Investigation Guideline

Appendix 120
December 1999 (Revised October 2000)

Fixed-Position Electric Heaters (excl. Central Heating)

I. Introduction

A. Background Information

Fixed-position electric heaters consist of a variety of sizes and shapes and are "hard-wired" directly to a building's circuitry. They differ most conspicuously from portable electric heaters in that they have **no cord or plug connection**. They can be installed in the ceiling, wall, or floor of a room, and may be flush with or protruding from these surfaces. These heaters may be used by consumers to provide supplemental heating in addition to a central heating system, or they may serve as the only source of heat. As permanently mounted fixtures, these heaters are often energized continuously for long periods of time, and are frequently unattended.

Data collected by CPSC staff over the 1999 / 2000 heating season indicate that this type of space or room heating is most commonly found in regions where winters are generally mild and electricity is relatively inexpensive. A majority of the investigations involved apartment and other multiple-residence structures. Virtually all heaters were not installed by consumers but by builders or electrical or heating professionals. In about half of the investigated incidents, a failure was observed by the consumer. Failures included melted or broken heating elements, stalled or improperly fitted fans, damaged thermal limit switches, and degraded electrical connections. In the remaining incidents, heaters ignited nearby combustibles such as clothing, towels (on racks), mattresses, bedding, furniture, or paper.

In 1997, fixed-position electric heaters were associated with about 2,000 non-arson fires attended by fire departments, 10 deaths, 60 injuries, and about $21 million dollars in property loss (*1997 Residential Fire Loss Estimates*). Recent compliance activities related to these products have heightened staff awareness of the potential safety hazards in some of the basic heater designs. There are currently two Underwriters Laboratories (UL) voluntary standards that apply to fixed-position electric heaters: *Electric Baseboard Heating Equipment* (UL1042) and *Fixed and Location-Dedicated Electric Room Heaters* (applies to all fixed heaters other than baseboard) (UL2021). Numerous variations of design can be used to manufacture heaters in conformance with these standards.

Any samples and photos collected, along with these investigative reports, will serve as the primary source of data upon which staff will assess the adequacy of the current voluntary standards.

B. Product Description

Fixed-position electric heaters are often referred to by their type of installation, for example, baseboard heater or in-wall heater. Although these heaters are not central heating units, they may occasionally be referred to as "wall furnaces". Fixed-position electric heaters for residences are currently permitted by the voluntary standards to be rated at up to 6 kilowatts and up to 250 volts. Control devices such as the on/off switch or thermostat can be found on the heater's faceplate or at a location distant from the heater.

There are three basic designs for fixed-position electric heaters: radiant, forced-air, and convection.

Radiant – These heaters use glowing red metal wires (sheathed or unsheathed) and reflectors to direct infrared energy into the room. Radiant heat is primarily absorbed by objects directly in front of the heater (not by the surrounding air) and so is most efficient for heating small spaces, such as a bathroom. The reflective surface behind the heating element works to direct more of the infrared radiation into the room, instead of back into the mounting surface. Radiant heaters tend to have tightly woven mesh faceplates rather than louvered grills to maximize the amount of infrared energy transmitted.

Forced-air – Any fixed-position electric heater having a fan or blower has a forced-air design. The fan directs air across the metal wire heating element (sheathed or unsheathed) and into the room. The heating elements for forced-air designs usually operate at a much lower temperature than those in radiant heaters because the air movement reduces the element temperature. Therefore, the element should appear dark under normal operating conditions, as opposed to glowing red. These designs have louvered faceplates to direct the forced airflow.

Convection – Convection heaters use input power to heat an element with a large surface area, then depend on natural convection to distribute the warmed air into the room. Fixed-position electric heaters with convection designs do not have fans. Virtually all fixed-position convection heaters have finned metal heating elements. Baseboard heaters are a primary example of a convection heater.

The different types of heating elements are long metal wires (sheathed or unsheathed); coiled metal wires; metal fins; and quartz tubes. Long metal wire elements may or may not be sheathed in a metal tube or casing. In radiant heaters only, heating elements are hot enough to appear glowing red. The average lifetime of a fixed-position electric heater is estimated at 10 years, though CPSC investigations have revealed that these heaters, especially baseboard designs, are sometimes used for up to twice as long. The prices of fixed-position electric heaters vary from under $50 for small wattage units to a few hundred dollars for long baseboard heaters.

Fixed-position electric heaters may be mounted in the ceiling, wall, or floor of a room. Some examples are listed below: (See Appendix for pictures)

Fixed-Position Heater Type	Characteristics
Wall Heater	Usually radiant or forced-air design; heating element may be glowing metal wire (radiant), non-glowing wire, or finned. (10% of fixed heater sales)
Floor Insert Heater	Usually convection airflow with finned heating element.
Baseboard	Usually convection airflow w/ finned heating element; length-to-height ratio is about 3-to-1. (80% of fixed heater sales)
Kickspace Heater	Variant of wall heater, sized to fit in cabinet "kickspace" (between bottom edge of cabinet door and the floor).
Ceiling Heater Unit	Usually raidant or forced-air design; heating element may be glowing metal wire (radiant) or non-glowing wire; often integrated with a lamp and/or fan.

Note: The faceplates or grills may look like exit ducts of a central heating system. However, unlike central heating systems, there may be heating elements with temperatures of several hundred degrees Celsius located directly behind these faceplates. Similarly, there are portable heaters that resemble and are advertised as baseboard heaters. However, for these investigations, we are only interested in fixed-position baseboard heaters.

C. Specific Items of Interest

- CPSC staff are interested in learning about how fixed-position electric heaters contributed to the ignition of a fire in each incident. What conditions were present leading up to the incident, and what was the result (fire inside heater, surface of heater igniting items placed against it, etc.)?

- Describe the heating element of the heater as fully as possible. If the heating element was sheathed, we would like to know since current UL standards do not require sheathed heating elements to endure the same rigorous tests as unsheathed elements.

- If the heater was a baseboard design, describe the location of the point of ignition (if fire) or internal failure. An ignition point or failure in the middle of a baseboard heater indicates a possible problem with the heating element, whereas electrical connection problems are more likely to occur at one end.

- Look for and report any effects of aging, especially the extent to which debris and dust cover the heater's faceplate and heating element (if observable). If heaters similar to the product involved in the incident exist in other rooms of the house, observe them also and report on any build-up and on their general condition.

- Describe the room where the heater was located. Was the heater in contact with anything such as furniture, drapes, carpeting, or stored items for long periods of time?

- If a fire incident report is available from the fire department, determine what was reported as the *type of material first ignited* and the *form of material first ignited*. Describe the arrangement of the ignited material relative to the heater; for example, newspapers wedged underneath the entire length of a baseboard heater, towel hanging from a rack 12" above a wall heater, etc.

- Try to find out whether the ignited material was actually touching the heater, as this may indicate how the fire started. (If there was any distance between the ignited material and the heater, a spark or flame from within the heater may have escaped, indicating an internal failure.)

- Describe what event(s) alerted the victim/consumer to the situation, such as a smoke detector, smoke, flames, odors, sparks, burning smell, excessive heat from the product, an unusual noise, reaction of pet, etc. Had the consumer noticed previous problems with the heater?

- Describe how the consumer reacted once he/she was alerted to the incident; for example, turned thermostat to lowest setting, turned control to OFF position, disconnected power at circuit breaker, etc.

- Did the consumer receive verbal or written instructions for cleaning the heater? How often was cleaning recommended? How often was cleaning performed, if at all? Who performed the cleaning?

D. Headquarters Contacts

Randy Butturini, ESEE – 301-504-0508 x1416
Dean LaRue, ESEE – 301-504-0494 x1317
Bill King, ESEE – 301-504-0508 x1296

II. Instructions for Collecting Specific Information

A. Free Text Summary

Please provide a summary of the sequence of events that occurred prior to, during, and subsequent to the incident using the format prescribed in the *Field Manual for Investigation Procedures and Reporting Techniques* (2/00) [Chapter 7 (p.48)]. Be sure to assign one of the Product Codes as **312-Electric baseboard heaters** or **388-Electric heaters, not elsewhere classified**, as appropriate.

B. Description of the Incident Environment

- Was the heater installed with the original construction of the room, or was it added later? Describe when and by whom the heater was installed. Obtain any installation and care instructions, if possible. If the residence is a rental unit, contact the landlord or maintenance staff to try to obtain this information.

- Describe any property damage, including the degree to which the fire spread (e.g., heater only, small area surrounding heater, room, floor of house, entire structure, etc.). If possible, obtain the dollar amount of property loss from official reports.

- Describe the intended purpose of the heater, such as if it was the only heat source or a supplemental heat source for the room in which it was used. Determine how often the heater was used, and for what typical lengths of time. How long was the heater in use prior to the incident? If possible, determine the typical control settings (e.g., thermostat, fan setting) used for the heater, and record the settings at the time of the incident.

- Indicate the experience or knowledge the victim/consumer had of the product, (e.g., whether instructions or operating manual had been read, understood, kept). Determine whether any maintenance, such as cleaning or vacuuming the accumulated dust on the heating element had been performed, when it was last performed, and by whom. Describe the cleaning procedure used.

- Determine if there was a smoke detector in the home. If so, give the distance between the point of ignition and the nearest detector. If a detector was present but did not sound an alarm, determine if it had been disabled in any way (e.g., batteries removed) or if the consumer was aware of any reason why the detector would not function properly.

- Determine whether the branch circuit was Ground Fault Circuit Interrupter protected (GFCI breaker). If so, indicate the electrical capacity of the GFCI and whether it operated to turn off the current during the incident.

- Describe the overcurrent protection device (e.g., fuse, circuit breaker) and its electrical capacity. Determine whether this device turned off the current during the incident.

C. Description of Injured Persons

- Describe any deaths or injuries sustained, and provide the age and sex of all victims. For all injuries, determine the type and length of medical treatment and any residual health effects and medical follow-up needed.

- Describe any pre-existing health conditions or immobility conditions of the victims that may have impaired their ability to evacuate the fire scene.

- Try to determine the level to which the consumer perceived any hazards associated with the product.

D. Description of Product

- Provide the manufacturer, brand name, model and serial numbers, and age of the heater.

- Describe the product characteristics (e.g., type, size, dimensions, BTU rating, volts, amps, watts). If this information is not listed on the exterior of the heater, then check the owner's manual, if possible. Describe the presence of any indicator lights and their function(s).

- Describe heater type (e.g., wall-mounted, baseboard, kickspace, floor insert, ceiling, etc.), design (forced-air, radiant, or convection), and heating element, if possible. Is the faceplate of the heater flush with, or protruding from, the mounting surface?

- Describe the types of heater controls (thermostat, on/off switch, fan controls, etc.), and list all control settings. Does the heat control have an "off" position?

- Indicate if the heater controls are found on the unit. If so, give the location on the faceplate (top, bottom, left side, right side). If controls are not on the unit, then give the distance between the location of the controls/thermostat and where the heater is mounted.

- Indicate product history (e.g., previous problems, defects, malfunctions, maintenance repairs, etc.). If the heater was repaired, include the dates and who performed the repairs (factory service personnel, other repair personnel, consumer, etc.). For all repairs, including any performed on the unit after the incident, obtain repair records if possible.

- Describe the disposition of the product, including whether the it was examined, repaired, and/or discarded after the incident. If possible, talk to the person who performed the repairs to determine what caused the incident. If fire officials, arson investigators, or other parties examined the heater, collect their documentation or interview them to get their opinion as to what caused the incident.

E. Product Safety Standards

- Describe any safety certification labels, such as UL. Describe any safety features the product has (e.g., warning light, audible alarm).

- Provide wording of any warning labels or other information visible on the heater, using photographs if necessary.

III. Photographs of Incident Scene

- Include photographs of the products involved in the investigation report. **If possible**, go on-site to photograph the fire scene or obtain photos from the fire department or insurance agent.

- Photograph location of the heater to illustrate the surrounding area. If the heater is still mounted in its original position, photograph the heater to illustrate clearances to the adjacent walls, ceiling, and floor as applicable (e.g., distances to walls on both sides of a kickspace heater; distances to ceiling, floor, and walls on both sides of wall heater).

- Photograph close-up views of the heater involved in incident and fire damaged components mentioned in any fire report. Also photograph any safety markings still visible.

IV. Instruction for Obtaining Samples and Documents Related to the Investigation

- Obtain copies of official reports including fire incident and investigation, police, emergency response, medical records, and coroner's reports. If applicable, collect insurance incident, casualty, and investigation reports. Obtain reports concerning any testing or analysis performed on the product as a result of the incident, or indicate if any analysis is planned (e.g., for an insurance claim).

- Also obtain the instruction manual for the heater, service/repair orders, and copies of relevant correspondence between the consumer and manufacturer.

- **Collect all samples of fixed-position electric heaters, including any mounting enclosure**. You do not need to collect the thermostat if it is remote from the heater. If the fire department removed the product, request to obtain it once they have concluded their investigation. **Send heater samples to the sample custodian at the CSPC warehouse and notify Randy Butturini in Engineering Sciences at** rbutturini@cpsc.gov **or 301- 504-0508 x1416**.

See the APPENDIX (p. 13) following the data record sheet for examples of fixed-position electric heaters.

Data Record Sheet (rev. 10/00) for Fixed-Position Electric Heaters

Complete this data record sheet and attach it to the Epidemiologic Investigation Report Form 182. Unless otherwise specified, check only one response under each item.

1. **Task #:**_____
2. Type of heater installation
   _____ In-wall
   _____ Baseboard
   _____ Floor
   _____ Kickspace (at floor level, under cabinet)
   _____ Ceiling
   _____ Cabinet
   _____ Other, specify_____
   _____ Unknown
3. If in-wall heater, describe the wall where heater is installed
   ____ Not applicable
   ____ Exterior wall (i.e., other side of wall is outdoors)
   ____ Interior wall (i.e., other side of wall is indoors)
   ____ Other, specify _____
   ____ Unknown
4. Position of heater relative to mounting surface
   ____ Protruding
   ____ Flush
   ____ Unknown
5. Type of heater design
   ____ Convection (no fan)
   ____ Forced-air (fan)
   ____ Radiant (no fan)
   ____ Other, specify_____
   ____ Unknown
6. Type of heating element
   ____ Glowing red metal wire (radiant heaters only)
   ____ Dark, non-glowing metal wire
   ____ Metal fins **– Skip to Question 8**
   ____ Quartz tube (heating element contained inside a glass enclosure; found only in radiant heaters) **– Skip to Question 8**
   ____ Other, specify_____
   ____ Unknown

(continued next page)

7. Was heating element sheathed?
   ____ Yes
   ____ No
   ____ Unknown
8. Age of heater
   Number of years_____
   Consumer does not know exact age, but heater has been installed for about
   ____ years.
   ____ Unknown
9. Type of dwelling
   ____ Detached (separate) house
   ____ Attached house (e.g., townhouse, duplex)
   ____ Apartment building or condominium
   ____ Manufactured home
   ____ Mobile home
   ____ Other, specify_____
   ____ Unknown
10. Person who installed heater
    ____ Building contractor
    ____ Heating/electrical contractor hired by consumer
    ____ Consumer
    ____ Other, specify_____
    ____ Unknown
11. Electrical rating of heater
    Volts_____
    Amps_____
    Watts_____
    ____ Unknown
12. Dimensions of heater
    Length_____in.
    Width_____in.
    Depth_____in.
    ____ Unknown
13. Intended purpose of heater for the room in which it was used
    ____ Sole source of heat
    Supplemental heat
    ____ Unknown
14. Heater Controls (circle one response for each feature)

a)	Controls located on heater	Y ☐	N ☐	Unk ☐
b)	Heat control has an "off" setting	Y ☐	N ☐	Unk ☐
c)	On/Off switch separate from other controls	Y ☐	N ☐	Unk ☐

(continued next page)

d) Warning light ☐ Y ☐ N ☐ Unk

e) Adjustable thermostat ☐ Y ☐ N ☐ Unk

List all thermostat settings _____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____

Thermostat setting at time of incident_____

f) Fan speed control ☐ Y ☐ N ☐ Unk

Fan setting at time of incident_____

15. Length of time heater was in use prior to incident

____ More than 24 hours continuously
____ Between 6 and 24 hours
____ Between 1 and 6 hours
____ Less than 1 hour
____ Unknown

16. Frequency with which the heating element was cleaned prior to incident

____ Never
____ Not since beginning of consumer use
____ Less than once a year
____ About once a year
____ More than once a year
____ Unknown

17. Heater problems observed during the investigated incident **(check all that apply)**

____ Overheating/smoke confined to heater (no sparks or flame)
____ Heat damage to contacted or nearby objects/structures – no sparks or flames (e.g., scorch marks on items)
____ Fire / flames confined to heater
____ Emission of sparks or hot components
____ Fire / flames spread beyond heater
____ Rapid cycling of thermostat (i.e., clicking noise)
____ "Popping" noises
____ Blown fuses Voltage _____ Amps _____
____ Tripped circuit breakers / GFCI Voltage _____ Amps _____
____ Other, specify_____
____ None
____ Unknown

18. Historical heater problems observed separate from and not including the investigated incident **(check all that apply)**

____ Overheating/smoke confined to heater (no sparks or flame)
____ Heat damage to contacted or nearby objects/structures – no sparks or flames (e.g., scorch marks on items)
____ Fire / flames confined to heater
____ Emission of sparks or hot components

(continued next page)

____ Fire / flames spread beyond heater
____ Rapid cycling of thermostat (i.e., clicking noise)
____ "Popping" noises
____ Blown fuses Voltage _____ Amps _____
____ Tripped circuit breakers / GFCI Voltage _____ Amps _____
____ Other, specify_____
____ None
____ Unknown

19. First material ignited
____ Not applicable
____ Carpet/Flooring
____ Wall/Wall-covering
____ Drapes
____ Furniture
____ Clothing
____ Bedding
____ Fire limited to heater only
____ Other, specify_____
____ Unknown

20. Type of carpet / flooring, if carpet / flooring was first material ignited
____ Not applicable
____ High pile carpet
____ Low pile carpet
____ Vinyl or linoleum flooring
____ Wood flooring
____ Other, specify_____
____ Unknown

21. If incident involved a baseboard heater, where along the length of the heater was the point of ignition or failure?
_____ Not applicable
_____ At or near the center
_____ At or near one end
_____ Unknown

22. If a heater similar to the one involved in the incident is present, what is the appearance of its faceplate?
____ Not applicable
____ Clean
____ Dusty (no clogging observed)
____ Clogged (clogging observed)
____ Unknown

END of data record sheet

APPENDIX

Some examples of fixed-position heaters are pictured below:

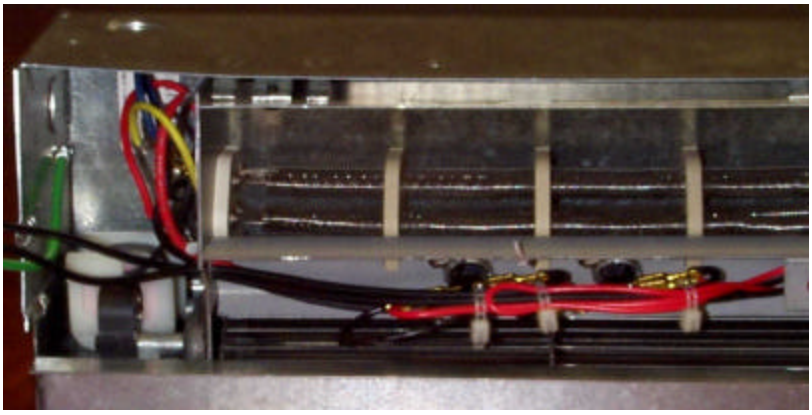
Baseboard, convection type heater

Baseboard heater with faceplate removed, exposing non-glowing, finned metal heating element

Close-up of baseboard heater control knob

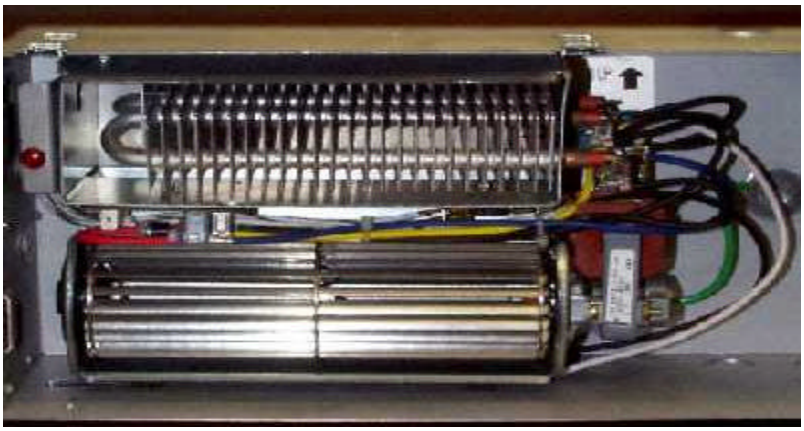
In-wall forced-air type heater

Above heater with faceplate removed, exposing non-glowing, sheathed metal wire heating element and blower



Wall insert forced-air type heater with controls on faceplate

Above heater with faceplate removed, exposing non-glowing, finned metal heating element and blower



Kickspace heater

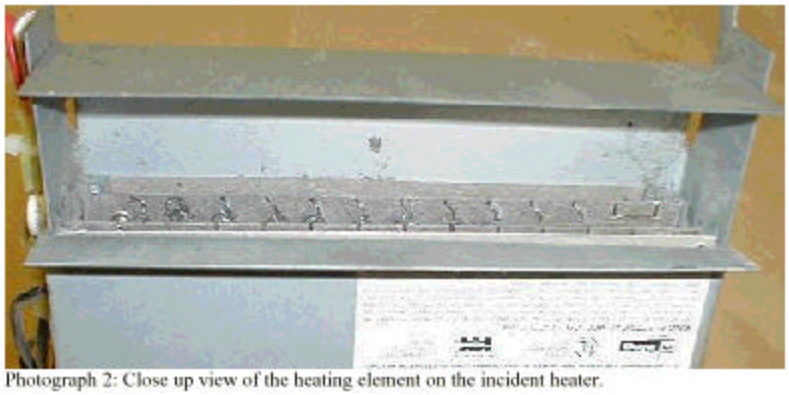
Ceiling radiant type heater

Floor insert heater

In-wall forced-air heater with faceplate removed

Photograph 1: Photograph shows a front view of the electric forced air heater involved in this IDI.

Close-up of non-glowing, unsheathed metal wire heating element in the above heater



Photograph 2: Close up view of the heating element on the incident heater.

In-wall radiant heater with glowing red, sheathed, metal wire heating element