

The State of the Art in Fire Investigation

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*National Academy of
Sciences Committee*

April 23, 2007

***Was the fire really
arson?***

*And what is the likely
error rate when the
investigator says it is?*

*Some
numbers*

Some numbers

In 2005, there were 1,602,000 fires reported in the US (down 3% from 2004). These fires caused 3,675 civilian deaths, 17,925 civilian injuries, 87 firefighter deaths and 10.7 billion in property damage. Source: NFPA

Some numbers

*511,000 were structure fires (down 3% from 2004), causing 3,105 civilian deaths, 15,325 civilian injuries, and 9.2 billion in property damage.

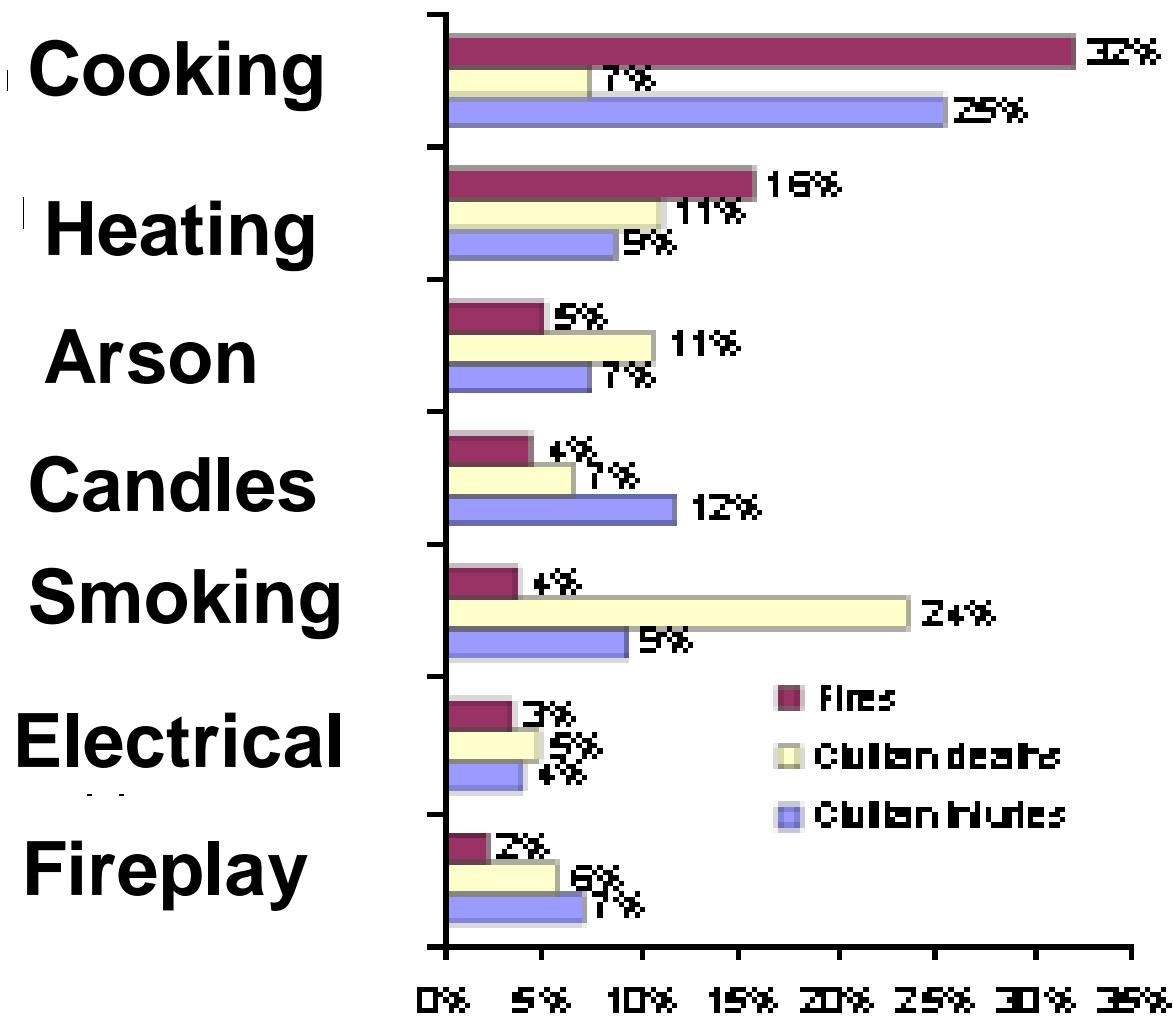
*290,000 were vehicle fires (down 2% from 2004), causing 520 civilian fire deaths, 1,650 civilian fire injuries and 1.3 billion in property damage.

*Some
numbers*

~500,000

*structure fires
per year in the U. S.*

Major household fire causes 2000-2004



Some numbers

~10 %

Are called

“incendiary or suspicious”

Some numbers

*That's 50,000
chances per year
to make a serious error*

Some numbers

*Even if the error rate is
only 5%*

Some numbers

*That's 2,500 miscalls
every year*

*A 5% error
rate is wildly
optimistic*

*What can
happen*

**“A fire
investigation
is just like
a forensic
autopsy.”**

*Except when
it's not!*

Pathologist v. Fire Investigator Education

- M.D.

Pathologist v. Fire Investigator Education

- M.D.
- High school, maybe some college

Pathologist v. Fire Investigator Curriculum

- Undergraduate Science
- 4 years medical school

Pathologist v. Fire Investigator Curriculum

- Undergraduate Science
- 4 years medical school
- Not specified

Pathologist v. Fire Investigator Training

- 1 year internship
- 2-5 years residency

Pathologist v. Fire Investigator Training

- 1 year internship
- 2-5 years residency
- Former firefighter
- POST training 40-80-120 hours
- “seminars”

Pathologist v. Fire Investigator Certification

- State Medical Board

Pathologist v. Fire Investigator Certification

- State Medical Board
- Employer or
- Association

Pathologist v. Fire Investigator Mythology

?

- Shiny alligatoring
- Crazed glass
- Depth of Char
- Lines of demarcation
- Sagged springs
- Angle of the “V”
- Spalling

Fire Investigator Mythology

The Fundamental Myth:

**Accelerated fires burn
“rapidly” and “intensely,”
therefore...**

Fire Investigator Mythology

The Fundamental Myth:

**...any fire that burns
“rapidly” or “intensely”
must be accelerated.**

Fire Investigator Mythology

A Corollary Fundamental Myth:

Accidental fires start as “slow, smoldering fires.” Even after they make the transition to flaming combustion,...

Fire Investigator Mythology

A Corollary

Fundamental Myth:

they remain “slow, smoldering fires.”

Fire Investigator Mythology

- Shiny alligatoring

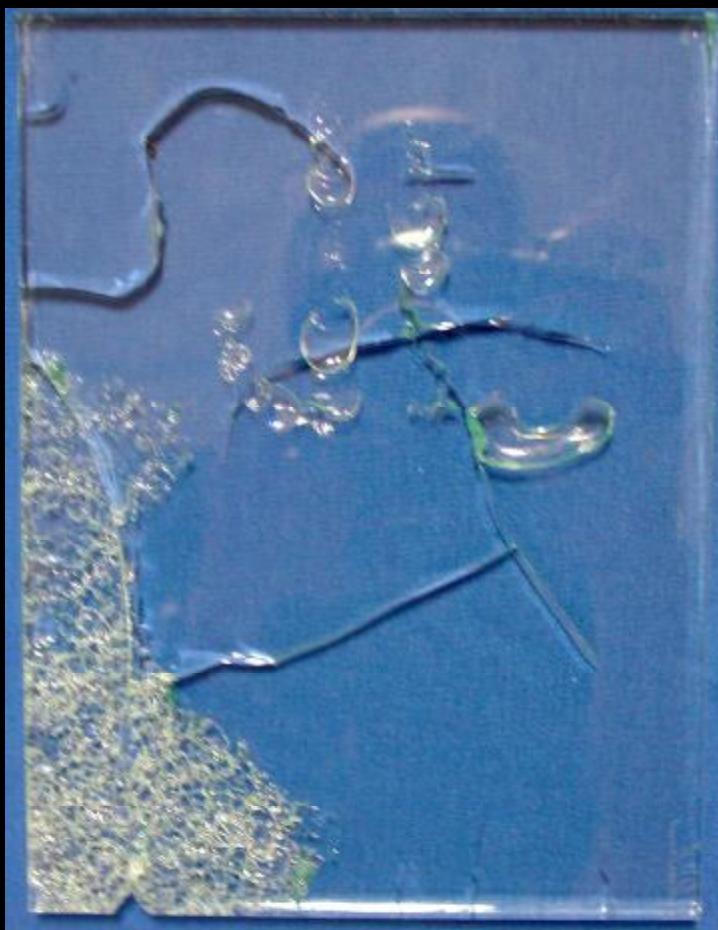


Fire Investigator Mythology



Fire Investigator Mythology

- Crazed glass

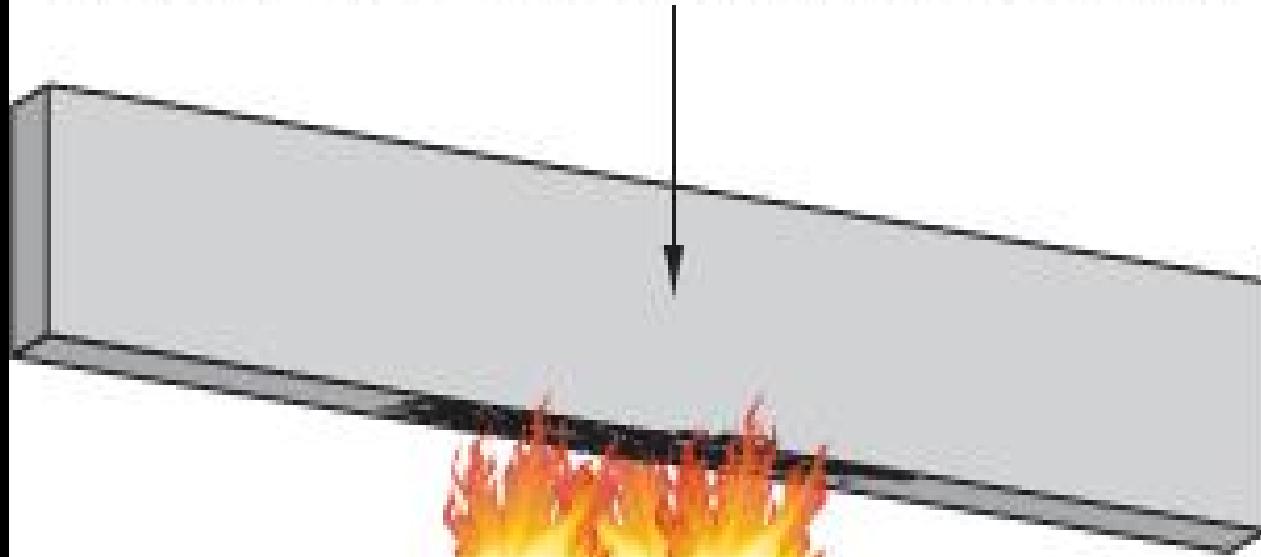


Fire Investigator Mythology

- Depth of char

A 2x10 requires over 4 hours to burn

Fire from below does not cause the side surfaces to burn



Fire attacks only the bottom surface

Fire Investigator Mythology

- Lines of demarcation



Fire Investigator Mythology

- Lines of demarcation



Fire Investigator Mythology

- Lines of demarcation



Fire Investigator Mythology

- The angle of the “V”

From the US Army Field Manual:

“A normal fire, consuming wood plastic or electrical insulation, would burn with a “V” pattern of approximately 30°, measured vertically. If an accelerant was used, or if highly combustible material was involved, the “V” would be narrower as the temperature of the fire increased, due to the additional heat...”

Fire Investigator Mythology

- The angle of the “V”

From the US Army Field Manual (2005):

“...content of the accelerant or flammable liquid. This would cause a faster rise of heat and flame, resulting in a “V” pattern of approximately 10°, depending on the heat flux generated by the accelerant.”

Fire Investigator Mythology

- Spalling



Fire Investigator Mythology

- Spalling



Fire Investigator Mythology

*Where did
these
myths
originate?*

- Shiny alligatoring
- Crazed glass
- Depth of Char
- Lines of demarcation
- Sagged springs
- Angle of the “V”
- Spalling



ARSON AND ARSON INVESTIGATION

SURVEY AND ASSESSMENT



National Institute of Law Enforcement and Criminal Justice
Law Enforcement Assistance Administration
United States Department of Justice



*United States
Department of
Justice, 1977*

***“Although burn
indicators are widely
used to establish the
causes of fires, they have
received little or no
scientific testing.”***

They recommended “a program of carefully planned scientific experiments be conducted to establish the reliability of currently used burn indicators. Of particular importance is the discovery of any circumstances which cause them to give false indications (of, say, a fire accelerant).”

“A primary objective of this testing would be to avert the formidable repercussions of a court ruling on the inadmissibility of burn indicators on the grounds that their scientific validity had not been established.”

Three years
later. . . .

Fire Investigation Handbook

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

NBS Handbook 134

*United States
Department of
Commerce,
National Bureau
of Standards,*

1980

*With significant input
from the
National Fire Academy*

Response to new knowledge,
standards, and reliability
requirements

Response to new knowledge, standards and reliability requirements

Whining in the US
US reaction similar to *Miranda*
Acceptance in the UK



INTERNATIONAL ASSOCIATION OF ARSON INVESTIGATORS

IAAI *amicus* brief

Benfield, 1997, Kumho, 1999

“If a stringent *Daubert* analysis is applied, the testimony of experts with years of experience and training in their field could be systematically excluded even though their investigations comport with **traditional** and accepted procedures. . . .

IAAI *amicus* brief

Testimony is properly admitted ... when the testimony is non-scientific, when the methodology does not approach the outer boundaries of scientific knowledge, and when the evidence derives from experience and training. In these instances, the investigations rely on ‘**less scientific**’ techniques and methodology.”

Context for Concern:

- The investigator testifies that he sees “pour patterns,” BUT
- The laboratory results are negative for the presence of any ignitable liquid residues.

OR

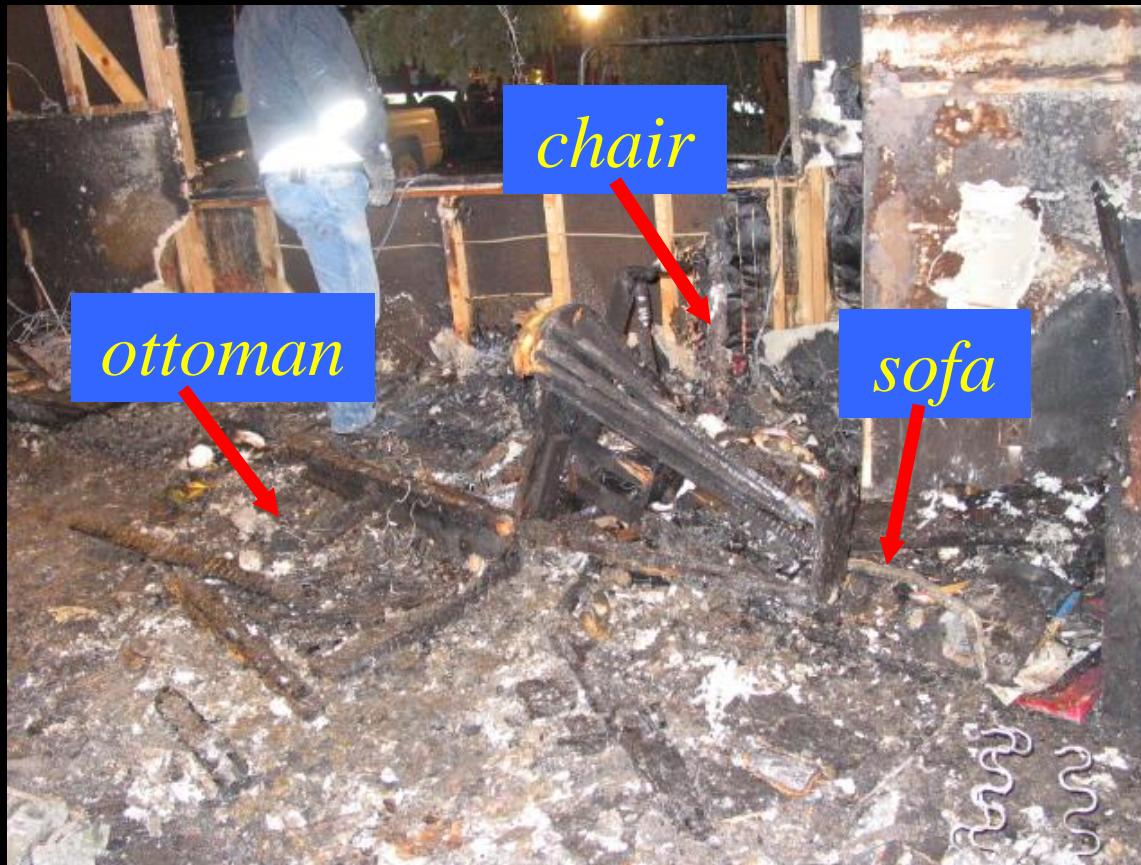
Context for Concern:

- All the fire damage is contiguous, but by performing a calculation, referring to a model, or relying on “experience” in reading fire patterns, the investigator opines that there **MUST** have been multiple origins.

Context for Concern:



Context for Concern:



Context for Concern:

- IF this is really an arson fire
- THEN the defendant is the only possible perpetrator. (Usually this is because the defendant gives an account of an accidental fire, and only the arsonist has a motive to lie.)

Sources of Error:

- Overlooking critical data

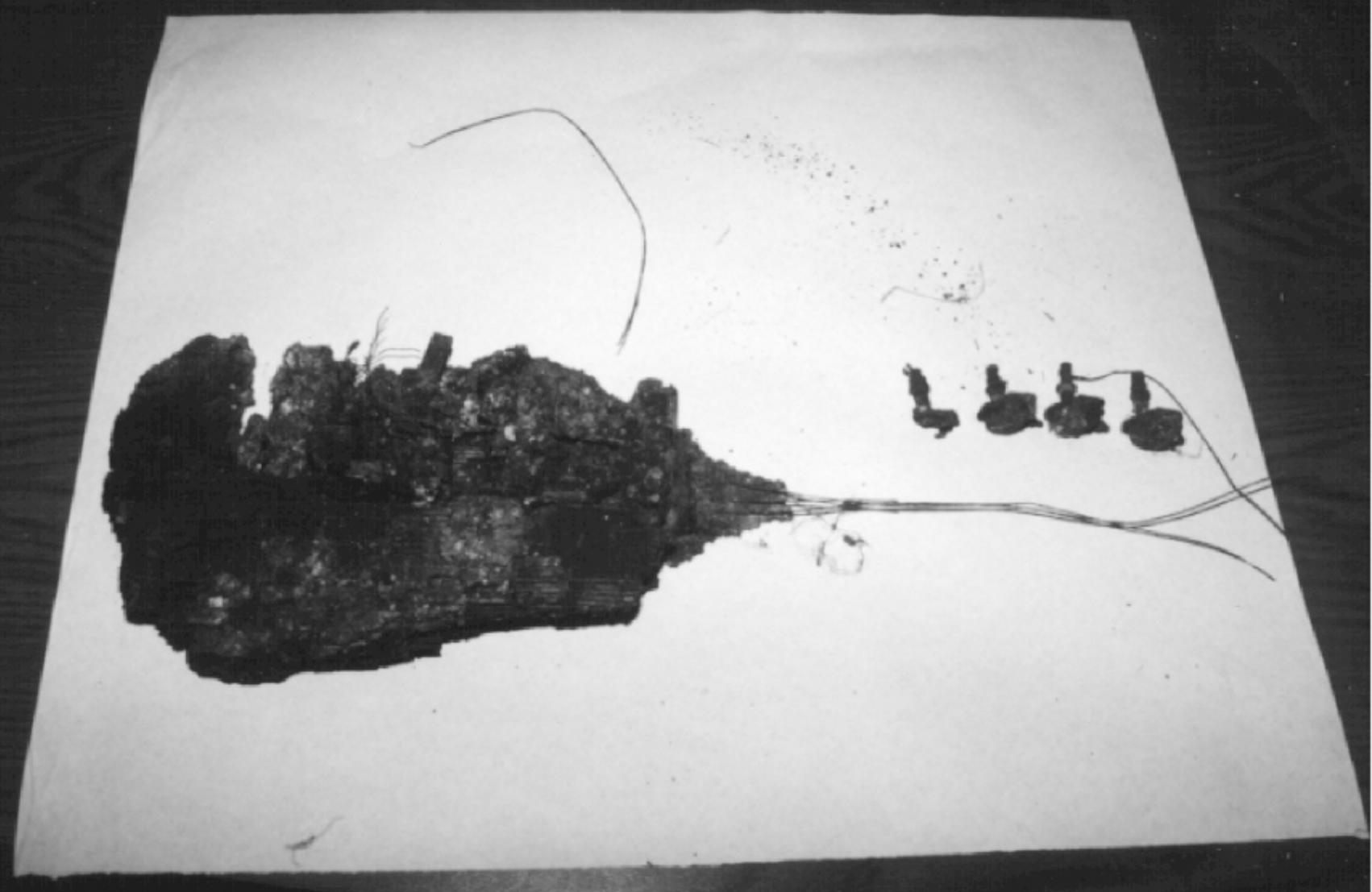
Sources of Error:

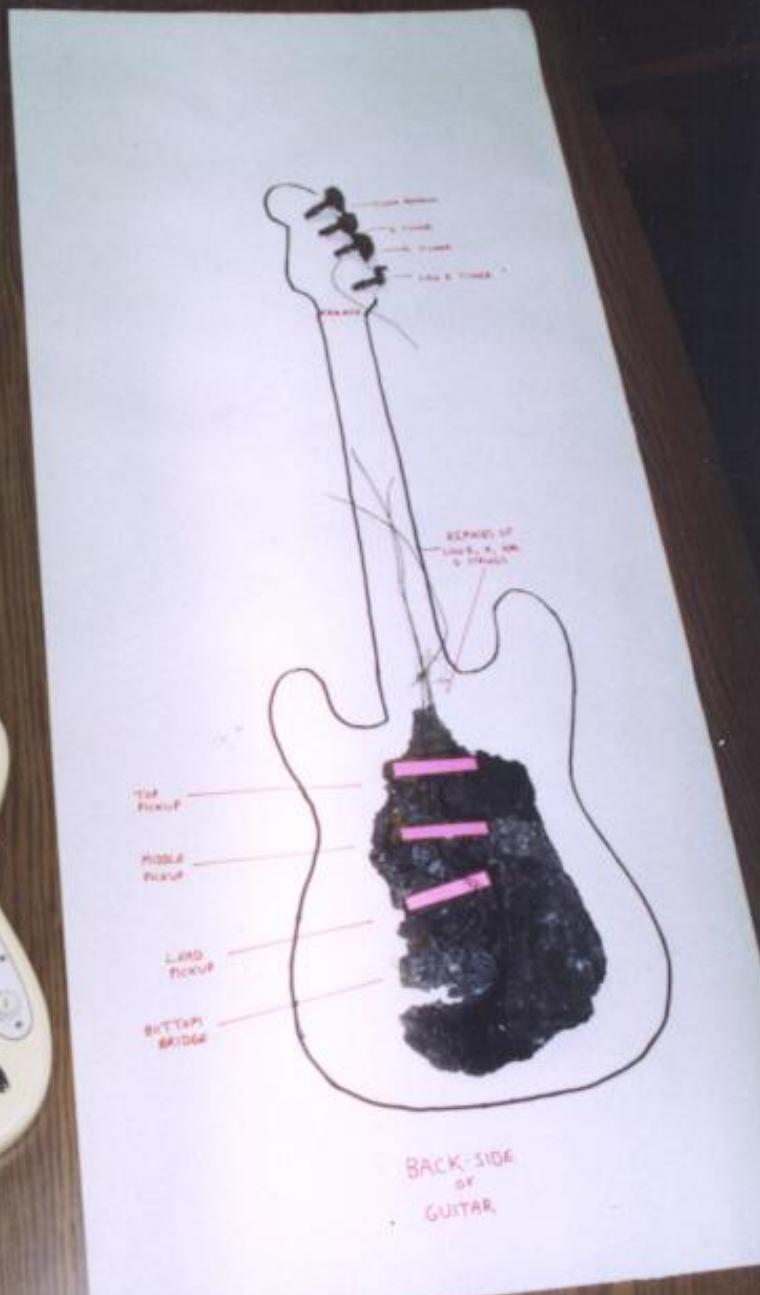
- Overlooking critical data

Fire scenes are big messy places where everything is black or gray. People looking specifically for “evidence of arson” may overlook “evidence of an accident.”

***“The following items
were noted as missing:
Investigators were not able
to find the remains of an
electric guitar which was
indicated to have been near
the front window in the den
of the residence.”***









Sources of Error:

- Misinterpreting critical data

The V-pattern at the doorway might be explained as a result of an accelerant burning there, or it might simply be the result of ventilation.



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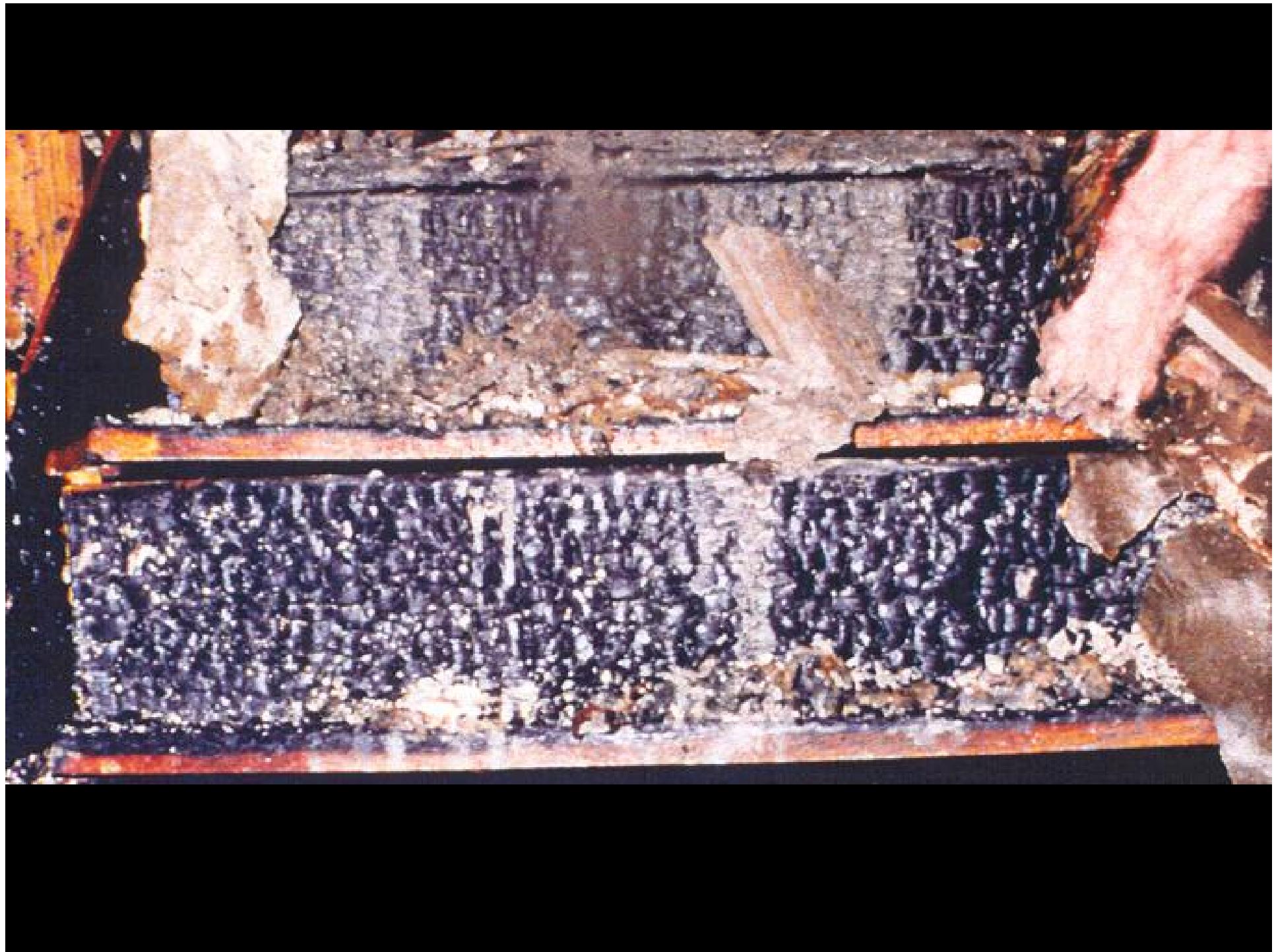
*“The tragedy of science...
The slaying of a beautiful
hypothesis by an ugly fact.”*

-Thomas Huxley

Sources of Error:

- Misinterpreting irrelevant data

Any of the myths used as indicators of arson fall into this category.



Sources of Error:

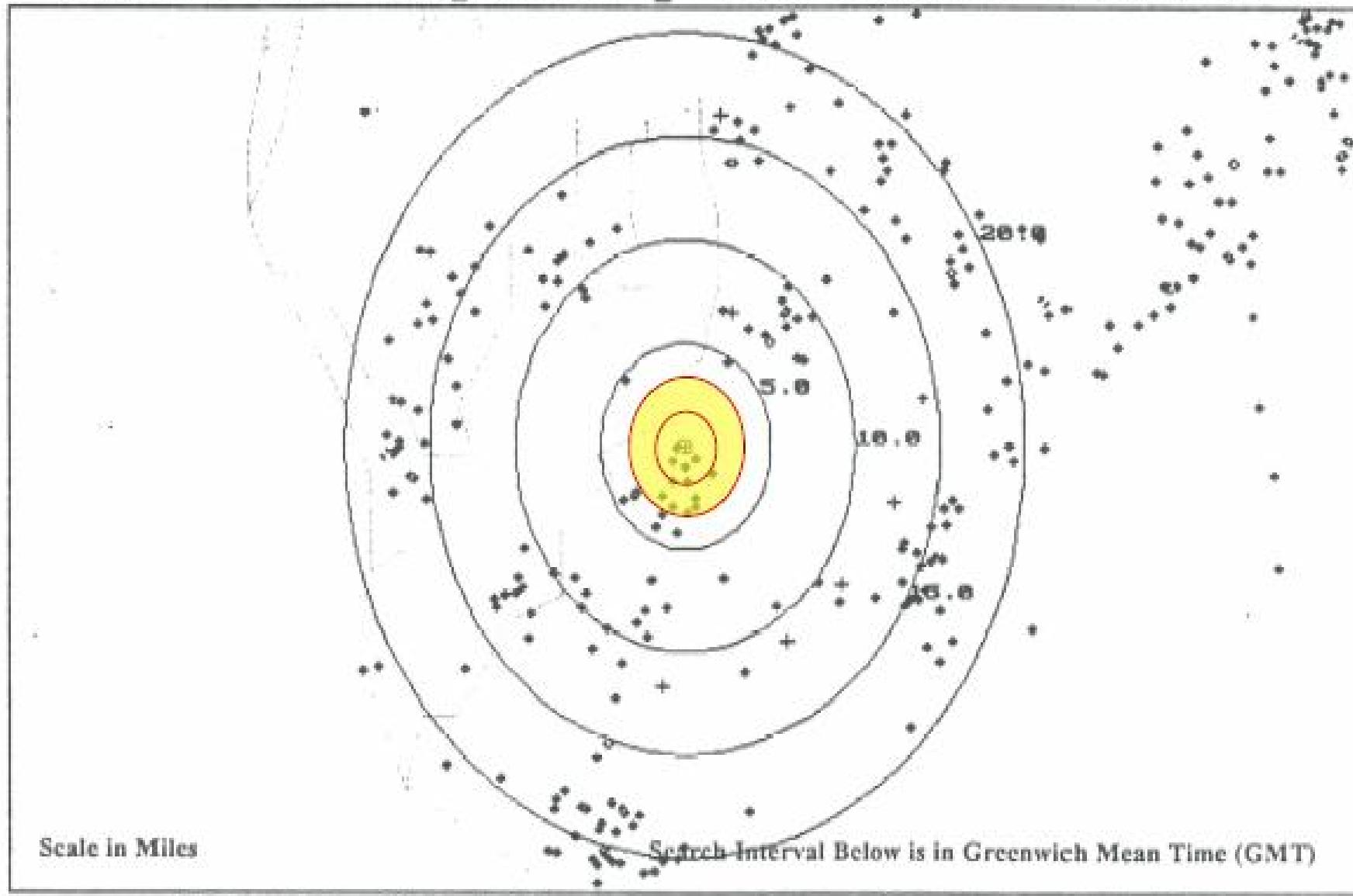
- Ignoring inconsistent data

Also known as “inconvenient ” material.

“Eyewitnesses must be wrong.”

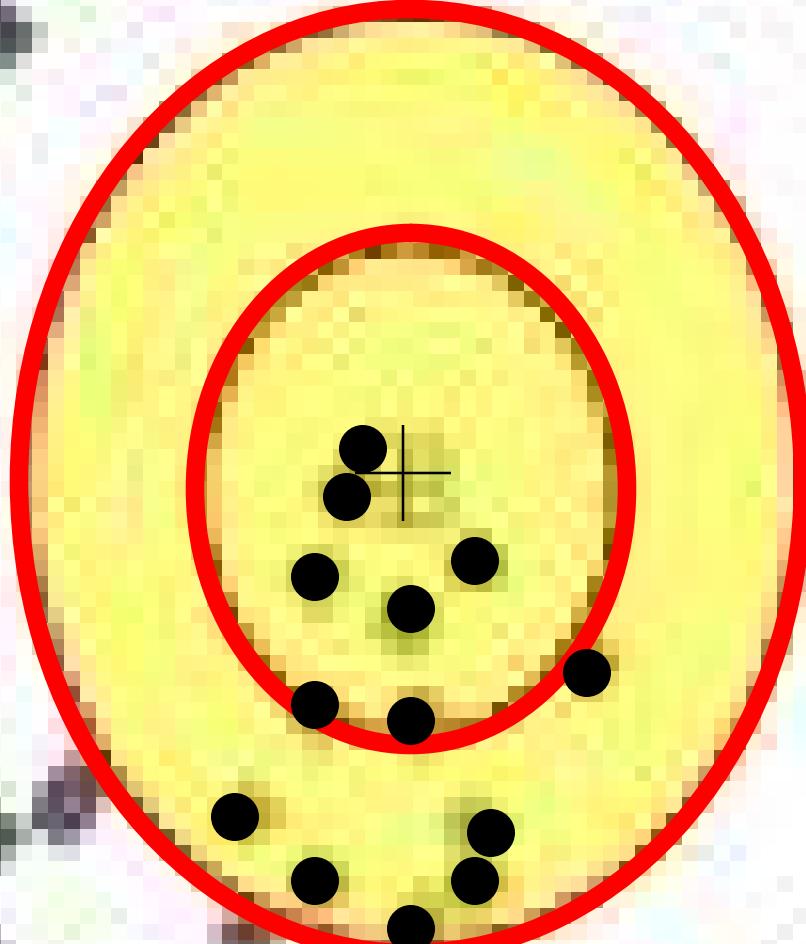
“A negative lab report is ‘inconclusive’.”

National Lightning Detection Network



Error bar

~ 2.4 mi



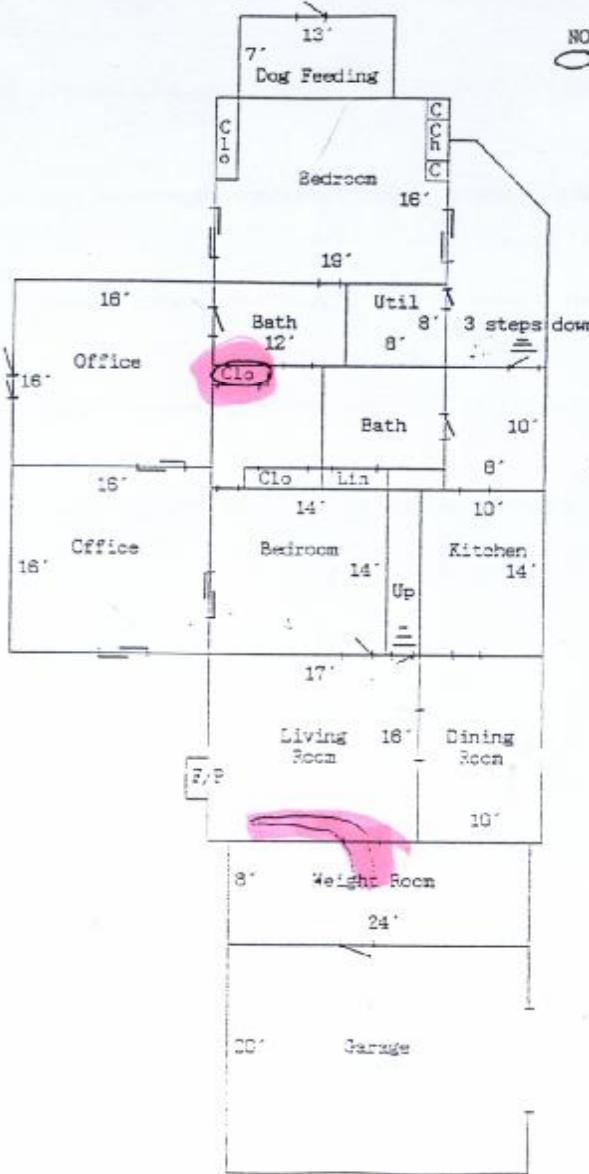
Sources of Error:

- Two dimensional thinking

Fire is a 3 dimensional phenomenon, but most of the record is left on 2 dimensional surfaces (floors and walls). Too often, arson investigators look only at the floor, because that's where an arsonist would be expected to pour gasoline.

NORTH ←

FILE NUMBER: 92-WB139
INSURED: MANSON AND EVE JOHNSON



Sources of Error:

- Poor communication

Lack of a “principal investigator” leads to the formulation of hypotheses by people who do not have all of the data.

Sources of Error:

- Faulty Chemistry or Engineering

Just because these witnesses are more educated than the arson investigator, that does not make them immune to all of the errors listed above (though most do not believe the myths).



NEUTRAL

GROUND

LINE





“Red Flags” that MIGHT indicate that an error has occurred

- *No motive*

“Red Flags” that MIGHT indicate that an error has occurred

- *Arson call based entirely on the appearance of the burned floor in a post-flashover compartment*



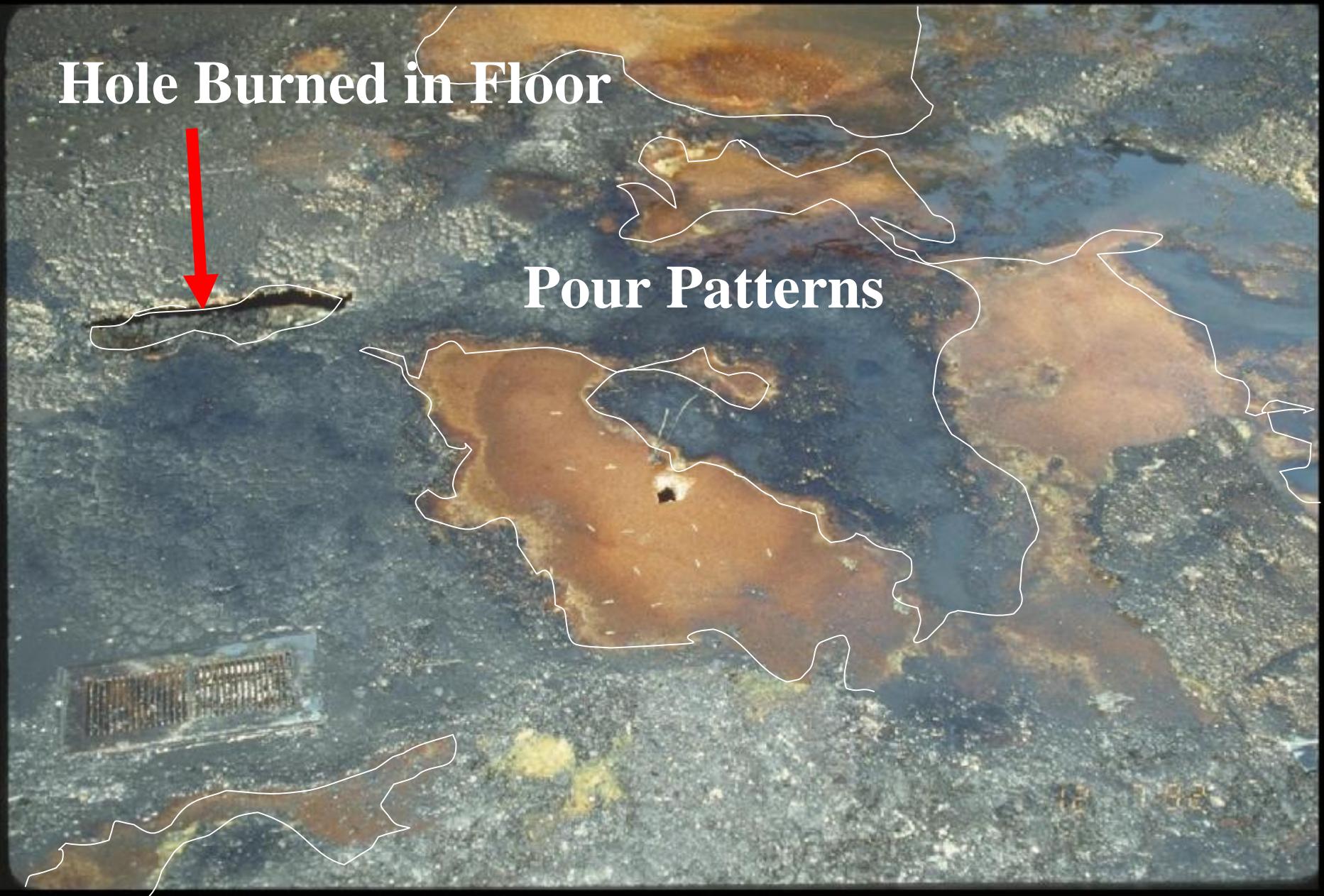




Hole Burned in Floor



Pour Patterns









No smoke on wall

“Donut Hole”



Unburned Carpet

“Red Flags” that MIGHT indicate that an error has occurred

- *Arson call based on “low burning,” OR crazed glass, OR spalling, OR “shiny alligatoring,” OR a “narrow V pattern,” OR “melted/annealed metal.”*

“Red Flags” that MIGHT indicate that an error has occurred

- *Arson call based on an unconfirmed canine alert.*



“Red Flags” that MIGHT indicate that an error has occurred

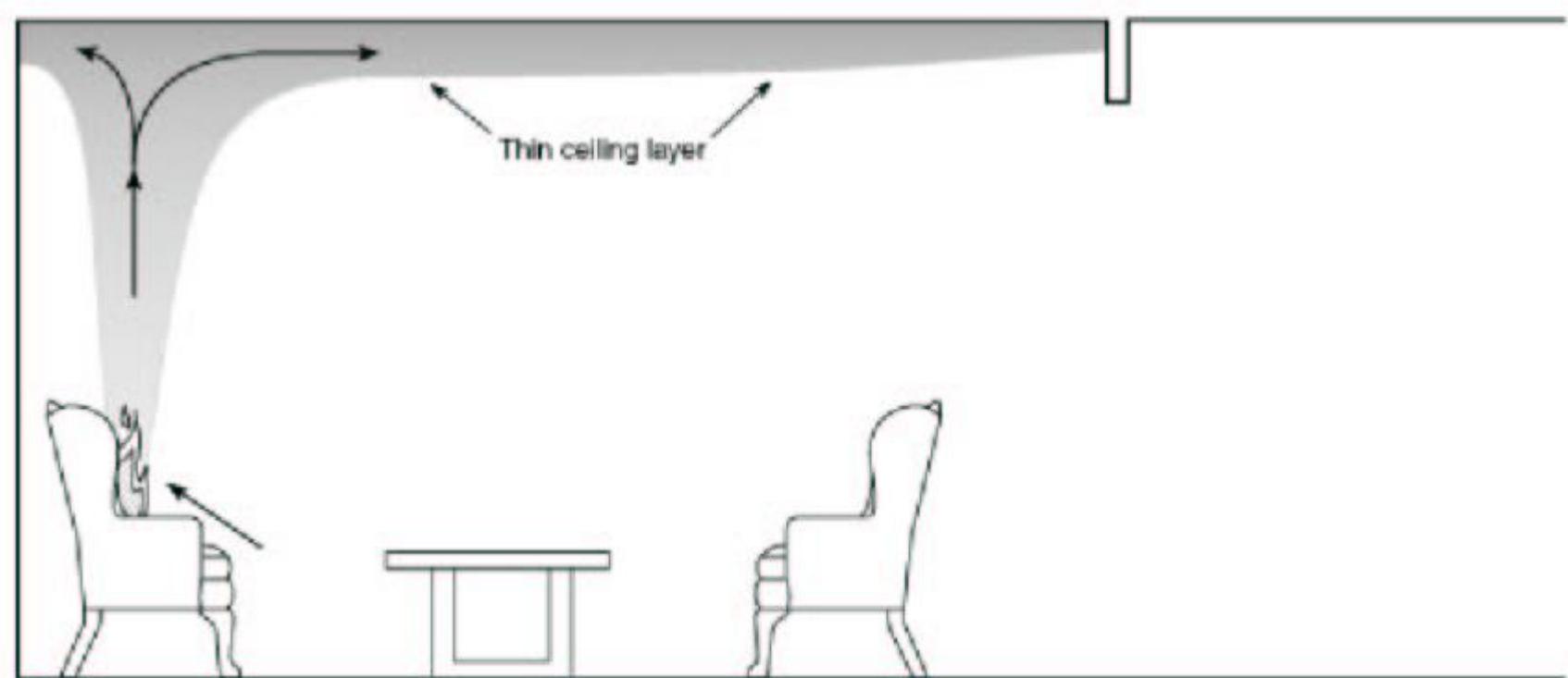
- *Arson call based on a fire that “burned hotter than normal.”*

“Red Flags” that MIGHT indicate that an error has occurred

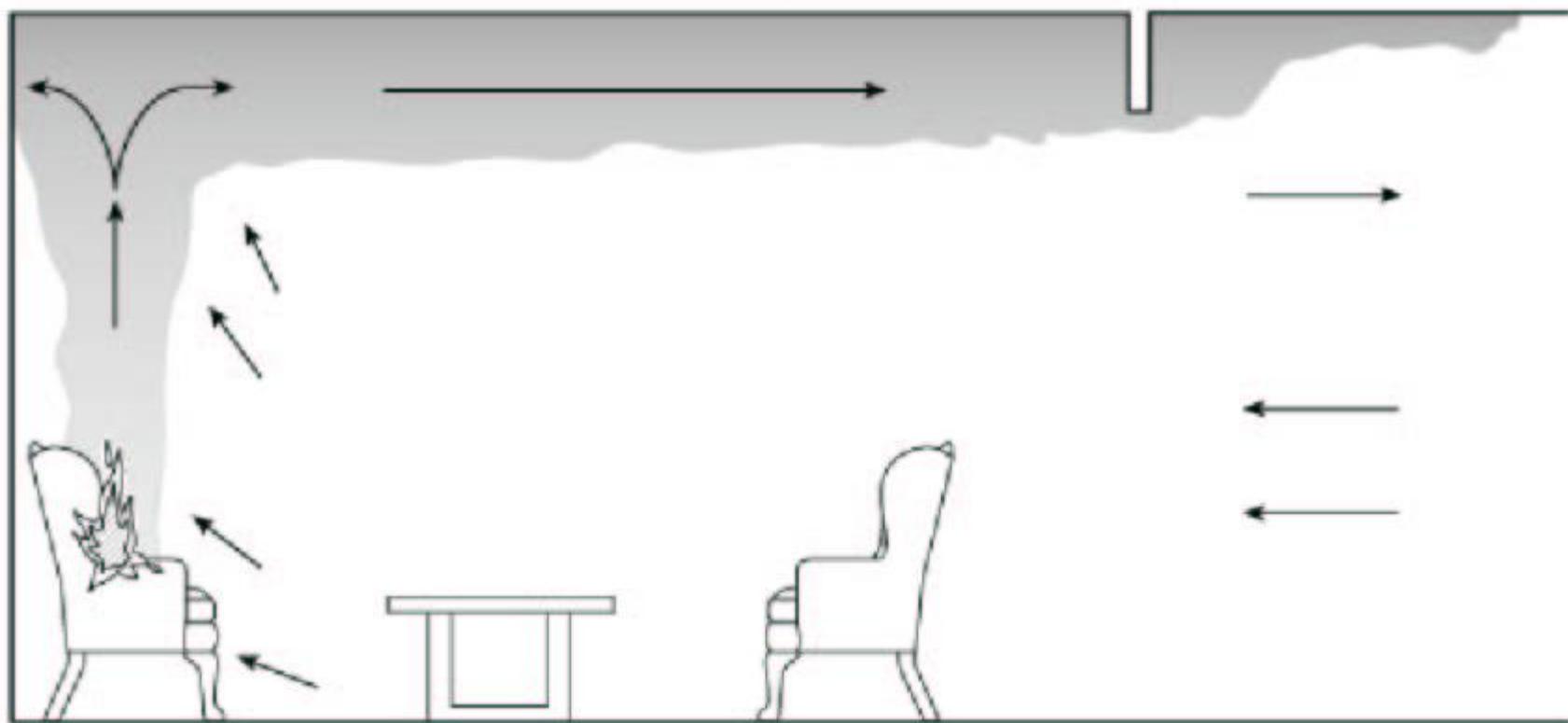
- *Arson call based on a fire that “burned faster than normal.”*



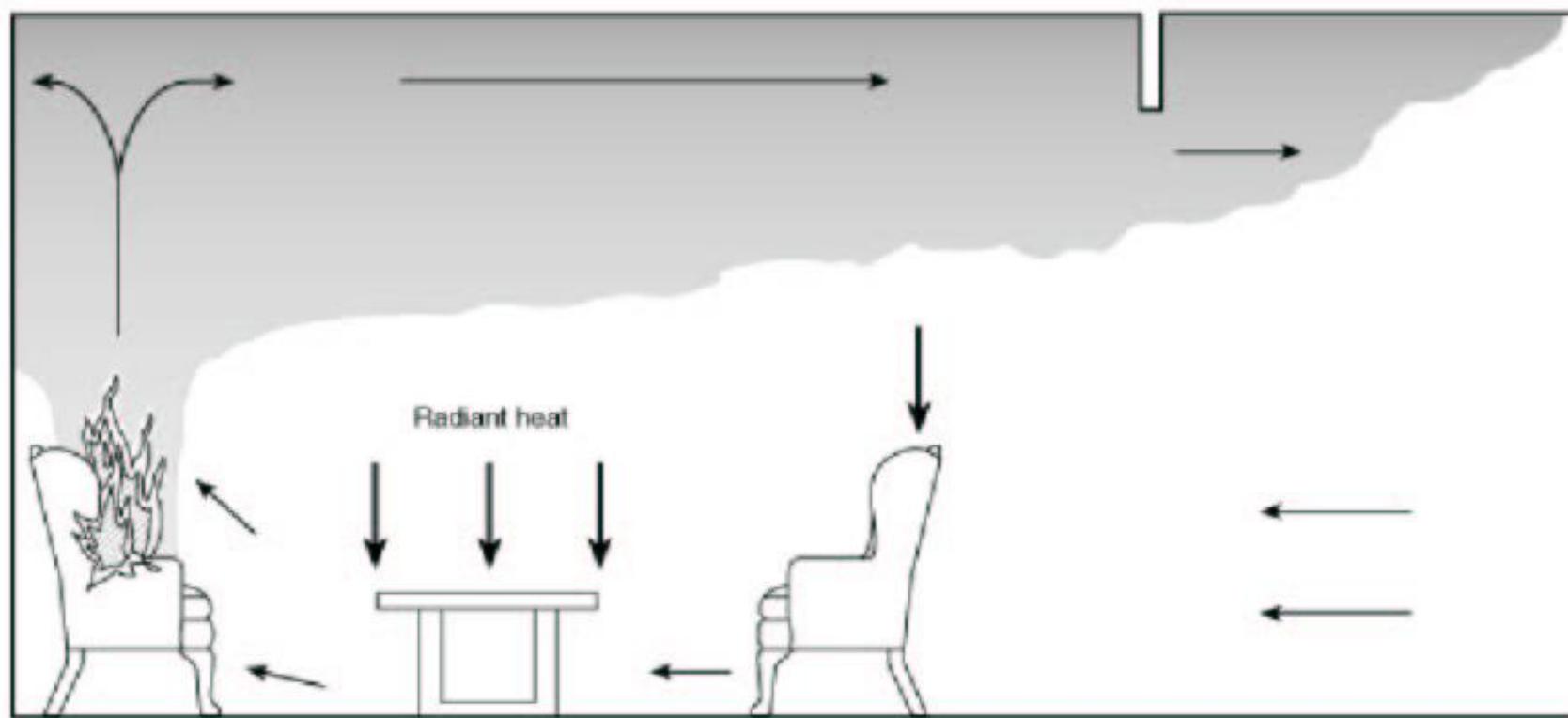
Free Burning Stage



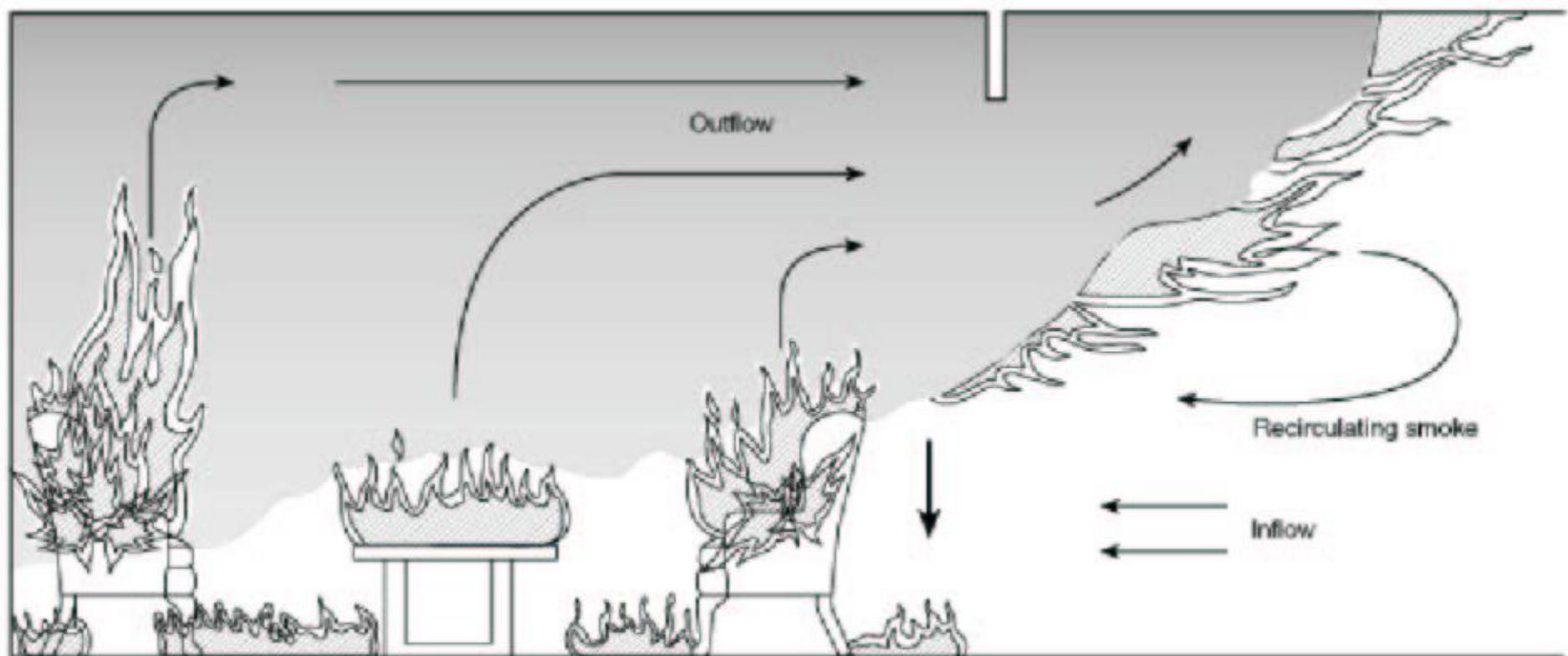
Hot Gas Layer Forms



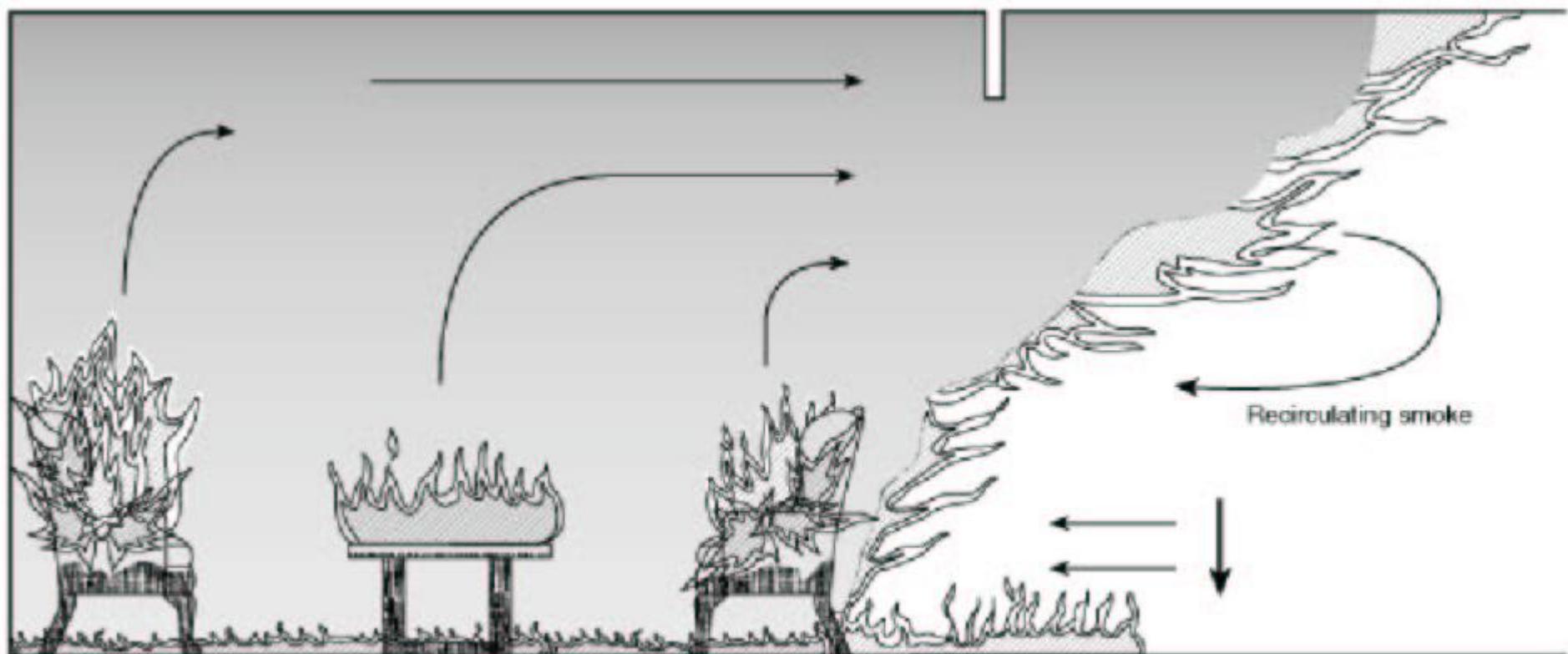
Radiation Sends Heat DOWN



Flashover Occurs, Igniting Everything



Full Room Involvement



“Red Flags” that MIGHT indicate that an error has occurred

- *Inconsistent accounts by neutral eyewitnesses.*

“Red Flags” that MIGHT indicate that an error has occurred

- *The accused refuses to cop a plea that involves no jail time.*

“Red Flags” that MIGHT indicate that an error has occurred

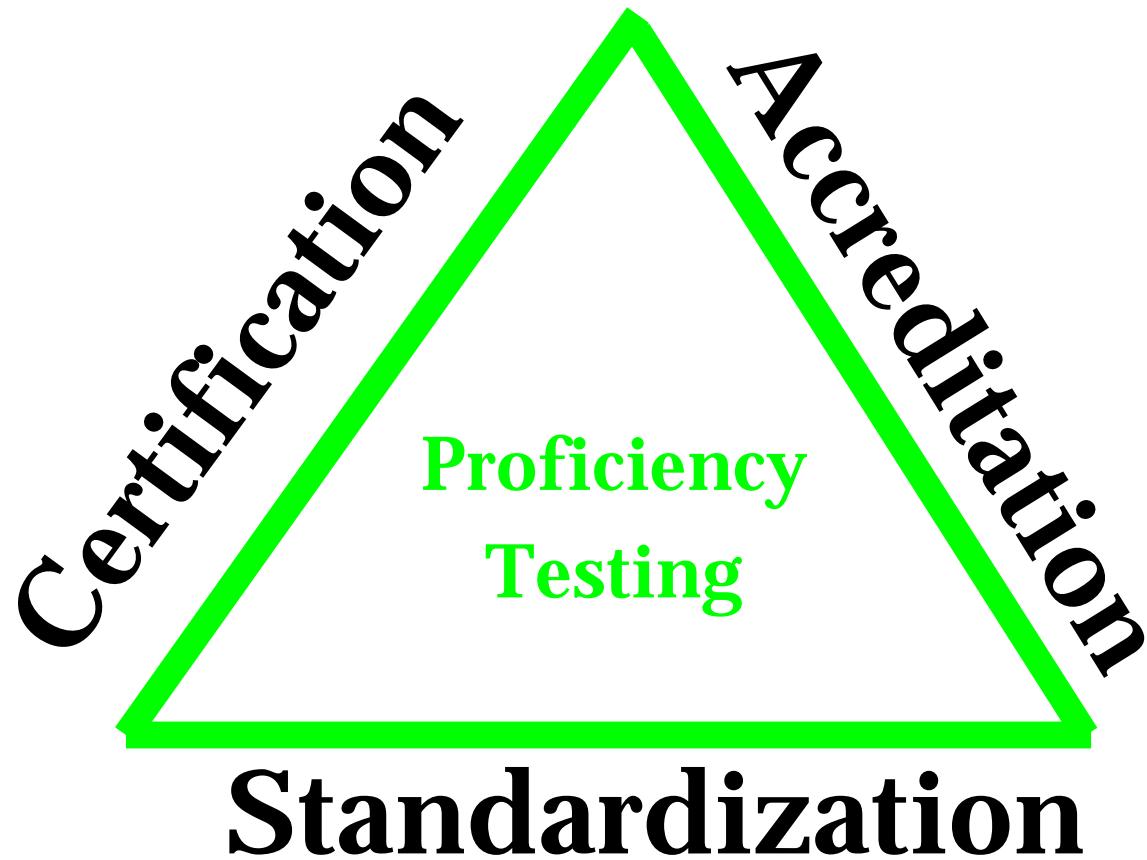
- *The accused are your parents' age, and have so far lived exemplary lives.*

“Red Flags” that **MIGHT** indicate that an error has occurred

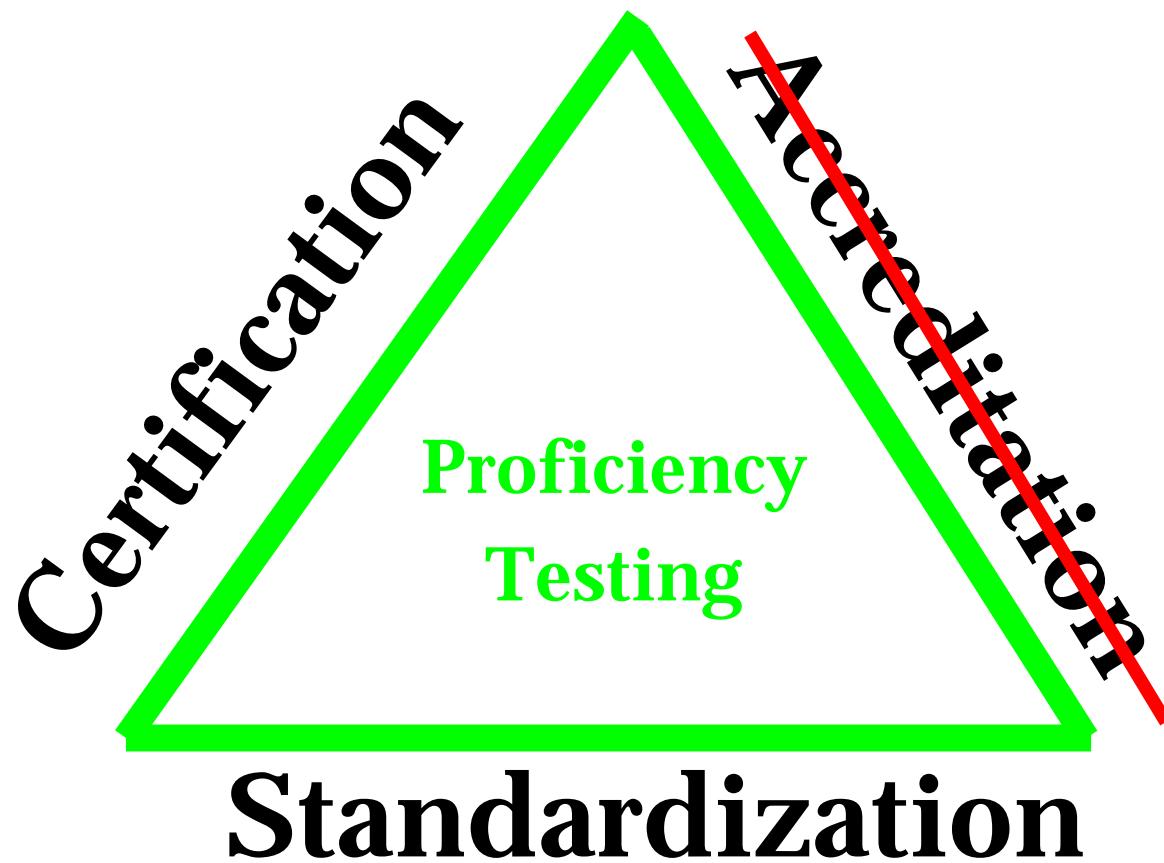
- *A mathematical calculation or a computer model is required to “prove” the origin(s) or the cause.*

The solution

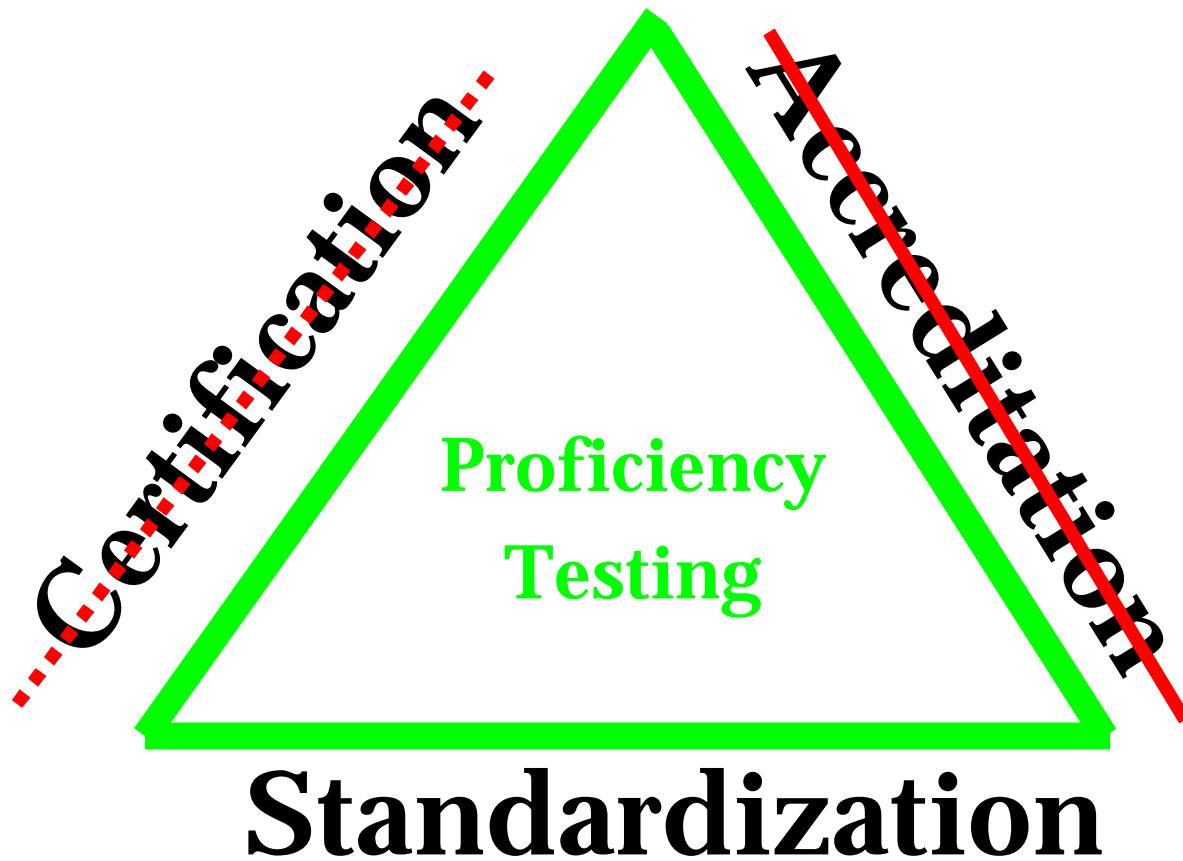
The Quality Triangle in Forensic Science



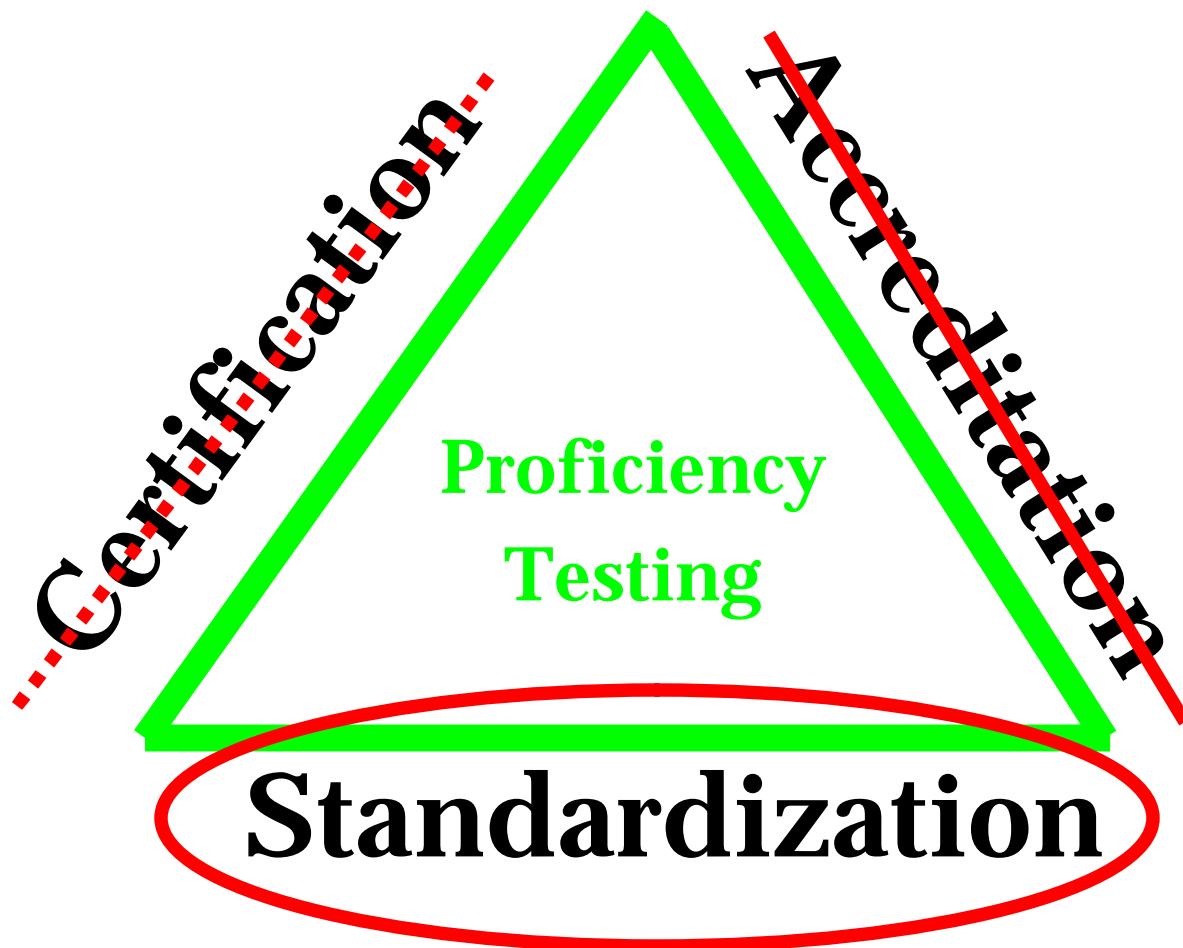
The Quality Triangle in Forensic Science



The Quality Triangle in Forensic Science



The Quality Triangle in Forensic Science



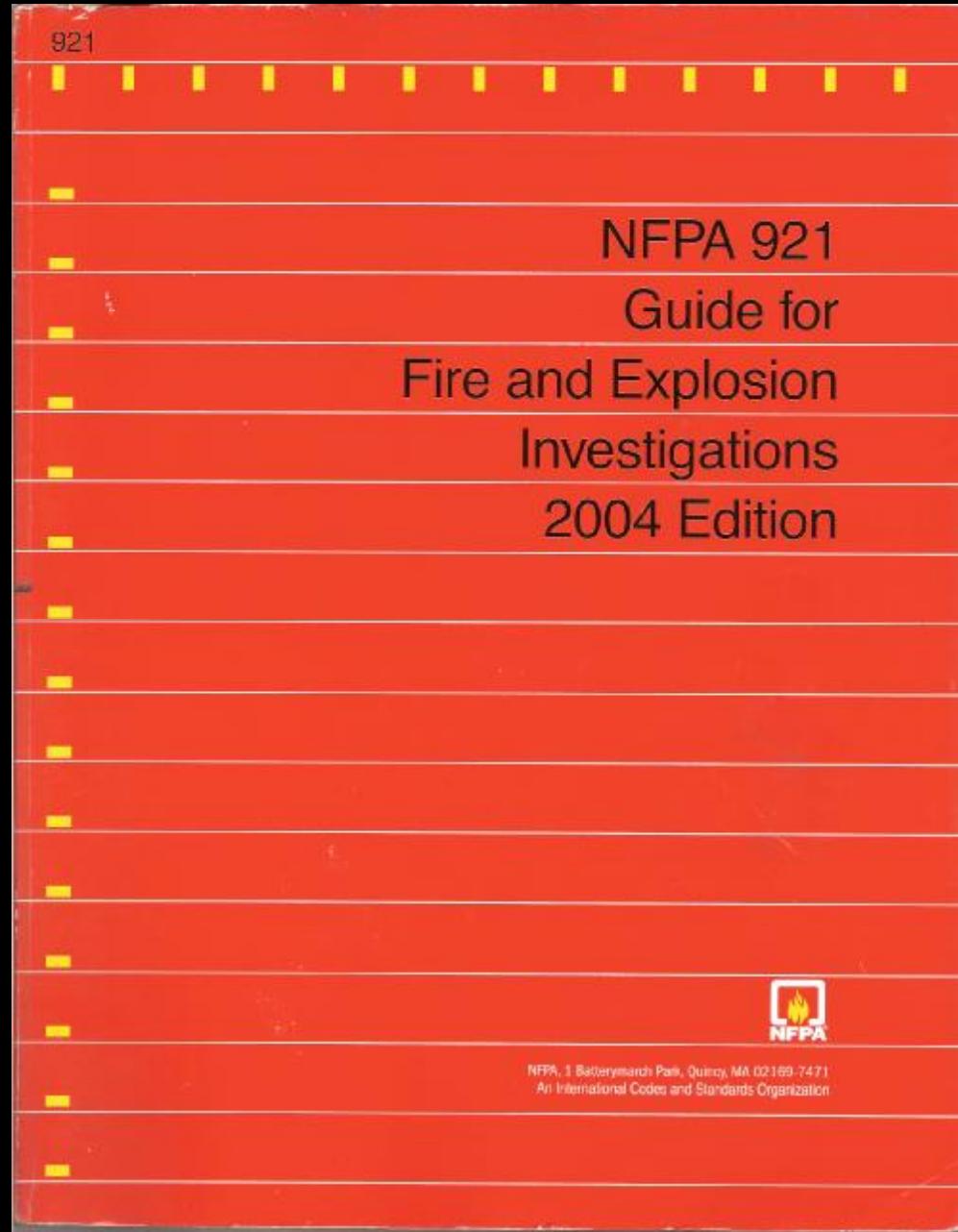
921

NFPA 921
Guide for
Fire and Explosion
Investigations
2004 Edition

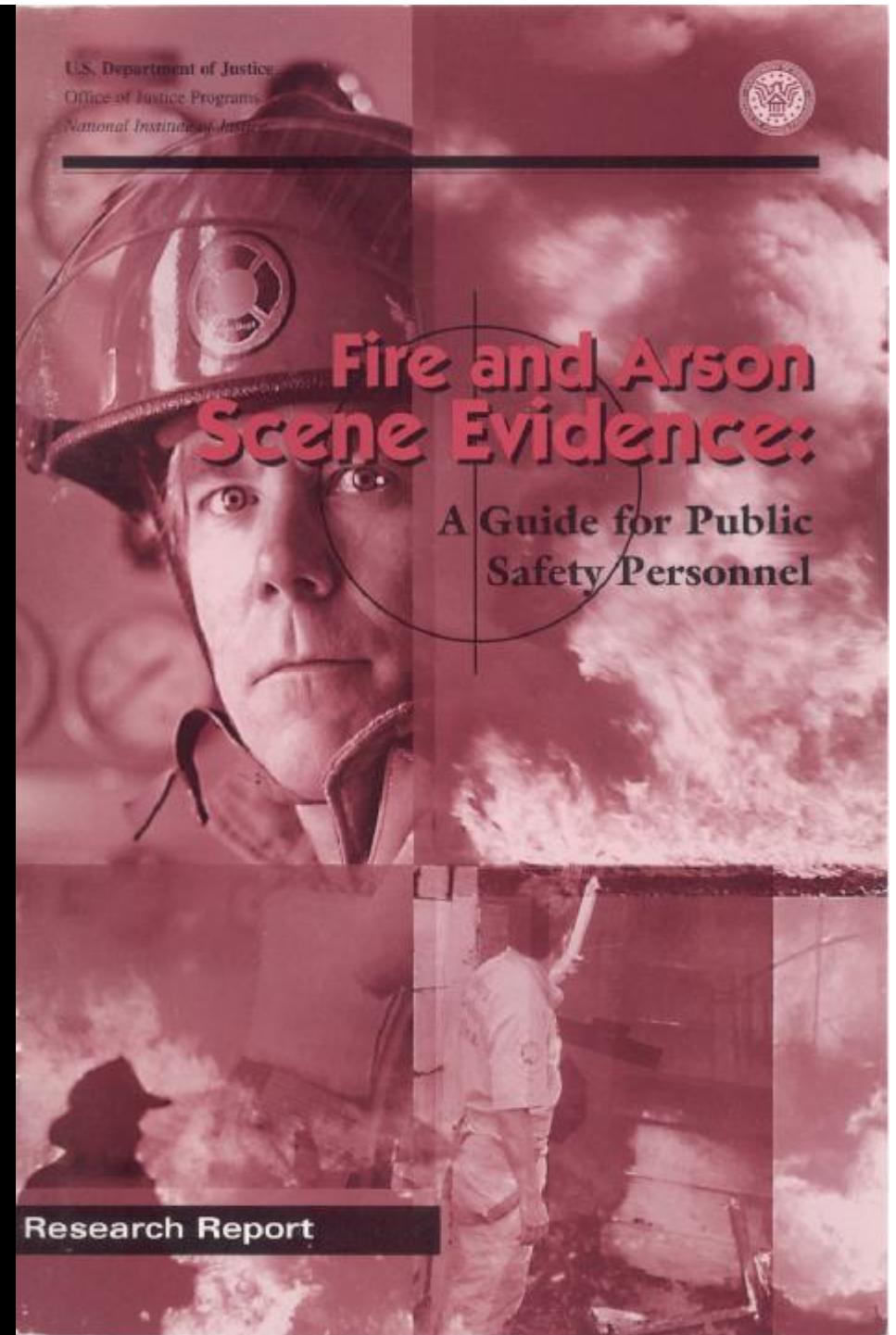


NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

*This document
represents the
Standard of
Care in Fire
Investigation*



NIJ, 2000



More Peer Review!

More Peer Review!

“It is ... essential in this science-related area that the courts administer the Federal Rules of Evidence in order to achieve the “end(s)” that the Rules themselves set forth, not only so that proceedings may be “justly determined,” but also so “that the truth may be ascertained.” -- Steven Breyer, writing for the majority in GE v Joiner

More Peer Review!

That means the COURT must authorize the expenditure of funds for an expert to advise defense counsel (or at least to have a special master review that which fails the “smell test”). Otherwise....

The right “to be confronted with witnesses against him, to have compulsory processes for obtaining witnesses in his favor, and to have the Assistance of Counsel for his defense” is an empty promise.

Chicago Tribune



31° F

ENTERTAINMENT BUSINESS HOMES JOBS CARS SHOPPING PLACE ADS

Breaking news: Saddam Hussein's death sentence upheld

Texas man executed on disproved forensics

Fire that killed his 3 children could have been accidental

By Steve Mills and Maurice Possley
Tribune staff reporters
Published December 9, 2004



Forensic

Review

Exchange

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