



CPSC Staff Study on Electrical Fires*

Aged Electrical Systems Research Application Symposium

October 18-19, 2006

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*These comments are those of the CPSC staff, have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.



Outline

- About the U.S. Consumer Product Safety Commission (CPSC)
- CPSC Staff Study on Electrical Fires
- CPSC Staff Electrical Wiring Activities/Strategies



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CPSC's Mission

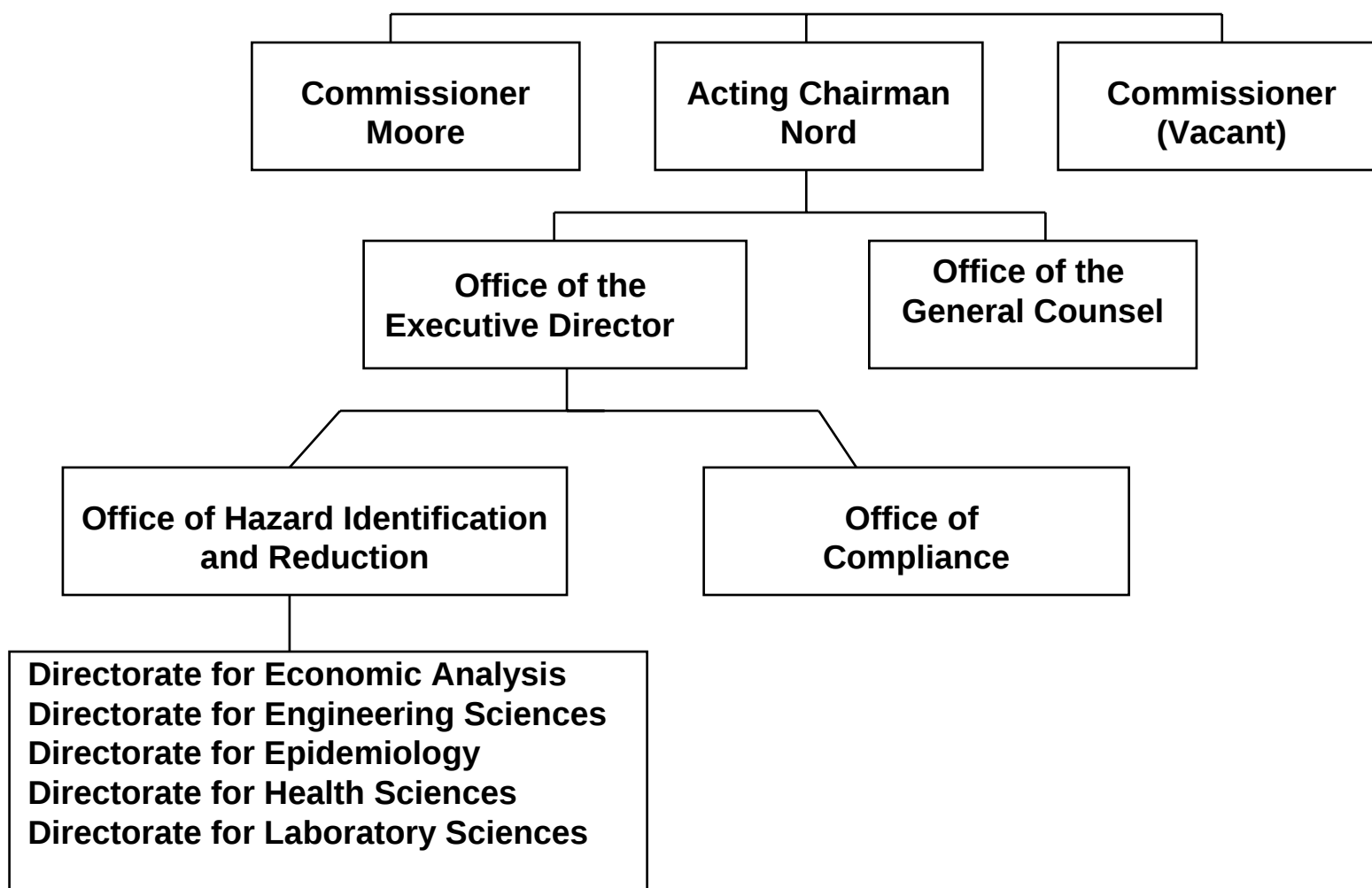
- To protect the public against unreasonable risks of injuries and deaths associated with consumer products
- Jurisdiction over 15,000 types of consumer products



CPSC History

- Established - 1972 under the Consumer Product Safety Act
- Independent Federal regulatory agency
- 3 Commissioners
 - (Acting) Chairman Nancy Nord
 - Commissioner Thomas Moore
 - Commissioner (vacant)

CPSC Organizational Chart*



* abbreviated



Size of CPSC

- FY 2006 budget of \$62.3 million
- About 420 staff
 - Headquarters, ~290 (Bethesda, MD)
 - Field, ~100 (throughout country)
 - Laboratory, ~30 (Gaithersburg, MD)



CPSC Functions

- Collect & analyze data
- Perform applied research
- Encourage voluntary standards
- Develop performance safety standards
- Enforce regulations
- Require safety labeling & special packaging
- Recall defective products
- Ban hazardous products
- Inform consumers



CPSC History - Acts

Jurisdictional authority under 5 Acts

- Consumer Product Safety Act – 1972 (CPSA)
- Federal Hazardous Substances Act – 1960 (FHSA)
- Flammable Fabrics Act – 1953 (FFA)
- Poison Prevention Packaging Act – 1970 (PPPA)
- Refrigerator Safety Act – 1956 (RSA)

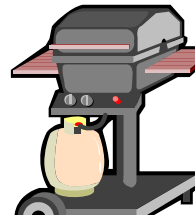
CPSC – Jurisdiction

15,000 Types of Consumer Products

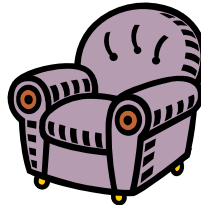
- Electrical appliances



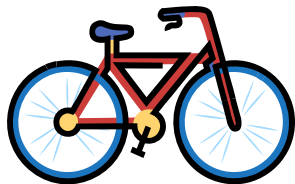
- Combustion appliances



- Furniture and home accessories



- Sports and recreational equipment



- Children's toys and furniture



- Home wiring

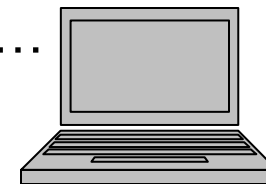


- Fabrics, materials, and accessories



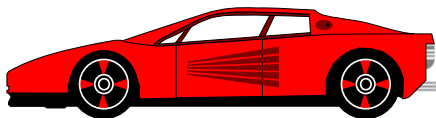
- Powered equipment and tools

- And more...



CPSC Does NOT Have Authority Over:

- Tobacco products
- Medical devices
- Food and drugs
- Boats
- Motor vehicles

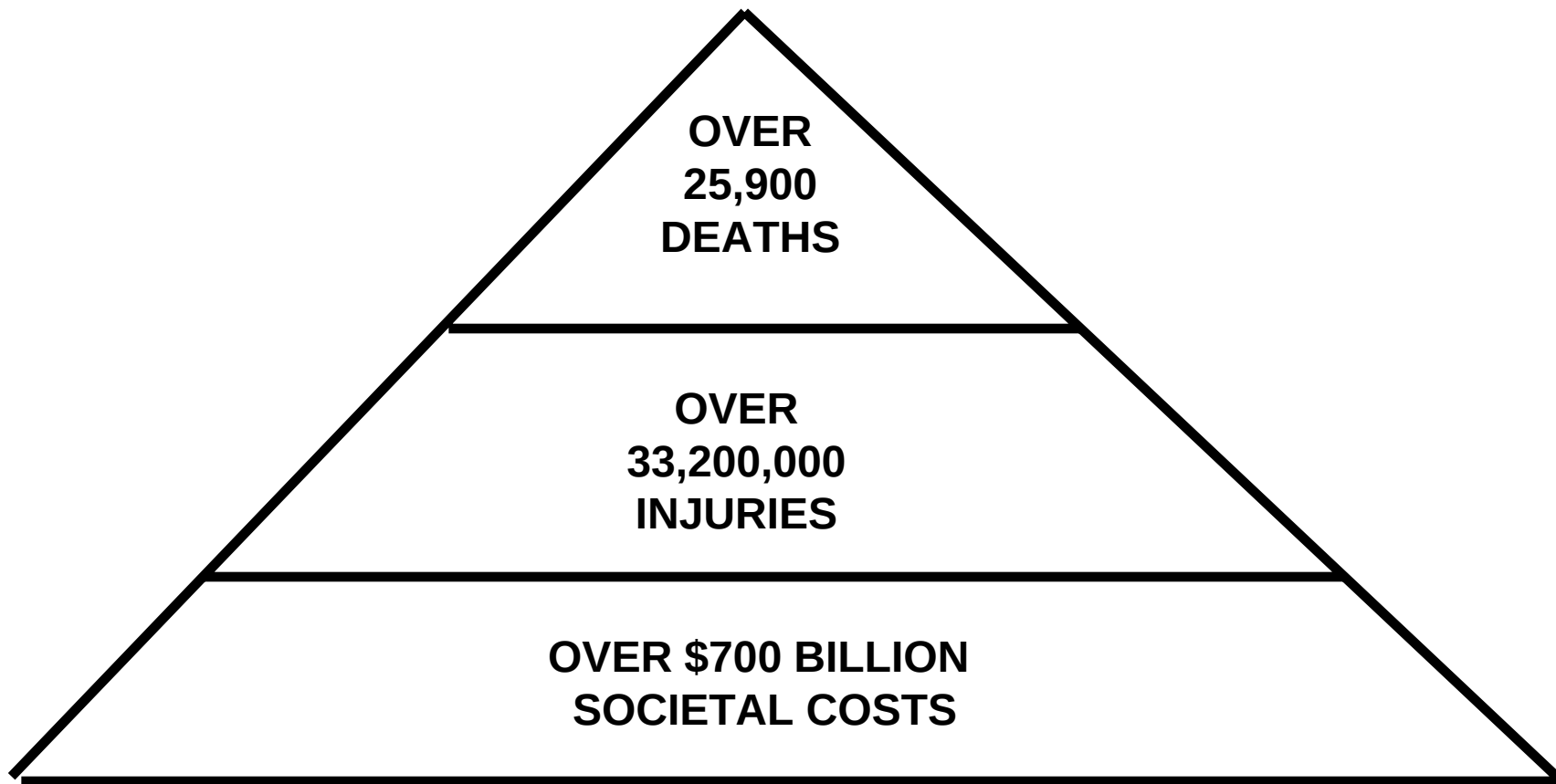


- Aircraft
- Firearms
- Pesticides
- Workplace products
- Alcoholic beverages





Annual Impact of Consumer Products





Data Sources

- National Electronic Injury Surveillance System (NEISS)
- Death Certificate File (DTHS)
- In-Depth Investigations File (INDP) including Special Studies
- Injury/Potential Injury Incident File (IPII)
 - ☐ Hotline/Website reports
 - ☐ Newspapers/Internet
 - ☐ Other sources
- National Fire Incident Reporting System (NFIRS, USFA)



CPSC Use of Data

- Define size of problem
 - set priorities, project decisions
- Characterize problem
 - design effective intervention
- Support recalls
- Propose voluntary standard requirement
- Justify regulatory action
- Information and/or educational materials



Various Fire Projects (1996-2006)

- Arc Fault Circuit Interrupters (AFCIs)
- Countertop Cooking Appliances
- Transient Voltage Surge Suppressors
- Smoke Alarms
 - Wireless Interconnect
 - Sound Effectiveness
 - Survey (alarms, sprinklers, fire extinguishers)
- Heaters
 - Portable
 - Fixed
- Range Cooking Fires
- Mattresses/Bedding (open flame)
- Gas Water Heaters
- Upholstered Furniture
- Candles
- Batteries
- Lighting (halogen torchieres)
- Receptacles



Leading Causes of Home Fires

1999-2002 Annual Averages

- ☐ Cooking Equipment - 28 %
- ☐ Heating Equipment - 14%
- ☐ Intentional - 9%
- ☐ Electrical Distribution and Lighting Equipment- 9%
- ☐ Smoking Materials - 7%
- ☐ Candles – 5%

Source: National estimates based on NFIRS and NFPA survey, NFPA Fire Analysis and Research Division



Leading Causes of Home Fire Deaths

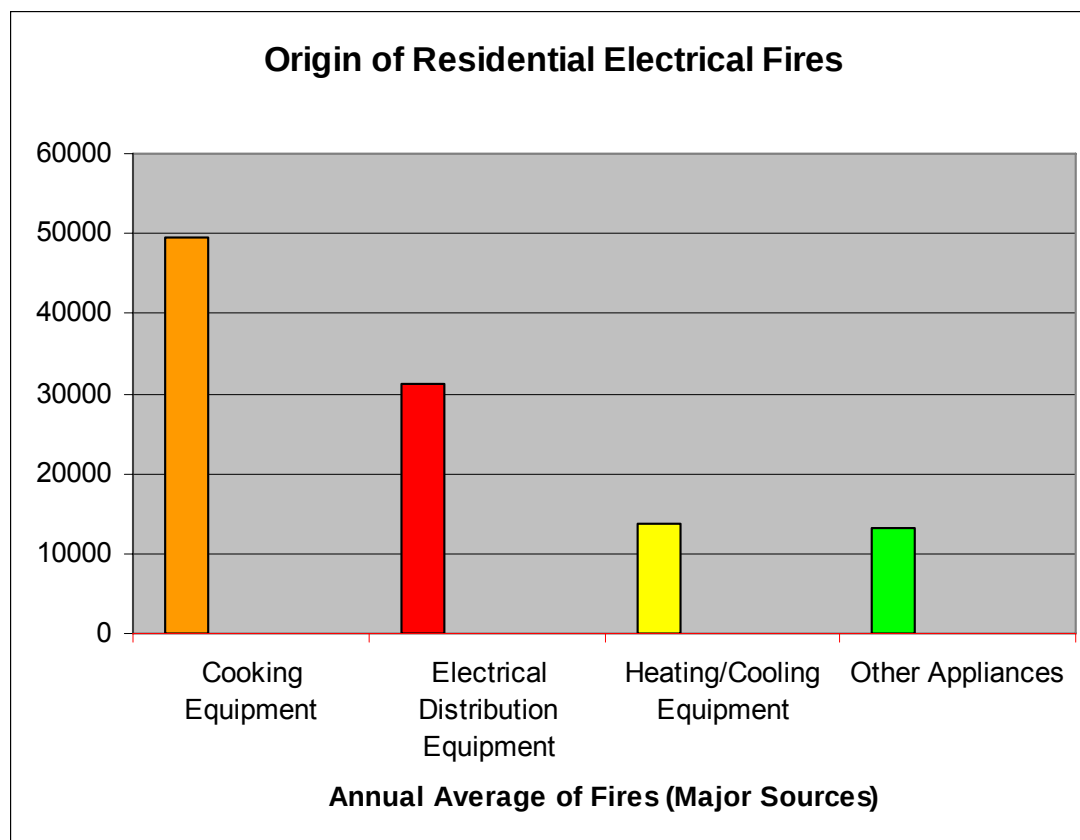
1999-2002 Annual Averages

- ☐ Smoking Material - 29%
- ☐ Intentional - 19%
- ☐ Heating Equipment - 11%
- ☐ Cooking Equipment - 9%
- ☐ Electrical Distribution or Lighting Equipment - 8%
- ☐ Playing with Heat Source – 8%
- ☐ Candle - 5%

Source: 1999-2002 National estimates based on NFIRS and NFPA survey, NFPA Fire Analysis and Research Division

Residential Electrical Fire Losses

1999-2002



Source: 1999-2002 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission - does not include arson related fires and all sources are not shown



Statistics – Annual Residential Electrical Fire Loss Estimates, 1999-2002

Total Electrical Fires

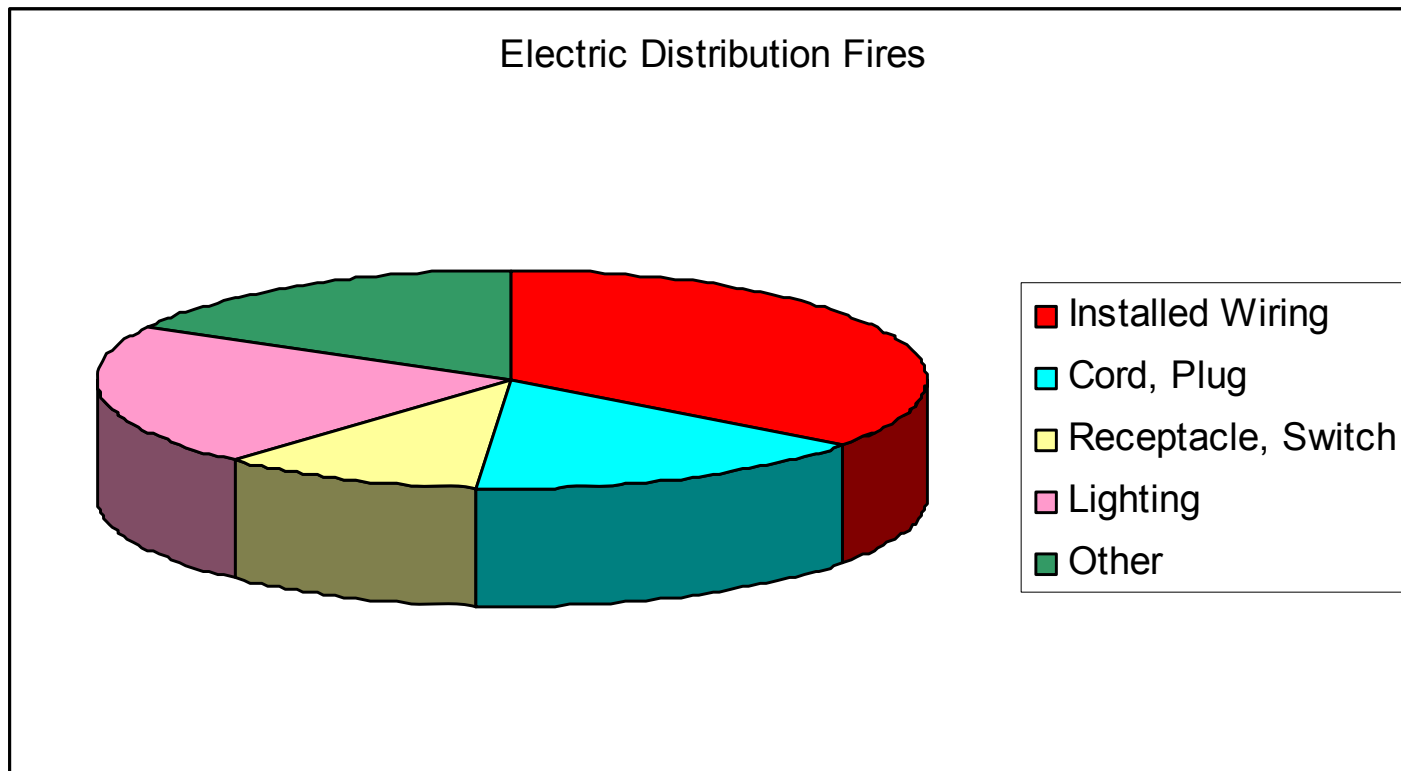
- 113,300 Fires
- 520 Deaths
- 4500 Injuries
- \$1,539 Million property loss

Electrical Distribution Fires

- 31,100 Fires
- 200 Deaths
- 900 Injuries
- \$629 Million property loss

Source: 1999-2002 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission - does not include arson related fires and all sources are not shown

Residential Electrical Distribution Fire Losses (1999-2002)



Source: 1999-2002 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission



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CPSC Staff Study on Electrical Fires Issues (1980s)

Focus on validating fires attributed to electrical cause

- Many fire investigation reports cite cause as “Electrical in Nature”
- Unseen electrical fire causes may result in extensive destruction that hides evidence
- Low cost benefit to allocate resources to investigate small residential fires
 - Focus is on large commercial fires



CPSC Staff Study on Electrical Fires Methodology

- Used local fire departments to conduct detailed investigations on selected fires
- Chose participants based on ability to devote investigation time
 - Investigators were compensated for time
- CPSC contracted with the U.S. Fire Administration
 - Trained fire departments using equivalent of NFPA 921
 - Developed special study questionnaire
 - National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) analyzed the investigations



CPSC Staff Study on Electrical Fires Methodology

- Fires selected by fire department based on physical evidence to substantiate cause of fire
 - Many large fires excluded
 - Branch circuits, panel boxes, receptacle outlets, and cords and plugs involved
 - Included mostly single family dwellings and apartments w/ individual meters
- 149 fires studied



CPSC Staff Study on Electrical Fires Results

Leading cause was electrical distribution system

Component	Number	Percent
Branch Circuit Wiring	50	34
Cords and Plugs	29	19
Receptacle outlets and switches	29	19
Service Equipment	21	14
Lighting Fixtures and lamps	19	13
Transformer	1	1
Total	149	100



CPSC Staff Study on Electrical Fires

Contributing Factors In Residential Electrical Distribution Fires by Age of Dwelling

Contributing Factors	Total		Age of Dwelling (Years)					
	Number	Percent	≤10	11-20	21-30	31-40	> 40	Unknown
Improper Alterations	55	37	1	2	9	7	29	7
Improper Initial Installation	30	20	4	4	8	3	7	4
Deterioration due to aging	25	17	2	3		5	9	6
Improper use	23	15	1	1	2	5	13	1
Inadequate electrical capacity	22	15			4	1	16	1
Faulty product	17	11	2	3	2	1	8	1
Unknown	9	6				2	4	3
Total	149*	100%*	10	13	25	24	86	23

* Note- Totals are greater than 100% since multiple factors were coded in 31 cases.



CPSC Staff Study on Electrical Fires

Ratio of Residential Electrical Distribution System Fires to Housing Population by Age of Dwelling

Age of Dwelling (years)	Percentage of All Dwellings in Study Areas	Percentage of Investigated Electrical Distribution System Fires	Index Ratio of Fires to Dwellings
≤10	19.8	6.4	0.32
11 to 20	17.3	8.5	0.49
21 to 40	28.7	29.1	1.01
over 40	34.2	56	1.64
Total	100	100	1.00



CPSC Staff Study on Electrical Fires Findings

- Fires occurred at highest rate in older homes
- Improper modifications/installations also key factors
- Inspection and correction of problems could be an effective means to reduce the potential for fires



CPSC Staff Study on Electrical Fires Findings

Wire Safety Issues

- Aging, environmental stress
 - Chafing, embrittlement, and corrosion
- Improper wiring practices/Improper installation
- Appliance/equipment load exceeds system design capacity
- Mishandling of wiring during maintenance
- Accumulated damage as wire ages



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CPSC Staff Activities to Address Electrical Wiring Fires

- CPSC staff strategies (early 1990s):
 - Inspection code for existing homes
 - New technology
 - Consumer education materials
 - Demonstrate practical safety improvements
 - Voluntary standards and codes
- Fire Protection Research Foundation (FPRF)
project on aging wiring



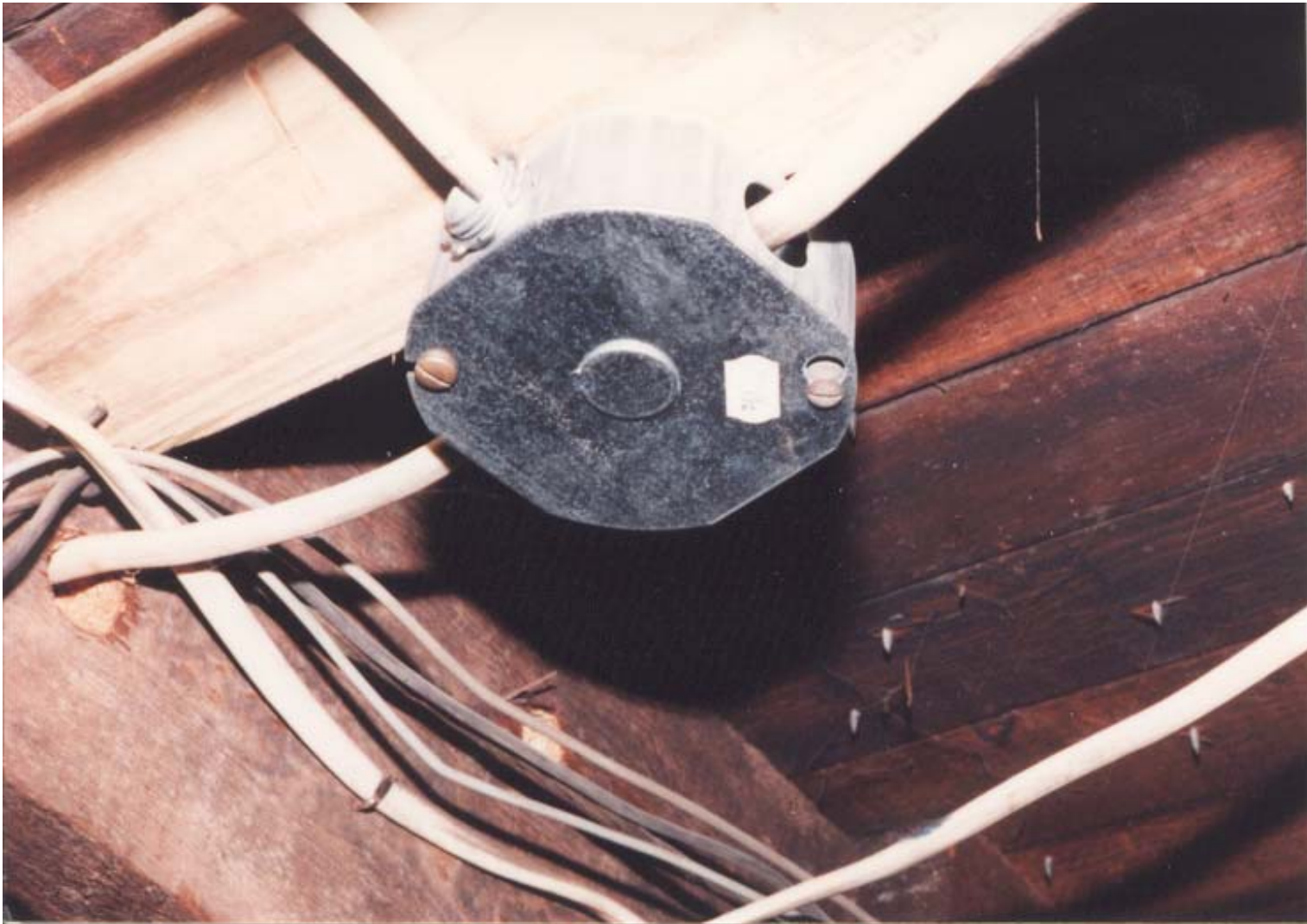
Inspection Code for Existing Homes

- Focus on re-inspection of electrical systems in existing residences
- Worked with industry to develop NFPA 73, *Electrical Inspection Code for Existing Dwellings*
- Complements the *National Electrical Code* (NFPA 70)
- Principal members include CPSC staff, UL, IEEE, IAEI, NECA, NEMA, EEI
- 5 year revision cycle

Exposed Electrical Box



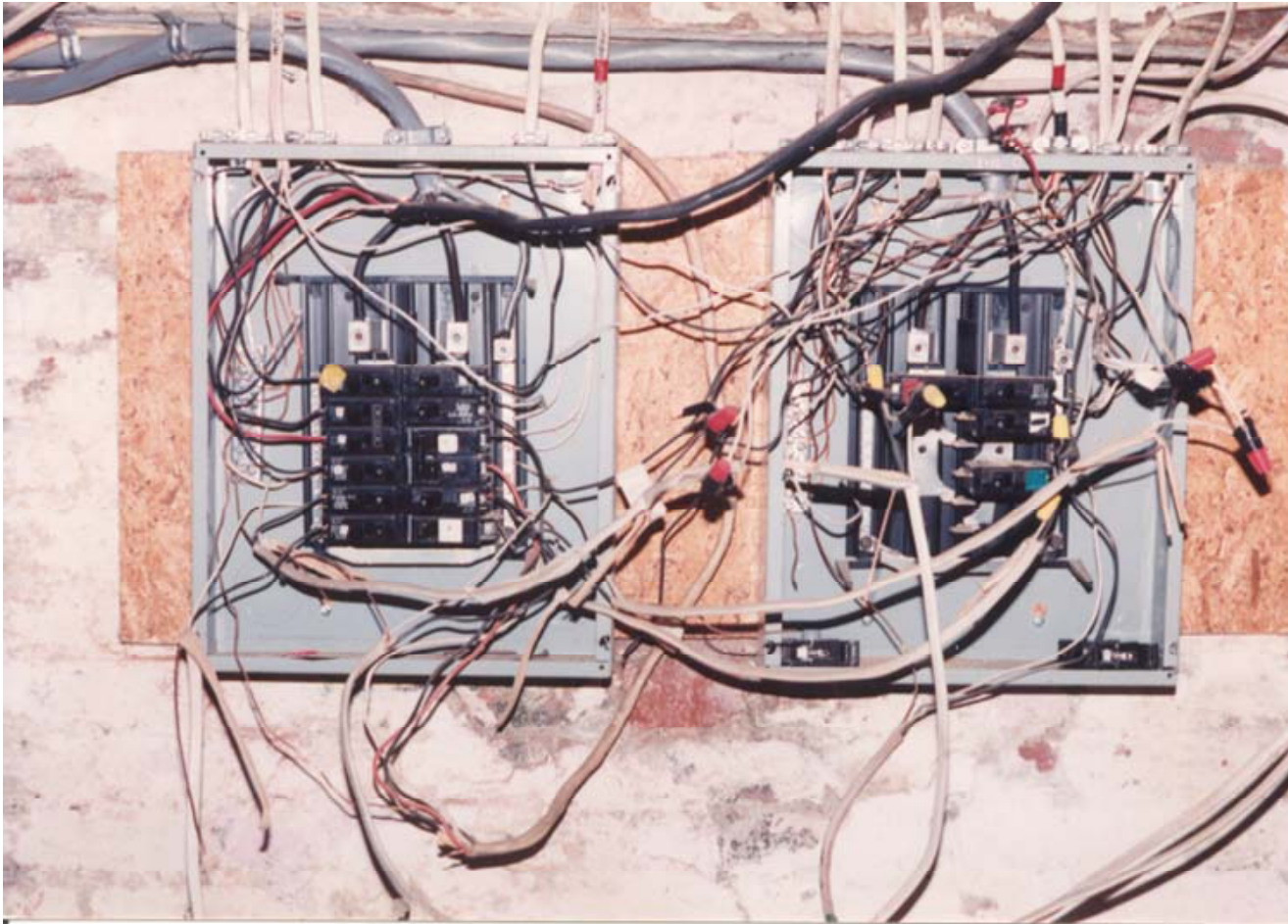
Junction Box - No Bushing



Receptacle With No Box



Bad Wiring



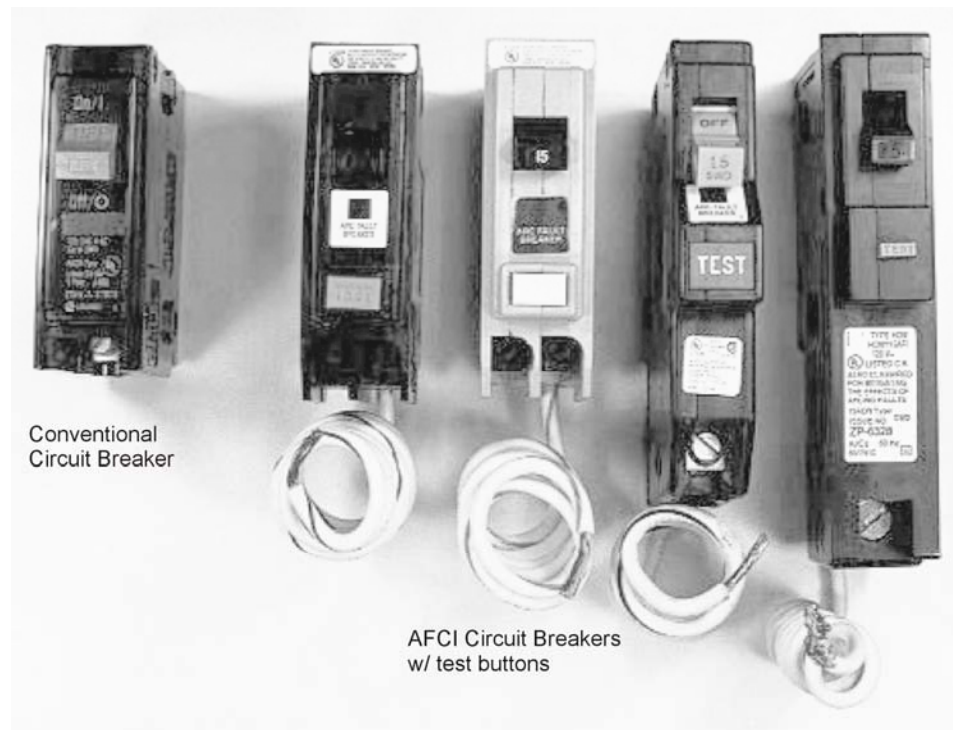


New Technology

- In 1994, CPSC sponsored study on *Technology for Detecting and Monitoring Conditions That Could Cause Electrical Wiring Fires* (UL contract)
- UL study found that arc fault detection appeared to be very promising, especially when added to an existing circuit protection device, e.g., a circuit breaker, and combined with ground fault detection technology

Arc Fault Circuit Interrupters (AFCIs)

By 1997, residential circuit breakers with arc fault protection were becoming commercially available





AFCIs

CPSC Staff Evaluations

- Efficacy
- Nuisance Tripping
- Consumer Usability
- Cost vs. Benefit
 - Older Construction - Benefits 2:1 for homes 20 years or older
 - New Construction
 - 30 years life - benefits equal cost
 - 40 years life - benefits greater than cost
 - Cost of Product Declining
 - Design and manufacturing costs
 - Required by *NEC*



Current Industry Technology Initiatives

- **Diagnostics:** non-destructive evaluation (NDE) techniques, inspection and detection technologies, and monitoring sensors for identifying wire system defects
- **Failure Mechanisms:** causes and models of wire system failure and analysis of maintenance data
- **Interconnection Technologies:** improved connectors, such as at terminations and splices in wire systems, training, management tools, and advanced distribution technologies, such as modular wiring, fiber optics, and wireless technologies
- **New Materials:** new materials for wire system components, such as conductors and insulation, and novel approaches for wire systems such as the application of microelectronic technology



Consumer Education Materials

- Videos - Four old homes inspected and improved (Washington, DC; Atlanta, GA; St. Louis, MO; and Redlands, CA)
 - Demonstrations of incremental wiring repairs
 - Affordable steps to remove gross hazards
- Consumer videos - *Wired for Safety*
- *CPSC Guide to Home Wiring Hazards*
- *CPSC Home Electrical Safety Audit Room by Room Checklist*
- Nationwide distribution of over 1000 sets of materials to state and local fire and electrical officials



Voluntary Standards and Codes

- *NFPA 70, National Electrical Code*
 - CPSC staff membership on Code-making panel 20 since 1970s (now CMP-17)
 - CPSC staff membership on Code-making panel 2 since 2000
- NFPA 73 – CPSC staff membership
- Voluntary standards – CPSC staff support of UL, ASTM, ANSI standards



Plan to Obtain Better Data

Fire Protection Research Foundation (FPRF)
project on aging wiring looking at:

- Evaluating wiring systems in existing homes
 - Lab testing of old components removed from homes being demolished
- Improving fire reports



Residential Electrical System Aging Research Project

Technical Advisory Committee

- Sponsors

- Organizations

- CPSC (USFA funds), CSA, UL, NFPA

- Industry

- Eaton, Hubbell, Leviton, Pass & Seymour/Legrand, Southwire, State Farm, Copper Development Association, Lightolier, Travelers, Cooper

- Fire Service, Code Writers, Technical Experts, Building Code Officials



Residential Electrical System Aging Research Project

Provide critical information for code panels

- NFPA 73 - *Electrical Inspection Code for Existing Dwellings*
- NFPA 70 - *National Electrical Code*
- AHJs
- Electrical equipment manufacturers
- Installers
- Property owners
- Insurers



Links

- CPSC website: www.cpsc.gov
- *Technology for Detecting and Monitoring Conditions that Could Cause Electrical Wiring System Fires*
 - <http://www.cpsc.gov/LIBRARY/FOIA/FOIA04/os/technolo1.pdf>
 - <http://www.cpsc.gov/LIBRARY/FOIA/FOIA04/os/Technolo2.pdf>
- *CPSC Guide to Home Wiring Hazards:*
<http://www.cpsc.gov/CPSCPUB/PUBS/518.pdf>
- *CPSC Home Electrical Safety Audit Room by Room Checklist:*
<http://www.cpsc.gov/CPSCPUB/PUBS/513.pdf>
- *Residential Electrical Distribution System Fires*, April 1, 1988 (4061)(84 pages):
<http://www.cpsc.gov/library/foia/foia04/os/reselecfire.pdf>
- *What Causes Wiring Fires in Residences?* Linda E. Smith and Dennis McCoskrie, *Fire Journal*, January/February 1990, (4061)(8 pages):
<http://www.cpsc.gov/library/foia/foia04/os/firejournal.pdf>
- *Analysis of Electrical Fire Investigations in Ten Cities*, NIST:
<http://fire.nist.gov/bfrlpubs/fire83/art002.html>



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Questions?

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