

Old Homes – Electrical Risks Explained

For the insurance
industry

Risk leading to structural fire due to faulty electrical system

- There are a *staggering* number of dangerous homes that are presently insured!!
- Reported fires due to faulty electrical since 2004
 - 633
 - ~ 1 home in 5000
 - \$78 MM property damages
 - 9% of total payout
 - 4 fatalities, 20 injuries
- Note: These figures are likely higher, as in a great number of fires the cause is undetermined.



Residential property loss in BC accounts for about 9% of total payout

What is causing the fires?

- Old home wiring is not necessarily unsafe, but serious hazards are often present in homes of all ages!
- The key is that we focus on those things that are causing the unsafe situations.



If we identify the risks before a fire, everyone WINS.

High-risk indicators

- **AGE OF HOME!!**
 - Risk increases with age
 - Statistically, older homes pose far greater risk than newer homes
- **HOMES WITH SECONDARY SUITE!!**
 - Statistics show a far greater number of risks present in homes with secondary suite than homes without secondary suite
 - Due to the higher proportion of handyman tinkering taking place
- **HOMES WITH ALUMINUM WIRING!!**
 - Statistics show, homes with aluminum branch-circuit wiring, pose far greater risk (by a factor of more than 50) than homes wired with copper
- **LOCATION OF HOME!!**
 - Statistics show higher degree of risks is less affluent areas
 - Due to the higher proportion of unauthorized work taking place

High risks due to age of home

KEY CAUSE OF HIGH RISK:

- Handyman tinkering
 - The *Vast* majority of electrical risks are a result of handyman tinkering

Also:

- Deterioration over time
 - Accounts for 17% of electrical fires
- Electrical wiring
 - Pre-1984 concerns are based on wiring type, depreciation and tinkering
 - Post 1984 the concerns are primarily tinkering

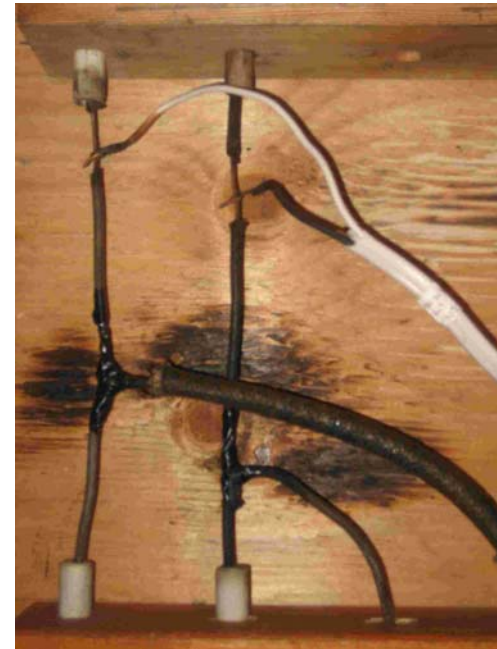


VERY Dangerous: no electrical box. Incredibly common with handyman add-ons.

Pre-1950 Knob and tube

History

- **All homes pre-1950** were wired with this type of wiring. On main and upper floors
- “***Knob and Tube***” derived from the ceramic knobs and tubes that secure and protect the wire runs
- **Note: Grounding is not new.** Basements were often wired, as were fixed appliances with armor clad cable, providing both mechanical protection and equipment grounding.



Knob-&-tube with dangerous handyman add-on (white cable). Burn marks on ceiling indicate connections are soldered - *not* a sign of poor connections.

Knob and tube

Qualities

- **Conductor quality:** Excellent!
 - Heavy gauge wire, minimal number of connections and soldered connections.
 - Minimal opportunity for heat build up along wire run
 - *If* there has been no overrating of fuses, the insulation will likely last indefinitely
- **Opportunity for shorts:** Minimal!
 - Conductors widely spaced apart
 - 8 in. along runs, 3 in. at boxes
- **KEY POINT:** Work *seldom* done by non-professionals



Knob and tube was seldom installed by non-professionals.

Knob and tube

Hazard

- No ground protection
 - 3-prong outlets often found installed on K&T circuits, giving false impression of ground protection.
 - **Note:** ground protection is NOT required for devices with a two-prong plug (e.g., table lamp)



3-prong receptacles are often found swapped in place of the original 2-prong receptacle, giving impression of ground protection.

1950 - 1962

Ungrounded, twin-conductor cable

1950

- Ungrounded, twin-conductor cable (NMD1) replaces knob-and-tube wiring
 - Replaced Knob-and-tube wiring due to ease of installation
 - Contained no ground. Two insulated conductors wrapped in paper and black cloth casing.

Hazard

- **Same as “knob-and-tube”:**
No ground protection
- Ground conductor in NMD not required in code until 1962



Common in houses 1950-1962, a black, twin-conductor cable with no ground wire. Wired to 2-prong ungrounded outlets

Ground protection solution

- If the insulation is intact and there has been no dangerous handyman add-ons, an excellent solution providing ground protection to knob-and-tube circuits is installation of **GFCI receptacles** or **GFCI breakers**



Modern GFCI receptacle provides ground protection on ungrounded circuits

1962 to 1984

Paper-wrapped cables

1962

- New, paper-wrapped cable with ground introduced (NMD3). Insulation temperature rating 60°C. Later NMD6 introduced, 75°C rating

Hazards

- *Not acceptable* for recessed lighting, popular 1970s and '80s.
- Fires occurred in recessed lighting as a result of conductor overheating. This was due to high temperatures generated inside the lighting fixtures

1984

- Required that all ceiling lighting be wired with cable rated at 90°C



Paper-wrapped cables used predominately 1960s to 1984. While excellent for most applications, *not* suitable for recessed lighting.

1984 to today

Modern cable

- Modern cable is rated 90°C, originally with black cloth jacket (NMD7), then white PVC jacket (NMD90)

Hazards

- Even modern cable is susceptible to error, if installed in wrong locations
 - Designed for dry locations indoors in residential buildings.
 - **Not suitable for:**
 - **Outdoor and wet locations**
 - **Underground applications**



If not wired correctly, modern electrical cable can be most dangerous

A unique period: 1965-1974

Aluminum wiring

History

- Aluminum wiring in vast majority of homes during period coincided with **Vietnam war**. An inexpensive solution to escalated price of copper
- **Can be extremely dangerous** if not checked and maintained regularly by a licensed electrical contractor familiar with aluminum wire testing
- US Consumer Product Safety Commission reports: **aluminum wired homes are 55 times more likely** to have one or more connections reach Fire Hazard Conditions than homes wired with copper.
- **The problem is not the aluminum cable, but the connections**



Aluminum wire, installed in the majority of houses 1965-1974

Aluminum wiring

Hazard

- **Poor connections**

- Under an electric load, e.g., electric kettle, cables and connections heat up; the greater the current, the greater the heat. When the load is disconnected the cables and connections cool down.
- Where aluminum meets copper this expansion and contraction occurs at different rates. **Over time the connections become loose.**
- Once exposed to air, a chemical process “oxidation” takes place further reducing the connection quality



Poor connections lead to fire. A common sight where aluminum conductors meet copper

Aluminum wiring

Solution

- **If any connections are poor**, an electrical contractor experienced in aluminum wiring repair can repair the connections, making the home as safe a home wired with copper.
- **Homes with aluminum wiring should be checked regularly** by a licensed electrical contractor familiar with aluminum wire testing, to assure the connections have remained sound.
- PowerCheck recommends every **5 years**



Aluminum-copper connections deteriorate over time, leading to fire

Limited number of receptacles!

- Of far greater concern with old home wiring is limited number of receptacles
 - Commonly found in homes pre-1980s
 - Often results in “**Handyman add-ons**” and/or undersized extension cords, both which can be *very* dangerous.
- This hazard is *not* addressed by replacement/elimination of knob-and-tube wiring



Image of extension cord wiring found in Vancouver home, which was stapled on wooden joist. Extraordinary that the house did not burn

Conclusion on wiring types

- All wiring types have risks associated with them if not installed correctly
- Particularly before 1984
- All homes 25 years and older should be checked for electrical safety. This will catch the vast majority of dangerous homes



SERVICE SIZE: Is 60-amps adequate?

- It may be!!
- “60-amp service” implies two lines of electrical power, each supplying 120 volts, each capable of supplying up to 60 amps of continuous current
- **60-Amp service is not necessarily unsafe**, as the fuses or breakers protect the incoming service cables from overcurrent.
- A licensed electrical contractor can determine if it is adequate size and if it is safely installed



Do-it-yourself 100-amp service kits are readily available from retail stores. Regardless of size, a staggering number of “modern services” are installed incorrectly. Image source: Home Depot

60-Amp service in all homes pre-1960

- Prior to 1960's, almost all homes had a 60-amp service

Hazard:

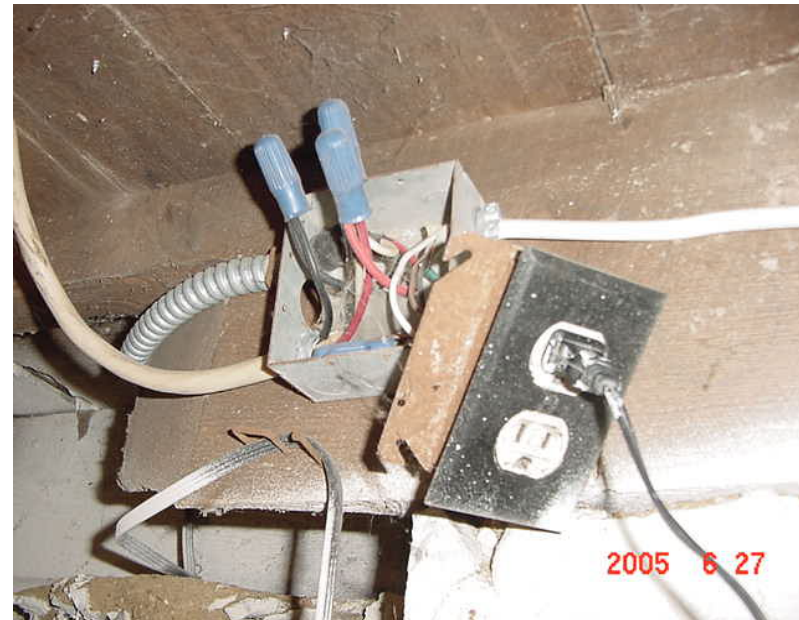
- In numerous houses examined, the panel has been illegally replaced with a larger 100-amp panel, while service conductors were not replaced, still rated for 60 amps.
- In the eyes of an untrained individual, these houses **could easily be interpreted as 100 A**, when in fact they are 60 amp with overrated fuses – very dangerous



100-amp service with modern circuit breakers does not imply it is safe. Service here installed by a handyman

Handyman tampering

- Without question, all research shows, the **leading cause of electrical fires** is due to “**Handyman tampering**”
- If handyman tampering is identified and eliminated, the number of accidental electrical fires will be greatly reduced



A NOT uncommon sight. Dangers like these found in 60% of pre-1950 homes, regardless of “New service upgrade”. This type of work is what causes fires

Commonly found hazards

- **Over-rating of fuses or breakers**, to sizes larger than circuit is designed.
- **Exposed electrical connections**, in contact with wood frame of the house (rather than in an electrical box)
- **Undersized extension cord**, so often stapled to baseboard, in place of permanent wiring
- **Incorrect location of heating devices**
 - **ALL OF THESE VERY DANGEROUS!**



Handyman dangers in the extreme. Unfortunately dangers such as this are so often present

Overrating of breakers/fuses

- **VERY dangerous**
- Surprisingly common
 - on both fuse boxes and modern circuit breaker panels
 - In 14% of pre-1950 homes
- Result: Conductor overheating, which can lead to **arcing and fire**



Over heated conductors as a result of overrating of fuses and/or breakers

Exposed electrical connections

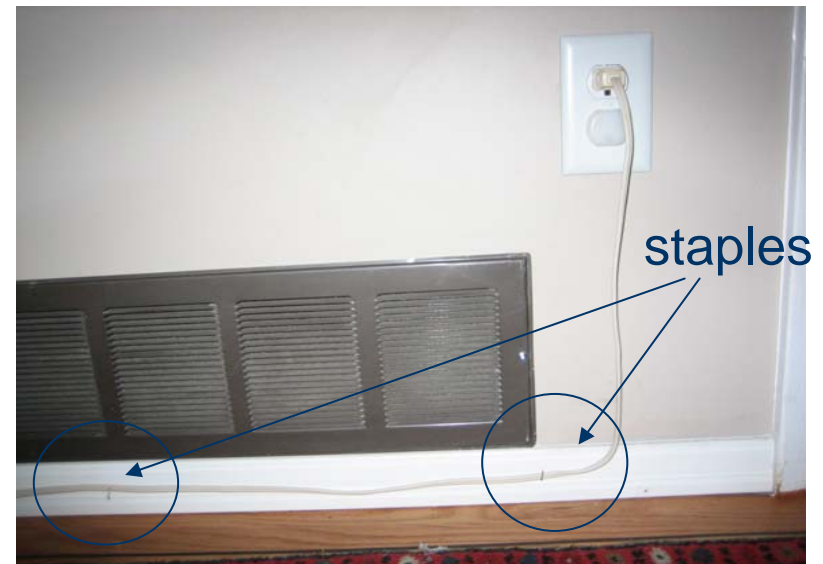
- **VERY dangerous**
- Often in direct contact with the wood frame of the house
- Surprisingly common
 - In 30% of pre-1950 homes
- Can *easily* lead to arcing followed by fire



Handyman add-on supplies power to New Westminster basement suite. Connections are sandwiched between wood. *Very dangerous.*

Undersized extension cords

- **VERY dangerous**
- Undersized extension cords stapled to the wall (where home owner requires extra receptacles)
- Are often used for applications greater than their rating
- Surprisingly common
 - In 16% of pre-1950 homes
- Can *easily* lead to arcing followed by fire



Undersized extension cord used as permanent wiring. Staples provide opportunity for arcing – **Most dangerous and most common**

Baseboard heating in dangerous location

- **Very dangerous**
- Often found installed in dangerous locations
 - Under bookshelves
 - In contact with curtains
 - Under flammable material (e.g. wood, fabric)
- **Can easily, and often do lead to electrical fire**



It is surprising how often these are installed under a bookshelf
- Very dangerous

Other Leading Fire Hazards

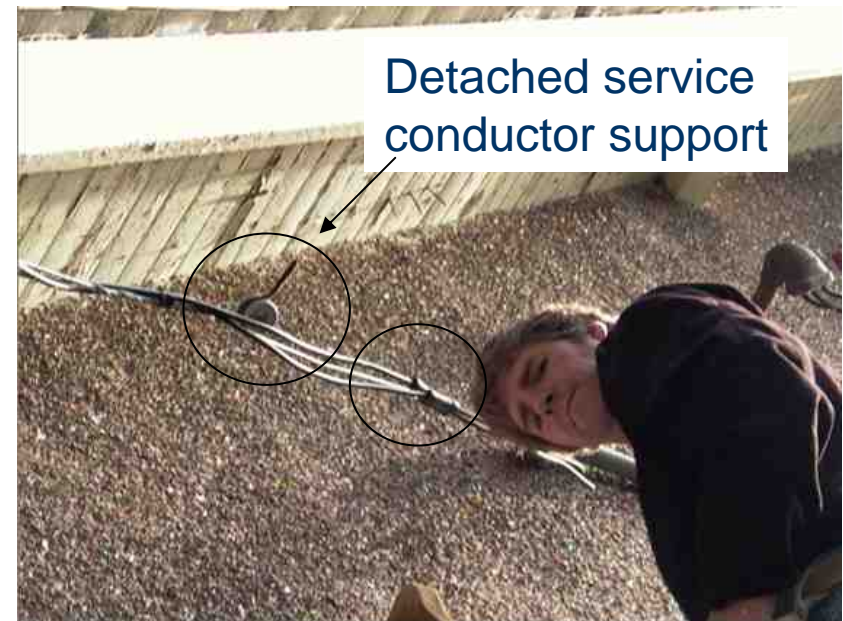
- Service conductor issues
 - Trees in contact with service conductors
 - Detachment of the neutral-cable support (Emily knob) at side of house
- Severed ground conductor
- Garage wiring



Home electrical ground has been severed; possibly by a lawn mower – *Most dangerous*

Detachment of service conductor support: Very dangerous!

- Service conductors support, at side of house, takes the tension of incoming conductors
- If it becomes detached (due to pressure from trees, rotten wood, storm) **tension is on line-conductor connections at side of house**
- **Very dangerous**
 - as tension can pull connections free, leaving a dangling hot cable, able to arc to side of house

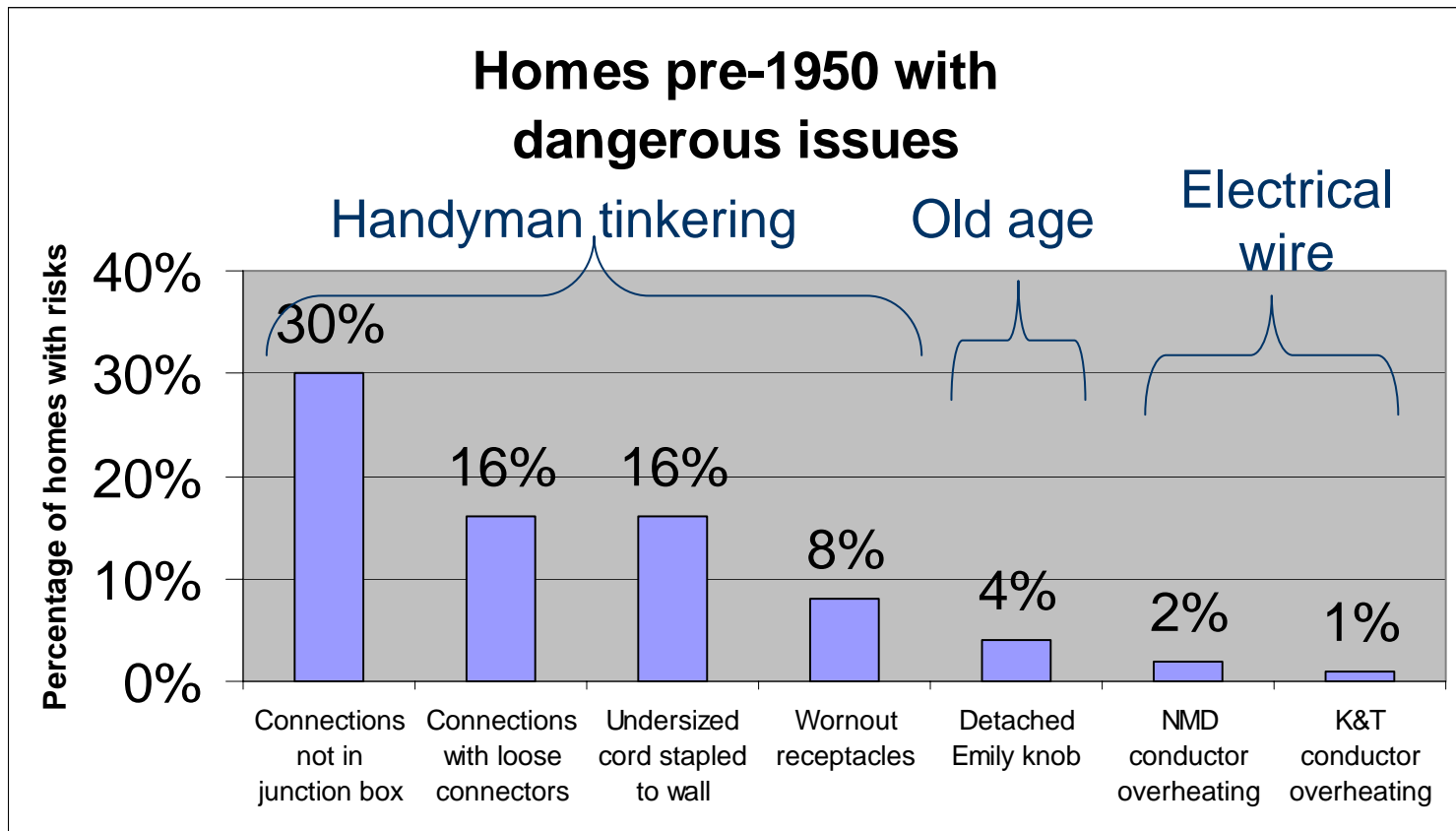


Service conductor support has broken free from side of house, putting tension onto the hot conductor connections (shown right)

Statistically old homes are far more dangerous

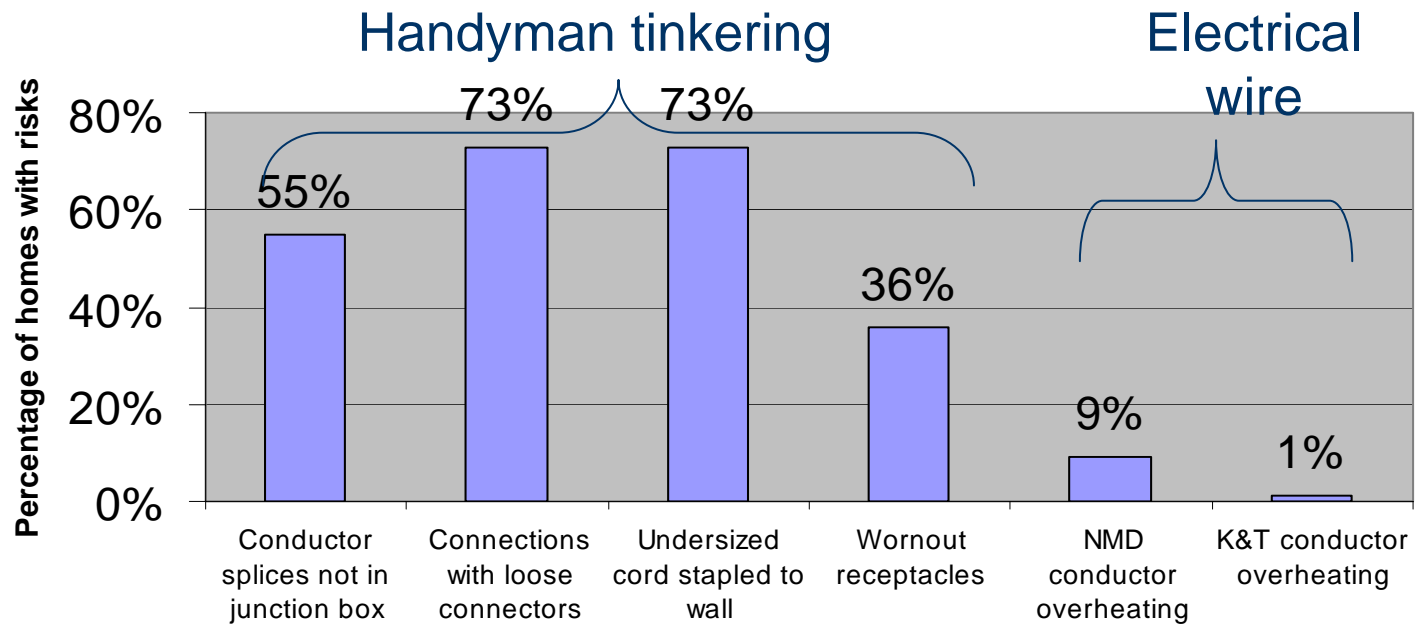
- “The older the home the more dangerous it is”
 - Homes pre-1950 with dangerous electrical hazards: **60%**
 - Homes pre-1950 with secondary suites with dangerous electrical hazards: **84%**
 - Homes with dangerous electrical hazards that have had “**service upgrade**” (modern 100-amp service): **88%**

Where are the hazards?

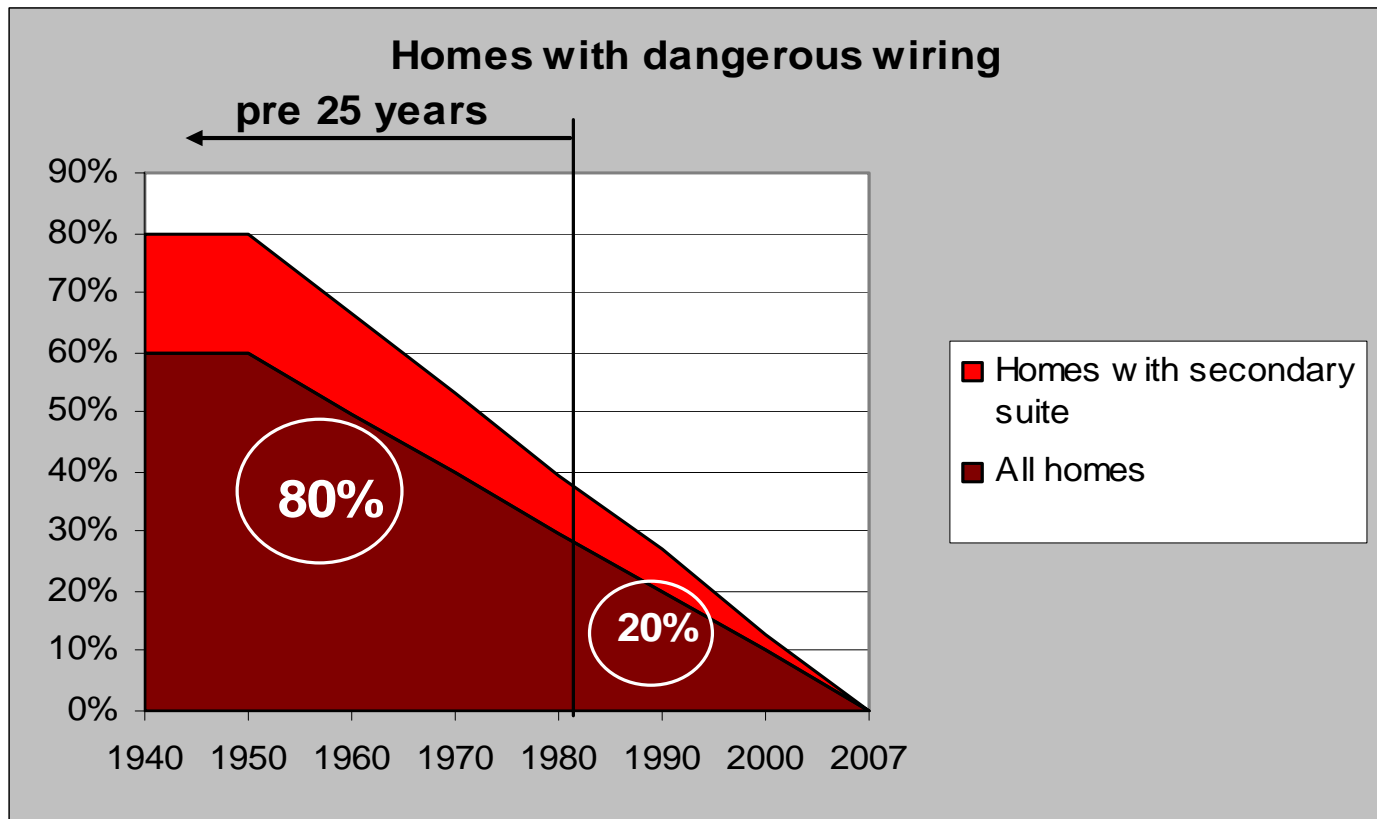


Homes with secondary suites: Significantly higher dangers present

Homes pre-1950 with secondary suites with dangerous issues



PowerCheck recommends homes older than 25 years be checked for electrical safety!!



Risk vs. age of home

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Who should have an electrical safety assessment?

- If the property is more than 25 years old
- If you have concerns about who installed the electrical equipment
- Prior to selling a property or when buying a previously occupied property

Summary

- Are old homes statistically more dangerous than new homes?
 - **Absolutely yes!**
- Are the dangers related to knob-and-tube wiring or 60-amp service?
 - **Seldom!**
- Does a “new service” or “electrical upgrade” imply a safe house?
 - **Absolutely not!**
- The right approach to assure the risk is low,
 - Have your home checked by a licensed electrical contractor who will provide a detailed document as to the safety of the house
 - This is the service provided by PowerCheck