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Appliance Fires: Determining Responsibility

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The determination of an electrical appliance as the cause of a fire is a serious judgment call which requires skill and care on the part of the fire scene investigator, and ultimate confirmation by a qualified electrical engineer. The correct selection of a suspect appliance, however, can be done using a few simple rules regarding the behavior of fires and electricity.

First and foremost, the appliance must be present at or near the origin of the fire. No amount of electrical engineering fault analysis can make up for the lack of this critical piece of evidence. Once this determination has been made, it is frequently possible for the field investigator to evaluate the appliance for evidence of electrical malfunction, eventhough the investigator may not be an electrical engineer.

An energized electrical circuit has the capability of recording the progress of a fire over time. When insulation is burned off an energized cable, and one conductor then touches another conductor or a ground, arcing can occur. This sometimes causes the activation (fusing or tripping) of an overcurrent protection device, but will almost always cause current downstream of the arc to cease flowing. Thus, it is possible to observe two short circuits, one on a power cord plugged into a wall receptacle and the other on a branch circuit supplying that receptacle, and state with almost absolute certainty that the short circuit on the power cord occurred first.

Using the same logic, arcing between service entrance cables and the distribution panel box can be determined to be secondary (fire induced) if arcing is present on a branch circuit powered by those cables. As a general rule, it can be stated that downstream arcing occurs first.

In applying this rule to the examination of an electrical appliance, we must look for evidence of arcing *inside the enclosure.* Most electrical appliances are equipped with power cords. When exposed to an advancing fire, the power cord insulation will frequently melt off, usually causing arcing outside the enclosure. If the fire then penetrates to the interior of the appliance, the power has been cut off, and no arcing can occur. On the other hand, when a fire originates within the enclosure of an appliance, the first energized circuits to be exposed will usually be those within the enclosure. Thus, arcing inside the enclosure indicates origin within the enclosure. A more detailed examination of the appliance by an electrical engineer is certainly in order once arcing inside the enclosure has been identified.

This having been said, it is necessary to point out that in reaching the above conclusions, certain assumptions were made, and like every rule or guideline, there are exceptions, and special cases where, as in all fire investigation, certainty is an elusive goal.

First, it is assumed that the field investigator is able to correctly distinguish between fire induced melting and melting caused by electrical activity. There have been numerous papers presented on this subject, but making the distinction still requires skill and experience. Generally, the smaller and more isolated the area of melting, the more likely it is that the melting was electrically induced. Copper is by far the best conductor in terms of exhibiting distinctions between fire induced melting and electrical arcing. As the size of the wire becomes smaller, the danger of confusion increases. Aluminum wiring melts at normal fire temperatures, and it is frequently impossible to find irrefutable evidence of electrical activity unless the wires are very large. Finally, care must be taken to avoid identifying melted solder as melted wire. There is a large amount of low melting point solder in most appliances equipped with printed circuit boards.

Second, it is assumed that the power cord or cable supplying the appliance is going to be exposed to an advancing fire prior to exposure of the internal wiring. This is generally, but not always true. The power cord may be protected by a piece of furniture, or the appliance may be "hard wired" to a branch circuit. In cases such as this, it is necessary to assess the fire resistance of the appliance enclosure. A plywood appliance enclosure will certainly offer less resistance than a metal one.

Finally, the susceptibility of the internal wiring to arcing as a result of exposure to heat must be taken into account. This is especially true of heat producing devices, whose internal insulation may be highly resistant to fire. Such a device can easily overheat, igniting surrounding combustibles, and the first wire to sustain arcing damage would be the external power supply. The result would be an appliance which appeared to be damaged by an advancing fire.

Once the field investigator is satisfied that a particular appliance is the likely cause of the fire, the appliance should be submitted to an electrical engineer for confirmation and determination of the exact nature of the failure. Fire inducing failures may be the result of a design flaw, a manufacturing defect, product misuse or abuse, or improper or inadequate servicing or maintenance. In the failure analysis process, it is frequently necessary to obtain an undamaged exemplar of the appliance in question, along with all of the literature supplied when a new product is purchased. Whenever possible, wiring diagrams and service manuals should also be obtained, as well as service or maintenance records.

The Consumer Products Safety Commission (CPSC) may have records of previous fires caused by the appliance in question. Requests for information from the Commission should be made in writing to:

U.S. Consumer Products Safety Commission
Office of the Secretary
Washington, D.C. 20207
Attention: Freedom of Information Officer.

(Requests should include the following sentence: "This information is being requested under the provisions of the Freedom of Information Act.")

Be prepared to wait for some time before any information comes back to you from the CPSC. Receipt of your request is usually acknowledged within thirty days, but because of the provisions of the Freedom of Information Act, which allow manufacturers to respond to all accusations against their products, and because of the volume of requests, a full report may take two years or more. Also, the CPSC has recently begun charging a fee for searching its files.

Be sure that your request to the CPSC is not unlimited in scope (All XYZ products ever made), but do not be overly limiting (Only XYZ brand left handed widgets model ABC123 manufactured in April of 1980). Neither type of request will yield a useful response. Ask for information regarding all appliances of a certain type (radios, TVs, coffee makers) sold by a particular manufacturer within two or three years before and after the manufacturing date of the appliance you are interested in. The CPSC process is long and frequently frustrating, but it is occasionally useful, and should be done in every case where an appliance is suspected. Occasionally, the investigator will be asked to provide details of the fire in question to the CPSC as part of their effort to keep track of dangerous products.

In summary, correctly assigning the responsibility for a fire to a particular electrical appliance requires the following steps:

1. Finding the appliance at the origin of the fire.
2. Finding evidence of origin on or in the appliance.
3. Finding the nature of the failure which caused the fire.
4. Researching the previous fire history of the appliance.

This type of accidental fire investigation can be as complicated and time consuming as any arson investigation, and the successful identification of the culprit can be just as challenging and rewarding. ■

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