Initial Fire Investigation for First Responders

IFIFR-Student Manual

1st Edition, 1st Printing-November 2014

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ACKNOWLEDGMENTS

The development of any National Fire Academy (NFA) course is a complex process aimed at providing students with the best possible learning opportunity we can deliver.

There are many players in course development, each of whom plays an equally important part in its success. We want to acknowledge their participation and contribution to this effort and extend our heartfelt thanks for making this quality product.

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COURSE GOAL

The goal of this course is to empower students with the knowledge to identify and define key concepts of fire dynamics and fire modeling and develop the ability to apply the available tools to fire investigation and prevention in order to support conclusions using scientific principles.

AUDIENCE, SCOPE AND COURSE PURPOSE

The target audience for “Initial Fire Investigation for First Responders” (IFIFR) is first responders and their advancement in the professional development of fire, rescue and emergency service personnel and the mitigation of loss of life and property from fire and other hazards. An integral part of that program is training and professional development in fire and life safety education programs/courses.

The scope of this course is to provide first responders with the fundamental understanding of the principles, processes and procedures involved in fire scene examination.

The purpose of this course is to provide first responders with the tools to understand the key role they play in fire scene examination and in preserving and protecting important evidence for any subsequent investigation. The content of the course will provide a clear definition of the role of the first responder in arson detection and provide essential knowledge to enable him or her to recognize the potential of intentionally set fires, preservation and protection of evidence, and proper reporting of information to appropriate officials. By strengthening the partnership between first responders and investigators, the chances for successfully solving arson-related crimes will increase. The course includes topics such as fire behavior, critical observations of the first responder, fire causes, scene security and evidence preservation, legal considerations, and documentation of findings.

GRADING METHODOLOGY

Assignments/Activities

Assignments are a combination of written exercises and group activities. The purpose of these exercises and activities is for the students to demonstrate their overall understanding of the course content that includes the ability of first responders to apply key concepts and principles to conduct scientifically valid origin and cause investigations and to serve as effective witnesses in criminal or civil litigation. The instructors will read, comment and provide feedback on students’ work at regular intervals throughout the course. At the end of the course, students are required to successfully pass a comprehensive written examination with a score of 70 percent or better.

Each evaluated assignment/activity receives a score. When evaluating course assignments/activities, instructors will consider the following:

- Did the student comprehensively answer the assigned questions?
- Did the student comprehensively address all issues within his or her response?
- As a professional, is the student writing at a collegiate level, analyzing, reflecting on and evaluating subject matter using appropriate grammar, punctuation and spelling?

As assignments and activities are evaluated throughout the course, emphasis should be placed on ensuring that instructor comments are positive, diagnostic and corrective. Diagnostic means that instructors clearly indicate in a positive and constructive manner where and how the assignment/activity succeeded or fell short of meeting course objectives and learning outcomes. Corrective means instructors specifically describe what the student must do to bring the assignment/activity/examination up to a passing level.

Student Activities

The activities required throughout the course are scored as follows:

- The written and verbal responses to questions and issues raised in the activities include all of the required elements listed in the objectives for the activity in accordance with the learning outcomes.
- Instructors will document the evaluation of students' activities on the Initial Fire Investigation for First Responders Evaluation Master Sheet. Any corrective and/or diagnostic comments about the students' plans should also be written on the form.
- Instructors will record the appropriate grade for each student on the Initial Fire Investigation for First Responders Evaluation Master Sheet.
- Instructors will share grade sheets, including any comments/recommendations with the student after completion of the required activities/assignments and grading.

Note: The Initial Fire Investigation for First Responders Evaluation Master Sheet will be used for official record-keeping of students' scores and will be turned in to the training specialist at the conclusion of the course.

Final Course Grade

The student's final grade for IFIFR will be computed as follows:

Point Distribution:

- Attendance: 10 points
- Classroom participation/discussion: 10 points
- Learning activities: 30 points
- Examination: 50 points

SCHEDULE

TIME	DAY 1	TIME	DAY 2
8:00 - 9:30	Introduction, Welcome and Administrative	8:00 - 9:00	Unit 3: Fire Causes (cont'd)
9:30 - 9:40	*Break*	9:00 - 9:10	*Break*
9:40 - 10:40	Unit 1: Fire Behavior	9:10 - 10:00	Unit 3: Fire Causes (cont'd) Unit 4: Vehicle Fires
10:40 - 10:50	*Break*	10:00 - 10:10	*Break*
10:50 - 12:00	Unit 1: Fire Behavior (cont'd)	10:10 - 12:00	Unit 4 : Vehicle Fires (cont'd) Activity 4.1: Vehicle Fire Examination
12:00 - 1:00	*Lunch*	12:00 - 1:00	*Lunch*
1:00 - 2:50	Unit 2: Fire Scene Examination	1:00 - 1:50	Unit 5: Fire Cause Determination
2:50 - 3:00	*Break*	1:50 - 2:00	*Break*
3:00 - 4:00	Unit 2: Fire Scene Examination (cont'd)	2:00 - 2:50	Unit 5: Fire Cause Determination (cont'd)
4:00 - 4:15	*Break*	2:50 - 3:00	*Break*
4:15 - 5:00	Unit 3: Fire Causes	3:00 - 5:00	Activity 5.1: Fire Scene Examination Final Examination and Evaluation

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FIREFIGHTER CODE OF ETHICS

Background

The Fire Service is a noble calling, one which is founded on mutual respect and trust between firefighters and the citizens they serve. To ensure the continuing integrity of the Fire Service, the highest standards of ethical conduct must be maintained at all times.

Developed in response to the publication of the Fire Service Reputation Management White Paper, the purpose of this National Firefighter Code of Ethics is to establish criteria that encourages fire service personnel to promote a culture of ethical integrity and high standards of professionalism in our field. The broad scope of this recommended Code of Ethics is intended to mitigate and negate situations that may result in embarrassment and waning of public support for what has historically been a highly respected profession.

Ethics comes from the Greek word ethos, meaning character. Character is not necessarily defined by how a person behaves when conditions are optimal and life is good. It is easy to take the high road when the path is paved and obstacles are few or non-existent. Character is also defined by decisions made under pressure, when no one is looking, when the road contains land mines, and the way is obscured. As members of the Fire Service, we share a responsibility to project an ethical character of professionalism, integrity, compassion, loyalty and honesty in all that we do, all of the time.

We need to accept this ethics challenge and be truly willing to maintain a culture that is consistent with the expectations outlined in this document. By doing so, we can create a legacy that validates and sustains the distinguished Fire Service institution, and at the same time ensure that we leave the Fire Service in better condition than when we arrived.

FIREFIGHTER CODE OF ETHICS

I understand that I have the responsibility to conduct myself in a manner that reflects proper ethical behavior and integrity. In so doing, I will help foster a continuing positive public perception of the fire service. Therefore, I pledge the following…

- Always conduct myself, on and off duty, in a manner that reflects positively on myself, my department and the fire service in general.
- Accept responsibility for my actions and for the consequences of my actions.
- Support the concept of fairness and the value of diverse thoughts and opinions.
- Avoid situations that would adversely affect the credibility or public perception of the fire service profession.
- Be truthful and honest at all times and report instances of cheating or other dishonest acts that compromise the integrity of the fire service.
- Conduct my personal affairs in a manner that does not improperly influence the performance of my duties, or bring discredit to my organization.
- Be respectful and conscious of each member's safety and welfare.
- Recognize that I serve in a position of public trust that requires stewardship in the honest and efficient use of publicly owned resources, including uniforms, facilities, vehicles and equipment and that these are protected from misuse and theft.
- Exercise professionalism, competence, respect and loyalty in the performance of my duties and use information, confidential or otherwise, gained by virtue of my position, only to benefit those I am entrusted to serve.
- Avoid financial investments, outside employment, outside business interests or activities that conflict with or are enhanced by my official position or have the potential to create the perception of impropriety.
- Never propose or accept personal rewards, special privileges, benefits, advancement, honors or gifts that may create a conflict of interest, or the appearance thereof.
- Never engage in activities involving alcohol or other substance use or abuse that can impair my mental state or the performance of my duties and compromise safety.
- Never discriminate on the basis of race, religion, color, creed, age, marital status, national origin, ancestry, gender, sexual preference, medical condition or handicap.
- Never harass, intimidate or threaten fellow members of the service or the public and stop or report the actions of other firefighters who engage in such behaviors.
- Responsibly use social networking, electronic communications, or other media technology opportunities in a manner that does not discredit, dishonor or embarrass my organization, the fire service and the public. I also understand that failure to resolve or report inappropriate use of this media equates to condoning this behavior.

Developed by the National Society of Executive Fire Officers

A Student Guide to End-of-course Evaluations

Say What You Mean ...

Ten Things You Can Do to Improve the National Fire Academy

The National Fire Academy takes its course evaluations very seriously. Your comments and suggestions enable us to improve your learning experience.

Unfortunately, we often get end-of-course comments like these that are vague and, therefore, not actionable. We know you are trying to keep your answers short, but the more specific you can be, the better we can respond.

Actual quotes from student evaluations:	Examples of specific, actionable comments that would help us improve the course:
1 "Update the materials."	• The (ABC) fire video is out-of-date because of the dangerous tactics it demonstrates. The available (XYZ) video shows current practices. • The student manual references building codes that are 12 years old.
2 "We want an advanced class in (fill in the blank)."	• We would like a class that enables us to calculate energy transfer rates resulting from exposure fires. • We would like a class that provides one-on-one workplace harassment counseling practice exercises.
3 "More activities."	• An activity where students can physically measure the area of sprinkler coverage would improve understanding of the concept. • Not all students were able to fill all ICS positions in the exercises. Add more exercises so all students can participate.
4 "A longer course."	• The class should be increased by one hour per day to enable all students to participate in exercises. • The class should be increased by two days so that all group presentations can be peer evaluated and have written abstracts.
5 "Readable plans."	• The plans should be enlarged to 11 by 17 and provided with an accurate scale. • My plan set was blurry, which caused the dotted lines to be interpreted as solid lines.
6 "Better student guide organization," "manual did not coincide with slides."	• The slide sequence in Unit 4 did not align with the content in the student manual from slides 4-16 through 4-21. • The instructor added slides in Unit 4 that were not in my student manual.
7 "Dry in spots."	• The instructor/activity should have used student group activities rather than lecture to explain Maslow's Hierarchy. • Create a pre-course reading on symbiotic personal relationships rather than trying to lecture on them in class.
8 "More visual aids."	• The text description of V-patterns did not provide three-dimensional views. More photographs or drawings would help me imagine the pattern. • There was a video clip on NBC News (date) that summarized the topic very well.
9 "Re-evaluate pre-course assignments."	• The pre-course assignments were not discussed or referenced in class. Either connect them to the course content or delete them. • The pre-course assignments on ICS could be reduced to a one-page job aid rather than a 25-page reading.
10 "A better understanding of NIMS."	• The instructor did not explain the connection between NIMS and ICS. • The student manual needs an illustrated guide to NIMS.

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UNIT 1: FIRE BEHAVIOR

TERMINAL OBJECTIVE

The students will be able to:

1.1 Explain the fundamental principles of combustion and the influence that the fire triangle/fire tetrahedron have on fire behavior and fire scene examination.

ENABLING OBJECTIVES

The students will be able to:

1.1 Identify and describe the major principles of combustion that affect the ignition, growth, development, spread and extinguishment of fire.

1.2 Explain the significance of the fire tetrahedron on fire behavior and its impact on fire causes.

1.3 Identify and describe three methods of heat transfer and their relationship to fire development.

1.4 Identify the difference between the five types of building construction.

1.5 Explain the link between building construction principles related to fire growth, development and spread.

1.6 Differentiate between flashover and backdraft.

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UNIT 1:
FIRE BEHAVIOR

Slide 1-1

ENABLING OBJECTIVES

- Identify and describe the major principles of combustion that affect the ignition, growth, development, spread and extinguishment of fire.
- Explain the significance of the fire tetrahedron on fire behavior and its impact on fire causes.

Slide 1-2

ENABLING OBJECTIVES (cont'd)

- Identify and describe three methods of heat transfer and their relationship to fire development.
- Identify the differences between the five types of building construction.

Slide 1-3

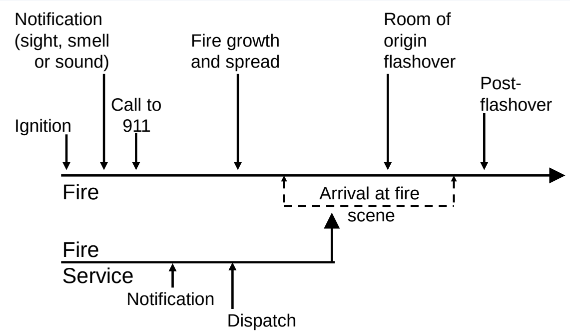
ENABLING OBJECTIVES (cont'd)

- Explain the link between building construction principles related to fire growth, development and spread.
- Differentiate between flashover and backdraft.

Slide 1-4

I. THE IMPORTANCE OF ESTABLISHING A TIMELINE THROUGH FIRE BEHAVIOR

FIRE TIMELINE



Slide 1-5

A. Establishing a timeline for the fire is a critical step in any fire investigation.

B. Can be used to support or disprove statements or hypotheses.

C. Helpful to identify conflicts or discrepancies during the data collection process.

II. FIRE BEHAVIOR

FIRE BEHAVIOR

Fire behavior is a complex phenomenon that must be understood to formulate scientifically valid opinions and conclusions.

Slide 1-6

A. Fire behavior is a complex phenomenon that must be understood to formulate scientifically valid opinions and conclusions.

DVD PRESENTATION

"NFPA IGNITION AND DEVELOPMENT"

Slide 1-7

DEFINITION OF FIRE

"Fire is a rapid oxidation process, which is a chemical reaction resulting in the evolution of heat and light in varying intensities."

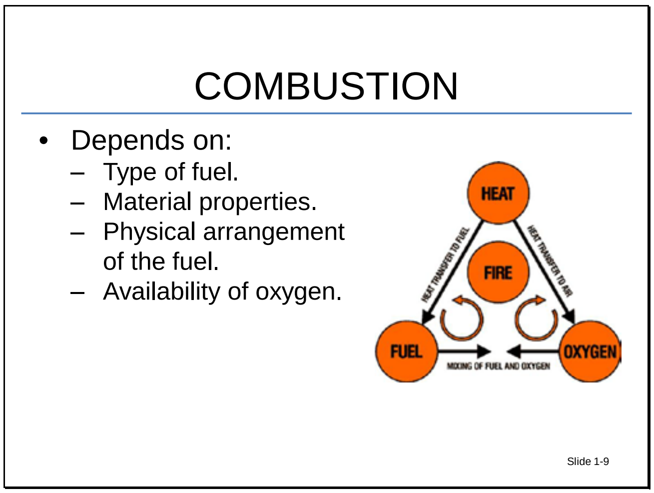
— National Fire Protection Association (NFPA) 921, *Guide for Fire and Explosion Investigations*

Slide 1-8

B. Definition of fire.

1. “Fire is a rapid oxidation process, which is a chemical reaction resulting in the evolution of heat and light in varying intensities” (National Fire Protection Association (NFPA) 921, *Guide for Fire and Explosion Investigations*).

2. A fundamental understanding of fire and its related chemical reactions is essential to successfully determining the origin and cause of a fire.



3. The amount of heat, the color of the light, smoke production, and the toxicity of the products of combustion depend upon four factors:

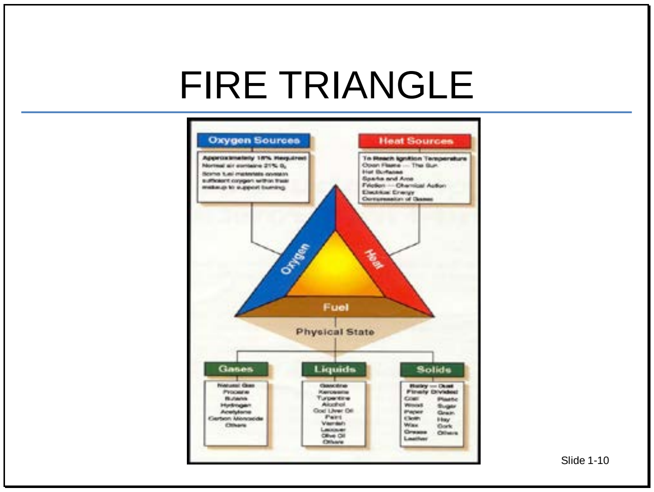
a. Type of fuel.

b. Material properties.

c. Physical arrangement of the fuel.

d. Oxygen available to support combustion.

C. Principles of combustion.



1. Fire triangle elements.

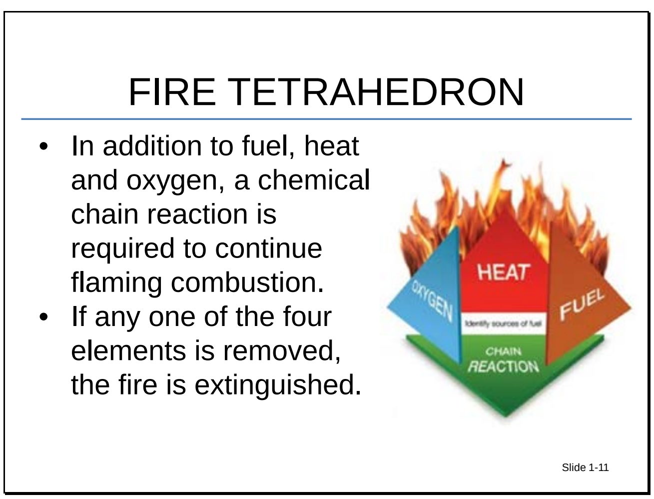
   a. Fuel in the form of a gas, can change from a solid or liquid to a gas.

   b. Sufficient heat to vaporize the material and ignite the vapor.

   c. Oxygen above the minimum levels needed to sustain combustion.

      - Air is an oxidizer.

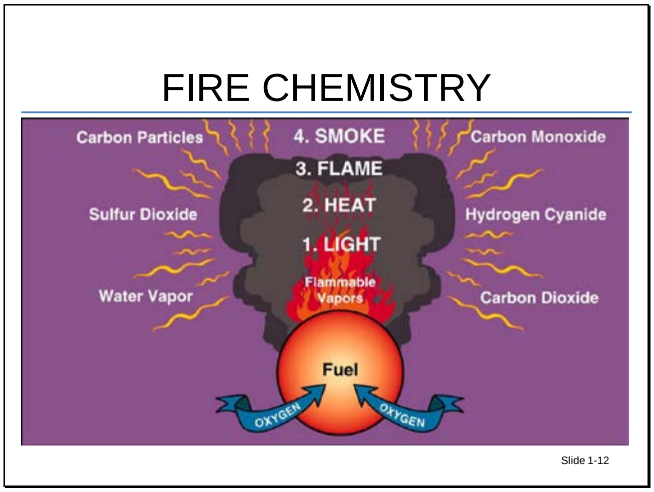
      - Air is about 21 percent oxygen.



2. Fire tetrahedron.

   a. The fourth element is the uninhibited chain reaction that allows the continuous heating of the fuel mass.

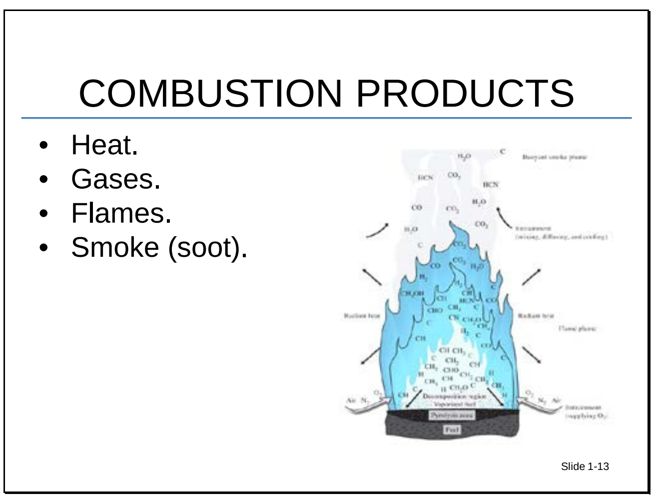
b. Continuous production of flammable gases, which then are ignited by the flame.



3. Fire chemistry.

a. Fire is a complex series of chemical reactions that emit a variety of combustion products.

b. Besides carbon dioxide and water vapors, there are many other byproducts produced that may be harmful to fire service personnel and occupants. These include carbon monoxide and hydrogen cyanide.



c. Fire is a combination of heat, gases, flames and smoke (soot).

FACTORS THAT IMPACT FIRE DEVELOPMENT

- Size, number and arrangement of ventilation openings.
- Thermal properties of the compartment.
- Ceiling height of the compartment.
- Size, composition and location of the fuel package first ignited.
- Availability and location of additional fuel(s).

Slide 1-14

4. Factors that impact fire growth, development and spread.

   a. Size, number and arrangement of ventilation openings.

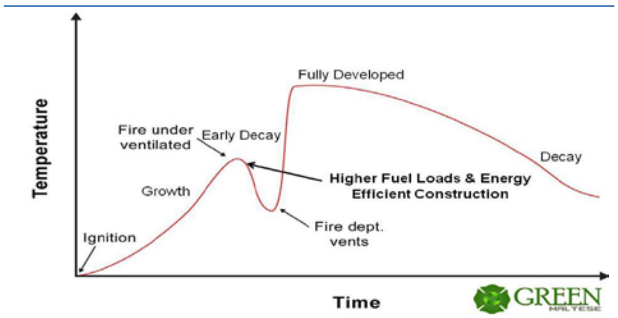
   b. Thermal properties of the compartment.

   c. Ceiling height of the compartment.

   d. Size, composition and location of the fuel package first ignited.

   e. Availability and location of additional fuel(s).

MODERN FIRE DEVELOPMENT



Slide 1-15

5. Fire development based on time and temperature.

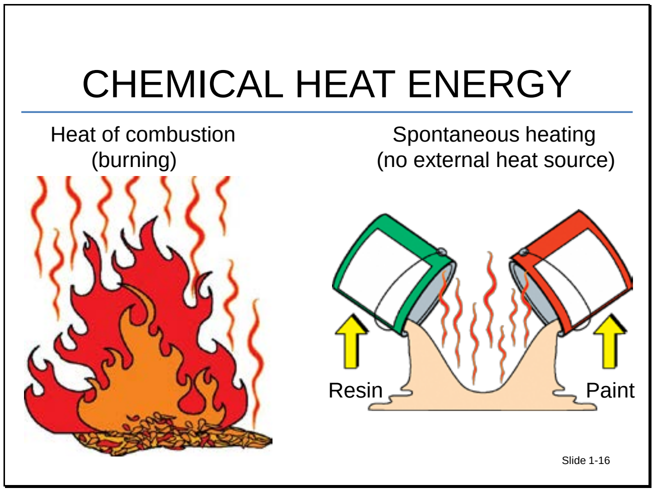
6. Stages of fire.

   a. Growth.

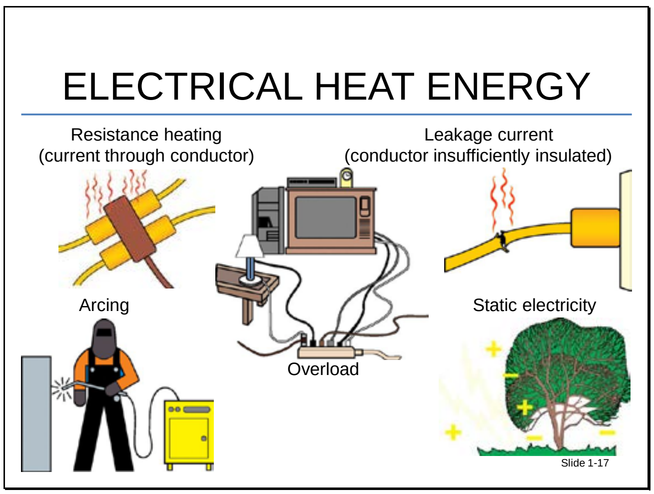
b. Fully developed.

c. Decay.

D. Types of heat energy.



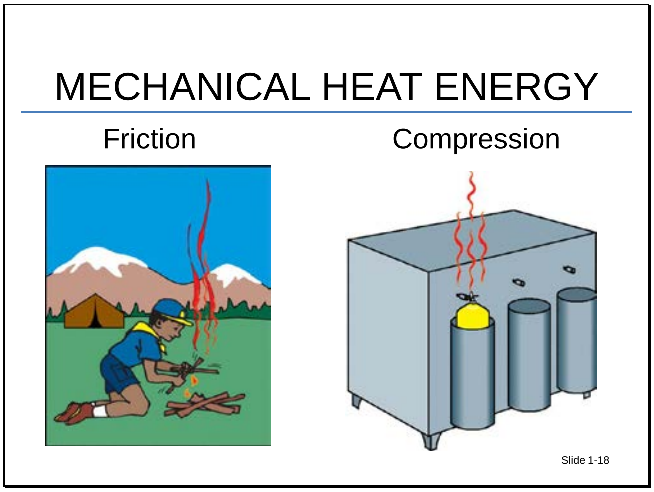
1. The four common types of heat energy are chemical, electrical, mechanical and nuclear, but we are only going to focus on the three most common types.



2. Electrical.

a. Resistance heating (current through conductor).

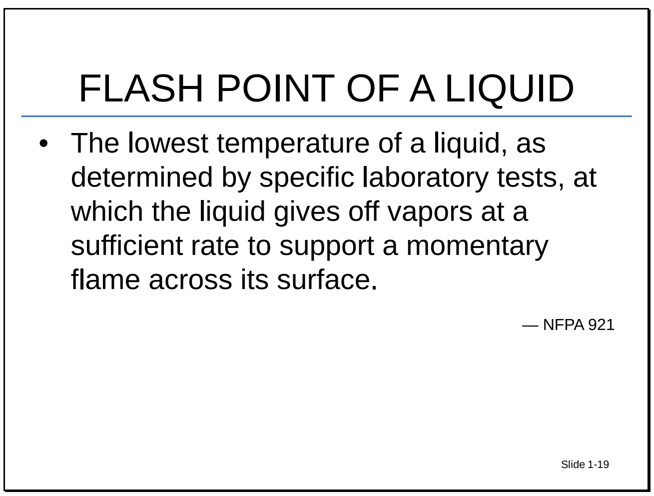
b. Leakage current (conductor not well-insulated).



3. Mechanical.

   a. Friction (applying brakes on a car).

   b. Compression (heat pump).



E. Flash point — the lowest temperature of a liquid, as determined by specific laboratory tests, at which the liquid gives off vapors at a sufficient rate to support a momentary flame across its surface.

FLASH POINT OF A LIQUID (cont'd)

- Examples:
  - -45 F (-43 C) for gasoline.
  - 100 F (38 C) for fuel oil No. 2.

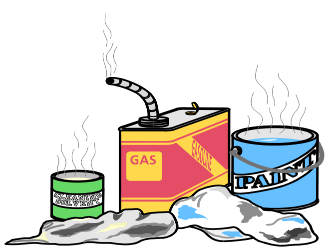
Slide 1-20

1. Gasoline has a flash point of about -45 F (-43 C).

2. Fuel oil No. 2 (home heating oil) has a flash point of 100 F (38 C) or greater.

FLAMMABLE LIQUIDS

Flammable liquids have a flash point below 100 F (38 C).



Slide 1-21

F. Flammable and combustible liquids.

1. The flash point of a product determines if the product is classified as flammable or combustible.

   a. A flammable liquid has a flash point below 100 F (38 C).

COMBUSTIBLE LIQUIDS

Combustible liquids have a flash point at or above 100 F (38 C).

Slide 1-22

b. A combustible liquid has a flash point of 100 F (38 C) or above.

2. The ability to discriminate between flammable and combustible liquids is critical with respect to their possible role in fire causation.

IGNITION TEMPERATURE

- Minimum temperature that a substance should attain in order to ignite under specific test conditions.
- Autoignition is combustion by heat without the assistance of a spark or a flame.
- Piloted ignition is combustion by heat with the assistance of a spark or a flame.

— NFPA 921

Slide 1-23

G. Ignition temperature.

1. The minimum temperature that a substance should attain in order to ignite under specific test conditions.

2. Autoignition is combustion by heat without the assistance of a spark or a flame.

3. Piloted ignition is combustion by heat with the assistance of a spark or a flame.

4. Common ignition temperatures.

a. Newspaper: 392 F (200 C).

b. Kerosene: 410 F (210 C).

c. Paraffin: 473 F (245 C).

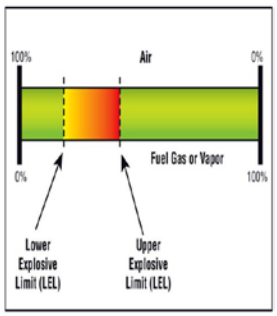
d. Gasoline: 650 F (343 C).

e. Ethyl alcohol: 689 F (365 C).

f. Acetone: 869 F (465 C).

FLAMMABLE OR EXPLOSIVE LIMITS

- Lower explosive limit (LEL) — lowest concentration of vapor in the air that will burn.
- Upper explosive limit (UEL) — highest concentration of vapor in the air that will burn.



Slide 1-24

H. Flammable or explosive limits.

1. Lower explosive limit (LEL) — lowest concentration of vapor in the air that will burn.

2. Upper explosive limit (UEL) — highest concentration of vapor in the air that will burn.

3. Common flammable limits:

   a. Gasoline: 1.4 to 7.6 percent.

   b. Kerosene: 0.7 to 5.0 percent.

   c. Ethyl alcohol: 3.3 to 19.0 percent.

   d. Acetylene gas: 2.5 to 99.9 percent.

PYROLYSIS

- A process in which material is decomposed, or broken down, into simpler molecular compounds by the effects of heat alone; pyrolysis often precedes combustion.
- Generally applies to solid fuel.
- The effect on wood is charring.

— NFPA 921

Slide 1-25

I. Pyrolysis.

1. The chemical decomposition of matter through the action of heat.

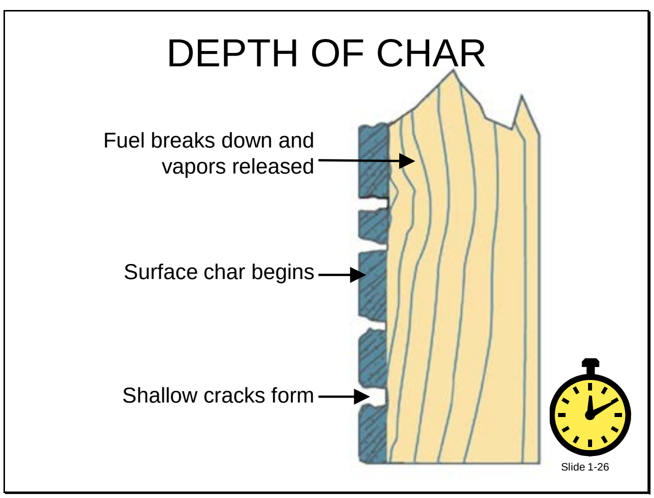
2. Process begins when fuel is heated and generally applies to solid fuels.

3. Continues through specified stages.

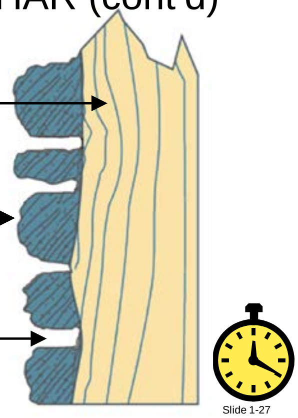
   a. Various gases form during decomposition.

   b. Combustibility of gases increases decomposition.

   c. Decomposition moves deeper into the material (wood), and charring begins.



DEPTH OF CHAR (cont'd)



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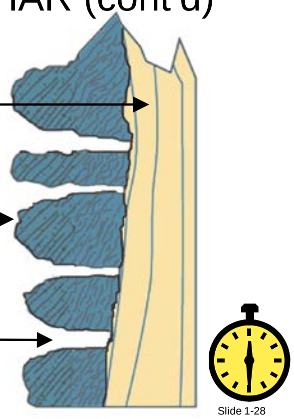
DEPTH OF CHAR (cont'd)



Slide 1-28

DVD PRESENTATION

"UL/NIST NEW VERSUS OLD FURNISHINGS"

Slide 1-29

PEAK HEAT RELEASE RATE

Peak Heat Release Rate	
Burning cigarette	5 W
Burning match	80 W
Small trash can fires	50 to 300 kW
Burning upholstered chair	80 kW to 2.5 MW
Burning upholstered sofa	3,000 kW or 3 MW
Burning Christmas tree	1.6 MW to 5.2 MW

kW = 1,000 watts MW = 1 million watts

Slide 1-30

4. In typical fires, as the fire grows in size, the heat release rate (HRR) will become limited by either the amount of fuel or the amount of oxygen that is available; this is referred to as peak HRR.

5. It is important to understand the amount of energy that materials burning in a compartment can generate so that the peak HRR can be helpful in determining fire growth and spread.

DVD PRESENTATION

"NIST POTATO CHIP RACK FIRE"

Slide 1-31

HEAT RELEASE RATE VERSUS BRITISH THERMAL UNIT

- British thermal unit (Btu).
  - Amount of heat energy required to raise the temperature of 1 pound of water by 1 F (-17 C).
  - Measured in Btu/second.

Slide 1-32

J. HRR.

1. The rate at which heat energy is generated by burning.

2. The heat released from a burning material may correlate directly to the amount of resulting fire damage.

HEAT RELEASE RATE VERSUS BRITISH THERMAL UNIT (cont'd)

- Heat release rate (HRR).
  - Rate at which heat energy is released by burning.
  - Measured in kilowatts (kW).

Slide 1-33

3. Nowadays the fire load (amount of heat produced) has altered fire behavior dramatically, so that fire damage patterns are becoming increasingly difficult to use as indicators.

   a. Heat is measured in British thermal units (Btu).

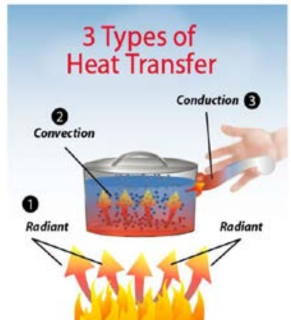
   b. A Btu is the amount of heat required to raise 1 pound of water by 1 F (-17 C) at a temperature of 60 F (16 C).

4. The Btu generated from a single piece of furniture with foam padding may generate a tremendous amount of heat and cause severe fire damage.

III. METHODS OF HEAT TRANSFER

HEAT TRANSFER

- Heat transfer affects fire suppression activities and fire cause determination.
- Often helps explain why fire spreads from one location to another.



Slide 1-34

A. Heat transfer.

1. Heat transfer from one location to another affects fire suppression activities and fire cause determination.

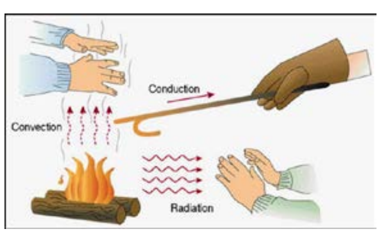
2. It also explains why a fire often spreads from one location to another.

3. Observing fire spread may be vital to reconstructing where the fire started and how and why it traveled to other locations.

4. Certain fire travel predictions can also be made for some classifications of buildings.

THREE METHODS OF HEAT TRANSFER

- Convection.
- Conduction.
- Radiation (radiant heat).

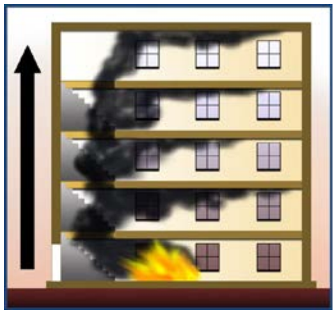


Slide 1-35

B. Three methods of heat transfer.

CONVECTION IS THE RISING OF HEATED AIR

Upward travel of hot gases — for example, an open stairwell.



Slide 1-36

1. Convection is the rising of heated air.

   a. The air at the top of a room is usually warmer than the air near the floor.

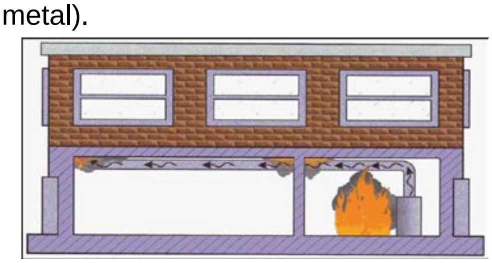
   b. Cool air drawn into the base of the fire helps the hotter gases rise due to buoyancy.

   c. A wood-frame, balloon-constructed building has a fire that starts in the basement and then travels into the attic. This may be a result of convected heat traveling up through open wall cavities and igniting combustible materials.

   d. Many first responders may assume that the second fire was a secondary fire (area/point of origin).

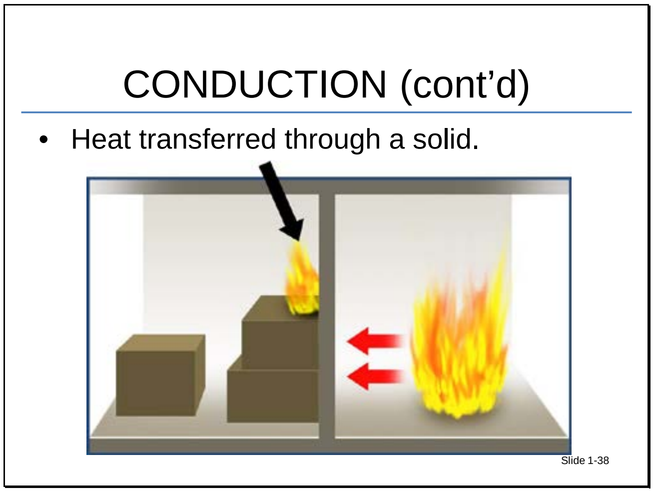
CONDUCTION

- Transfer of heat through a solid medium, such as building materials (e.g., brick, metal).



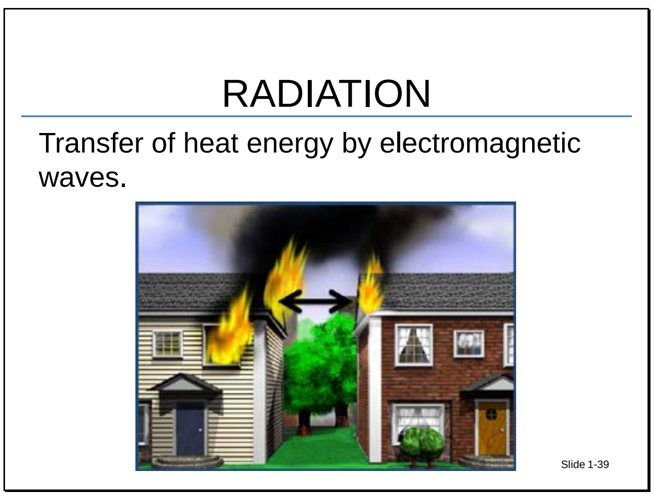
Slide 1-37

2. Conduction is the transfer of heat through a solid medium, such as metal or brick.

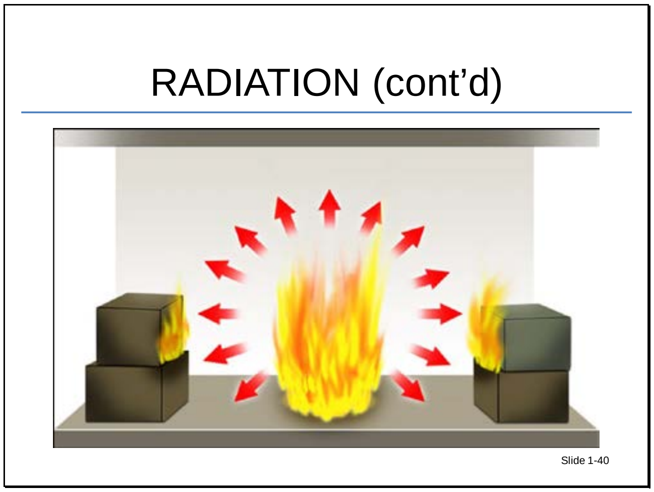


a. When heat is applied to one side of a brick, the brick will warm and the opposite side will be heated.

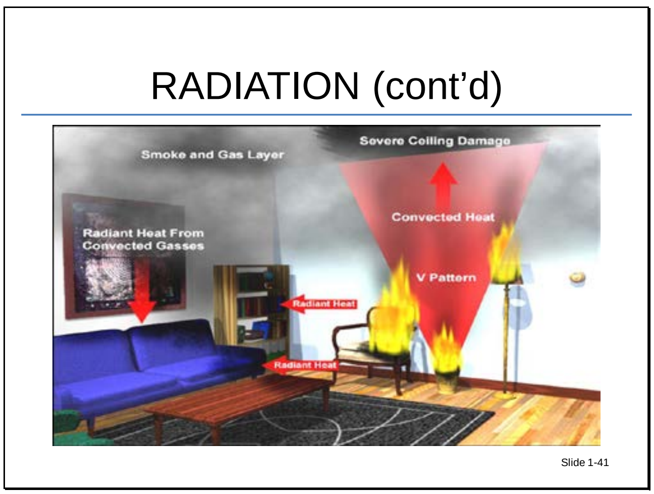
b. If this brick is located too close to combustible materials, it could cause a fire.



3. Radiation (radiant heat) is the transfer of heat energy by electromagnetic waves that are transmitted through the air.



a. The person sitting in front of a roaring fireplace feels radiant heat.



b. The onset of flashover is dependent upon several factors, one of which is the formation of a ceiling jet that contains a tremendous amount of radiant heat energy.

IV. FLASHOVER AND BACKDRAFT

FLASHOVER

- Transition phase from a fire in a room to a room on fire.
- As the fire continues to burn, all the contents of the fire area are gradually heated to their ignition temperatures.
- Simultaneous ignition occurs, and the area becomes fully involved.

Slide 1-42

A. Flashover.

1. The transition phase of fire when a room becomes heated such that flames flash over the entire surface and all combustible materials reach their ignition temperature simultaneously (i.e., from a fire in a room to a room on fire).

2. As a fire starts, convection carries the heated gases upward and outward from the fire.

3. This results in thermal stratification, which may cause other combustibles in the room to be heated to their ignition temperature.

4. At this time, in approximately 15 to 30 seconds, the entire upper portion of the room may ignite.

5. Flashover can occur while firefighters are in the room.

6. Because of the amount of heat and smoke generated in only a few seconds, it may appear that an ignitable liquid (accelerant) was present.

7. Careful examination should help discriminate between flashover effects and flammable liquid fires.

   a. Burning over the surfaces of materials.

   b. Lack of normal fire spread from the area/point of fire origin.

   c. Lack of accelerant residue.

8. Demarcation line of burning or high heat damage appears to be consistent around the room.

9. The demarcation line is the line that separates burned areas from unburned areas or the areas of high heat damage from those of light or no heat damage.

DVD PRESENTATION

"NIST FLASHOVER" AND "NFA FLASHOVER DEMONSTRATION"

Slide 1-43

BACKDRAFT

- In the hot smoldering phase, burning is incomplete because of insufficient oxygen.
- As soon as the needed oxygen enters the smoldering compartment, combustion resumes at a violent (explosive) rate.

Slide 1-44

B. Backdraft.

1. The phenomenon resulting from:

   a. A structure remaining closed during a fire.

   b. Incomplete combustion due to a lack of O_2 entering the structure.

   c. The fire consuming large amounts of oxygen and depleting the oxygen supply so that the fire smolders.

d. A sudden supply of O_2 that may cause a violent reaction.

2. Also referred to as a smoke explosion.

3. The fire continues to produce large amounts of heat and carbon monoxide.

4. Carbon monoxide (flammable limits of 12.5 to 74.0 percent and ignition temperature of 1,128 F (609 C)) can become a highly volatile fuel.

5. The missing component of the fire triangle is oxygen.

   a. A window can break and allow oxygen to enter.

   b. A person can open a door and allow oxygen to enter.

   c. The fire can burn through the structure and allow oxygen to enter.

6. The seat of the fire, or the lowest level of burning, is a critical factor in the backdraft potential.

   a. The area above the fire will be in a positive pressure mode.

      - If an opening is made, the heated fire gases will push outward.

   b. The area below the fire will be in a negative pressure mode.

      - If an opening is made, the air will rush in.

   c. When a fire burns through the roof or exterior walls and fresh oxygen is provided, the fire usually returns to being free-burning.

   d. Occasionally, this will occur in the negative pressure area (below the seat of the fire), and a backdraft may occur.

   e. Witnesses may report that the building was just smoking (puffing) and then it exploded.

7. Careful examination should help discriminate between a backdraft and an explosion.

   a. Window glass broken just prior to or during the backdraft normally will be heavily sooted on the inside.

   b. Normally, the backdraft will not cause the localized structural damage anticipated from other types of explosions.

DVD PRESENTATION

"NEW BRIGHTON, PA, BACKDRAFT"

Slide 1-45

V. TYPES OF BUILDING CONSTRUCTION

CHARACTERISTICS CRITICAL TO FIRE SCENE EXAMINATION

- Building construction type.
- Occupancy classifications.
- Structural loads.
- Fire travel predictions.
- Fire protection systems.

Slide 1-46

A. There are several building construction features that may impact fire growth, development and spread that are critical to fire cause determination.

FIRE LOADING

- Measurement of the maximum heat that would be produced if all combustibles in the fire area were consumed.
- Varies with the type of occupancy and structural features.
- May override fire protection systems' capabilities and provide access problems for firefighters.

Slide 1-47

B. Fire loading refers to the maximum amount of heat that would be generated if all combustible materials are consumed.

1. Fire loading varies with occupancy type and structural features.

2. Structures with excess fire loads may override fire protection systems' capabilities and present access and life safety issues.

LARGE, OPEN SPACES

- Found in warehouses, churches, large atriums and theaters.
- Contribute to fire spread.
- Vertical ventilation is key factor in onset of flashover.

Slide 1-48

C. Large, open spaces are found in various types of buildings and can play a factor in the onset of flashover due to the impact of ventilation.

FIRE, SMOKE AND HEAT MOVEMENT

- Determined by:
  - Building construction and layout.
  - Fuel load.
  - Built-in fire protection and heating, ventilating, and air conditioning (HVAC) systems.
  - Fire department ventilation efforts.
- Contributes to fire spread from floor to floor and room to room.

Slide 1-49

D. Fire, smoke and heat movement are determined by a number of factors that include:

1. Building construction and layout.

2. Fuel load.

3. Fire protection and building services systems.

4. Fire department suppression and ventilation efforts.

FLOOR PENETRATIONS

Slide 1-50

E. Floor penetrations and other void spaces commonly used for piping and duct work can provide a pathway for rapid fire spread throughout the structure.

BUILDING CONSTRUCTION FEATURES AND FIRE SPREAD

- Understanding building construction types and features will help in determining fire growth and spread.
- Development, spread and control of a fire within a structure often depend on the type of construction and the ability of structural elements to remain intact.

Slide 1-51

F. Understanding building construction features will help in determining several factors.

1. Determine how heat, smoke and fire may have traveled through the structure.

2. Identify the role that voids, renovations, alterations and vertical openings in structures play in fire causation.

BUILDING CONSTRUCTION TYPES

Slide 1-52

G. There are five primary types (classifications) of building construction.

1. Fire-resistive (Type I).

2. Noncombustible (Type II).

3. Ordinary (Type III).

4. Heavy timber (Type IV).

5. Wood-frame (Type V).

H. Building construction methods and materials change constantly. Items such as trusses, wooden I-beams, and “eyebrows” on the front of the building can pose special problems.

I. Fire-resisitve Type I construction.

1. Typically concrete and steel.

2. Noncombustible structural members (walls, floor and roof).

3. Members protected from fire effects by encasement or sprayed-on materials.

4. Contents of structure are primary fuel load.

5. Penetrations in floor/ceiling assemblies.

6. Spaces and/or voids between floors.

7. Heating, ventilating, and air conditioning (HVAC), electrical, plumbing chases.

8. Damage to protected structural members.

NONCOMBUSTIBLE TYPE II CONSTRUCTION

Slide 1-54

J. Noncombustible Type II construction.

1. Noncombustible structural steel or concrete framework.

2. Often exposed steel and concrete.

3. Members unprotected or have limited protection from fire effects.

4. Contains only noncombustible materials.

5. No or limited fire-resistance ratings (one hour).

6. Most of the same considerations as Type I.

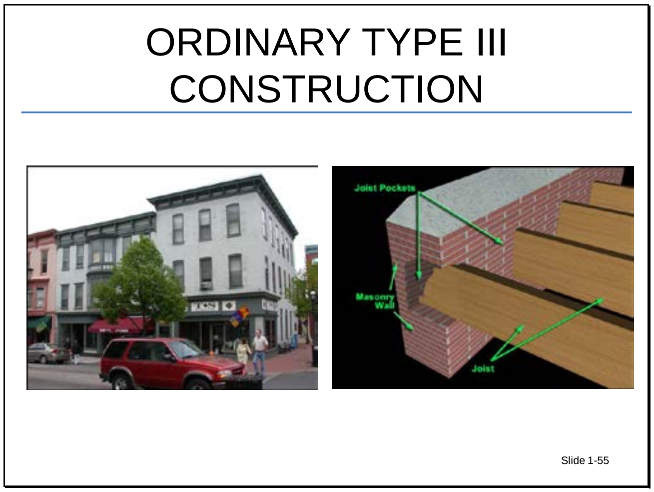
   a. Contents of structure are primary fuel load.

   b. Penetrations in floor/ceiling assemblies for building services.

   c. Spaces and/or voids between floors.

7. Unprotected structural members.

8. Possible lightweight construction.



K. Ordinary Type III construction.

1. Noncombustible walls, typically load-bearing concrete or brick.

2. Floors, structural framework and roof are typically wood.

3. Members unprotected or have limited protection from fire effects.

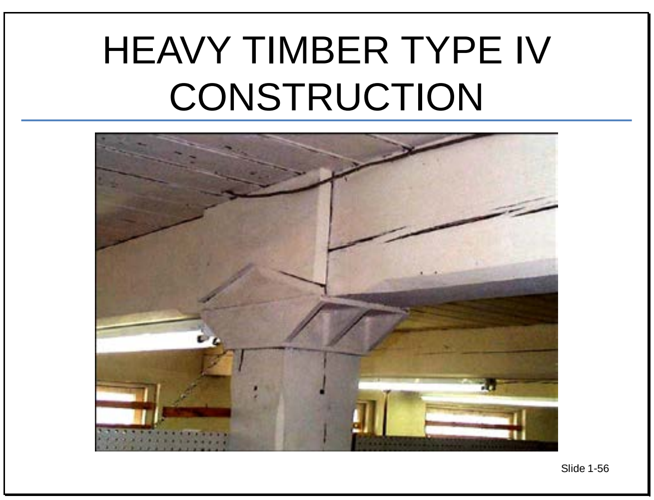
4. Often exposed concrete, brick or wood.

5. Interior structural members are fuel.

6. Combustible concealed spaces between floors, ceilings and partition walls.

7. Safety (intergrity) of floors, walls and roof.

8. Possible lightweight construction.



L. Heavy timber Type IV construction.

1. Sometimes referred to as "mill construction."

2. Noncombustible walls, typically load-bearing concrete or brick.

3. Structural members are unprotected (exposed) concrete, brick and wood with large cross-sectional areas.

4. Members unprotected or have limited protection from fire effects.

5. Structural members are unprotected wood with large cross-sectional areas.

6. Fire resistance comes from physical sizes of construction elements.

7. No specific fire-resistance ratings.

8. Exterior walls are noncombustible.

9. Includes balloon-frame and platform-frame construction.

10. Many modern multifamily buildings are constructed this way.

11. Almost all turn-of-the-century homes fall into this category.

12. This type of structure is in everybody's area.

13. Interior structural members are fuel.

14. Combustible concealed spaces between floors, ceilings and partition walls.

15. Safety (integrity) of floors, walls and roof.

WOOD-FRAME TYPE V CONSTRUCTION

Slide 1-57

M. Wood-frame Type V construction.

1. Combustible walls are typically wood.

2. Floors and roofs are typically wood.

3. Members unprotected or have limited protection from fire effects.

WOOD-FRAME CONSTRUCTION ISSUES

- Extensive combustible concealed spaces.
- No firestopping in framing members.
- Heavy fuel load.
- Safety (integrity) of floors, walls and roof.
- Possible lightweight construction.

Slide 1-58

4. Wood-frame construction issues:

a. Extensive combustible concealed spaces.

b. No firestopping in framing members.

c. Heavy fuel load.

d. Safety (integrity) of floors, walls and roof.

e. Possible lightweight construction.

PLATFORM-FRAME CONSTRUCTION

Slide 1-59

5. In platform-frame construction, the walls of each successive story are built on a platform formed by the preceding floor.

   a. Modern wood-frame construction.

   b. The joists for the deck may be full-dimension lumber or lightweight construction.

   c. Once the floor/deck is in place, walls are placed on it with a sill at the bottom of the wall and a plate at the top.

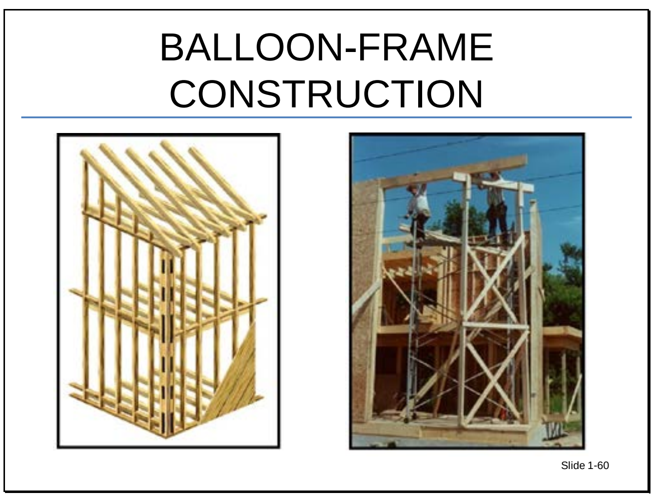
   d. Platform-frame construction provides a natural fire barrier for vertical extension within walls.

6. Openings in the walls for water, plumbing or HVAC pipes can create a void for fire extention.

7. Multifamily dwellings will frequently have extensive vertical openings and void spaces.

   a. Kitchen, bath and dryer vents, plumbing, electrical, and heating/air conditioning ducts.

   b. Double walls for deadening sound between dwelling units.



8. In balloon-frame construction, studs run from the foundation to the attic.

   a. Used extensively in many parts of the country until the late 1930s for residential and light commercial buildings.

   b. Floor joists are tied into the wall, allowing for fire extension in any direction.

VIEW LOOKING DOWN INTO WALL "STUD CAVITY"

Slide 1-61

c. Firestopping is not a common practice and is rarely found.

LIGHTWEIGHT CONSTRUCTION

Slide 1-62

N. Lightweight construction.

1. It can be used in all types of construction, but it's usually in Type II, Type III and Type V.

LIGHTWEIGHT CONSTRUCTION (cont'd)

Slide 1-63

2. Lightweight metal in wood trusses can fail after five to 10 minutes of fire exposure.

METAL CONNECTORS

Slide 1-64

3. This is another example of lightweight wood trusses that are common in this type of construction.

DANGERS OF ENGINEERED WOOD I-BEAM FLOORS

- Used in nearly 50 percent of today's residential construction.
- Structural components comprised of top and bottom flanges.
- May be solid or laminated wood, united with a plywood or Oriented Strand Board (OSB) web of various depths.

Slide 1-65

4. Lightweight laminated wood I-beams or I-joists are typically constructed of 3/8-inch plywood sandwiched into 2-by-3 inch top and bottom chords. This assembly is typically used for floor joists and roof rafters.

5. Floor-joist hangers attached to the bottom chord of parallel chord trusses may experience early failure under fire conditions.

6. Floor joist is toenailed into position. Entire load is being supported by three or four nails.

7. Floor joists or roof rafters held by metal joist hangers could be subject to early collapse under fire conditions. Entire load is supported by lightweight metal bracket.

DANGERS OF ENGINEERED WOOD I-BEAM FLOORS (cont'd)

- The collapse potential of engineered wood I-beams exposed to fire presents an extreme danger to first responders.

Slide 1-66

8. Lightweight construction is subject to early collapse when structural supports are involved.

VI. SUMMARY

SUMMARY

- The importance of establishing a timeline through fire behavior.
- Fire behavior.
- Methods of heat transfer.
- Flashover and backdraft.
- Types of building construction.

Slide 1-67

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UNIT 2:
FIRE SCENE EXAMINATION

TERMINAL OBJECTIVES

The students will be able to:

2.1 *Conduct a systematic fire scene examination by following the scientific method.*

2.2 *Discuss the roles and responsibilities of first responders and fire investigators related to fire scene examination.*

ENABLING OBJECTIVES

The students will be able to:

2.1 *Examine a structure from the exterior to interior in a systematic manner to identify indicators that may be helpful during the course of a fire scene examination.*

2.2 *Explain the significance of various fire patterns and fire spread issues.*

2.3 *List the most common types of fire protection systems that should be documented during a fire scene examination.*

2.4 *Define and name the seven steps of the scientific method.*

2.5 *Apply the scientific method to a fire scene examination.*

2.6 *Understand the difference between the roles of first responders and fire investigators.*

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UNIT 2: FIRE SCENE EXAMINATION

Slide 2-1

ENABLING OBJECTIVES

- Examine a structure from the exterior to interior in a systematic manner to identify indicators that may be helpful during the course of a fire scene examination.
- Explain the significance of various fire patterns and fire spread issues.

Slide 2-2

ENABLING OBJECTIVES (cont'd)

- List the most common types of fire protection systems that should be documented during a fire scene examination.
- Define and name the seven steps of the scientific method.

Slide 2-3

ENABLING OBJECTIVES (cont'd)

- Apply the scientific method to a fire scene examination.
- Understand the difference between the roles of first responders and fire investigators.

Slide 2-4

I. FIRST RESPONDER'S ROLE

FIRST RESPONDER'S ROLE

- Often the first person on the fire scene, and he or she is in the best position to observe critical information.
- Often the person who decides to request a fire investigator.
- Often decides if overhaul operations should be delayed.

Slide 2-5

A. The first responder is often the first person on the scene, and he or she can observe and collect critical information.

1. Specific location of the fire.

2. Type and quantity of materials burning.

3. Impact of fire suppression efforts on fire behavior.

B. The first responder decides whether to delay overhaul until fire origin and cause determination is completed.

1. Overhaul may require removing furniture, moving equipment, and opening walls and ceilings to check for hidden fire.

2. If overhaul is done before fire investigation is completed, the first responder must ask:

   a. Is there critical evidence that may be altered, lost or destroyed?

   b. Is the area or room of fire origin clearly defined?

   c. Should overhaul in the area or room of origin be delayed?

C. Considerations for the delay of overhaul:

1. Opening walls, pulling ceilings and shoveling debris outside may destroy or conceal evidence.

2. Evidence may be contaminated or destroyed as it is removed.

D. Precautions to take if overhaul occurs before origin and cause determination is made:

1. Make a photographic or video record of the scene and position of potential clues or evidence.

2. Collect and safeguard evidence.

   a. Only if it will be altered or destroyed.

   b. If an incendiary fire is suspected, secure the scene and notify fire investigators.

3. Avoid exposing (and causing evaporation of) hidden pockets of ignitable liquid residue before the scene can be processed.

FIRST RESPONDER’S ROLE (cont’d)

- Perform a preliminary scene examination.
- Secure the scene to preserve and protect evidence from further damage and destruction.
- Notify investigators when necessary.

Slide 2-6

4. Perform a preliminary scene examination.

5. Secure the scene to preserve and protect evidence from further damage and destruction.

6. Notify investigators when necessary.

NATIONAL FIRE PROTECTION ASSOCIATION 921, *GUIDE FOR FIRE AND EXPLOSION INVESTIGATIONS*

- Called a “guide” by the National Fire Protection Association (NFPA).
- Considered to be a “standard of care” by state and federal courts.
- Developed by an open committee consensus process.
- Basis for certification programs by professional organizations.

Slide 2-7

E. National Fire Protection Association (NFPA) 921, *Guide for Fire and Explosion Investigations* contains recommended guidelines that are widely used by fire investigators throughout the country to conduct fire and explosion investigations.

NATIONAL FIRE PROTECTION ASSOCIATION 921, *GUIDE FOR FIRE AND EXPLOSION INVESTIGATIONS* (cont’d)

- Developed as a model for the advancement and practice of fire and explosion investigation, fire science, technology, and methodology.
- Basis for fire and explosion investigator training and education programs.

Slide 2-8

1. Developed as a model for the advancement of fire science and to promote the use of the scientific method in fire investigation.

2. Serves as the basis for most fire investigator training and continuing education programs.

II. SCIENTIFIC METHODOLOGY

NATURE OF FIRE SCENE EXAMINATIONS

- Complex endeavor involving knowledge, skill, technology and science.
- Compilation of factual data and analysis must be done objectively and truthfully.
- First responders and fire investigators must work together as a team and share information to be successful.

Slide 2-9

A. Fire cause determination and investigation should be based on a team approach focusing on the collection of all facts and circumstances, analyzed objectively and truthfully to reach valid conclusions.

METHODOLOGY

- Reliance on systematic approach with attention to all relevant details.
- Use of systematic approach will often uncover new factual data for analysis.
- May require previous conclusions to be re-evaluated.

Slide 2-10

B. The process used to collect and analyze data should follow a systematic approach.

PROCESS

- Proper methodology is:
  - First determine and establish the origin(s).
  - Then determine cause (circumstances, conditions or agencies that brought the ignition source, fuel and oxidant together).

Slide 2-11

C. The first responder needs to process a fire scene in an orderly and logical manner.

1. Outside to inside.

2. Least damaged to most damaged.

3. Once the origin is established, the circumstances or conditions responsible for ignition must be identified.

D. This may be difficult depending on the severity of the fire damage.

E. Significantly fire-damaged structures usually have fire damage to several rooms or floors.

1. Inspection starts outside with a 360-degree observation of the scene.

2. Determine which portions appear most damaged and least damaged.

3. Continue inside the structure from the least burned area toward the most damaged (likely room or area of origin).

4. Limited fire damage usually results from fires that do not reach flashover or are otherwise suppressed.

   a. Start inside the room from the least damaged area toward the area of greatest fire damage.

   b. Note the extent of smoke and heat damage.

SYSTEMATIC APPROACH

- Recommended systematic approach is that of the scientific method.
- Used in physical sciences.
- Provides for the proper collection, analysis and evaluation of data necessary in a successful investigation.

Slide 2-12

5. A fire scene examination that follows the scientific method provides for the proper collection, analysis and evaluation of information used to determine the origin and cause of a fire.

SYSTEMATIC METHOD

Slide 2-13

F. The scientific method is based on the following steps:

STEP 1: RECOGNIZE THE NEED

- Problem exists.
- Fire or explosion has occurred.
- Cause should be determined so that future similar incidents can be prevented.

Slide 2-14

1. Recognize the need — a fire has occurred, and a fire cause needs to be determined.

STEP 2: DEFINE THE PROBLEM

- Define the manner in which the problem can be solved.
- Proper origin and cause investigation conducted.
- Examination of scene and combination of other data collection methods.
- Review of previous investigations of the incident, interviews, scientific testing.

Slide 2-15

2. Define the problem — determine the manner in which the origin and cause of the fire can be identified.

STEP 3:
COLLECT DATA

- Facts are now collected.
- Collected by observation, experiment or other direct data gathering means.
- This is "empirical data."
- Must be based on observation or experience.
- Capable of being verified.

Slide 2-16

3. Collect data — based on observation, experience or other means, it is capable of being verified.

STEP 4:
ANALYZE THE DATA

- All data must be analyzed.
- Essential step before forming final hypothesis.
- Based on knowledge, training, experience and expertise.
- Form hypothesis based on evidence, rather than speculation.

Slide 2-17

4. Analyze data — an essential step before forming a final conclusion based on knowledge, training and experience.

STEP 5: DEVELOP A HYPOTHESIS

- Based on the data analysis.
- Form a hypothesis that explains what happened.
- Based solely on empirical data.
- Known as “inductive reasoning.”

Slide 2-18

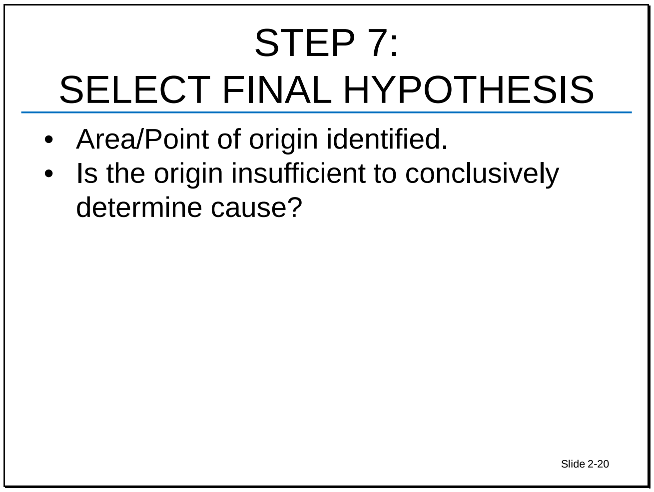
5. Develop a hypothesis — based on data analysis, identify potential scenarios or reasons why the fire may have occurred.

STEP 6: TEST THE HYPOTHESIS

- Must withstand the test of careful and serious challenge.
- Deductive reasoning.
- Comparison of all known facts as well as body of scientific knowledge.
- Can be experiment or research.

Slide 2-19

6. Test and select final hypothesis — compare all known facts and information necessary to form a valid conclusion concerning the fire’s origin and cause based on generally accepted scientific principles.

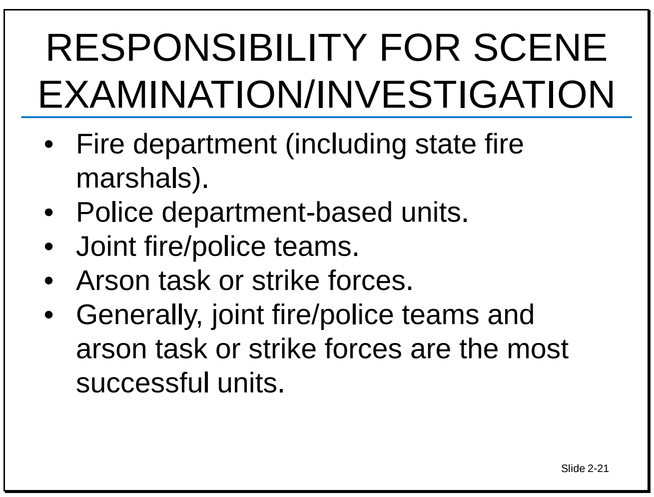


7. Select final hypothesis.

   a. Area/Point of origin identified.

   b. Is the origin insufficient to conclusively determine cause?

III. FIRE SCENE EXAMINATION



A. Responsibility for fire/arson investigation.

   1. Fire department.

   2. Police department (or other law enforcement agencies).

   3. Joint fire/police teams.

   4. Arson task or strike forces.

SCENE EXAMINATION

- The major objective of a fire scene examination is to determine the origin and cause of a fire through the recognition, identification and analysis of fire (burn) patterns.

Slide 2-22

B. The major objective of a scene examination is to determine the origin, cause and associated responsibility.

SCENE EXAMINATION (cont'd)

- Requires reconstruction of the events leading up to the time that the ignition source (heat) came in contact with the first material ignited (fuel) to determine the fire cause.

Slide 2-23

C. Examination requires personnel to reconstruct the events and circumstances that led up to the time of the fire.

SCENE EXAMINATION (cont'd)

- There are four basic steps in determining the area of origin:
  - Examine the exterior of the structure or vehicle and surrounding area.
  - Examine the interior of the structure or vehicle.
  - Interview everyone present who may have information related to the fire.
  - Analyze and evaluate information using the scientific method.

Slide 2-24

D. The four basic steps in determining the area/point of origin are:

1. Examine exterior.

2. Examine interior.

3. Obtain information from witnesses (interviews).

4. Analyze information using the scientific method.

SCENE EXAMINATION (cont'd)

- Areas of least to most damage.
- Evaluate patterns.
- Evaluate all potential accidental sources of ignition.
- Notify investigators if there is any indication of an intentionally set fire.

Slide 2-25

E. Recommended systematic approach works from the exterior to the interior and from the least damage to the most damage.

1. Evaluate any fire patterns that are observed.

2. Evaluate all potential accidental ignition sources in or around the area of origin.

SCENE EXAMINATION (cont'd)

- The determination of fire cause begins with the identification of the point of origin.
- The general systematic approach is to work from areas of least damage to most damage.

Slide 2-26

F. The first step in successfully determining the fire cause is to identify the area/ point of origin.

SCENE EXAMINATION (cont'd)

- Once the origin is identified, a careful analysis of this area is required to determine the cause.
- Personnel should keep in mind that the area of greatest damage is not always the point of origin.

Slide 2-27

G. Once the suspected area/point of origin has been identified, every layer of debris must be carefully and thoroughly examined to identify the potential cause.

SCENE EXAMINATION (cont'd)

- The ignition sequence is an event that allows a competent ignition source to initiate combustion.
- The act or conditions that led to the ignition of the fuel package establishes the fire cause.

Slide 2-28

H. The ignition sequence is the act or circumstances that contributed to the cause of the fire and must be identified in all incidents to properly classify a fire as either accidental, natural, incendiary or undetermined.

IV. EXAMINATION OF EXTERIOR STRUCTURAL COMPONENTS

EXTERIOR EXAMINATION

- Conduct a 360-degree exterior examination of the fire scene.
- The results of the exterior examination should be fully documented.
- Note burn patterns and other evidence that may be present or other information that may be important to the investigation.

Slide 2-29

A. Personnel should first conduct a 360-degree exterior examination of the fire scene. The results of the exterior examination should be fully documented. Any signs of burn patterns, evidence, or other information that may be pertinent to the investigation should be noted.

EXTERIOR EXAMINATION (cont'd)

Areas of greatest fire involvement.

Slide 2-30

B. Note areas of greatest damage.

EXTERIOR EXAMINATION (cont'd)

Fire patterns and wind conditions.

Slide 2-31

C. Note areas where fire exited the building.

1. Examine doors to determine if they were open prior to or during the fire.

2. Doors open during fire generally will be more damaged on the side of fire travel.

3. Doors closed during fire generally will be damaged evenly across.

EXTERIOR EXAMINATION (cont'd)

Burn patterns at ventilation points.

Slide 2-32

D. Examine all sides of the structure.

1. Walk around the entire structure.

2. Note items that may be critical to fire origin and cause determination.

E. Note building construction classification type or method of construction.

F. It often helps to view the building on fire from the top of an aerial device to get another perspective on the path of fire travel.

V. EXAMINATION OF INTERIOR STRUCTURAL COMPONENTS

PRIOR TO ENTRY

- Safety first!
- Proceed from areas of least damage to most damage.
- Be aware of evidence contamination issues (e.g., refueling of gasoline-powered equipment).

Slide 2-33

A. Security prior to the fire.

1. Signs of forced or broken windows.

a. Were windows forced or broken during fire suppression?

b. Is clear or stained glass located inside or outside the building?

2. Signs of forced entry or broken doors.

a. Were they forced during fire suppression?

b. Type and number of locks on the door?

UNUSUAL EVENTS OR OUT-OF-PLACE ITEMS

- Fuel containers that do not belong in the area.
- Repair work in progress.
- Electrical equipment on the outside of the structure.

Slide 2-34

B. Unusual events or out-of-place items.

1. Fuel containers that do not belong in the area.

a. Found in a hidden area?

b. Are containers empty or full?

2. Repair work in progress.

a. Are there signs of heating devices?

- Torches.
- Paint-removing heaters.
- Space heaters.
- Ladders to units on the roof.

b. Ladders to the roof may also indicate an attempt to extinguish a fire.

3. Electrical equipment on the outside of the structure.

   a. Holiday lighting.

   b. Heat tapes for pipes.

   c. Heat tapes for edges of roof.

C. The process surveys structural elements to check for path of fire and smoke spread.

1. The examination proceeds from the least damaged area to the most damaged area.

   a. This helps avoid hasty and perhaps faulty judgments about the area of fire origin.

   b. All visible fire patterns and clues are evaluated to determine the area of fire origin.

2. Lightly smoke-stained, damaged and charred areas to heavily smoke-stained, damaged and charred areas.

3. Components may be charred more heavily on the side facing the fire origin, as it was exposed longer to the heat source.

   a. Holes in the ceiling may have helped the fire spread.

   b. Damage could be due to fire suppression activity.

   c. There may have been openings in or damage to the ceiling prior to the fire.

4. Areas above doors closest to the fire origin may have more severe charring.

5. Ceiling damage as one approaches the area of fire origin should become greater.

6. Check floor for all fire damage and compare it to the ceiling damage in the room/area of origin.

   a. Note carpet burns or melting.

   b. Carefully evaluate extensive damage, such as holes burned through. Look for signs of distinct patterns of burned and unburned areas.

7. Doors can also provide clues about fire travel.

   a. Doors closed at the time of fire should exhibit an even burn pattern.

   b. Edges of the door should be protected from burning or charring.

   c. Doors closed at the time of fire with fire on bottom side may indicate use of ignitable liquids.

   d. Doors open at the time of fire should exhibit a distinct burn pattern.

      - Burning should be greater at the hinged side of the door.

      - If fire came from low burning, the burn pattern on the door should be at an angle.

D. Nonstructural building components.

1. May provide clues to the lowest level of fire activity.

2. Shelving should be evaluated for burning on the bottom as well as on the top.

a. The top will often be protected by the material placed on it.

b. If shelves collapsed onto other shelves, find the lowest level of burning.

VI. FIRE EFFECTS AND INDICATORS

COMMON FIRE SCENE PATTERNS/TERMINOLOGY

- "V" pattern.
- Trailers.
- Charring.
- Lines of demarcation (smoke/heat line).
- Calcination of gypsum board.
- Clean burn.
- Protected areas.

Slide 2-37

A. There are several terms used to describe many types of patterns that may be commonly found at fire scenes.

FIRE PATTERNS

- Major objective of a fire scene examination is the recognition, identification and analysis of fire patterns.
- Analysis of fire patterns is performed in an attempt to trace fire spread, identify areas and point of origin, and identify the fuels involved.

Slide 2-38

B. An important step in the fire cause determination process is to analyze fire patterns, which may prove helpful in locating the area/point of origin and identifying the fire cause.

DYNAMICS OF PATTERN PRODUCTION

The damage created by flame, radiation, hot gases and smoke creates patterns that investigators use to help locate the area or point of origin.

Slide 2-39

C. Dynamics of pattern production.

1. As fire travels through a structure, it creates various patterns that may assist in determining the origin and cause.

2. Relatively even burning on interior surfaces may indicate burning from a thermal layer of radiant heat due to flashover.

3. Items in the path of the fire, such as shelves, may block the fire's normal path.

"V" PATTERNS

- Created by flames, convective or radiated heat from hot fire gases, and smoke within the fire plume.
- Appearance and size depends on:
  - Heat release rate (HRR).
  - Geometry/Size of fuel package.
  - Ventilation.
  - Ignitability of vertical surface.

Slide 2-40

D. The characteristic pattern from a fire is commonly referred to as a "V" pattern.

1. Fire normally progresses upward and outward.

a. Wind direction associated with ventilation may affect this.

b. Heat release ratio and geometry/size of fuel package.

c. Ceiling damage directly above the area of origin will usually be significant.

“V” PATTERN (cont’d)

Slide 2-41

2. Examine “V” patterns at the base of walls for possible sources of ignition.

a. It is common for items like a trash container to be found in the area of origin, and it should be evaluated to determine its role in the fire.

b. Was something present that was observed during fire suppression?

INVERTED “V” PATTERN

Slide 2-42

E. An inverted “V” pattern is not necessarily an indicator of an incendiary fire. The proper interpretation is a fire of relatively short duration that did not fully develop from floor to ceiling.

FIRE PATTERNS

- There are two basic types of fire patterns:
  - Movement patterns.
  - Intensity patterns.

Slide 2-43

F. The two basic types of fire patterns that may be found at fire scenes are movement patterns and intensity patterns.

MOVEMENT PATTERNS

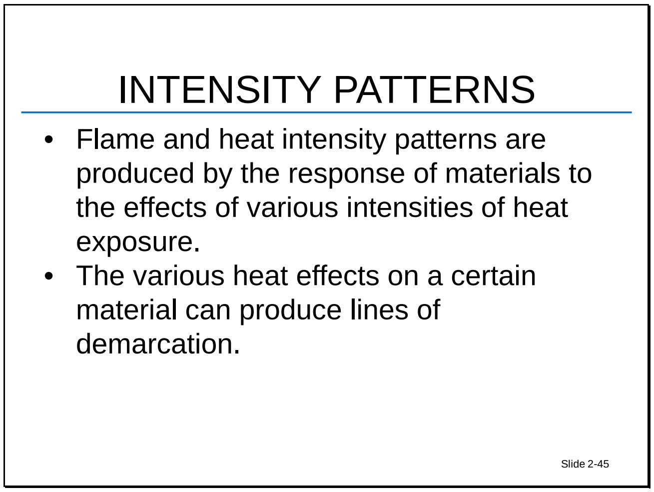
- Flame and heat movement patterns are produced by the growth movement of fire and products of combustion away from an initial heat source.
- If accurately identified and analyzed, these patterns can be traced back to the origin of the heat source that produced them.

Slide 2-44

G. Movement patterns.

1. Produced by the growth of the fire and products of combustion away from the initial heat source.

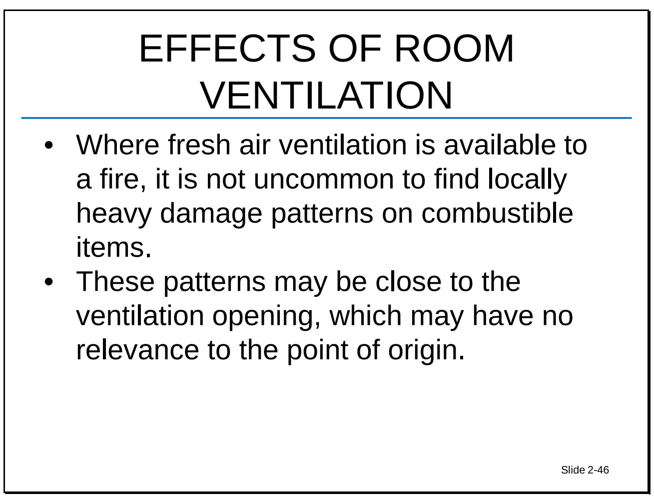
2. Can be traced back to the origin of the heat source if properly evaluated.



H. Intensity patterns.

1. Produced by the response of materials to the effects of exposure to various levels of heat.

2. The heat effects on certain materials can produce distinctive lines of demarcation.



I. Ventilation can produce burn patterns that may be confused with the area/point of origin.

VENTILATION

- Autoventilation — caused by the fire breaking through an obstruction, such as a window or roof.
- Mechanical ventilation is caused by fire department cutting a hole in roof or breaking windows.

Slide 2-47

J. Autoventilation — caused by the fire breaking through an obstruction, such as a window or roof. Mechanical ventilation is caused by the fire department cutting a hole in the roof or breaking windows.

POST-FLASHOVER DAMAGE

- It is not uncommon for the flashover process to modify or obliterate many of the fire indicators that existed prior to flashover.
- This is especially true for fire patterns.

Slide 2-48

K. Flashover can modify or destroy many of the indicators and patterns that are used by investigators to identify the origin and cause of the fire.

WARNING

- In most cases, no single pattern in and of itself should be relied upon to draw a conclusion as to a fire's origin and cause.
- Old thoughts, theories and literature gave different meanings and interpretations to some patterns.

Slide 2-49

L. No single pattern should be relied upon to conclusively determine the fire's origin and cause.

WARNING (cont'd)

- Patterns should be examined and evaluated in light of other information obtained from sources at the scene.

Slide 2-50

1. There are many different meanings and interpretations given to the creation and analysis of fire patterns; therefore, be cautious in relying solely upon them during fire cause determination.

2. Always examine fire patterns in conjunction with information collected at the scene.

LOW BURN PATTERNS

- The investigator should identify these areas of low burning and be cognizant of their possible proximity to a point of origin.
- In a compartment where the fire has transitioned through flashover to the fully developed stage, burning down to floor level is not necessarily indicative of an origin at the floor level.

Slide 2-51

M. Low levels of burning must be evaluated.

1. It could lead to the area or point of fire origin.

2. It could be the result of a secondary fire resulting from burning material dropping below the original point of origin.

LINES OF DEMARCATION

- Lines or areas that are borders defining the differences in certain heat and smoke effects of the fire on various materials that may be used to determine direction of fire spread or differences in intensity of burning.

Slide 2-52

N. Lines of demarcation.

1. Lines of demarcation are lines that separate burned from unburned areas.

LINES OF DEMARCATION (cont'd)

- The production of lines, areas of demarcation, and subsequent fire patterns that they define depend on a combination of variables:
  – The material itself.
  – The rate of heat release of the fire.
  – Fire suppression activities.
  – Temperature of the heat source.
  – Ventilation.
  – Time that the material is exposed to the heat.

Slide 2-53

2. Lines of demarcation may be caused by burning materials, ventilation, length of time that materials are exposed to heat, or fire suppression activities.

LINES OF DEMARCATION (cont'd)

Slide 2-54

SURFACE EFFECTS

The characteristics of the material and shape and texture of the surface can affect the shape of the lines of demarcation displayed and the amount of pyrolysis and combustion by differing surface areas.

Slide 2-55

O. The lines of demarcation may be affected by the type of surfaces and the extent of combustion that occurred.

PENETRATION OF HORIZONTAL SURFACES

- Penetration of horizontal surfaces from above or below can be caused by radiant heat, direct flame impingement, or localized smoldering, with or without the effects of ventilation.

Slide 2-56

P. Penetration of horizontal surfaces.

1. Penetration of horizontal surfaces may be caused by radiant heat, direct flame contact, or localized burning.

PENETRATION OF HORIZONTAL SURFACES (cont'd)

- In fully involved compartments, hot gases may be forced through small, pre-existing openings in a floor, resulting in a penetration.
- Penetration may also be the result of intense burning under items such as polyurethane mattresses, couches or chairs.

Slide 2-57

2. Penetrations may also be caused by hot gases being forced through pre-existing openings or intense burning under items such as mattresses, couches or chairs.

PENETRATION OF HORIZONTAL SURFACES (cont'd)

- Penetration in a downward direction is often considered unusual because the more natural direction of heat movement is upward through the action of buoyancy.

Slide 2-58

3. The normal direction of heat movement is upward, therefore any evidence of downward burning in floors and/or ceilings should be carefully evaluated.

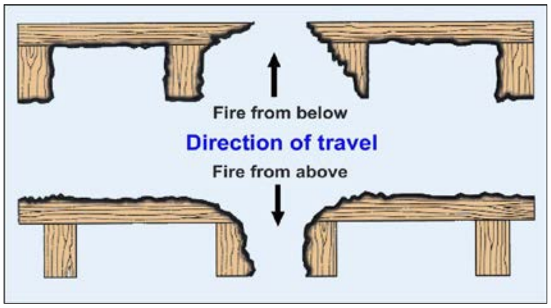
PENETRATION OF HORIZONTAL SURFACES (cont'd)

- A hole burned into a surface, whether from above or below, may be identified by examining the sloping sides of the hole.

Slide 2-59

4. Examination of the sloping sides of holes in horizontal surfaces can help determine whether they were created from above or below the surface.

BURNING PATTERNS THROUGH FLOORS



— NFPA 921, *Guide for Fire and Explosion Investigations*

Slide 2-60

TEMPERATURE DETERMINATION

The amount of heating depends on the temperature and velocity of the airflow, the geometry and physical properties of the heated item, its proximity to the source of heat, and the amount of heat energy present.

Slide 2-61

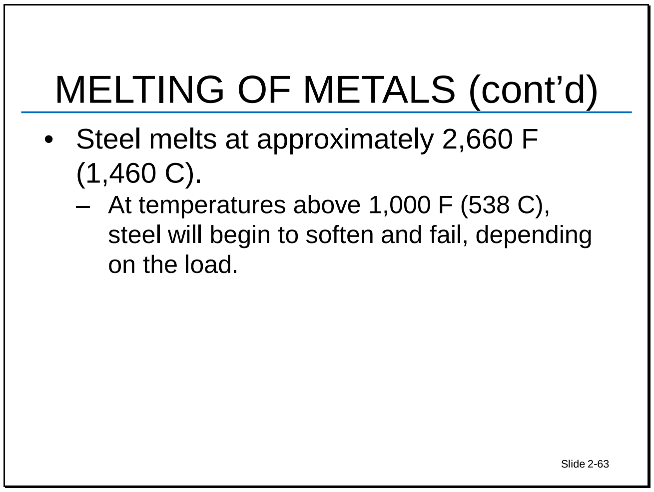
Q. The amount of heating depends on several factors, including the temperature and velocity of the airflow, physical properties of the burning item, its location in relationship to the heat source, and the amount of energy present.

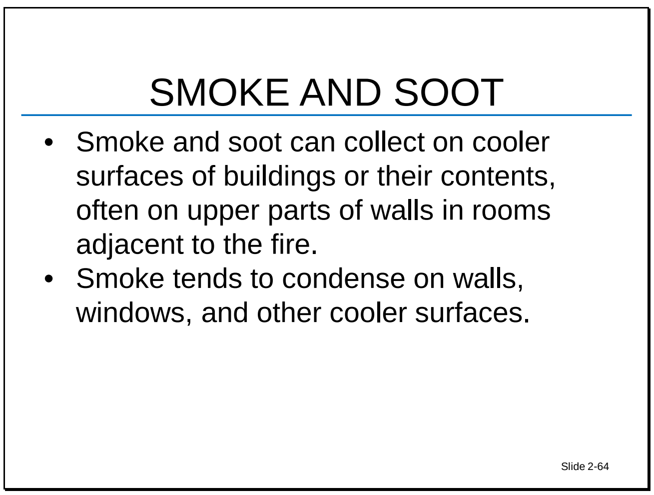
MELTING OF METALS

- Aluminum melts at approximately 1,220 F (660 C).
- Copper melts at approximately 1,981 F (1,083 C).

Slide 2-62

R. Melting of metals (aluminum, copper and steel) may provide a clue regarding the approximate temperatures that the fire may have reached.





S. Smoke and soot can collect on cooler surfaces of buildings or their contents, often on upper parts of walls in rooms adjacent to the fire. Smoke tends to condense on walls, windows, and other cooler surfaces.

CLEAN BURN

- Produced most commonly by conductive heat or intense heat transfer to a surface.
- Although they can be indicative of intense heating in an area, clean burn areas by themselves do not necessarily indicate areas of origin.

Slide 2-65

T. Areas of clean burn by themselves do not necessarily indicate the areas/points of origin, but they typically are an indication of intense heating or direct flame contact in the area.

CLEAN BURN ON INTERIOR OF STRUCTURE

Slide 2-66

CALCINATION

- Moisture content is driven out of gypsum due to heat.
- The paper surface will char and might also burn off.

Slide 2-67

U. Calcination usually occurs when the moisture content of gypsum board (drywall) is depleted due to intense heating in the area.

HEAT SHADOWING

- The object blocking the travel of the heat energy may be solid or liquid, combustible or noncombustible.

Slide 2-68

V. Heat shadowing.

1. Heat shadowing occurs when objects located within the compartment block or limit the flow of heat.

HEAT SHADOWING (cont'd)

- Any object that absorbs or reflects the heat energy may cause the production of a pattern.

Slide 2-69

2. Patterns created by the effects of heat shadowing can be produced by any object that absorbs or reflects heat energy.

What aided in the fire spread?

Heating, ventilating, and air conditioning (HVAC) unit supply and return vents may influence fire spread in a room.

Slide 2-70

FLOORS

Burning from full room involvement can also produce burning of floors around door thresholds and baseboards due to radiation or air sources (ventilation).

Slide 2-71

W. Evidence of burning on floors around door thresholds and/or baseboards can be caused by full room involvement or ventilation.

PROTECTED FLOOR AREAS

- The presence of furniture, stock, counters or storage may result in these linear patterns.
- These patterns may also result from wear on floors and the floor covering due to high traffic, and they may be confused with ignitable liquid pour patterns.

Slide 2-72

1. Protected areas on the floor can be caused by furniture, office equipment, appliances, etc. that are located in the area and present at the time of the fire. The patterns created should not be confused with ignitable liquid (pour) patterns.

PROTECTED FLOOR AREAS (cont'd)

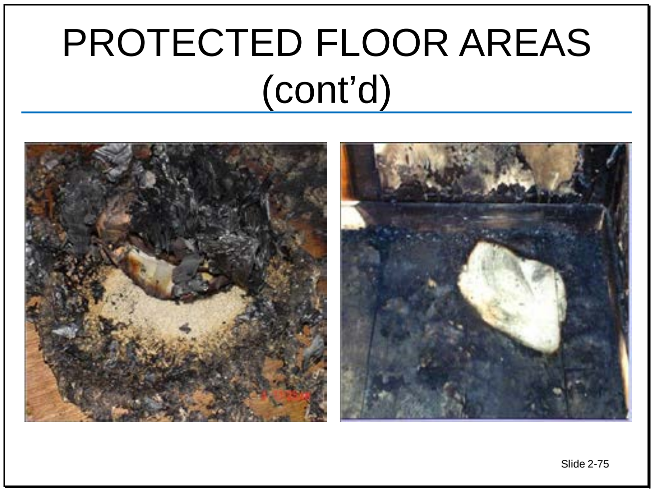
Slide 2-73

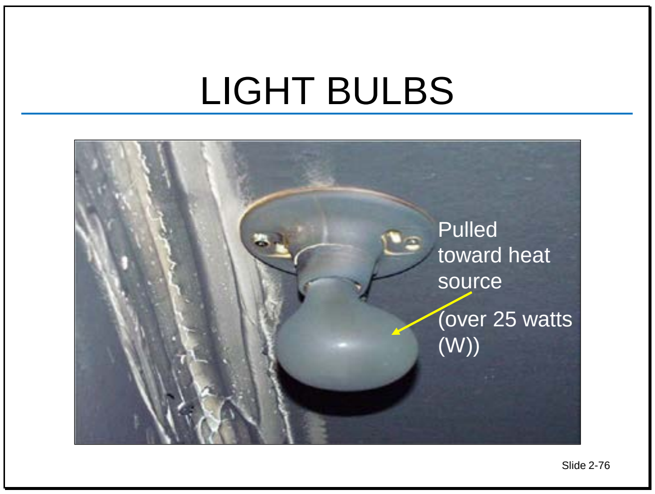
PROTECTED FLOOR AREAS (cont'd)

- Irregularly shaped objects on the floor, such as clothing or bedding, may also provide protection and produce patterns that may be confused with ignitable liquid pour patterns.

Slide 2-74

2. Other items that are located on the floor may also produce patterns that can be confused with ignitable liquid (pour) patterns.

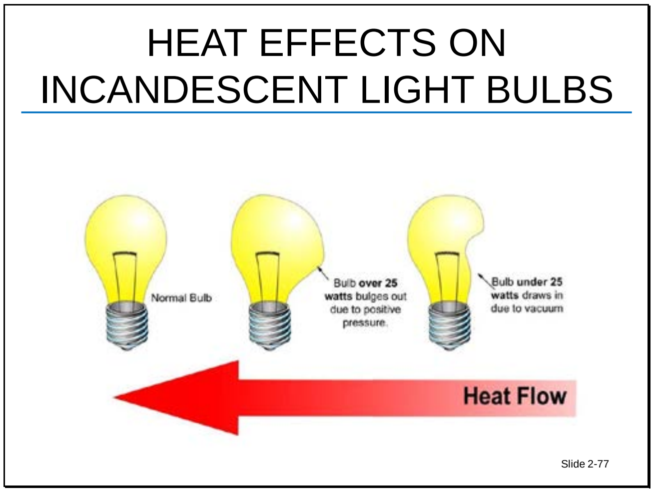




X. Incandescent light bulbs may begin to distort when subjected to a temperature of 900 F (482 C) for a length of 10 minutes, and they will usually distend in the direction of the fire origin or source of heat.

1. Bulbs will usually have smoke residue on them.

2. The side toward the fire origin may have less residue.



3. Bulbs heated evenly may not leave a clue.

4. Bulbs may rupture with only a small part of the glass globe missing.

5. Bulbs may distort in such a manner that no significant clues remain.

VII. EXAMINATION OF BUILDING CONTENTS

A. All contents and furnishings should be left in place so that they can be used as indicators to help identify the location or sources of heat that may have been present.

BUILDING CONTENTS

- Patterns can be present on the sides, tops and bottoms of building contents.
- Patterns will be similar in shape but may display only a portion of the pattern due to limited side of items.

Slide 2-79

B. Patterns may be found on top of shelves, tables, dressers or other items.

1. Fires originating on top of dressers, shelves and tables should be evaluated for a cause.

2. Look for electrical items, evidence of smoking materials, or possible accelerants.

3. Items that do not seem to belong.

    a. Were there items moved into or out of the area before the fire occurred?

    b. Were cheaper items substituted for expensive items?

    c. Were items arranged in an unusual way?

    d. Were items placed in a safe area as opposed to one not normally secured?

    e. Were items of clothing missing from closets?

4. A large pile of clothing placed on a bed and set on fire may indicate an interpersonal or domestic problem (spite/revenge motive).

    a. Do items appear to be out of place?

    b. Were pieces of furniture or other items conveniently rearranged for a fire?

    c. Was furniture used to block doors and make entry difficult?

C. Examination of contents.

1. Furniture may provide clues to the fire origin or path of fire travel.

   a. Is one side burned more heavily than another?

   b. Is it burned more on the top or the bottom?

   c. Was there a high fuel load?

   d. Are the legs or feet of furniture burned at or near the floor?

2. Examination of appliances may reveal if the damage was related to the cause of the fire or was the result of the fire.

   a. If the power switch can be located, was the power on or off?

   b. Were the appliances plugged in at the time of the fire?

   c. Is the appliance case or cabinet more heavily damaged on the inside or the outside?

   d. Is there any indication that the fire originated at or near an appliance?

   e. Heating sources, such as a kitchen stove, heater, iron or other appliances, should be evaluated carefully.

D. All appliances and equipment located in or near the area/point of origin need to be examined, especially to document if any of them were left on or operating at the time of the fire.

ROLE OF ELECTRICAL SYSTEM AND EQUIPMENT

Avoid disturbing electrical cords and equipment.

Slide 2-81

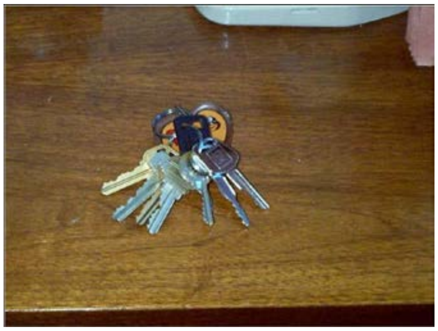
E. The role of the electrical system and any electrical equipment or appliances that may be in or near the area/point of origin must be evaluated to rule them in or out as a potential cause of the fire.

INVENTORY

Slide 2-82

F. The presence or absence of inventory should be noted, as it may have a connection to the underlying cause of the fire. The inventory should be consistent with the use/occupancy of the building.

ACCOUNTABILITY OF KEYS



Slide 2-83

G. The accountability of keys and who they were assigned to should be documented, as it may provide a clue as to who had access to the building/structure.

VIII. FIRE PROTECTION SYSTEMS

DVD PRESENTATION

"SFPE CHEMISTRY OF FIRE"

Slide 2-84

A. Sprinkler system(s), if present, must be inspected to determine if it was operational and activated as designed.

B. Fire protection systems play a critical role in the detection, notification and control of fire. Personnel need to understand the basic operations of the systems and their impact with respect to fire cause determination.

AUTOMATIC ALARM AND DETECTION SYSTEMS

- Intended to indicate and warn of abnormal conditions.
- Recognize when a fire is occurring and activate the fire alarm system.
  - Alert occupants.
  - May alert the fire department.
  - May automatically activate fire suppression systems.

Slide 2-87

C. Automatic alarm and detection systems are intended to warn of potential fire-related emergencies.

1. Alert occupants.

2. Alert fire department.

3. Automatically activate fire suppression systems.

NOTIFICATION APPLIANCES

Horn

Bell

Strobe

Voice

Slide 2-88

D. Notification appliances typically consist of horns, bells, strobes and voice.

FIRE ALARM CONTROL PANEL

- Fire alarm control unit.
- Specific power requirements, including backup power.
- May be connected to monitoring service.

Slide 2-89

E. A fire alarm control panel may be connected to a monitoring service, which can provide information that is helpful in establishing a timeline related to the fire. These units should be inspected to ensure that they were operating properly at the time of the fire.

PURPOSE OF SMOKE AND HEAT DETECTORS

- Detect.
- Warn.
- Notify.
  - Did the devices activate as intended? If not, why not?

Slide 2-90

F. Smoke and heat detectors are designed to detect, warn and notify occupants and/or the fire department in the event of a fire-related emergency. Personnel need to check and see if these devices activated as intended. If not, why not?

SMOKE DETECTORS

- Ionization.
  - Generally more responsive to flaming fires.
  - Small amount of radioactive material between two electrically charged plates, which ionizes the air and causes current to flow. Disrupted when smoke enters chamber.

Slide 2-91

1. There are two basic types of smoke detectors. The first one is ionization. Ionization detectors operate using a small amount of radioactive material and a sensing chamber.

SMOKE DETECTORS (cont'd)

- Photoelectric.
  - Generally more responsive to fires that begin with a long period of smoldering.
  - Aims a light source into a sensing chamber away from a sensor. Light is reflected onto the sensor when smoke enters the chamber.

Slide 2-92

2. The second one is photoelectric. Photoelectric detectors operate using a light source and a sensing chamber.

HEAT DETECTORS

- Generally used in situations where smoke detectors cannot be used.
- Often installed in unheated areas.
- Generally very reliable and less prone to false alarms than smoke detectors.

Slide 2-93

3. Heat detectors are less prone to false alarms and are used in cases where smoke detectors cannot be used (i.e., often installed in unheated areas).

SYSTEMS DOCUMENTATION

- Did it perform as designed? Why or why not?
- Proper installation?
- Evidence of alteration or tampering?
- Changes in nature of contents or occupancy?
- Sources of technical assistance — designer, installer, code official.

Slide 2-94

G. The documentation of fire protection (smoke and heat detection) systems is important to the investigation of fire origin and cause.

1. Did these systems perform as designed? If not, why not?

2. Were the systems properly installed in accordance with applicable standards and regulations?

3. Is there any evidence of tampering?

4. Were there any recent changes in the use/occupancy of the building that warranted modification to the fire protection systems?

IX. SUMMARY

SUMMARY

- First responder's role.
- Scientific methodology.
- Fire scene examination.
- Examination of exterior structural components.
- Examination of interior structural components.

Slide 2-95

SUMMARY (cont'd)

- Fire effects and indicators.
- Examination of building contents.
- Fire protection systems.

Slide 2-96

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APPENDIX

FIRE SCENE EXAMINATION CHECKLIST

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Fire Scene Examination Checklist

This checklist is provided to help the first responders conduct a systematic examination of the fire scene to help determine the area of fire origin and the possible cause.

1. Should overhaul be delayed to allow fire cause determination? [ ] yes [ ] no

2. Exterior examination observations.

   a. Classification of building construction ________________________

   b. Estimated age of construction ________________________

   c. Area(s) of greatest damage ________________________

   ____

   ____

   d. Area(s) where fire exited building ________________________

   ____

   ____

   e. Are there obvious fire patterns? [ ] yes [ ] no

   f. Was building secure prior to the fire? [ ] yes [ ] no

   g. Are there any unusual signs or objects? ________________________

   h. Note anything unusual about the electrical system or equipment:

   ____

   ____

   ____

   ____

3. Interior examination observations.

a. What area has the least damage? ______________________________

____

____

____

b. What area has the most damage? ______________________________

____

____

____

____

c. Note damage to the following structural components:

Door moldings ______________________________

____

____

____

Walls ______________________________

____

____

Ceiling ______________________________

____

____

Floor ______________________________

____

____

d. Note damage to the following nonstructural components:

Shelving ____

____

____

Incandescent light bulbs ____

____

____

Window glass ____

____

____

Broken window glass ____

____

____

Melted metal objects ____

____

____

Doors ____

____

____

4. Note the lowest level of burning: ____

____

____

5. What is the source of fire or secondary fire? ______________________________

____

____

6. Examination of building contents.

   a. Unusual items ______________________________________

   ____

   ____

   b. Furniture ______________________________________

   ____

   ____

   c. Appliances ______________________________________

   ____

   ____

7. Document fire patterns.

   a. "V" patterns. [ ] yes [ ] no

   b. Lines of demarcation. [ ] yes [ ] no

8. Document fire travel/spread.

   a. Even levels of burning. [ ] yes [ ] no

   b. Extent of charring. [ ] yes [ ] no

Notes:

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UNIT 3:
FIRE CAUSES

TERMINAL OBJECTIVES

The students will be able to:

3.1 Explain the four fire cause classifications.

3.2 Describe various common accidental and incendiary fire causes.

3.3 Explain the basic principles and components of a residential electrical system.

ENABLING OBJECTIVES

The students will be able to:

3.1 Define fire cause and identify four classifications of cause.

3.2 List various accidental and incendiary fire causes.

3.3 Explain basic principles of residential electrical systems.

3.4 List various indicators of incendiary fires.

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UNIT 3:
FIRE CAUSES

Slide 3-1

ENABLING OBJECTIVES

- Define fire cause and identify four classifications of cause.
- List various accidental and incendiary fire causes.
- Explain basic principles of residential electrical systems.
- List various indicators of incendiary fires.

Slide 3-2

I. PURPOSE AND CLASSIFICATIONS OF FIRE CAUSES

PURPOSE AND CLASSIFICATIONS OF FIRE CAUSES

- Accidental.
- Natural.
- Incendiary.
- Undetermined.

Slide 3-3

A. Four possible fire cause classifications.

1. Accidental — fires that are not the result of a deliberate, (intentional) malicious act.

2. Natural — fires that ignite without human intervention.

3. Incendiary — fires that result from deliberate, malicious actions or circumstances in which the person starting the fire knows that it should not have been started.

4. Undetermined — fires where the cause cannot be proven to an acceptable level of certainty.

FIRST MATERIAL IGNITED

- Material is that which sustains combustion beyond the ignition source.
- Initial fuel can be part of the ignition source.
- Vital element in understanding the events that caused the fire.

Slide 3-4

B. First material ignited.

1. Material that sustains combustion beyond the ignition source.

2. The fuel load present is critical to understanding the circumstances responsible for the fire cause.

SOURCE AND FORM OF HEAT OF IGNITION

- Source of ignition may be at or very near point of origin.
- Physical evidence may remain, be heavily damaged, or be destroyed.
- Source of ignition should be identified in order for the cause to be proven.

Slide 3-5

C. There are four primary heat sources.

1. Chemical heat sources (e.g., acids, water-reactive materials).

   a. Heat of combustion — amount of heat during complete oxidation (the caloric fuel value).

   b. Spontaneous heating — increase in temperature without drawing heat from surroundings.

   c. Heat of decomposition — breakdown or loss of material due to thermal (heat) energy.

   d. Heat of solution — heat released when a substance is dissolved in liquid.

2. Electrical heat energy (e.g., overloading of circuit, loose connections).

   a. Resistance heating — the generation of heat by electric conductors carrying current. Example: heating element in an electric heater.

   b. Induction heating — influencing a conductor by an alternating magnetic field. Example: soldering of wires or metals together.

   c. Dielectric heating — dirt/dust on surface of an insulator allows ground fault leak of current. Example: a microwave oven.

   d. Heat from arcing.

   e. Static electricity.

   f. Lightning.

3. Mechanical heat energy (e.g., motors; heating, ventilating, and air conditioning (HVAC) units).

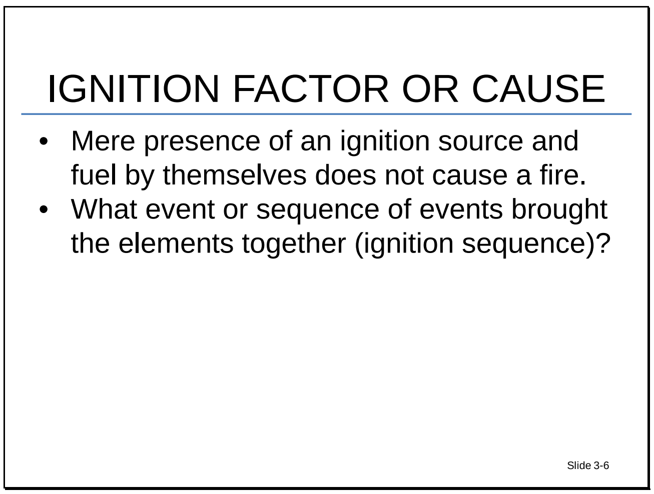
    a. Friction heat.

    b. Friction sparks.

    c. Heat of compression.

4. Nuclear heat energy.

II. DETERMINING FIRE CAUSES



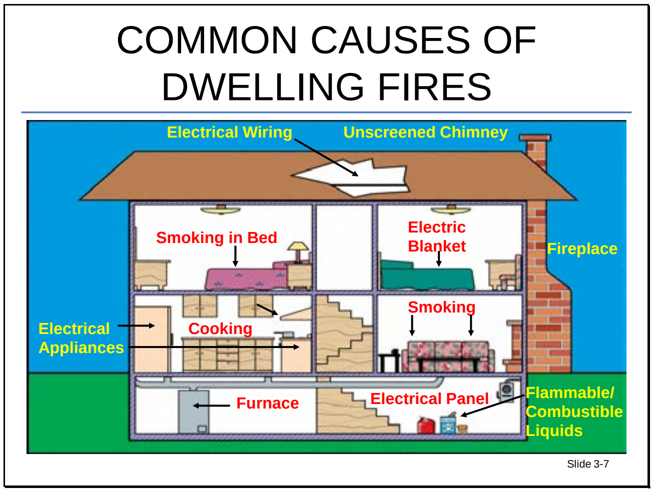
A. Ignition factor or cause.

1. The presence of fuel and an ignition source in and of themselves does not establish the cause of the fire; the event, actions or circumstances that brought the fuel and ignition source together must be identified.

2. The propensity for fuel to ignite is dependent on the following:

    a. Mass of the fuel.

    b. Form (physical state) of fuel (i.e., solid, liquid, gas).



B. There are several common accidental causes of most residential fires:

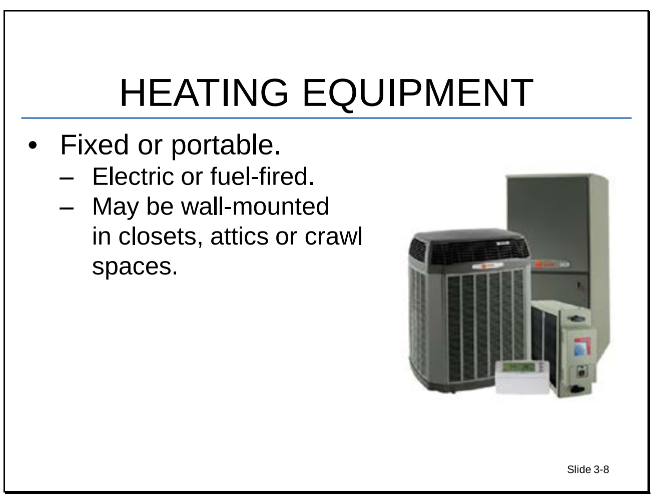
1. Heating equipment.

2. Combustibles too close to heat sources.

3. Smoking.

4. Electrical malfunctions.

5. Cooking.



C. Heating equipment.

1. Fire causes involving heating equipment may include fixed or portable space heaters.

a. Electric or fuel-fired.

b. May be wall-mounted in closets, attics or crawl spaces and can be free-standing in other locations.

2. Fires may start in combustibles placed near a heating unit.

a. Papers.

b. Clothing.

MAJOR FIRE CAUSES

- Defective equipment.
- Too close to combustibles.
  - Installation.
  - Storage.
- Misuse of equipment.

Slide 3-9

3. Major fire causes may be due to defective or overheated equipment.

a. May be installed too close to combustibles.

b. May have malfunctioned due to manufacturing defect, improper installation or misuse.

D. There are two basic types of kerosene heaters.

1. Convective.

a. Usually circular in shape. Its fuel tank is located below the wick and combustion chamber. The wick absorbs and delivers fuel to the combustion chamber.

b. Convective heaters circulate warm air upward and outward in all directions. They are designed for large areas, or even several rooms, but never for a small, closed area, such as a bedroom.

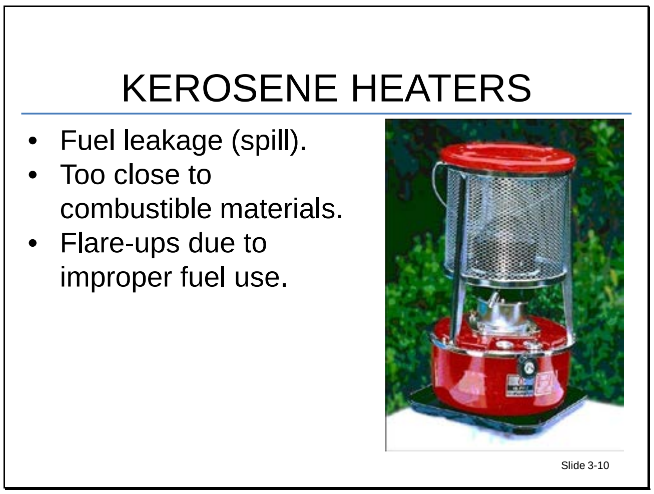
c. Must be moved for refueling because they do not have a removable fuel tank.

2. Radiant.

   a. Usually rectangular in shape and designed for smaller areas. They also feature a wick, combustion chamber, and, in addition, a reflector that directs heat at people or objects.

   b. Some radiant heaters have electric fans to increase the flow of warm air.

   c. Many radiant models have a removable fuel tank, which allows only the fuel tank to be transported for refueling.



3. Most of the fires associated with kerosene heaters are due to:

   a. Fuel spills.

   b. Placement too close to combustible materials.

   c. Using improper fuel (i.e., gasoline versus 1-K grade kerosene).

PORTABLE ELECTRIC HEATERS

- Too close to combustibles.
- Use of extension cords.
- Tip-overs.
- Oil-filled.

Slide 3-11

E. Portable electric heaters (oil-filled/space/standard).

1. Common causes of accidental fires involving portable electrical heaters may be due to:

    a. Combustibles located too close to units.

    b. Use of extension cords that are not properly rated for the unit.

    c. Units being knocked over and then coming in contact with combustible materials.

2. Check controls of the unit.

    a. Most units have a tilt or overturn switch.

    b. Designed to cause the unit to turn off if tilted or knocked over.

3. Check location of the unit.

    a. Is the unit in a normal location, or is it in a location where it would not normally be expected to be placed?

    b. Would the unit be expected to be used based on time of year (i.e., heater being used during hot weather)?

4. Once the heater is located, check whether the unit was plugged into an extension cord and if there is any evidence of an overload or short circuit.

SOLID-FUEL HEATING EQUIPMENT

- Over-fueled.
- Improper fuel.
- Too close to combustibles.
  - Chimney/Flue fires.

Slide 3-12

F. Solid-fuel heating systems (e.g., wood, coal).

1. Check fuel supply.

   a. Overfilled?

   b. Improper fuel?

2. Fires may occur in nearby combustibles, including the fuel stored nearby.

   a. Check combustion and flue areas.

   b. Proper installation of flue or pipe where it passes through walls or ceilings.

   c. Creosote buildup on seams of flue pipe could cause a fire.

3. Stovepipes, flues or chimneys that appear extremely clean may have been involved in a chimney fire.

   a. Produces extreme temperatures.

   b. May ignite nearby combustibles. Check manufacturer or code requirements for proper installation relative to distances from combustibles, etc.

4. Flammable and combustible materials igniting fuels improperly stored nearby.

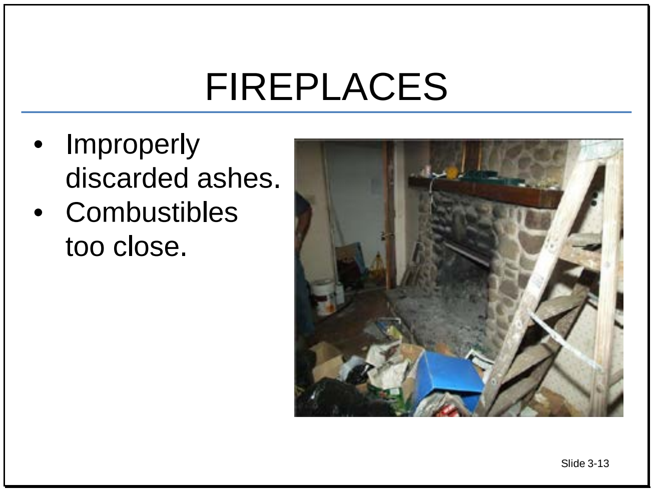
5. Old solid-fuel unit converted to burn fuel oil.

   a. Not suitable.

b. Not designed for liquid fuel.

- Subject to overheating.

- Leaks combustion products.



G. Fireplaces.

1. Hot ashes and coals. Check disposal habits of occupants.

    a. Be careful of occupant cover-up.

    b. Compare account of events with observations/evaluation of area/ point of origin.

2. Time frame may seem extreme.

3. Consider insulating effects of ashes and container construction.

4. Attempt to locate remains of container used to hold ashes and coals.

5. Combustibles placed or stored near fireplace? Consider distance from fireplace and time that material was exposed to heat.

6. Animal activity.

OIL- AND GAS-BURNING EQUIPMENT

Slide 3-14

H. Oil- and gas-burning equipment.

1. Check firebox, pipes and flue.

a. Excess soot (carbon) may indicate incomplete combustion.

b. Malfunction.

c. Improper adjustment.

2. Check controls and fuel lines.

a. Prior trouble with equipment.

b. Fresh tool marks.

c. Recent repairs attempted?

CHIMNEY OR FLUE FIRES

- Creosote can ignite between 1,170 F (632.2 C) and 1,300 F (704.4 C).
- Coating as thin as 1/8 inch is sufficient to cause fire.

Slide 3-15

I. Chimney or flue fires.

1. Creosote buildup may ignite from sparks or overheating.

a. Only a very thin coating is required to ignite under the proper conditions.

CHIMNEY OR FLUE FIRES (cont'd)

- Type of wood being burned normally has very little influence on accumulation.
- Temperatures as high as 2,000 F (1,093.3 C) may be reached.

Slide 3-16

b. The type of wood has little influence on the extent of heat buildup.

2. Can cause roof fires as burning soot and debris are drawn out of flue.

3. Point of origin may be near the area where flue passes through combustible construction materials.

4. Check to determine the last time that the chimney was cleaned.

CHIMNEY MATERIALS ARE CONDUCTORS OF HEAT

- Installed without recommended clearances.
- Constant use of appliance may cause combustible materials to ignite.

Slide 3-17

5. Chimney materials are conductors of heat and may cause nearby combustible materials to ignite.

a. Can be a problem if improperly installed without recommended clearances per applicable codes.

b. Constant use of appliance may cause combustible materials to ignite if not properly maintained.

J. Cooking equipment.

1. Common causes are due to:

a. Misuse.

b. Incorrect installation.

c. Inattention while in use.

2. Check location of room’s trash container and other combustible materials in the immediate area. Ignition of container can occur by:

a. Splattering grease.

b. Conduction of heat from unit.

3. Attempts by occupants to remove burning fuel.

a. Occupants frequently attempt to remove burning pans from cooking equipment.

b. Burning pan and fuel may be dropped or thrown, may cause burn injuries to occupants.

c. Point of origin may be located at floor level (or signs of burning fuel at floor level).

d. Debris (evidence) may also be located in (or near) sink.

4. Check time factors.

a. Did the fire occur during normal meal preparation time?

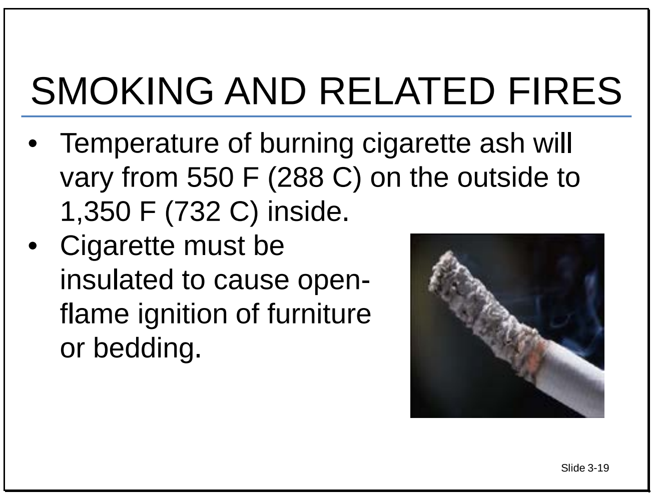
b. Check for other evidence of meal preparation.

5. Check number of cooking elements being used. Check positions of elements and oven controls.

6. Check for repair or adjustment of unit and fuel supply.

a. Tool marks.

b. Missing cover plates and screws.



K. Smoking and related fires.

1. Heat generated by burning cigarettes varies greatly.

a. Usually reaches 550 F (288 C) measured on the outside surface of glowing ash.

b. Can be as high as 1,350 F (732 C) measured in the center of glowing ash.

2. Temperatures even higher than those mentioned have been estimated or recorded by various researchers.

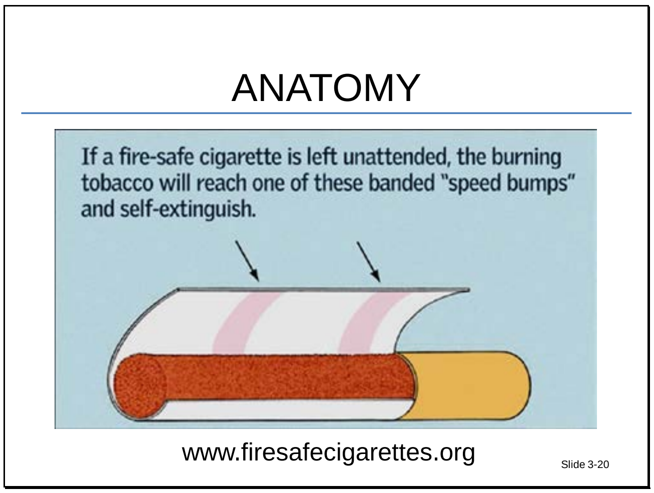
3. Cigarettes and the ignition of most combustibles.

   a. Usually local char or damage due to small contact area.

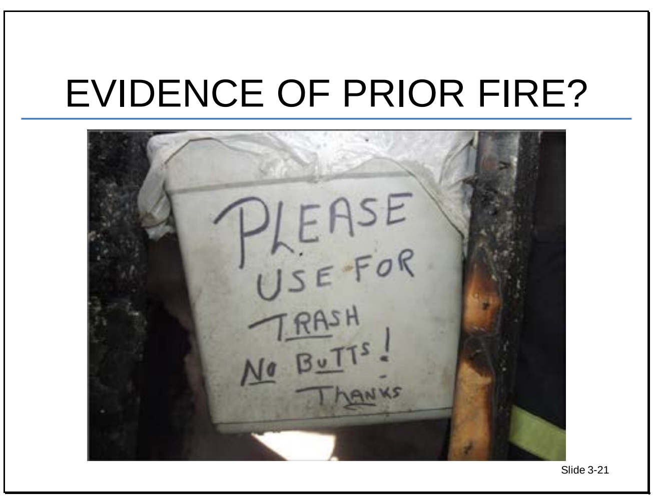
   b. Cigarettes usually must be insulated to ignite combustibles.

   c. Increases surface contact and allows buildup of heat.

   d. Insulation effect occurs when cigarette or burning ash falls between the cushions on a sofa or chair.



4. Fire-safe cigarettes are designed to self-extinguish if left unattended.



5. Trash receptacles and other "nonapproved" containers for cigarette butts should be examined to determine if there is any evidence of prior fires or the possibility that improperly discarded smoking materials could be the cause.

Slide 3-22

6. Smoldering furniture usually requires a long period of time to produce open burning (flaming).

   a. It is difficult to identify an absolute minimum time period necessary for a slow, smoldering fire to reach open, flaming combustion.

   b. Smoldering fires inside padded furniture may produce temperatures of 1,400 F (760 C) to 1,600 F (871 C).

   c. Frequently, more extensive damage will be observed on the inside of the furniture frame than on the outside.

7. Personnel should look for ashtrays, cigarette packs, matches, lighters, and any other related evidence to support the possibility of smoking as a fire cause.

8. Although foamed plastic, foam rubber, or polyfoam furniture padding can be manufactured with fire safety considerations in mind, they do contribute to the overall fuel load.

   a. May produce more heat than older (cotton) padded furniture.

   b. May or may not ignite easily upon contact with lighted cigarette (depends on chemical composition of material and actual circumstances of ash placement).

L. Flammable and combustible liquids storage.

1. Improper storage of flammable liquids.

   a. Can occur in almost any storage area.

   b. Residential occupancies (e.g., utility rooms, kitchen cabinets, garages, carports, bathrooms, storage sheds, basements).

   c. Commercial/Industrial occupancies (offices, plant or work areas, storage closets, warehouse areas).

2. Can occur either inside or outside.

   a. Improper selection and use of storage containers.

   b. Lightweight plastic containers may become brittle with age and develop cracks or leads or may be punctured by sharp objects.

   c. Flammable liquids may cause deterioration of container.

   d. Lightweight metal containers may rust or deteriorate along seams and slow leaks may develop.

3. Improper use of flammable liquids.

   a. Gasoline, kerosene and lighter fluid may be used as cleaning fluids.

   b. They may be spread over large floor areas, causing the vapors to ignite by ignition sources in the areas.

4. Flammable liquids and ignition sources.

   a. Flammable liquid vapors usually settle to the lowest level in the involved area.

   b. May contact ignition source and flashback over long distances (or in certain situations, an explosion may occur).

   c. Common ignition sources may include:

      - Gas appliances.
      - Water heaters.
      - Stove/Range.
      - Electrical equipment.
      - Light switches.
      - Motors.
      - Static electricity.

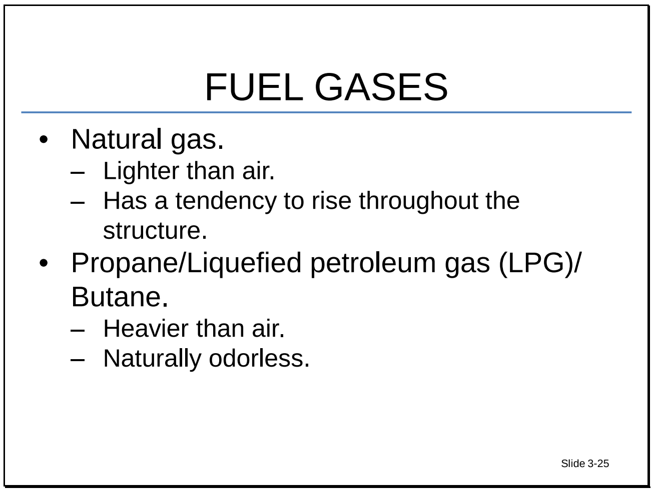
Slide 3-24

5. Other indicators assist in the identification of accidental fires involving flammable or combustible liquids.

   a. Presence of cleaning equipment containing residue of flammable or combustible liquids.

b. Stories of occupants concerning what liquids were stored in the area, the last time anyone was in the area and whether he or she noticed any odors or observed any spills or leaks, etc.

c. Were children reported to have been playing in areas containing stored flammable or combustible liquids?



M. Fuel gases.

1. Natural gas.

a. Natural gas (or manufactured gas) is lighter than air and will rise to upper levels of a structure.

b. Explosions involving natural gas usually produce damage centered at the upper levels of the structure involved.

2. Liquefied petroleum gases (LPGs), such as butane or propane, are heavier than air and normally will settle to lower levels of a structure.

a. Explosions involving LPGs usually produce damage centered at the lower levels of the area involved.

b. Structural components should be carefully examined to identify area(s) of most severe damage. Failures typically occur at the weakest point of a structure.

3. Many people wrongly believe that liquefied petroleum and natural gases are poisonous, and they may attempt to use gas-fueled cooking equipment to commit suicide.

4. All flammable liquid vapors are heavier than air and normally will settle to lower levels of the structure.

   a. Explosions involving flammable vapors usually produce damage centered at the lower levels of the area involved.

   b. Check for extinguished pilot lights and controls set to the “on” position.

   c. Destruction of fuel lines during fire may increase burn rate, and the resulting charring may appear unnatural.

   d. Point of origin in area of gas appliance (requires confirmation of appliance malfunction).

N. Open flames and sparks.

1. Welding and cutting.

   a. Often conducted in areas of combustible storage.

   b. Fire may smolder for a long period after completion of welding and cutting operations.

2. May result in fire from effects of heat conduction and/or convection.

3. When welding or cutting objects that are connected to or pass through combustible construction, fires can occur.

   a. May ignite combustibles through careless flame contact.

b. Fires may be caused remote from the location where work is being performed.

4. Indicators of fire caused by welding/cutting.

   a. Slag in area of origin.

   b. Spot burning in area.

   c. Welding or cutting equipment in area.

   d. Metal objects showing evidence of recent welding/cutting.

5. Friction and sparks from machinery.

   a. High-speed rotation of objects may result in extreme heat generation if machinery is improperly lubricated.

   b. Similar to open-flame cutting in relation to fire cause and investigative indicators.

   c. May cause fire if heated material contacts combustibles.

   d. May cause a fire by convection of heat. Indicators of fire caused by friction:

      - Report of trouble or noise from equipment involved.

      - Point of origin near or inside suspected equipment.

      - Localized damage to metal parts (may produce actual melting of metal).

6. Thawing pipes and soldering with open flames.

   a. Similar to open-flame cutting in relation to investigative indicators.

   b. Electrical welding equipment is often used to thaw pipes; if improperly grounded, this can result in a fire.

SPONTANEOUS HEATING

- Certain materials and conditions must be present.
- Produced in one of three ways:
  - Chemical action.
  - Fermentation.
  - Oxidation.

Slide 3-27

O. Spontaneous heating leading to ignition.

1. Sometimes used as a catchall by investigators.

   a. Somewhat rare.

   b. More common in rural or farm areas.

2. Many organic materials and some metals are subject to oxidation and/or fermentation that results in spontaneous heating.

3. Spontaneous heating is produced in three ways:

   a. Chemical action (e.g., unslaked lime and water).

   b. Fermentation or microbial thermogenesis.

   c. Oxidation.

SPONTANEOUS HEATING (cont'd)

- Fermentation is most common.
- Conditions needed.
- Indicators of spontaneous heating.
- Materials susceptible.
  - Charcoal.
  - Cloth.

Slide 3-28

4. The most frequently encountered fire situation involving spontaneous heating is fermentation.

   a. Moisture is a prime factor.

   b. Drying time prior to storage.

   c. Storage while wet or “green.”

5. Spontaneous heating may be accelerated by outside heat sources.

   a. Sunshine.

   b. Storage near steam pipes/heater.

   c. Hot air ducts.

   d. Heat produced by friction (vibration of the mass of stored material or vibration of the storage container).

6. Available air is important to spontaneous heating.

   a. Too much air or air movement may dissipate heat and keep mass below ignition temperature.

   b. Too little air may restrict heating.

   c. Example: A rag soaked in an organic-based oil may produce spontaneous heating if wadded at the bottom of a trash can. If laid open on the ground or floor, the rag may simply dry.

7. Mass of material is important. Usually requires several inches of material to allow spontaneous heating.

8. Spontaneous heating may occur for hours, days or months prior to reaching ignition temperature. Bacteriological preheating may initiate the process.

   a. Spontaneous heating may continue or halt, depending on all other factors present.

   b. Indicators of spontaneous heating.

      - Charring inside mass or more than one area of charring in mass.

9. Some common materials that are susceptible to spontaneous heating:

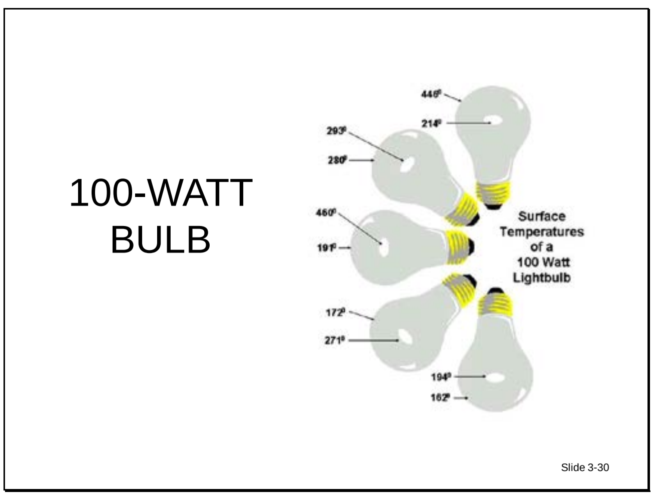
   a. Linseed oil.

   b. Charcoal.

   c. Fish meal.

   d. Wool waste.

   e. Foam rubber.

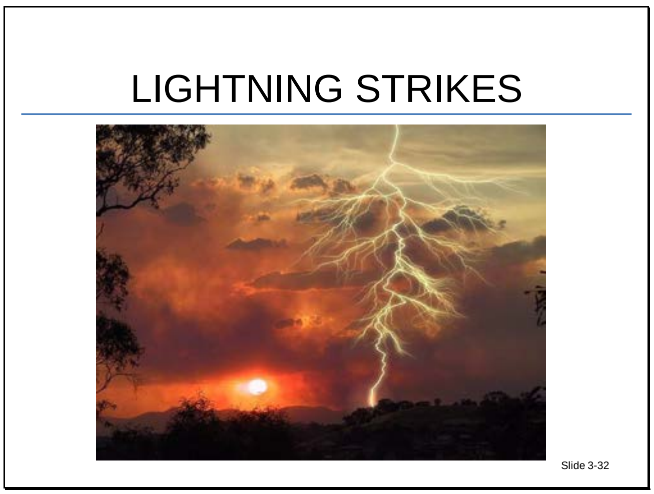


P. Light bulbs can cause fires.

1. Light bulbs may serve as a potential ignition source in certain situations.

2. High-wattage bulbs may ignite combustible materials nearby, depending upon the duration of heating and the ignition properties of the material.

3. Halogen lamps and bulbs can generate high temperatures, making any combustible materials placed on or near them susceptible to ignition.



Q. Lightning strikes Earth hundreds of times per minute.

1. Each year, many electrical storms pass through communities, which can cause fires to start.

2. Fires may be discovered immediately, or they may not appear for some time.

R. The electrical discharge usually consists of several electrical strokes.

1. Each lasts a few millionths of a second.

2. Discharges occur 20 to 80 thousandths of a second apart.

3. Generated current can reach 200,000 amperes.

4. Potential between clouds and Earth may reach 100,000 million volts and generate temperatures as high as 54,000 F (29,982 C).

S. Damage from lightning is usually evident when it strikes a building.

1. Witnesses hear, see or feel the strike.

2. Lightning strikes may be recorded at lightning tracking stations.

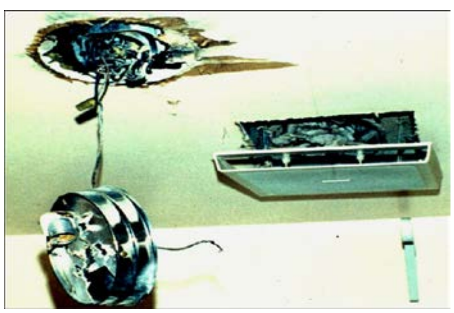
LIGHTNING STRIKES (cont'd)

Slide 3-35

3. The weather service may confirm the presence of an electrical storm in an area prior to fire.

4. Physical damage may be evident, such as damaged siding, roof/floor joist, or concrete/brick; splintered wood; etc.

LIGHTNING STRIKES (cont'd)



Slide 3-36

5. Damaged electrical equipment.

   a. Holes blown in roofs, ceilings or walls.

   b. Sources of ground may be vulnerable.

OTHER ACCIDENTAL FIRE CAUSES

- Sunlight reflected off shiny objects.
- Chemical reactions.
- Christmas trees.
- Candles.
- Campfires.
- Debris (trash) burning.
- Discarded cigarettes in brush.

Slide 3-37

T. Other accidental fire causes.

1. The sun’s rays can be concentrated to produce ignition temperatures of common combustible materials. Many items/articles are reported to have been involved in such fires.

    a. Defective window glass.

    b. Magnifying glass.

    c. Eyeglasses.

    d. Prisms.

2. Chemical reactions.

    a. Oxidizing agents coming in contact with certain materials may produce heat/fire.

    b. Contamination of chemicals may produce sufficient heat to cause autoignition or ignition of nearby combustibles.

3. Christmas trees.

    a. Often ignited by faulty Christmas tree lights.

    b. Improperly watered trees drastically increase the potential for ignition.

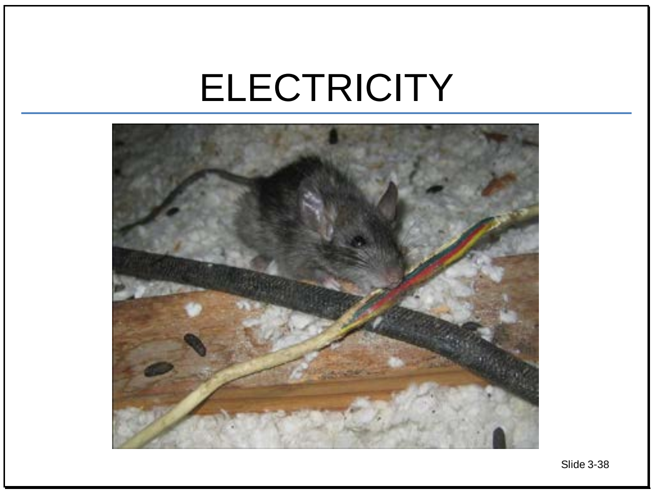
    c. Often burn quickly and generate intense heat.

4. Candles.

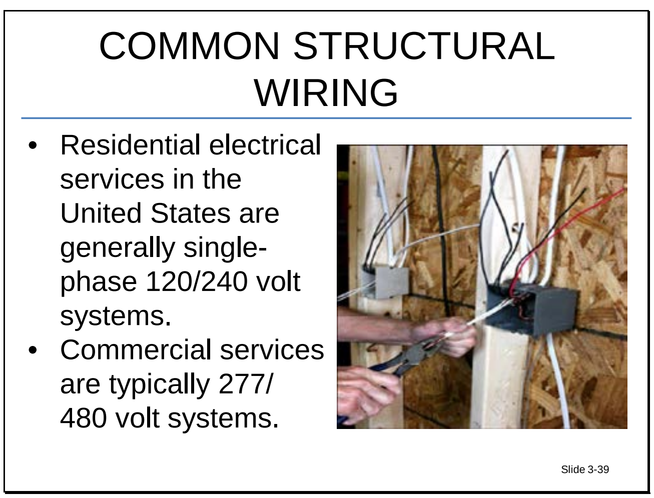
   a. Unattended candles can be knocked over and come in contact with combustible materials, causing ignition.

   b. Candles in use for lighting and/or heat near combustible materials may serve as a competent ignition source.

III. ELECTRICAL SYSTEMS



A. An understanding of the various terms, components and systems associated with electricity is essential to fire cause determination.



B. A working knowledge of 120/240 volt single-phase electrical systems, which are typically used in residential and smaller commercial structures, is important so as to identify electricity as a potential cause.

C. Structural wiring used in residential or commercial applications is typically copper; however, aluminum wiring may have previously been used.

1. Aluminum wiring expands and contracts at a much higher temperature than copper wire; therefore, it may develop loose connections over time at screw terminals.

2. Aluminum wiring oxidizes more than copper wire and is more likely to develop resistance heating. Over time, this high-resistance connection can cause ignition of structural members and combustible materials in the vicinity.

ELECTRICAL HAZARDS

- Electrical hazards may be present on a fire scene long after the fire is over.
  - Never assume that just because the structure suffered heavy damage, all sources of electrical energy have been safeguarded against.
  - Electrical energy can be present in the form of energized circuits or stored energy.

Slide 3-40

D. Electrical hazards may be present on a fire scene long after the fire is over.

1. Never assume that just because the structure suffered heavy damage, all sources of electrical energy have been safeguarded against.

2. Electrical energy can be present in the form of energized circuits or stored energy.

ELECTRICAL HAZARDS (cont'd)

- Never attempt to disconnect electrical utility service from the structure. This should only be accomplished by the utility representative.
- Electrical service may be brought to a structure from overhead or underground and multiple sources.

Slide 3-41

3. Never attempt to disconnect electrical utility service from the structure. This should only be accomplished by the utility representative.

4. Electrical service may be brought to a structure from overhead or underground and multiple sources.

ELECTRICAL SERVICES

- A meter is normally found in this type of enclosure.
  - Removing meter **does not** disconnect power.
  - Can also be in an enclosure that is found indoors.

Slide 3-42

E. A meter is normally found in this type of enclosure.

1. Removing meter **does not** disconnect power.

2. Can also be in an enclosure that is indoors.

ELECTRICAL FIRE CAUSES

- Electrical fires are usually caused by:
  - Unsafe equipment or improper installation.
  - Loose connections.
  - Overloads.

Slide 3-43

F. Electrical fires are usually caused by:

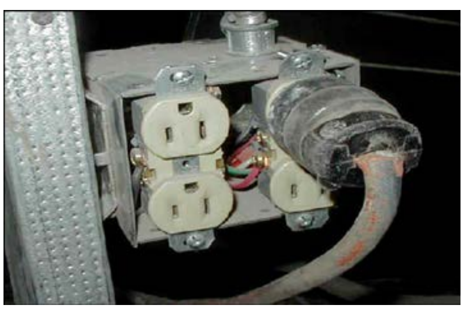
1. Unsafe equipment or improper installation.

2. Loose connections.

3. Overloads.

ELECTRICAL FIRE CAUSES (cont'd)

Cover removed from wiring or outlet box.



Slide 3-44

4. Absence of protective covering exposes wiring to damage.

MISUSE OF EXTENSION CORD

Slide 3-45

5. Misuse of extension cord.

ELECTRICAL FIRE CAUSES (cont'd)

- Grounding prongs removed from extension cords.
- Damage can be caused by improper splices or physical abrasion (e.g., placed under rugs and furniture).

Slide 3-46

6. Grounding prongs removed from extension cords.

7. Damage can be caused by improper splices or physical abrasion (e.g., placed under rugs and furniture).

OVERLOADS

- Too many devices plugged into a circuit, causing heated wires and possibly a fire.
- Damaged tools overheating.
- Lack of adequate overcurrent protection.

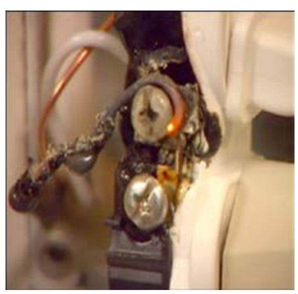
Slide 3-47

8. Too many devices plugged into a circuit, causing heated wires and possibly a fire.

9. Damaged tools overheating.

10. Lack of adequate overcurrent protection.

LOOSE CONNECTIONS



Slide 3-48

IV. INDICATORS OF INCENDIARISM

INDICATORS OF INCENDIARISM

- How the fire was set.
- Use of ignitable liquids.
- Materials used to construct incendiary devices.
- Indicators of incendiary fire.
- Presence of incendiary devices to delay detection, accelerate fire or slow extinguishment.

Slide 3-49

A. Causes of incendiary fires are limited only by the imagination of the firesetter.

1. The first responder must understand how incendiary fires are set (or started) to make accurate origin and cause determinations.

2. The use of ignitable liquids as accelerants is common in incendiary fires.

3. The first responder must know what materials are commonly used to construct incendiary devices.

4. Common indicators of an incendiary fire may include multiple fires, trailers, or the presence of liquid accelerants.

5. Incendiary devices are used as a means to delay the detection, accelerate the fire's spread, or slow the extinguishment of the fire.

INCENDIARY FIRE CAUSES

Absence of all potential accidental fire causes.

Slide 3-50

B. Absence of all potential accidental fire causes.

MULTIPLE FIRES

- More than one point of origin.
- Must prove that each fire is independent of the others.

Slide 3-51

TRAILERS

Any combustible or flammable material used to spread fire from one point or area to another.

Slide 3-52

C. A trailer is any combustible or flammable material used to spread fire from one point or area to another.

COMMON CLASS A TRAILERS

- Newspapers.
- Rope, string, twine.
- Clothing, bedclothes.
- Tissue paper.
- Waxed paper.
- Building contents.

Slide 3-53

1. Common combustible materials that can be used as trailers include:

    a. Newspaper.

    b. Sheets.

    c. Clothing.

    d. Household trash.

    e. Rope, string, twine, etc.

    f. Bounce™ (fabric softener sheets).

2. Trailers usually leave a char or burn pattern on surfaces where used.

    a. Floors.

    b. Carpets.

    c. Stairs.

D. Cigarette and match delay.

1. Effectiveness of delay depends on length of cigarette, tightness of tobacco, and whether or not match is fully inserted into cigarette.

2. Matches bundled around cigarette provide additional fire intensity.

3. Filter-tip cigarettes limit delay to approximately seven minutes.

4. The length of delay (time) varies widely depending on the type of device, materials, environmental conditions, construction, placement and ventilation.

E. Highway flares.

1. Ignition of flare may be delayed by use of model rocket fuse, cigarette, or match. Such fuses are very inexpensive and are available at most hobby shops.

2. Flares may produce temperatures up to 1,200 F (648.9 C).

3. Flares usually burn for 15 to 30 minutes.

4. Flares are available in various colors, shapes and sizes.

5. Highway flares may also be used as fuses in the construction of Molotov cocktails.

    a. Standard highway safety flare is taped to bottle filled with accelerant.

    b. Flare is ignited, and bottle is thrown.

STANDARD MOLOTOV COCKTAIL WITH PAPER WICK

Slide 3-58

F. Molotov cocktails.

1. Standard Molotov cocktail.

2. Thin-walled bottle filled with gasoline and wicked with rag, paper towel or similar materials.

3. Arsonist (bomber) lights wick and throws “cocktail.” Cocktails often malfunction.

4. Cocktails and other ignition devices.

   a. Bottle is filled with accelerant, and bottle opening is wicked with combustible material.

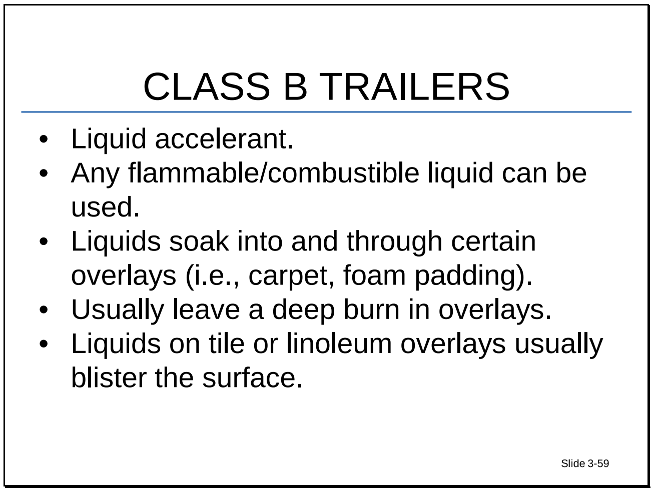
   b. Several strike-anywhere matches are taped to neck of bottle.

   c. Bottleneck is scraped across a rough surface, and tampon wick is ignited (provides easy wick ignition).

5. Thickened accelerants and cocktails.

6. Chemical Molotov cocktails (sometimes called British Molotov): Bottle is filled with mixture of gasoline and concentrated sulfuric acid. Bottle then is capped and may be stored for long periods.

G. Presence of flammable accelerants.



1. Class B (liquid) trailers include a wide variety of flammable and combustible liquids.

    a. Gasoline.

    b. Kerosene.

    c. Alcohol.

    d. Lighter fluid.

    e. Any other common or readily available ignitable liquid(s).

2. Often found in areas where they would not normally be in a given occupancy.

3. When found throughout area and:

    a. Not caused by explosion of container. No sign of a container explosion.

    b. Not due to container leakage. No sign of container leakage.

CLASS B TRAILERS (cont'd)

- Most liquid accelerants contain large amounts of hydrogen and carbon.
- Some other liquid accelerants do not contain hydrocarbons and are used as liquid trailers.

Slide 3-60

4. Although most ignitable liquids used as accelerants are derived from crude oil (petroleum-based), there are others that are not but can also be used as liquid trailers.

   a. Ethanol.

   b. Rubbing (isopropyl) alcohol.

   c. Acetone.

COMMON CLASS B HYDROCARBON LIQUIDS

- Gasoline.
- Kerosene.
- Lighter fluid.
- Turpentine.
- Any other common or readily available liquid accelerant.

Slide 3-61

COMMON CLASS B NONHYDROCARBON LIQUIDS

- Ketones.
  - Acetone.
  - Methyl ethyl ketone.
- Alcohol.
  - Methyl alcohol.
  - Ethyl alcohol.
  - Isopropyl (rubbing) alcohol.

Slide 3-62

PRESENCE OF LIQUID ACCELERANTS

- In unusual locations.
- Throughout the area.
- Above floor area.

Slide 3-63

5. The presence of liquid accelerants in locations where they would not normally be found or located throughout an entire area may be an indication that they were used to intentionally set a fire.

   a. On or in furniture.

   b. Inside drawers, cabinets, boxes, etc.

   c. Inside files, desks, books, etc.

LIQUID BURNS ON CARPET

Slide 3-64

6. Ignitable liquid accelerants that are poured on steps may be absorbed in carpet and padding (if present), and patterns may be visible once the debris in the area is carefully removed.

   a. Evidence (residue) may be recovered from the area beneath the steps.

   b. Evidence (residue) may also be recovered from between the boards (risers) on the steps.

LIQUID BURN ON STEPS

Slide 3-65

7. Ignitable liquids may soak into any absorbent material.

   a. Carpet: Liquid often leaves distinct patterns, and the residue may remain in the carpet and pad on edge of burned area or in charred pad.

      - Area may require cleaning away of debris before pattern is visible.

- Pouring water onto floor may indicate direction of settling or running of accelerant.

b. Floor-length drapes act like wicks.

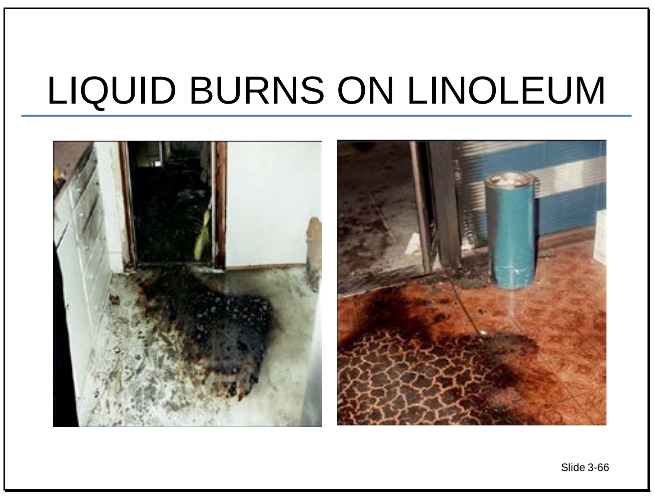
c. Porous materials, such as plaster walls, can also absorb liquids.

8. Common indicators of the presence (or use) of some flammable/combustible liquid accelerant (fuel) charring of floor surface.

a. Many accidental structure fires can produce significant floor charring.

b. Temperatures at floor level during flashover can exceed 1,100 F (593.3 C).

c. Evidence of burns or grooves between floorboards may indicate the presence of a liquid fuel. Point out that ignitable liquids may run in between floorboards, burn, and produce fire patterns between the edges of floorboards.



9. Blistering or destruction of floor tiles.

a. Asphalt and vinyl tiles may be blistered or destroyed in an area where flammables spread.

b. May be difficult to locate evidence (residue) due to adhesive in back of tiles.

LOW BURN AT FLOOR LEVEL

Slide 3-67

c. Ignitable liquids may settle in the lowest parts of the floor surface, the corners of rooms and along the base of walls, or areas of heavy occupant travel or use.

EQUIPMENT OR APPLIANCES AS INCENDIARY FIRE CAUSES

- Tampering.
- Fuel placed nearby.
- Used at unusual times.
- Unusual location.
- Check control settings.
- Tool marks.

Slide 3-68

H. Common equipment or appliances as incendiary fire causes.

1. If equipment or appliances are suspected as being the ignition source, personnel should check for any evidence of tampering, fuels nearby, and use at unusual times or in unusual locations, as well as examine the control settings to determine if they were on at the time of the fire.

SAFETY DEVICES — APPLIANCES

- Most appliances have built-in safety features that will function as designed and not result in ignition.
- Ignition may result if there is product failure **or** the appliance safety device is physically tampered with.

Slide 3-69

2. Although most appliances have built-in safety features, they may be disabled or tampered with to allow the appliance to overheat and serve as an ignition source for a fire.

CURLING IRON

Slide 3-70

3. Electrical equipment and/or appliances used as incendiary devices.

4. Almost any electrical equipment or appliance may be used as an incendiary device.

    a. Heating elements placed in or on combustibles to produce heat.

    b. To activate some other device (timer).

5. Examples of common electrical devices.

a. Coffee makers placed in or on combustibles — check for evidence of combustible fuel being arranged nearby (i.e., fuels such as gasoline may be placed in water reservoirs) or the thermal cutoff being bypassed.

b. Heat produced by electrical devices depends on design, wattage and position.

c. Equipment found in unusual locations.

d. Electric appliances used at unusual times.

6. Heating equipment, such as hot water heaters, provide a convenient heat source.

7. Appliances that at one time may have had a history of causing fires are often used as an “invented” fire cause to cover incendiarism.

   a. Check control settings.

   b. Check for tool marks on fuel lines.

8. Evidence of tampering with fuel supply lines, wiring, etc. should be documented.

STRUCTURAL DAMAGE PRIOR TO FIRE

- Holes in walls, floors or ceilings.
- Could be accidental.
- Poor upkeep of building.
- Document and relay information to investigators.

Slide 3-73

I. Personnel should note any holes in walls, floors or ceilings, as they may have been made intentionally to aid in the spread of the fire; however, they also may have been pre-existing and not related to the cause of the fire.

REMOVAL OR SUBSTITUTION OF CONTENTS PRIOR TO FIRE

- Expensive objects, antiques, etc. may be removed.
- Substitution of contents.
- Contents out of place or not assembled.

Slide 3-74

J. Removal or substitution of contents prior to fire.

1. Expensive objects, antiques, or objects with sentimental value may be removed.

a. Neighbors may have noticed removal of contents.

b. Neighbors may be able to state that objects are missing.

2. Substitution of contents.

a. Owner may remove usable contents and replace with junk furnishings.

b. Arsonist hopes officer will not be able to identify quality of contents.

c. Arsonist thinks total destruction by fire will cover the switch.

3. Neighbors may have witnessed an exchange of contents or the presence of a truck or delivery trailer before the fire.

4. Contents out of place or not assembled.

a. The owner or occupant may stack or pile combustible contents to provide fuel for the fire.

b. Evidence of empty storage containers is unusual and should be noted for follow-up.

5. The occupant may have obtained “junk” furnishings to fill the structure.

a. Such furnishings may be damaged, obsolete or even fire damaged.

b. The occupant believes the fire will destroy the furnishings.

6. Major appliances removed prior to fire.

a. Major cost items may be removed, and substitute items may or may not be used.

b. Substitute appliances may not be connected to power outlets or fuel lines.

c. Substitute appliances may be empty, in bad repair, or in poor condition.

7. Substitute appliances may not fit the area of installation.

   a. Check floor or cabinet cutout area for indications that the unit does not properly fit.

   b. Check for indentations of leveling or leg buttons in floor covering.

ABSENCE OF PERSONAL ITEMS OR IMPORTANT PAPERS

- Most homes or businesses contain personal items.
- Absence of personal items may indicate only low value contents were left to burn.
- Important papers are often removed.

Slide 3-75

K. Absence of personal items or important papers.

1. Most homes and businesses contain personal items.

2. Absence of personal items may indicate that only basic contents were left to burn.

   a. Business, commercial or industrial occupancies.

      - Hand tools.

      - Portable power tools.

      - Work clothing (uniforms).

      - Business machines (computer, fax machine, etc.).

      - Petty cash.

   b. Residential occupancies.

      - Expensive clothing.

      - Jewelry.

- Family photographs.

- Family records (birth certificates, family Bible, etc.).

- Hobby equipment (guns, fishing or other sports equipment).

- Tools.

3. Important papers are frequently removed prior to a set fire.

   a. Insurance policies: Some people continue to believe it necessary to have their copy of an insurance policy in order to collect on that policy.

   b. Marriage and church records.

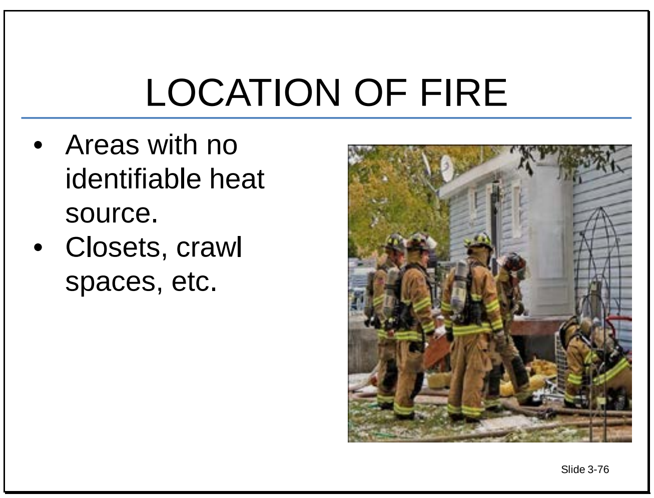
   c. Checking and savings account books.

   d. Titles and deeds.

   e. School records.

   f. Wills.

L. Other factors related to incendiarism.



1. Fires that are determined to have occurred in areas that do not have identifiable heat sources may be incendiary, such as closets, crawl spaces, under stairways, etc.

2. Unnatural fire spread may be due to an accelerant.

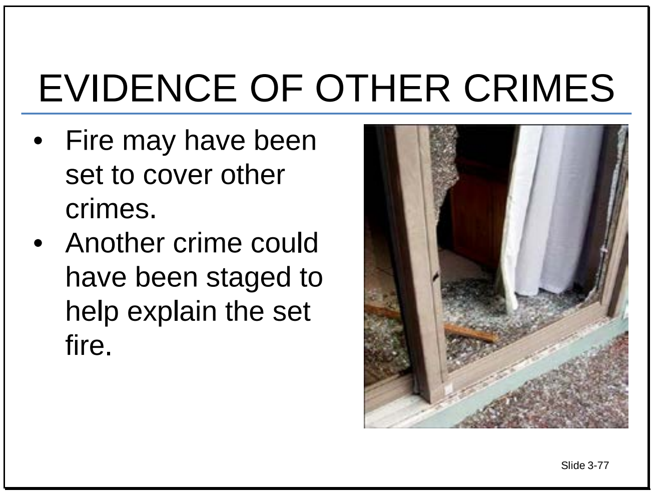
a. What appears to be unnatural fire spread by itself proves nothing.

b. These situations should cause the officer to conduct an extensive scene examination.

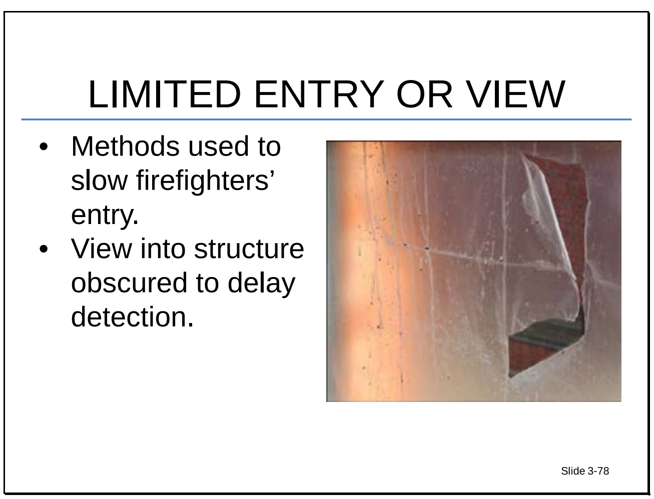
3. Excessive fire damage as compared to similar fires in similar occupancies.

a. Fire damage may have been increased due to use of an accelerant.

b. Structure fires may produce extreme temperatures (up to or above 2,000 F (1,093.3 C)) in many cases.



4. Some incendiary fires are set to cover up other crimes, such as burglary and homicide.



M. Limited entry or view.

1. Methods used to slow firefighters' entry.

a. Removal of door hardware.

b. Doors or windows nailed, bolted or wired shut.

c. Contents moved to block doors or windows.

WINDOWS COVERED TO DELAY DETECTION

Slide 3-79

2. Occasionally, the view into the structure will be blocked or obscured to delay detection of fire.

PREVIOUS FIRES IN SAME STRUCTURE

- May indicate incendiarism.
- Watch for "junk" furniture.

Slide 3-80

N. Previous fires in same structure.

1. A second fire in the same structure over a short period may indicate incendiarism.

2. The first fire may have been an unsuccessful arson attempt.

3. The first fire may not even have been reported.

4. The second fire may involve large quantities of flammable accelerants.

5. The second fire could result in injuries to the firesetter.

PRESENCE OF FUEL NEAR THE POINT OF ORIGIN

- Readily available fuels.
- Question the reason.

Slide 3-81

O. Discovery of flammable liquid containers.

1. Arsonists sometimes use readily available materials on-scene to set fires.

2. Firefighters may detect flammable or combustible liquid odors, since they can remain after extinguishment.

3. If containers are used and not damaged, they may help to prove that fire was not accidental in nature.

4. If the container is retrieved and properly preserved for investigators, it may be able to be processed for the presence of latent fingerprints.

P. Timing of incendiary fires.

FIRES ON HOLIDAYS OR WEEKENDS

- Necessary setup time.
- Excuse for owner to be out of town.
- Delayed detection and more burn time.
- Arsonist believes there is less chance of injury.

Slide 3-82

1. Fires on holidays or weekends at commercial/industrial complexes.

   a. Provides the arsonist with the necessary setup time while employees are away.

   b. Provides excuse for owner to be out of town.

   c. Fewer people in the area often causes a delayed detection and more burn time.

   d. Arsonist believes there is less chance of injury to others.

2. Time of day.

   a. Determine if fire cause or occupant's explanation of fire fits the time of the fire.

   b. Kitchen fire (food on stove) at odd times may (or may not) be an indication of incendiarism.

   c. Sofa fire (cigarette dropped into sofa) during daytime hours.

   d. Often sofa/furniture fires caused by cigarettes are discovered early in the fire's progress if occupants are in the area.

3. Time of year.

   a. Fires during electrical storms or bad weather.

   b. The arsonist may believe lightning is a convenient "cover" for the set fire.

   c. Snowstorms may delay response by the fire department.

FIRES DURING RENOVATIONS/ REMODELING

- Causes.
  - Poor housekeeping.
  - Temporary electrical wiring.
  - Presence of liquid accelerants.
- Owner may decide to sell the property to the insurance company.

Slide 3-83

Q. Fires during renovations/remodeling.

1. Causes.

   a. Poor housekeeping.

   b. Temporary electrical wiring.

   c. Presence of flammable liquids.

2. Owner may decide to sell the property to the insurance company.

   a. The structure was in worse condition than originally thought.

   b. The would-be renovator found the job to be too much work.

   c. Money ran out before the job was completed.

STATEMENTS BY OWNERS OR OCCUPANTS

- Complaints about the structure.
- Arguments with neighbors.
- Domestic problems.

Slide 3-84

R. Any statements made by owners, occupants or other witnesses at the scene should be carefully documented, since they can provide key information for the investigation.

COMPARE SIMILAR MATERIALS AND SITUATIONS

Did the fire produce the results that one would anticipate when compared to the many other fires in similar occupancies that you have observed?

Slide 3-85

S. Personnel should also compare similar situations and circumstances involved in the current incident to others that they have previously experienced. This can help determine whether things “add up.”

V. SUMMARY

SUMMARY

- Purpose and classifications of fire causes.
- Determining fire causes.
- Electrical systems.
- Indicators of incendiarism.

Slide 3-86

UNIT 4: VEHICLE FIRES

TERMINAL OBJECTIVES

The students will be able to:

4.1 *Explain the basic methodology used to conduct a thorough vehicle fire examination.*

4.2 *Describe the three major compartments of a vehicle and their roles in fire spread.*

4.3 *Effectively preserve and document evidence that can be used by fire investigators as part of a follow-up investigation.*

ENABLING OBJECTIVES

The students will be able to:

4.1 *Identify and understand basic vehicle components and construction.*

4.2 *Recognize and understand potential ignition sources and materials capable of being ignited.*

4.3 *Preserve the scene and document information that is important to investigators.*

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UNIT 4:
VEHICLE FIRES

Slide 4-1

ENABLING OBJECTIVES

- Identify and understand basic vehicle components and construction.
- Recognize and understand potential ignition sources and materials capable of being ignited.
- Preserve the scene and document information that is important to investigators.

Slide 4-2

I. REASONS FOR VEHICLE FIRE INVESTIGATIONS AND MOTIVES

CAUSES OF VEHICLE FIRES

- All motor vehicles contain sources of ignition, as well as solid, liquid and vapor fuels.
- Causes of vehicle fires will be difficult to determine in many cases due to the extent of damage.
- Even badly burned vehicles can provide information that will be of benefit to the investigator.

Slide 4-3

A. Vehicles often are burned for many of the same reasons as structures.

B. However, certain motives are usually found only in vehicle arson.

C. All fire-damaged vehicles can provide important information that can be used to determine cause and responsibility.

D. Vehicle fires can occur accidentally, and vehicles may be destroyed by fires of various causes.

   1. Improper or careless use of lighted cigars/cigarettes.

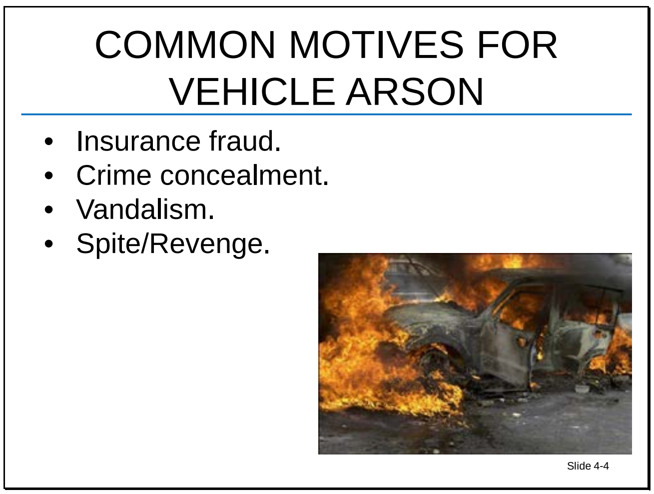
   2. Leaking flammable liquids in contact with some ignition source.

   3. Overheating of mechanical equipment.

E. Accidental vehicle fires can cause vehicle destruction.

F. Most accidental vehicle fires cause only localized damage.

G. Most total-loss vehicle fires are thought to be of incendiary cause.



H. Common motives for vehicle arson.

   1. Insurance fraud.

   2. Crime concealment.

   3. Vandalism.

   4. Spite/Revenge.

I. Uncertain economic periods affect the number of vehicle fires.

J. Ownership of the vehicle may have an effect on the burning of the vehicle.

1. Company-owned (fleet, public, etc.) vehicles are seldom destroyed by fire.

2. Privately owned vehicles (POVs) are destroyed by fire.

K. Many vehicle fires share the same motives as structure fires.

1. Cost to repair mechanical problems with vehicles sometimes may be a reason to burn the vehicle.

2. The vehicle may be a “lemon” or subject to recall and has lost its value.

L. Financed vehicles burn, while vehicles owned outright seldom burn. Exceptions are:

1. Owner who is in dire need of ready cash.

2. Car is expensive to operate or maintain; no one will purchase it.

M. Insured vehicles burn, while uninsured vehicles seldom suffer total-loss fires.

N. Fire injuries to operators/passengers may indicate incendiarism.

1. Injuries may have been caused by throwing flammable accelerants onto a burning vehicle.

2. Stories are often developed by injured operators/passengers to cover incendiarism.

O. Other facts that point to incendiarism.

1. The time of the fire is related to possible incendiarism — many cases of vehicle incendiarism occur late at night.

2. The area where the vehicle is located is important; most incendiary vehicle fires occur on remote roads, back alleys, vacant lots, or in other locations that provide cover.

3. The area of the country may affect the number of total-loss vehicle fires. This fact may be related to regional standards of living.

REASONS FOR VEHICLE FIRE EXAMINATIONS

- Reduce insurance costs.
- Prevent loss of jobs, income and services.
- Fire prevention/Public safety.
- Criminality.
- Liability.

Slide 4-5

P. Reasons for vehicle fire investigations.

1. Identify defective vehicle components that may contribute to fire causes.

2. Identify fires of incendiary origin, and reduce insurance fraud.

3. Fire prevention.

II. PROBABILITY OF ACCIDENTAL VEHICLE FIRES

COMBUSTIBILITY OF VEHICLES

- Large amounts of flammable liquids.
- Many electrical circuits.
- Combustible interiors.
- Vehicles have a compartmentalized design.
- Fuel systems are designed for safety.
- Flame retardant fabrics are used.

Slide 4-6

A. Combustibility of vehicles.

1. Not all experts agree about the combustibility of modern vehicles.

2. Modern vehicles have a compartmentalized design and other system safety features to limit the potential for accidental fires.

MODERN VEHICLE SAFETY DESIGN

- Electrical systems.
- Fuel systems.
- Interior finishes.
- Ignition systems.

Slide 4-7

B. Modern vehicle safety design.

1. Electrical overload protection helps limit short-circuit damage.

2. Damage from short circuits is usually limited to the wiring between the short and the first-line fuse.

3. Equipment and accessory short circuits usually cause only localized damage.

4. Materials used as electrical insulation seldom add to the overall fire damage.

5. Interior finishes and ignition systems also have built-in safeguards to limit their role in fire cause.

6. Fuel systems that have protection are limited in their ability to contribute to the fuel load or serve as a potential ignition source.

7. Newer fuel systems (nonvented) may pose explosion hazards.

8. Older fuel systems usually do not pose explosion hazards.

   a. Flammable vapors are released from the storage tank.

   b. Vapors usually burn away at or near the tank filler neck.

9. Metal fuel lines seldom melt if they contain liquids to help dissipate absorbed heat.

10. Fabrics are often flame retardant. Foam padding is often manufactured to resist attack from fire.

11. Vehicle designs usually provide the maximum separation between fuel and ignition sources. Overall moderate ignition fire possibilities.

THINGS TO REMEMBER

- Small compartment size in vehicles may result in more rapid fire growth, depending on fuel and ignition source.
- Just because it has wheels, it doesn't mean you can forget fire behavior.
- Many fire dynamics principles apply the same as in a structure fire.

Slide 4-8

C. Personnel should remember that basic fire science and fire dynamics principles that impact fire behavior apply equally to vehicle fires and structure fires.

III. INCIDENT SCENE EXAMINATION

TWO EXAMINATIONS MAY BE NECESSARY

- Incident scene examination.
- Detailed vehicle examination.

Slide 4-9

A. Two examinations may be necessary.

1. Incident scene examination.

2. Detailed vehicle examination.

VEHICLE EXAMINATION

- It is better to examine the vehicle before it is moved.
- Valuable evidence is nearly always destroyed when the vehicle is moved.

Slide 4-10

B. The vehicle should be examined at the scene prior to being moved, since movement may destroy or alter valuable evidence.

OBJECTIVES OF A VEHICLE INVESTIGATION

- Determine the fuel source.
- Find the heat source.
- Determine what actions brought the fuel source and heat source together.
- Identify the fire's point of origin.

Slide 4-11

C. As is the case with structure fires, the primary objectives of a vehicle fire investigation are to identify the fuel source, the heat source, and the actions or circumstances that brought them together.

CONDUCTING THE PROPER ORIGIN AND CAUSE INVESTIGATION

A systematic approach divides the vehicle into three or four separate areas:
- Engine compartment.
- Passenger compartment.
- Trunk.
- Underside.

Slide 4-12

D. A proper vehicle origin and cause investigation must follow a systematic approach and should include an examination of the engine compartment, passenger compartment, trunk area, and underside of the vehicle.

ACCELERANT RESIDUE IN SOIL

Slide 4-13

E. Accelerant residue may be recovered from soil located under or near the vehicle.

1. Accelerant may leak through from vehicle interior.

2. Accelerant may be used as a trailer to allow arsonist to start fire some distance from vehicle.

3. Accelerant residue may be several inches down into soil.

4. Accelerant container is often recovered at incident area.

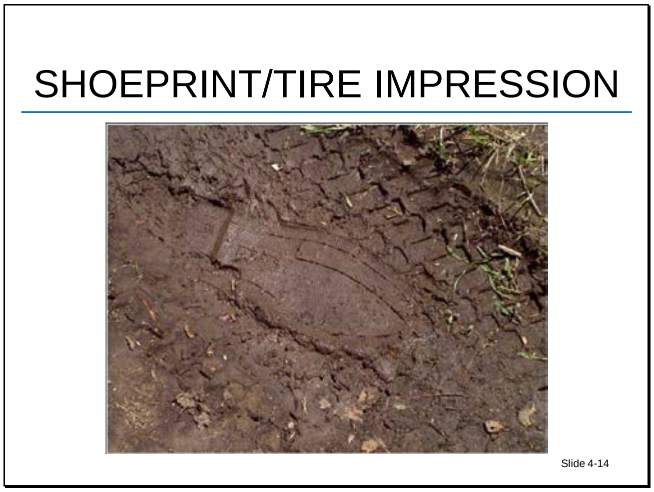
    a. Accelerant container may be discarded by throwing into nearby cover.

b. Accelerant container may be thrown from vehicle used to transport arsonist after fire was set.

F. Damage to the surrounding area should be noted.

1. May be caused by ignitable liquids (accelerants) on the ground.

2. May be caused by intense burning.



G. Shoeprints can place the owner at the incident scene.

1. May contradict story of vehicle being stolen and then burned.

2. May help to identify accomplices.

3. May indicate direction of departure from the incident scene by people and/or vehicles.

IV. EXAMINATION OF VEHICLE'S EXTERIOR

EXAMINATION OF VEHICLE'S EXTERIOR

Slide 4-15

A. Personnel should begin their investigation with a complete examination of the vehicle's exterior.

1. At one time, the sagging of the vehicle's roof as a result of an intense fire was thought to indicate an incendiary fire.

    a. The sagging of the roof should be noted.

    b. The sagging of the roof does not prove that the fire was incendiary.

2. On newer vehicles, a sagging roof can be the result of burning certain types of seat padding.

3. Evidence of flammable accelerants on underside of vehicle.

    a. Usually indicated by soot on underside.

    b. Photograph and note.

4. Exterior fire damage — flammable accelerants may show evidence of running or dripping on vehicle exterior.

B. Gas cap missing.

1. Search for missing cap, note and photograph location if found.

2. Examine for evidence of explosion damage — driver may claim the missing cap was “blown off.”

3. Discovery of gas cap may disprove owner’s/operator’s story or alibi.

C. Any collision damage should be noted and documented to determine if it was caused by a recent accident or if the damage occurred previously (i.e., weeks or months earlier).

MECHANICAL CONDITION OF VEHICLE

- The mechanical condition of the vehicle prior to the fire should be established.
- Visual observations and owner statements should be documented for investigators.

Slide 4-18

D. One of the key pieces of information to obtain in a vehicle fire investigation is the mechanical condition of the vehicle prior to the fire. Personnel can assist in this effort by documenting their observations and any statements obtained from the owner at the scene.

TIRE PADS

Slide 4-19

E. The protected area between the rim and the surface (ground) may provide an indication of the condition of the tire(s) prior to the fire.

1. Pads will usually remain under vehicle wheels (rims) and should be documented as evidence.

2. Check for off-color wheel rims that were changed prior to the fire.

TIRE WEAR/TREAD

Slide 4-20

F. The extent of tire wear/tread should be noted and documented for investigators. The presence or absence of any skid marks should be noted. The lack of skid marks may contradict a driver's story.

1. Check tire tread for odd treads or uneven wear, which may indicate a change of tires prior to the fire.

2. Check for missing lugs that may indicate haste in fire preparations.

3. Check for jack impressions in ground around vehicle.

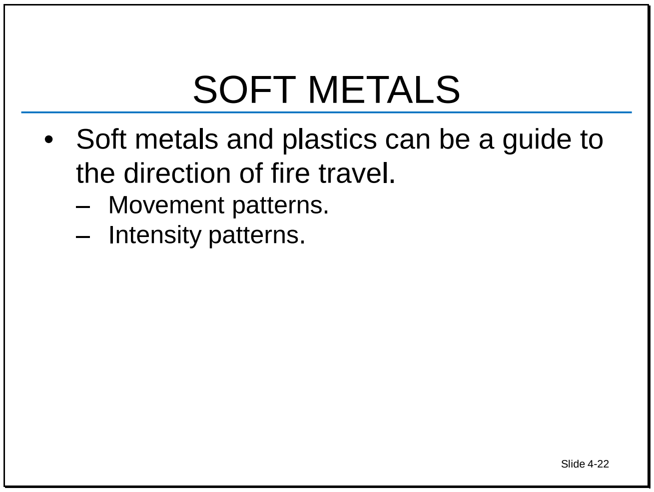
4. Original tires may be located on owner's/accomplice's property.

OXIDATION PATTERNS

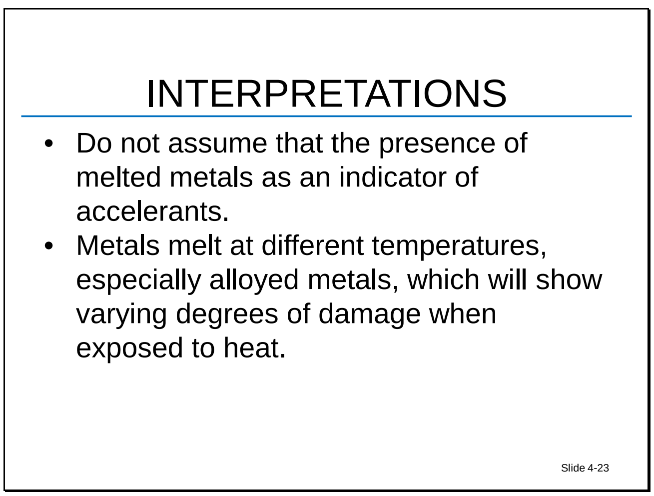
- Metal components that are exposed to the most intense or prolonged heating will begin to oxidize (rust) soon after extinguishment.
- Oxidation patterns become more defined with time.

Slide 4-21

G. Metal and metal components that are exposed to fire begin to oxidize (rust) soon after the fire has been extinguished. These patterns may be helpful in determining the fire's origin, however their value diminishes with time.



H. Soft metals, such as aluminum and plastic materials, can help determine the direction of fire travel by displaying a combination of movement and intensity patterns.



I. The proper interpretation of all the information collected from examination of the vehicle is based on the totality of all the circumstances and not on a single piece of data.

INTERPRETATIONS (cont'd)

- Remember, no one indicator makes a case.
- Common combustibles and ignitable liquids can produce the same flame temperatures.

Slide 4-24

V. EXAMINATION OF VEHICLE'S INTERIOR

EXAMINATION OF VEHICLE'S INTERIOR

Slide 4-25

EXAMINE VEHICLE'S INTERIOR

- Owner often removes accessories for later use.
- Owner may remove accessories to give or sell to accomplices, relatives or friends.
- Extent of damage is related to time and suppression activities.

Slide 4-26

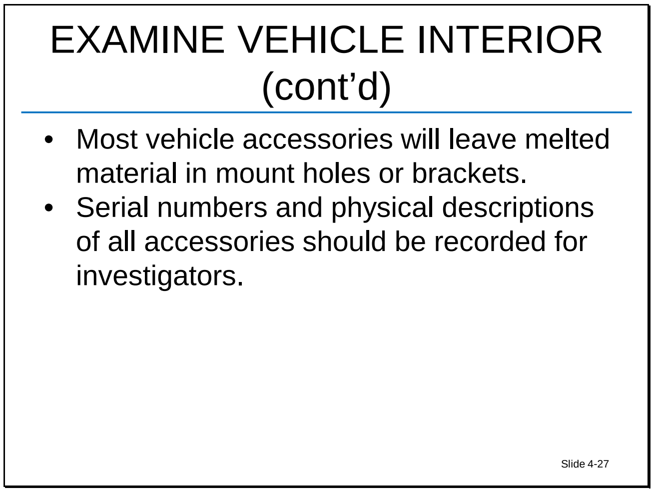
A. Examine vehicle's interior for evidence of accessories having been removed.

1. Owner often removes accessories for later use and gives or sells to accomplices, relatives or friends.

2. Examine vehicle's glove compartment.

   a. An empty glove compartment is usually considered suspicious.

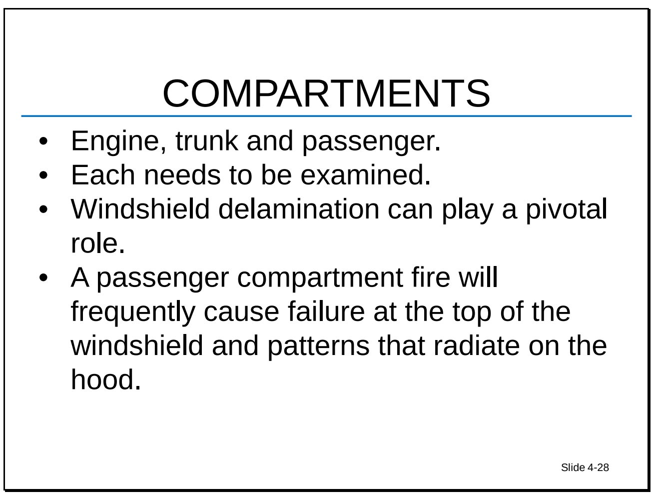
   b. Glove compartment may contain records of the vehicle's repair history and may help to identify prior mechanical problems.



3. Most vehicle accessories do not totally burn or melt.

4. Most vehicle accessories will leave melted metal in mount holes or brackets.

5. Empty mounting brackets/holes should be considered suspicious.



B. The engine, trunk and passenger compartments always need to be carefully examined, as they can contain important information related to the fire's origin and cause.

1. Windshield delamination may provide clues concerning fire origin.

2. A fire that originates in the passenger compartment usually causes failure at the top of the windshield.

C. Accelerant containers often left inside vehicle.

1. Arsonist often believes container will be totally consumed.

2. Most containers leave some evidence.

a. Glass jugs — search for neck and/or carrying ring.

b. Plastic jugs — search for melted plastic.

c. Metal cans.

3. Discovery of accelerant container may help to discredit cover or story of owner.

4. Container may provide accelerant comparison sample.

D. Combustibles inside vehicle.

1. Often leave little evidence.

2. Combustibles under seats may survive fire suppression activities.

E. Accelerant residue may be recovered from vehicle interior.

1. Accelerants usually settle to lowest level and may be recovered:

   a. From floor carpets.

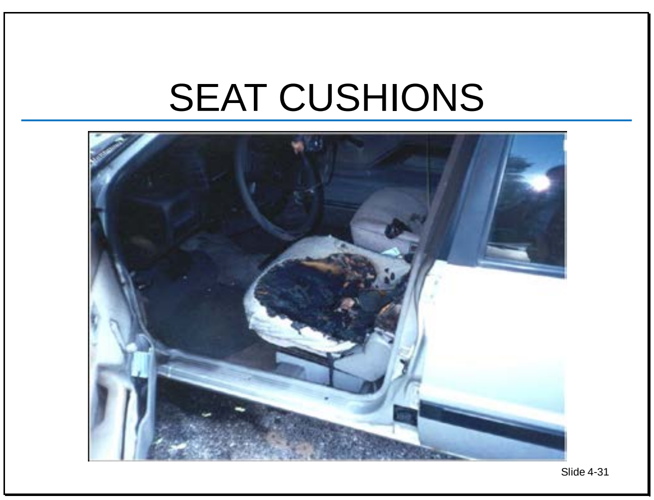
   b. On or under floor mats.

   c. In metal floor indentations.

   d. Around rubber grommets.

2. The sense of smell may not be effective in locating accelerant residue. Gasoline odors are commonly found in vehicles.

F. Vehicle air vents may provide a means for an arsonist to intentionally spread fire from one part of the vehicle to another.



G. Vehicle seat cushions.

1. Many types of foam rubber or synthetic materials are difficult to ignite without an open flame.

2. Certain types of foam rubber, polyfoam or foamed plastics may be ignited readily by an open flame.

3. Once ignited, these materials often produce large amounts of smoke and high heat.

H. Loss of spring temper in seats.

1. Extreme heat required.

   a. May be due to the burning of foam or synthetic cushion or padding materials.

   b. May be due to the presence of an accelerant or placement of combustible materials, such as newspapers.

2. Loss of spring temper does not mean that the fire was incendiary.

SWITCHES, HANDLES AND LEVERS

- Determine "on or off," if possible.
- Window positions.
  - Window rails within the door.
- Position of gear shift.
- Position of ignition switch.
- Any indication of tampering can be of assistance.

Slide 4-33

I. Personnel need to determine the operating positions of windows, gear shifts and ignition switches to identify if they are normal or if there is any indication of tampering.

POSITION OF DOORS AND WINDOWS

Slide 4-34

J. Position of vehicle doors and windows.

1. Vehicle doors and windows are often left open when vehicle is intentionally burned.

2. Ask whether firefighters had to open doors.

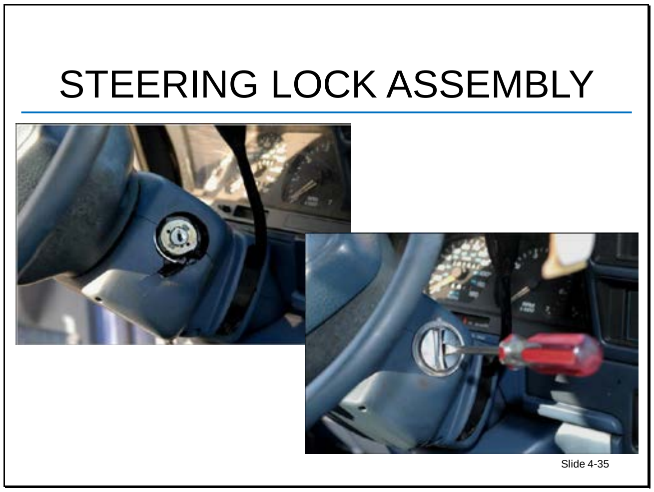
3. Open windows during very cold weather.

4. Closed windows during very hot weather. However, air conditioning must be considered.

5. Fire may self-extinguish if windows are closed.

6. If glass is melted, check window lift arms to determine position of windows at the time of the fire.

7. Melted window glass does not prove the fire was incendiary in nature.



K. Steering lock assembly.

1. May discredit story of stolen vehicle.

2. May require examination by expert locksmith to determine if assembly was damaged.

L. Examination of debris in vehicle's interior.

1. Ignition key.

a. Key may fall to floor when ignition switch melts or remain embedded in the white metal of ignition assembly.

b. Finding a single key is usually not normal, since most people carry more than one key.

2. Personal items.

a. All passengers should be questioned to determine items in the vehicle at the time of the fire.

b. Most items leave some type of evidence of their presence.

- Buttons.

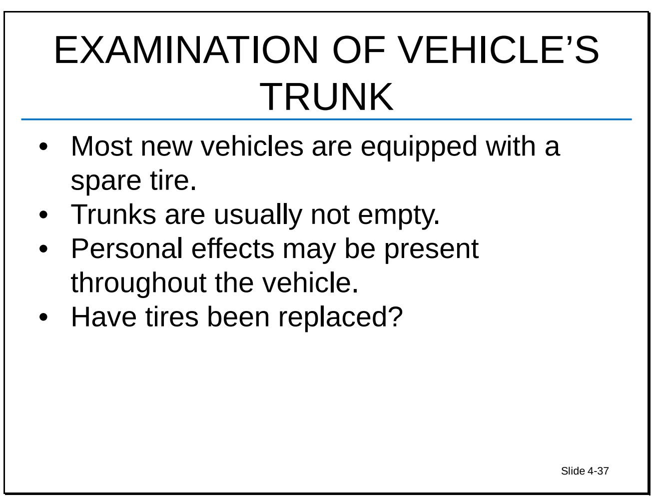
- Zippers.

- Shoe soles.

c. Inventory of the remains of personal items may help to identify a possible fraud motive.

3. Evidence (remains) of incendiary devices may be recovered from vehicle's interior.

VI. EXAMINATION OF VEHICLE'S TRUNK



A. Spare tire.

1. New vehicle usually has a new spare tire, which is often only a temporary one.

2. Compare wheel color or check local dealer to determine proper wheel color.

B. Jack (tools) should be present.

EXAMINATION OF VEHICLE'S TRUNK (cont'd)

- Personal items.
- Vehicle accessories.
- Vehicle fuel systems.
- Other contents.

Slide 4-38

C. Empty trunk usually considered suspicious (except with very new vehicle).

VII. EXAMINATION OF VEHICLE'S ENGINE COMPARTMENT

EXAMINATION OF VEHICLE'S ENGINE COMPARTMENT

- Look for missing vehicle pieces in debris near the vehicle.
  - Gas cap.
  - Keys.
  - Door lock assemblies.

Slide 4-39

A. Evidence of attempts to extinguish fire.

1. Check for dirt, sand or extinguishing agents.

2. Compare to owner's story.

B. Examine motor supports. Motor supports seldom receive extensive fire damage during accidental vehicle fires.

C. Examine radiator system. Solder in radiator joints usually does not melt out during accidental fire.

D. Examine fan, generator and air-conditioner belts. Belts are seldom destroyed in accidental vehicle fires.

E. Check for missing accessories in and around the vehicle. Battery, carburetor, generator, starter, etc. are not destroyed.

F. Motor and drivetrain.

   1. Check for missing or loose head bolts around motor.

   2. Check for missing or loose oil pan bolts under the vehicle.

   3. Check for damage to engine, such as holes in block, cracked heads, etc.

   4. Parts of drivetrain may be missing (such as the universal).

   5. Check to see if drivetrain is connected.

G. Mechanical examination of engine and drivetrain (may require services of an expert mechanic).

   1. Attempt to start and run engine.

   2. Disassemble and examine engine, transmission, etc.

EXAMINATION OF VEHICLE'S ENGINE COMPARTMENT (cont'd)

- Direct exposure of hood/trunk struts to fire can cause explosions.
  - Tires.
  - Shock absorbers.
  - Gas-filled struts.
  - Hood or hatch.
  - Suspension.

Exploded Gas Strut

Slide 4-40

H. Hood and trunk struts are under continuous pressure that can cause an explosion if directly exposed to fire.

VIII. EXAMINATION OF VEHICLE'S FUEL SYSTEM

EXAMINATION OF VEHICLE'S FUEL SYSTEM

- Tank fill cap and spout.
  - Often removed to allow fuel siphoning.
  - Cap may be discarded.
  - Owner may claim that a fuel tank explosion blew the cap off.
  - Check for damage to cap flanges.
  - Check for damage to filler spout.
- Fuel tank drain plug (may not be present in newer model cars).

Slide 4-41

A. Examine tank fill cap and spout.

1. Often removed to allow fuel siphoning.

2. Cap may be discarded by throwing into nearby ground cover, inside vehicle, or along the roadway as the arsonist leaves the area.

3. Owner may claim that a fuel tank explosion blew the cap off.

   a. Check for damage to cap flanges (found on older vehicles).

   b. Check for damage to filler spout.

EXAMINE FUEL TANK AND EXHAUST SYSTEM

Punctured Fuel Tanks

Slide 4-42

B. The fuel tank and exhaust system should be carefully inspected for evidence of intentional damage (puncture holes, etc.) to obtain fuel.

FUEL LINE TAMPERING

Slide 4-43

C. Examine fuel lines.

1. Connection may be loosened or fuel lines may be cut.

2. Check for evidence of tampering or recent tool marks.

D. Examine fuel pump and fuel line.

1. If connection comes off and the vehicle's motor is running, the fuel pump may continue to operate.

2. As long as the fuel pump is electrically operated, it will continue to run.

GAS TANKS

- Should be checked for crushing or penetrations.
- Check for the presence or absence of the fuel cap.

Slide 4-44

E. Less gas is more vulnerable to blow, but gas vapors will heat, vent and ignite, or plastic tanks will fail, and all fluid comes out and ignites.

GAS TANKS (cont'd)

- Fuel tanks exposed to heat or flame generally exhibit a line of demarcation that represents the fuel level at the time of extinguishment.
  - Many fuel tanks are plastic or a composite material and are totally consumed by fire.
- Check all fuel lines for tampering.

Slide 4-45

IX. NEW VEHICLE FUEL SYSTEMS

NEW VEHICLE FUEL SYSTEMS

- Clean Air Act of 1970.
  - Vehicle emission control.
  - Fuel system vapor recovery.

Slide 4-46

A. Clean Air Act of 1970 required new vehicle designs.

1. Vehicle emission control.

2. Fuel system vapor recovery.

B. Vehicle emission control systems.

1. Uses catalytic converters to convert hydrocarbons and carbon monoxide to safer compounds.

2. Converter construction and operation.

a. Usually covered by stainless steel shell.

b. Contains claylike compounds that are treated to react with hydrocarbon emissions.

c. Converters have very large interior surface areas.

d. When operating, catalytic converters generate heat (up to 1,600 F (871 C)).

- Usually, vehicle must have heat shields to protect from excess heat.

- Some states require converters to be covered on the bottom.

e. Fire dangers from converters.

- Undercoating near converter.

- Installation near converter.

f. If engine is not operating properly, the converter may reach temperatures of up to 2,500 F (1,371 C) and may cause ignition of nearby combustibles.

- Ground cover.

- Undercoating.

- Combustibles inside vehicle.

g. Converters and arson investigations.

- May be difficult to determine cause.

- May appear to be incendiary.

C. Fuel vapor recovery systems.

1. In some vehicles, fuel vapors escape illegally from the tank.

2. Newer design may use closed fuel systems.

a. Recirculates vapor.

b. Vapor collected for later burning by vehicle engine.

c. Fuel tanks not vented through filler cap.

3. Fire hazards.

   a. May allow extreme pressure buildup.

   b. May result in explosion of fuel tank.

HOT SURFACE IGNITION SOURCES

- Surface temperatures can reach in excess of 1,020 F (550 C).
- Exhaust manifolds.
- Turbochargers.
- Catalytic converters.
- Brake rotors.

Slide 4-47

D. Vehicles contain many metal surfaces, such as exhaust manifolds, turbochargers, catalytic converters and brake rotors, that can generate sufficient heat energy to ignite combustible materials in close proximity to them.

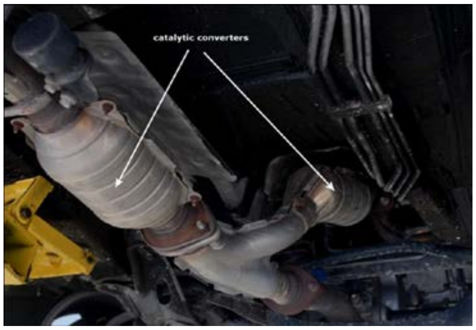
CATALYTIC CONVERTERS

- Catalytic converters have very high external temperatures — greater than 2,000 F (1,093 C) (especially if malfunctioning).
- They can ignite combustible liquids (brake/ transmission fluid).
- They can also ignite ordinary combustibles that come in contact with them.

Slide 4-48

E. Catalytic converters typically operate at very high temperatures (i.e., greater than 2,000 F (1,093 C)) and, under certain conditions, can ignite combustible liquids, such as brake or transmission fluid or ordinary combustibles.

CATALYTIC CONVERTERS (cont'd)



Slide 4-49

HEAT SHIELD

Slide 4-50

HOT SURFACES

- A hot surface ignition of vehicle fluids is not "impossible" but very improbable.
  - Gasoline vapors will normally ignite by an electrical arc, spark or open flame.
  - Testing the hypothesis of a hot surface ignition may be difficult.

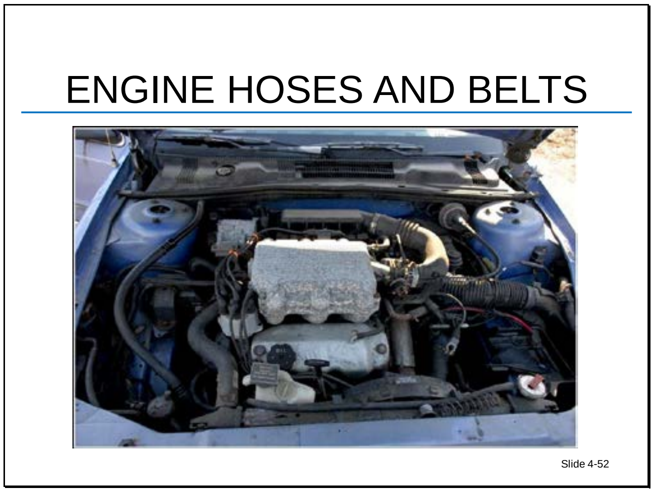
Slide 4-51

F. A hot surface ignition of fluids commonly found in vehicles is not impossible, however it rarely occurs.

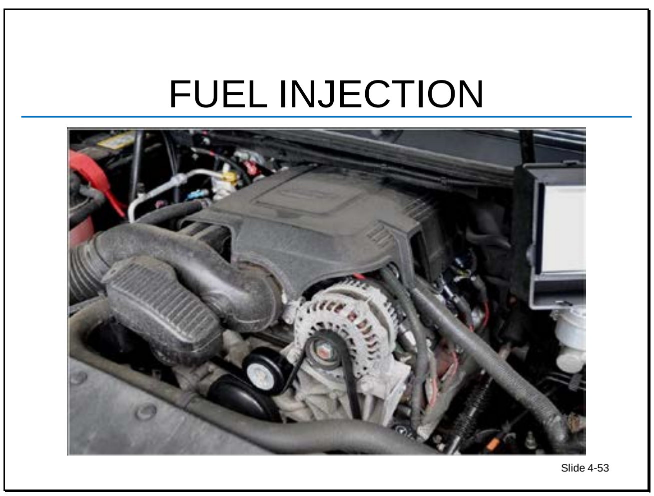
1. Gasoline vapors may ignite by an arc, spark or open flame.

2. It may be difficult to confirm whether a hot surface ignition has occurred.

3. Usually combustible or flammable liquid needs to be an atomized spray under pressure, such as fuel or transmission lines.



G. The condition of hoses and belts located in the engine compartment should be carefully inspected for signs of wear, tampering, etc.



H. Components of the fuel injection system may be tampered with or malfunction, which can play a role in the cause of the fire. Certified mechanics should be consulted to rule out the fuel injection system as a potential fire cause.

ALUMINUM ALLOY CARBURETOR

Slide 4-54

I. Examine carburetor.

1. Accidental carburetor fires may self-extinguish without damage to the entire vehicle.

2. Engine backfires can cause some damage to the carburetor and surrounding area (check for missing air filter).

3. Evidence of a carburetor fire may be observed by the evidence of burn patterns located on the hood of the vehicle directly above the carburetor's location.

X. EXAMINATION OF VEHICLE'S ELECTRICAL SYSTEMS

EXAMINATION OF VEHICLE'S ELECTRICAL SYSTEMS

- Most passenger vehicles are 12 volts, and current is limited to a few amperes (except for starters).
- Commercial vehicles and many recreational vehicles have 24-volt systems.
- Electrical causes of fires.
  - Sparks/Arcs.
  - Resistance heating.

Slide 4-55

A. Examine fuses and fusible links.

EXAMINATION OF VEHICLE'S ELECTRICAL SYSTEMS (cont'd)

- In modern vehicles, there are overcurrent devices that shut down current when there are short circuits.
  - Fuses.
  - Fusible links.

Slide 4-56

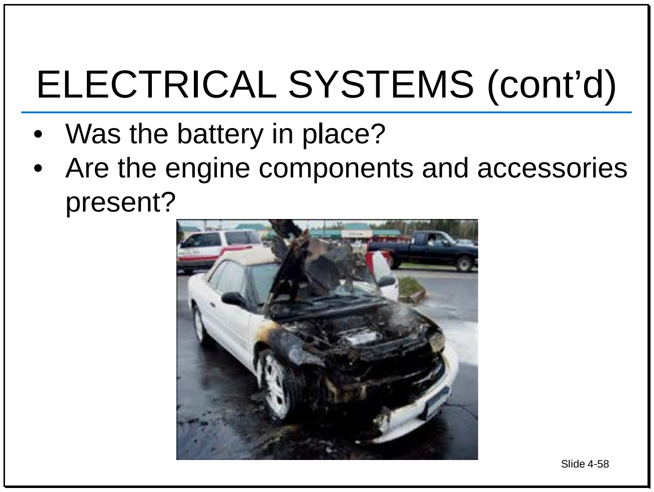
1. Modern vehicles are well-protected from electrical short circuits and current overloads; most accidental fires result in only localized damage.

FUSIBLE LINKS

Located in the wiring harness, often not visible without destruction or removal of the harness covering.

Slide 4-57

2. All fuses and fusible links should be examined and noted. Local automobile dealerships may provide assistance as to the location of fusible links.

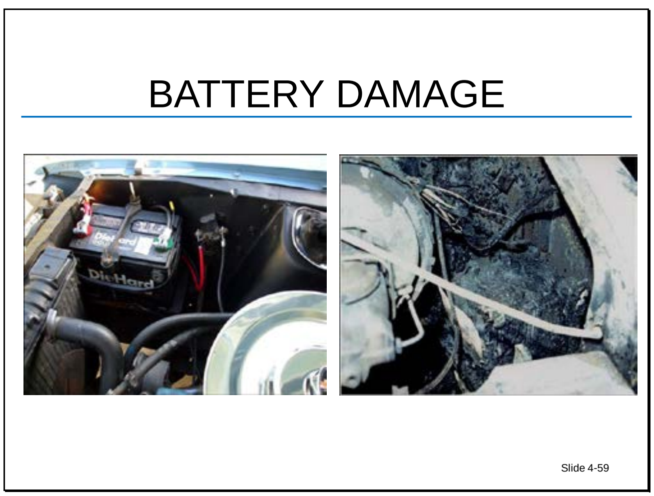


B. Examine battery.

1. Battery may drain rapidly when a short circuit occurs.

a. Battery that remains fully charged was probably not involved.

b. Check battery with tester or by shorting terminals.



2. Fires that occur in the engine compartment may result in extensive fire damage to the battery, however its role in the fire must be evaluated.

ACCIDENTS, RECALLS, SHORTS AND ARCS

- Ask or attempt to determine if the vehicle has ever been wrecked, salvaged or recalled.
- A true victim may not know, especially on a recently purchased vehicle.

Slide 4-60

C. The vehicle owner should be asked if the vehicle has ever been involved in an accident or subject to a recall. A true victim may not know the answers to these questions, especially if he or she has only owned the vehicle for a short period of time.

ACCIDENTS, RECALLS, SHORTS AND ARCS (cont'd)

- Arcs can result from worn insulation going to ground.
- Don't forget that batteries can hold large amounts of energy and deliver excessive amperage.

Slide 4-61

D. Shorts and arcs can result from worn insulation or improper installation of accessories.

ELECTRICAL QUESTIONS

- Was the vehicle running at the time of the fire?
- When was it last running?
- As in a structure, what was tampered with or bypassed?
- Has any equipment been added, altered or worked on?
- Who did the work and when?

Slide 4-62

1. Personnel should establish if the vehicle was running prior to and at the time of the fire.

2. The vehicle owner should be asked whether they recently did any work on the vehicle or if the vehicle has been serviced or is subject to a recall.

3. Check with neighbors of vehicle owner.

    a. May have witnessed vehicle being towed.

    b. May have witnessed repair work.

    c. May have reported vehicle idle for long period.

    d. May report complaints about vehicle made by owner.

XI. OWNERSHIP AND VEHICLE IDENTIFICATION NUMBER

OWNERSHIP AND VEHICLE IDENTIFICATION NUMBER

- The vehicle identification number (VIN) plate is normally in front of the driver on the dashboard.
- If it survives the fire, it should be recorded and photographed, and the Rosette rivets that hold it in place should be closely examined for authenticity.

Slide 4-63

A. The vehicle identification number (VIN) plate is normally found at the front corner of the driver's side dashboard and should be photographed if it is present and/or survives the fire.

OWNERSHIP AND VEHICLE IDENTIFICATION NUMBER (cont'd)

- Police.
- National Insurance Crime Bureau (NICB).
- Insurance company.
- National Crime Information Center (NCIC).
- Confidential VINs.
- Partial VINs.
- You need to know where to go for help.
- Police department auto theft units are a good resource.

Slide 4-64

B. VINs.

1. Prior to 1969, VINs were located in various places on the vehicle (hidden VIN).

    a. Contact police department, auto theft division.

    b. Contact the National Insurance Crime Bureau (NICB).

    c. Contact local dealership.

VEHICLE IDENTIFICATION NUMBER PLATE

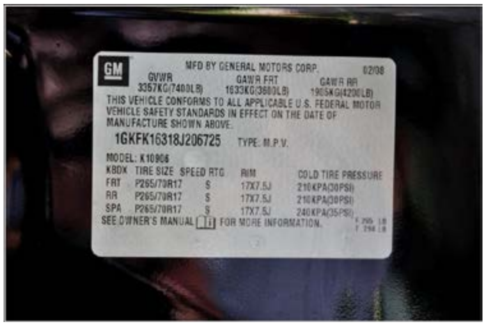
Slide 4-65

2. Since 1969, VINs are located on the left side of the dashboard.

    a. Visible from outside the vehicle.

b. Also found in other locations (hidden).

VEHICLE IDENTIFICATION NUMBER PLATE ON DOOR



Slide 4-66

3. Numbers found on door edge or door jamb after 1969 model year.

a. May be warranty number.

b. May not be VIN.

c. Environmental Protection Agency (EPA) and VINs should match.

VEHICLE IDENTIFICATION NUMBER PLATE ON DOOR (cont'd)

Slide 4-67

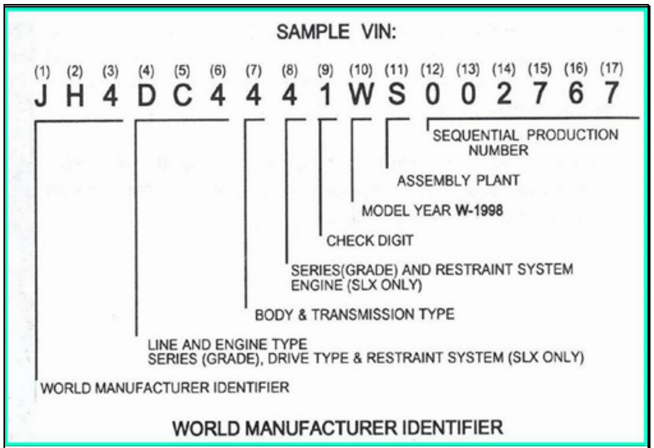
C. Compare VIN to insurance policy — the burned vehicle may not be the insured vehicle.

D. Altered or missing VINs (indicators of tampering).

1. Grind, file or sanding marks.

2. Over stamps.

3. Plastic replacement numbers (check Department of Motor Vehicles (DMV) for regulations covering new VINs and how to display them).



Slide 4-68

E. The common format for a VIN is a 17-digit combination of alphanumeric characters that specify critical information in respect to the origin and history of the vehicle (e.g., assembly plant, model year, body type, engine size, manufacturer, etc.).

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ACTIVITY 4.1

Vehicle Fire Examination

Purpose

To apply fire investigation skills to vehicle fires.

Directions

1. A series of pictures of a burned vehicle will be shown.

2. Report your observations.

ACTIVITY 4.1 NOTES

XII. SUMMARY

SUMMARY

- Reasons for vehicle fire investigations and motives.
- Probability of accidental vehicle fires.
- Incident scene examination.
- Examination of vehicle's exterior.
- Examination of vehicle's interior.
- Examination of vehicle's trunk.

Slide 4-79

SUMMARY (cont'd)

- Examination of vehicle's engine compartment.
- Examination of vehicle's fuel system.
- New vehicle fuel systems.
- Examination of vehicle's electrical systems.
- Ownership and vehicle identification number.

Slide 4-80

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APPENDIX

VEHICLE FIRE INSPECTION CHECKLIST

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Vehicle Fire Inspection Checklist

General Information

Date of Fire ____________________ Location ______________________
Time of Fire ____________________ ______________________

Operator's Name ____________________________ Phone ______________
Address ___________________________ City _________ ZIP ________
Driver's License Number _______________________ Birthday ___________
Hair __________ Eyes ________ Height ________ Weight _________

Legal Owner _______________________ Phone __________________
Address _________________________ City _________ ZIP _________
R/O (if not the operator) ____
Address _________________________ City _________ ZIP _________

Insurance Company ____
Policy Number _____________________________ Coverage ____________

Vehicle Make ______________________ Year ________ Color ________
Body Type ______________________ License _________ State ________
VIN _____________________________ Motor Serial Number ___________
Transmission Number ____________________ Mileage ________________
Special Equipment ____
____

Amount Owed on Vehicle ___________________ Bank _________________
Amount of Payment ______________ Is it current? [ ] yes [ ] no

Photographs taken? [ ] yes [ ] no Sketch made? [ ] yes [ ] no

Search made for [ ] cans [ ] bottles [ ] matches
[ ] other (describe) _____________________________________
____
____

Describe footprints, tire marks, other evidence ___________________________
____

Witnesses

Name ______________________________ Address ______________________________
City/ZIP ______________________________ Phone ____________________

Name ______________________________ Address ______________________________
City/ZIP ______________________________ Phone ____________________

Name ______________________________ Address ______________________________
City/ZIP ______________________________ Phone ____________________

Notes

Exterior Examination

<u>Body</u>

Evidence of prior damage? [ ] yes [ ] no

Describe ____________________

____

Where was heat concentrated? ____________________

Did the top panel sag or lose its temper? [ ] yes [ ] no

Did the door panels sag or buckle? [ ] yes [ ] no

Which bumper was damaged? [ ] front [ ] rear

Which fender skirt was damaged? [ ] rf [ ] lf [ ] rr [ ] lr

Under which fender was there fire damage? [ ] rf [ ] lf [ ] rr [ ] lr

Was the hood burned? [ ] yes [ ] no

Was the hood raised? [ ] yes [ ] no

Was there a pattern of paint damage? [ ] yes [ ] no

Describe ____________________

____

Which doors were open during the fire? [ ] rf [ ] lf [ ] rr [ ] lr

Was trunk compartment burned? [ ] yes [ ] no

Was trunk cover burned? [ ] yes [ ] no

Was trunk forced open? [ ] yes [ ] no

How? ____________________

By whom? ____________________

Did spare fit the vehicle? [ ] yes [ ] no

Were jack and lug wrench present? [ ] yes [ ] no

Did they fit the vehicle? [ ] yes [ ] no

Was gas cap on? [ ] yes [ ] no

Was it burned? [ ] yes [ ] no

Was it blown off? [ ] yes [ ] no

Were the flanges damaged? [ ] yes [ ] no

Were the license plates on the car? [ ] yes [ ] no

If "no," were they found? [ ] yes [ ] no

Was the antenna on? [ ] yes [ ] no

Were the mirrors on? Right: [ ] yes [ ] no

Left: [ ] yes [ ] no

Were they melted away? Right: [ ] yes [ ] no

Left: [ ] yes [ ] no

Were any accessories removed before fire? [ ] yes [ ] no

After? [ ] yes [ ] no

Was dirt or sand thrown on car during fire? [ ] yes [ ] no

After? [ ] yes [ ] no

Examination of Glass

	Windshield		Front Door		Front Vent		Rear Door		Rear Vent	
	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
Smoked	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Cracked	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Left open	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Closed	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Melted	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Rear Quarter		Back Window	
	Rt	Lt	Rt	Lt
Smoked	[ ]	[ ]	[ ]	[ ]
Cracked	[ ]	[ ]	[ ]	[ ]
Left open	[ ]	[ ]	[ ]	[ ]
Closed	[ ]	[ ]	[ ]	[ ]
Melted	[ ]	[ ]	[ ]	[ ]

Examination of Wheels and Tires

Wheels, Tires and Hub Caps

	Right Front		Left Front		Right Rear		Left Rear		Spare	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Signs of recent removal?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Burned?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Underneath burned?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Percent of wear?	________		________		________		________		________	

Notes

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Interior Examination

Positive vehicle identification through VIN? [ ] yes [ ] no
Floorboards burned? [ ] yes [ ] no
Evidence? ______________________________
Evidence of fire **underneath** floorboard? ______________________________
____
Front floor mat burned? [ ] yes [ ] no
Rear floor mat? [ ] yes [ ] no
Front seat cushion burned? [ ] yes [ ] no
Rear seat cushion? [ ] yes [ ] no
Temper gone from front seat springs? [ ] yes [ ] no
Rear seat? [ ] yes [ ] no
Condition of instrument panel? ______________________________
Is there an odor of accelerants under the debris? [ ] yes [ ] no
If "yes," where? ______________________________
Were there unusual objects in the vehicle? [ ] yes [ ] no
If "yes," where? ______________________________
Was the headliner burned? [ ] yes [ ] no
Was any upholstery left unburned? [ ] yes [ ] no
If "yes," where? ______________________________
Are there signs of excessive heat? [ ] yes [ ] no
If "yes," where? ______________________________
Is there evidence of personal belongings? [ ] yes [ ] no
If "yes," what? ______________________________
____
Were keys found? [ ] yes [ ] no
If so, which ones? ______________ How many? ______________
Who is known to have keys? ______________________________
____

Notes

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Examination of Accessories

Is there a radio?	[ ] yes	[ ] no
If "yes," is it burned?	[ ] yes	[ ] no
Is there a tape deck?	[ ] yes	[ ] no
If "yes," is it burned?	[ ] yes	[ ] no
Is there a CD player?	[ ] yes	[ ] no
If "yes," is it burned?	[ ] yes	[ ] no
Is there a cellular phone?	[ ] yes	[ ] no
If "yes," is it burned?	[ ] yes	[ ] no
Other ______________________	[ ] yes	[ ] no
If "yes," is it burned?	[ ] yes	[ ] no

Notes

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Mechanical Condition of Vehicle

Radiator:	Core melted?	[ ] yes	[ ] no
	Water in core?	[ ] yes	[ ] no
	Upper hose burned?	[ ] yes	[ ] no
	Lower?	[ ] yes	[ ] no
	Radiator cap in place?	[ ] yes	[ ] no
	Fan belt burned?	[ ] yes	[ ] no
	Other belts?	[ ] yes	[ ] no

Which? ____

____

Air ducts damaged or burned?		[ ] yes	[ ] no	
Soot under hood?		[ ] yes	[ ] no	
Oil level?		[ ] normal	[ ] low	[ ] empty
Block?		[ ] broken	[ ] intact	
Heads?		[ ] bolts loose	[ ] cracked	
Oil pan?		[ ] broken	[ ] cracked	
Manifold?		[ ] loose	[ ] secure	
Does engine run?		[ ] yes	[ ] no	
Gaskets recently removed?	head:	[ ] yes	[ ] no	
	oil pan:	[ ] yes	[ ] no	
	valve plate:	[ ] yes	[ ] no	

Electrical System

Spark plug wires connected?	[ ] yes	[ ] no
Wires burned?	[ ] yes	[ ] no
Distributor damaged?	[ ] yes	[ ] no
Distributor burned?	[ ] yes	[ ] no
Battery present?	[ ] yes	[ ] no
Battery with power?	[ ] yes	[ ] no
Battery burned?	[ ] yes	[ ] no
Battery cover present?	[ ] yes	[ ] no
Cover burned?	[ ] yes	[ ] no
Cables intact?	[ ] yes	[ ] no
Ignition system operational?	[ ] yes	[ ] no
System shorted out?	[ ] yes	[ ] no
Distributor points fused?	[ ] yes	[ ] no
Voltage regulator intact?	[ ] yes	[ ] no
Regulator burned?	[ ] yes	[ ] no

Evidence of “hot wiring”? ____

____

Notes

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UNIT 5: FIRE CAUSE DETERMINATION

TERMINAL OBJECTIVE

The students will be able to:

5.1 Assess a fire scene and apply proper investigative techniques and procedures in determining the origin and cause of a fire, when a fire scenario is given.

ENABLING OBJECTIVES

The students will be able to:

5.1 Determine the area or point of origin and the cause of a fire, when given fire scenarios.

5.2 Defend the conclusions reached regarding the fire origin and cause determination, when given fire scenarios.

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UNIT 5:
FIRE CAUSE
DETERMINATION

Slide 5-1

ENABLING OBJECTIVES

- Determine the area or point of origin and the cause of a fire, when given fire scenarios.
- Defend the conclusions reached regarding the fire origin and cause determination, when given fire scenarios.

Slide 5-2

I. FIRE CAUSE DETERMINATION

FIRE CAUSE DETERMINATION

- It is often the responsibility of first responders to determine the cause of all fires to which they respond.
- Knowing the process of fire origin and cause determination will help them to make more accurate decisions on the circumstances of the fire.

Slide 5-3

A. It is often the responsibility of first responders to determine the cause of all fires to which they respond.

B. Knowing the process of fire origin and cause determination will help them to make more accurate decisions on the circumstances of the fire.

KEY FIRE INVESTIGATION ASPECTS

- Behavior of fire.
  - Understanding of basic scientific principles related to fire ignition, growth and spread.
- Determination of area of fire origin.
  - Methodology required to successfully determine fire origin and cause.

Slide 5-4

C. Key fire investigation aspects.

1. Behavior of fire.

   a. Did fire behave normally for the materials or area involved?

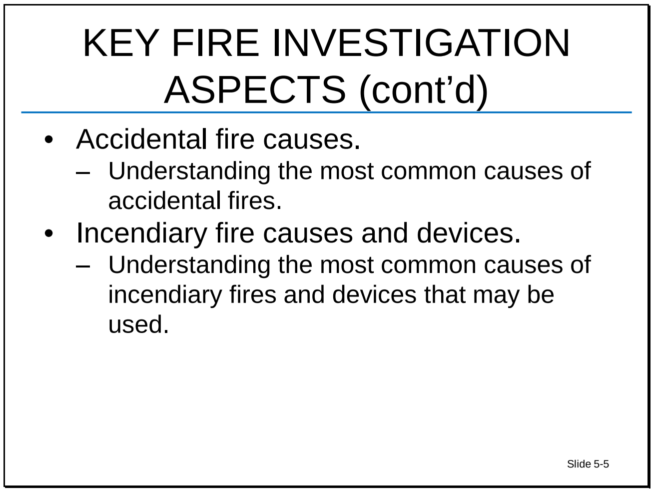
   b. What was different about this fire?

2. Determination of area of fire origin.

   a. Understanding and evaluating “V” patterns.

   b. Interpreting heat patterns.

   c. Determining the path of fire travel.



3. Accidental fire causes.

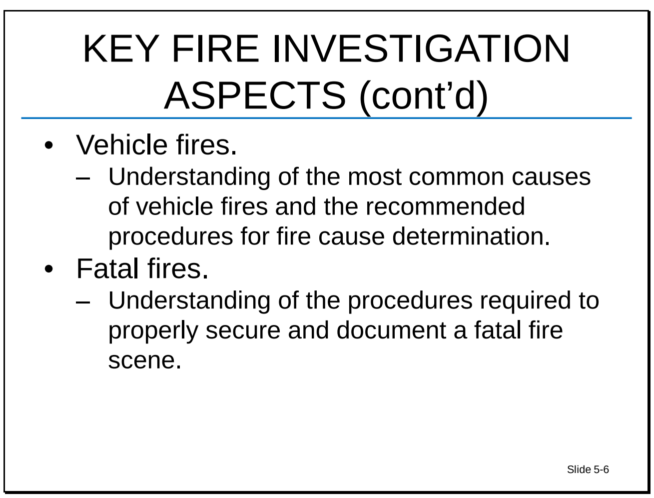
   a. Accidental fire causes found at the area or point of origin.

   b. Evaluating other factors to conclude fire cause was accidental.

4. Incendiary fire causes and devices.

   a. Incendiary fire causes found at the area or point of origin.

   b. Absence of any accidental fire cause at the area or point of origin.



5. Vehicle fires.

   a. Evaluating the extent of vehicle damage to determine origin and cause.

   b. Evaluating the compartmentation of fire in vehicles for deliberate fire spread.

II. APPLICATION OF FIRE INVESTIGATION SKILLS

A. Application of skills.

1. They should help you to arrive at a conclusion about the circumstances of the fire.

   a. Accidental cause, no further action involved.

   b. Accidental cause, follow-up required.

      - Juvenile involvement needs follow-up.

      - Appliance failure needs follow-up.

2. If you cannot reach a conclusion based upon the evidence found, you need an investigator.

3. Incendiary fires require an investigator.

B. Prepare report of fire response.

C. Prepare fire origin and cause determination report.

1. Write a report based on the findings, regardless of the outcome.

2. Write notes about the incident.

   a. In case you are put on a witness stand five years later and are asked details about the fire.

   b. In most cases, personal notes will not be admitted as evidence.

   c. You will be allowed to consult them while on the stand.

3. The official report, plus other reports prepared by fire investigators, will be entered as official evidence.

   a. They may become the proof that a fire did occur, and that all accidental fire causes were eliminated.

   b. This information may lead investigators to conclude that the fire was caused intentionally.

ACTIVITY 5.1

Fire Scene Examination

Purpose

To assess a fire scene and apply proper investigative techniques and procedures in determining the origin and cause of a fire.

Directions

1. Your class will be divided into small groups.

2. Slides (photographs) of the scenario will be shown by your instructor. The photographs are also available in your Student Manual (SM).

3. You have 40 minutes to record your observations and determine the area of fire origin and fire cause.

4. Each group will report its findings and provide reasons for its conclusions.

5. A video of the fire scene will be displayed after all groups report their findings and conclusions.

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ACTIVITY 5.1 (cont'd)

Fire Scene Examination

Scenario

At 0915 hours, fire department units responded to a residential structure fire at 1680 Seton St. The occupancy is a two-story, wood-frame, duplex-style townhouse.

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Slide 5-14

DVD PRESENTATION

Slide 5-15

DVD PRESENTATION

"NFPA 921 DETERMINING ORIGIN AND CAUSE"

Slide 5-16

III. SUMMARY

SUMMARY

- Fire cause determination.
- Application of fire investigation skills.

Slide 5-17

ACRONYMS

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ACRONYMS

Btu	British thermal unit
CFL	compact fluorescent light
DMV	Department of Motor Vehicles
EPA	Environmental Protection Agency
HRR	heat release rate
HVAC	heating, ventilating, and air conditioning
IFIFR	"Initial Fire Investigation for First Responders"
kW	kilowatt
LEL	lower explosive limits
LPG	liquefied petroleum gas
MWs	megawatts
NCIC	National Crime Information Center
NFA	National Fire Academy
NFPA	National Fire Protection Association
NICB	National Insurance Crime Bureau
OSB	Oriented Strand Board
POV	privately owned vehicle
PPE	personal protective equipment
SFPE	Society of Fire Protection Engineers
SM	Student Manual
UEL	upper explosive limits
VIN	vehicle identification number
W	watt

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