The problem of aging electrical wiring
by Jim Lardear, Spring 2004, NEC, NFPA

Extract:

Vietnam era aluminum wiring
No discussion of the hazards posed by aging wiring would be complete without a nod toward residential aluminum wiring systems.

Nationwide, between 1965 and 1974, an estimated 2 million homes and mobile homes were wired with aluminum wire. These systems consisted of aluminum electrical conductors for use in 15 and 20 ampere circuits (size 10 AWG and smaller) as well as all outlets, wall switches, circuit breakers, fuse holders, lamp holders, wire connectors, and relay switches connected to them.

In 1974, the CPSC determined that hazards associated with aluminum wire systems present "an unreasonable risk of injury or death" and later filed suit against more than two dozen manufacturers of aluminum wire and devices used in these systems.

According to a report published by the CPSC, homes wired with aluminum wire manufactured before 1972 ("old technology" aluminum wire) are 55 times more likely to have one or more connections reach Fire Hazard Conditions than is a home wired with copper. In 1972, manufacturers modified aluminum wire as well as switches and outlets to improve the performance of aluminum wired connections.

"The problem with aluminum wiring is only at the connection point, the wire itself is fine," says Alex Costantino, president of Aluminum Wire Repair Inc. (Aurora, CO).

According to Costantino, aluminum expands and contracts three times the rate of copper. "Every time the aluminum connection expands and contracts, it creates a gap that exposes the wire to air that enables the aluminum to oxidize," Costantino says.

This oxidation increases resistance and heat buildup along the circuit. "Since aluminum oxide is such a bad conductor, in some really high heat environments it acts as an insulator, potentially leading to hazardous arcs and glowing connections," he adds.

Protecting against arc faults
Arc faults are a discharge of electric current across a gap. In a home, arc faults can be years or just seconds in the making. Arc faults can be caused by a variety of factors including loose or improper connections to outlets or switches; cracked wire insulation stemming from age, heat, or corrosion; and electrical wire insulation chewed by rodents or punctured by nails. When they occur inside walls or ceilings, temperatures can exceed 10,000° F and turn wood studs into kindling.

According to CPSC estimates, fire originating in electrical distribution systems accounts for more than 10 percent of all home fires. In many of these situations, an arc fault can be blamed.

Since household fuses and circuit breakers do not respond to early arcing and sparking conditions, in January 2002, the National Electrical Code (1999 NFPA 70, Section 210-12), began requiring arc fault circuit interrupters (AFCIs) for all branch circuits supplying 125V, single phase, 15- and 20-ampere outlets for bedroom circuits in new residential construction.

However, according to the CPSC, AFCIs are particularly important where wiring may have degraded with age. These complex pieces of electronic technology can identify the specific "signatures" of the current or voltage waveform that are unique to electrical arcing.

An AFCI, which prevents electrical fires beyond the capabilities of traditional fuses and circuit breakers by detecting and de-energizing unseen arcing-faults in circuits, should not be confused with a Ground Fault Circuit Interrupter (GFCI), which protects against shock. Keep in mind that fuses and circuit breakers were not designed to protect a circuit against arcing faults. These devices just protect against overloads or short circuits.

"One of the dilemmas we face when talking with contractors and building owners is ‘why should I pay more for safety when everything is already safe enough?' That's why there was some push-back on things like AFCIs," Mercier says.

One of the current proposals for the 2005 NFPA 70 is that whenever a residence changes out their circuit breaker or fuse box, they have to add AFCI protection for the existing branch circuits.

"This initiative has garnered some support in the process leading to the 2005 code, but it hasn't reached consensus to date," King says. "We got our foot in the door with the current code by requiring AFCI protection in bedroom circuits in new residential construction. But if AFCIs are necessary in new homes, they are more than necessary in older ones."