

by Tom Henry, Tom Henry's Electrical Training Program

# Electrical Fires

Fire investigators tend to blame fires on that which they understand least, and that is electricity.

**A** more precise understanding of how and why these fires occur could help regulators target dangerous practices and products. And because fire findings frequently form the basis for liability and insurance law suits, better data might conceivably reduce pointless litigation and prolonged insurance claims.

In general, heat is the enemy of electrical equipment, whether transformers, motors, or cable, and the cooler a product runs the longer it can be expected to last. Fires cause arcing, but arcing can also cause fires. This can lead to what is called *cause hunting*.

Large fires burn away most of the evidence, but electrical circuits can lead to the fire's origin. Fires char the PVC insulation on the wires. If the wire is still energized, current will then arc across it. This often severs the wire, (copper melts at 1981°F) cutting off current downstream of the arc. This means the arc furthest away from the power source is located closest to the fire.

From the load center, investigators attempt to track the wire to the fire's origin. From there, they look for one or more of the ways electrical failures can cause fires: high-resistance connections, arcing between locknuts and enclosures, equipment grounding conductor too small, loose connections, brittle and discolored insulation, oversize overcurrent protection, ground faults, and short circuits.

Experienced investigators uniformly cite high-resistance connections as the most common electrical cause of fires. Loose connections, such as an untightened screw in a terminal, heat up and expand when energized. This encourages the copper wire to react with oxygen in the air. The resulting copper oxides are more resistive than copper. That causes them to heat up more than the surrounding wire, encouraging even more oxidation.

A well-developed oxide can reach 30-40 watts on a 15-20 ampere circuit. That is hot enough to glow and ignite surrounding fuel. Fortunately, most loose connections occur in boxes or appliances where fuel is limited.

A loose conductor termination could cause arcing at the connection and result in a potential fire hazard.

Too tight a conductor termination could deform the conductor or strip the threads of the terminal. Then proper tension would not exist between the conductor and the terminal. Ultimately, due to expansion and contraction from heating and cooling of the terminal, the connection could become loose, and arcing could result. Thus, the result might be the same as with a connection that was too loose.

It has been my experience that overheating is usually due to improper tightening, in particular when conductors are connected to a bus without the use of a torquing device. It is critical that all conductors be torqued properly to the recommended values. All strands should be distorted, and no air spaces should be evident.

When initial contact is made between electrical contact surfaces, no matter how smooth and level the surface, only a few high points touch. As the contact force increases, more points make contact until at optimum force most of the metal-to-metal contact has been accomplished. Contact theory tells us that these points are actually cold welds.

Thermography allows corrective actions to be taken before electrical, mechanical, or process equipment fails. On average, for every \$1 spent on infrared electrical inspection there is a \$4 return on the investment for materials and labor to fix the problem equipment before it fails.

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