true since gases are not vented to the outside. However, as the space heater operates, oxygen in the room is used, causing the combustion efficiency to become even less. As the combustion efficiency decreases, the contamination of the atmosphere increases.

The chemical reaction of the combustion process produces water vapor. For kerosene, the water vapor produced is just over one gallon of water (if condensation occurs) per gallon of kerosene burned. The heat energy contained in the water vapor is not recoverable unless the water condenses. Thus, water vapor buildup in the enclosed home can create problems with condensation, molds and mildew. And, if the relative humidity rises above 50 percent, the air temperature required to achieve equal comfort also will increase, requiring the use of more fuel.

Weatherization of modern homes presents a ventilation problem that homes in the first half of the century did not have. In those homes, it was not uncommon to see a curtain moving on a windy day. This meant that air in the home was being replaced by outside air. In the newer homes, especially electric, underground and "super insulated" homes, construction and tightness limit air infiltration. Further, in electrically heated homes there is no chimney to exhaust air. In these types of homes, windows must be opened a little for ventilation or a ventilation system must be built in during construction. The "rule of thumb" for ventilation is 1 square inch of air inlet for each 1,000 Btu per hour of heater output. This may not seem like a lot, but engineers have calculated that this size of opening can lose up to 12,000 Btu of heat per hour_almost the same amount of heat provided by the heater. There also is evidence that a space heater can compound an air quality problem in homes with a gas-fired range, refrigerator, dryer, water heater or furnace. Gases such as nitrogen dioxide, carbon monoxide, carbon dioxide and sulfur dioxide can accumulate at increased rates.

Fuel Quality

Fuel quality is a major problem with the kerosene heater. Pure or "water clear," "water white" or "lighting grade" kerosene is recommended as the ultimate in fuel use. Many problems occur when diesel fuel, furnace fuel and even gasoline are used in the heaters. Kerosene is a complex fuel classified as a light to middle distillate. Although jet fuel, diesel fuel and Number 1 fuel oil are similar to pure kerosene, they are not as pure and are not appropriate for use in kerosene heaters as a way to save kerosene or money.

Some people buy reasonably good fuel, but store it in contaminated containers. Contaminants from an impure product can cause the wick to gum or soot up with deposits. This can cause smoking and incomplete or improper combustion.

Shop around for a good source of high quality kerosene. Don't use furnace, diesel or jet fuel. **On threat of death by explosion, NEVER use any type of gasoline!**

Energy Content and Cost

The energy content of kerosene typically ranges between 120,000 and 130,000 Btu per gallon. This is slightly less than fuel oil, which has approximately 140,000 Btu per gallon.

Compare fuels on the basis of cost per unit of usable heat. For example, if we assume 94 percent combustion efficiency and an average heat energy content of 125,000 Btu per gallon, each gallon of

kerosene provides 0.94 x 125,000 or 117,500 Btu of "usable" heat energy--assuming all the water vapor condenses to release the latent heat. (Note: If the water vapor does not condense, the usable heat is 9,500 Btu lower). Thus, 100,000 Btu of "usable" heat requires 100,000 ÷ 117,500, or 0.85 gallon of kerosene. The amounts of other fuels needed to provide 100,000 Btu of usable (no energy tied up in water vapor) heat are shown in *Table I.*

Table I. Units of fuels per 100,000 Btu.		
Fuel	*Unit*	*Units per 100,000 Btu of usable heat*
Fuel Oil	gallon	1.21
Propane	gallon	1.57
Natural Gas	100s of cu. ft.	1.40
Electricity	kWh	29.31

Using natural gas at 60¢ per 100 cu. ft. as a base, 100,000 Btu of usable heat would cost 1.40 x $0.60 = $0.84. The maximum price we could pay for other fuels and still have the same out-of-pocket costs for fuel are given in *Table II.*

Table II.		
Fuel	*Unit*	*Maximum Price per Unit*
Fuel Oil	gallon	$0.69
Propane	gallon	0.54
Electricity	kWh	0.029
Kerosene	gallon	0.99

The Future

Our energy problem is not going to go away. Consequently, people are going to continue looking for ways to cut their fuel bills.

Consider the electric space heater. The cost of electricity is coming in line with the other fuels. If projections hold, the electric space heater may be more cost-effective. And, electricity does not rob the oxygen from the home interior like fossil fuels do when they burn.

There is also a move by the LP Gas industry to introduce the cabinet heater into the United States market. At present, there are a few items in the NFPA codes that hamper their use. The LP Gas units will likely be on the market in the near future, however.

If you plan to buy a kerosene heater, set up a checklist to go by. Can you and your family live by the safety requirements it takes to own and safely operate one? In all cases, be sure to budget a good ion exchange or photo electric cell smoke detector in your plans.

Space Heater Shopping Checklist

- The heater design does not allow flooding of the burner. Models with a wick fulfill this requirement. The fuel tank should be *below* the ignition point.
- What happens if the heater is jarred or tips over? Is there suitable safety shut off that puts the flame out if the heater is tipped?

- Does the heater have a low center of gravity--is it very stable (not "top heavy")?
- Check for durability. Is it constructed of reasonably heavy materials?
- Does it have a fuel gauge so the tank capacity can be easily monitored?
- Check for push button lighting, especially on newer models. This does away with match problems.
- Make sure there is no detectable odor or smoke as the unit operates.
- Have the dealer demonstrate lighting, operating, securing and maintenance procedures. How often should the unit be serviced by a trained repairman?
- Make sure it is tested by an approved testing laboratory such as Underwriters Laboratory. The seal of the testing laboratory should be affixed to the heater.
- Check the ratings. Estimate your Btu requirements by taking the square feet of floor area to be heated times 28. (A 20 x 20 ft. room = 400 sq. ft. x 28 or 11,200 Btu/hr.)
- Check local codes.

Safety Rules for Space Heater Use

1. Read and follow the directions in the instruction booklet.	8. Keep the heater out of traveled areas so that pets or humans do not bump it while walking by.
2. Use only pure kerosene. *NEVER* substitute diesel, jet, furnace fuel, gasoline, or any type of yellow kerosene.	9. Clean and maintain the heater. If it is smoking or not working properly, have it repaired.
3. Install either an ion or photo electric smoke detector.	10. Don't use flammable liquids or vapors near the heater. Tile cement, aerosols, lacquers and flammable liquids all can be ignited easily by the flame.
4. Use the heater only during waking hours. Don't use it overnight or at any time while sleeping.	11. When extinguishing the flame, cut down on the amount of unburned hydrocarbons in the home by moving the heater outside.
5. Open a window approximately 1 sq. inch for each 1,000 Btu capacity. On a 30" window, a 1/32" crack provides an opening of about 1 sq. in.	12. Store kerosene in a clean container outside of the house, preferably in a shed. Don't completely fill the tank with cool fuel since it will expand when it gets into the warmth of a home, resulting in an overflow of fuel.
6. Always refuel out of doors with unit off. Wipe up any spills. A spill can be a slipping hazard, or a single spark could start a fire.	13. Don't let children operate or refuel the heater. Limit servicing of the unit to adults who are familiar with proper operating and safety procedures.
7. Place the heater away from combustible materials.	

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