C12 Forensic Engineering Investigation of a Steam Iron Electrocution

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After attending this presentation, attendees will better understand the forensic engineering investigative process, the use of X-rays to determine defects, and the use of photography to document arc phenomena.

This presentation will impact the forensic science community by increasing knowledge of the necessary conditions for inducing ventricular fibrillation from a steam iron, which are that the person must contact a surface with a sufficient voltage potential, the person allows a path to ground, the iron must have a defect (or defects) that bypasses the internal pathways for current flow, and that there is a failure of the usual grounding provision for appliances that plug into a conventional outlet.

In a San Diego neighborhood in the early morning, a wife was ironing clothes using a conventional steam iron. A few minutes later, she suffered ventricular fibrillations, and died at the scene.

Initially, it was not clear that the iron had anything to do with the incident. However, the ensuing investigation showed that the iron was indeed defective and was the proximate cause of the death.

In this unfortunate case, all the necessary conditions were present to electrocute the user of the steam iron.

A systematic investigation found that there was a fault in the wire, a fault in the seal that separates the water chamber from the internal parts of the iron, and that a path to ground, except through the user, was not available.

The two-prong plug (rather than the three-prong usually found on irons) offered no separate ground connection from the appliance to the ground buss in the apartment wiring. Furthermore, an X-ray showed that the wires next to the plug were frayed and were in fact separated on the neutral (or return) side of the plug.

This meant the full 120 volt potential was conducted to the iron, with only intermittent, if any, current flow to the iron.

Internally, the seal that contained the water in the water chamber leaked. When the iron was in a vertical rest position, this leakage dripped water onto the connection from the energized circuit to the heating element embedded in the ironing surface.

It was further developed that the user of the iron was in the habit of wetting her finger and tapping on the heated surface of the iron to test if the iron was ready to use. In this case, even if the iron was cold to the touch, it was nevertheless a lethal hazard.

Given these conditions, a perfect storm existed. As the woman touched the iron, she inadvertently created a path to ground, killing her. The presentation will show the details of the findings, including the X-rays showing the frayed wiring, the ineffective seal, and most interestingly, photos of the instantaneous arc created across the heating element to circuit interface. And, had there been a three prong-wire, this incident would not have occurred. A Fault Tree representation helps to evaluate the risk potential of similar devices.

Electrocution, Steam Iron, Fault Tree

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