

Wildland Fire Origin and Cause Determination FI-210



NFES 002817

Student Workbook
APRIL 2016

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CERTIFICATION STATEMENT

on behalf of the

NATIONAL WILDFIRE COORDINATING GROUP

The following material attains the instructional design standards prescribed for training products developed and coordinated by the National Wildfire Coordinating Group. The training material is certified for interagency use and is known as:

Wildland Fire Origin and Cause Determination, FI-210


Operations and Training Committee Chair

4/1/16
Date

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Previous editions: this product replaces *NFES 2817, Wildland Fire Origin and Cause Determination, September 2005*.

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PREFACE

Wildland Fire Origin and Cause Determination, FI-210, has been developed by an interagency development group with guidance from the National Interagency Fire Center (NIFC), Fire Training under authority of the National Wildfire Coordinating Group (NWCG). The development group consists of the following representatives:

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Minnesota Department of Natural Resources

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The NWCG appreciates the efforts of these personnel and all those who have contributed to the development of this training product

FI-210, Wildland Fire Origin and Cause Determination

Unit 0 – Introduction

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National Wildfire Coordinating Group



NWCG TRAINING BRANCH



Mission:
To develop relevant National Wildfire Coordinating Group training in a cost-effective manner to meet the needs of the wildland fire community.

Vision:
To develop professional training packages which provide a solid training foundation and enhanced training experience to the wildland fire community.

E-mail comments or suggestions pertaining to this or any NWCG course to:
BLM_FA_nwcg_evaluation@blm.gov
 Online: training.nwcg.gov




FI-210 Wildland Fire Origin and Cause Determination

Unit 0



Welcome

- **Introductions**
 - Instructors
 - Students
- **Administrative Concerns**
 - Transportation
 - Meal schedule
 - Course hours
 - Breaks
 - Tobacco policy
 - Local information
 - Turn off cell phones, radios, pagers, computers

00-3-FI210-EP

Course Intent

- Provide information to guide the investigator, and to develop critical thinking skills as applied to wildfire investigations.
- Every wildland fire investigation is unique. These guidelines are not meant to be all inclusive or to exclude other investigative techniques.
- Portions of this course may not apply to every wildland fire investigation.
- Policy, time, assignment and resources may dictate the scope and extent to which these guidelines may be applied to a specific investigation.
- While this course provides guidelines for the investigator, a systematic approach should be applied to wildfire investigations.

00-4-FI210-EP

Course Objectives

1. Perform the common roles and responsibilities of a Wildland Fire Investigator (INVF) involved in an initial investigation environment.
2. Practice wildland fire investigation methods, evidence collection, and documentation processes in a realistic environment.
3. Identify the laws, regulations, and related court procedures associated with administrative, civil, and criminal litigation processes.
4. Describe the fundamentals of investigation.
5. Know the elements of professional code of ethics.

00-5-FI210-EP

Wildland Fire Investigator Certification: A National Initiative

- Proposed to the National Wildfire Coordinating Group (NWCG) in 2000
- Fire Investigation Working Team (FIWT) established
- NWCG Reorganization resulted in Working Team becoming the Wildland Fire Investigation Subcommittee (WFISC)



00-6-FI210-EP

Wildland Fire Investigation Subcommittee

- USDA-Forest Service
- Oregon Department of Forestry
- USDOJ-Bureau of Land Management
- Minnesota Department of Natural Resources
- USDOJ-Bureau of Indian Affairs
- Federal Law Enforcement Training Center (FLETC)
- USDOJ-Fish and Wildlife Service
- USDOJ-Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)
- West Virginia Division of Forestry

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Wildland Fire Investigation Subcommittee

- USDOJ-National Park Service
- California Department of Forestry and Fire Protection (CalFire)
- Saskatchewan Environmental Resource Ministry
- Alberta Forest Protection Division
- Australia, Australian Capital Territory RFS
- Australia, Victoria CFA
- New Zealand RFA
- British Columbia Ministry of Forests

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Wildland Fire Investigation Course Development

- Development authorized by NWCG Board in October 2001.
- Draft developed.
- National peer review .
 - 160 written comments
- Revised draft approved by NWCG.
- Originally released in 2005.
- Course revised 2016.

00-9-FI210-EP

Certification Process

Understand the requirements for agency certification.



00-10-FI210-EP

Wildland Fire Investigator Certification

- PMS 310-1 (Wildland Fire Qualification System Guide)
- Two levels of Wildland Fire Investigator certification:
 - INVF: Origin and Cause
 - INTM: Investigation Team Member



00-11-FI210-EP

Wildland Fire Investigator Certification

INVF: Origin & Cause

- Minimum skills/knowledge:
 - Fire behavior
 - Fire ignition sources and factors
 - Fire pattern interpretation
 - Investigation methodology and techniques



00-12-FI210-EP

Wildland Fire Investigator Certification Standards

Required Training:

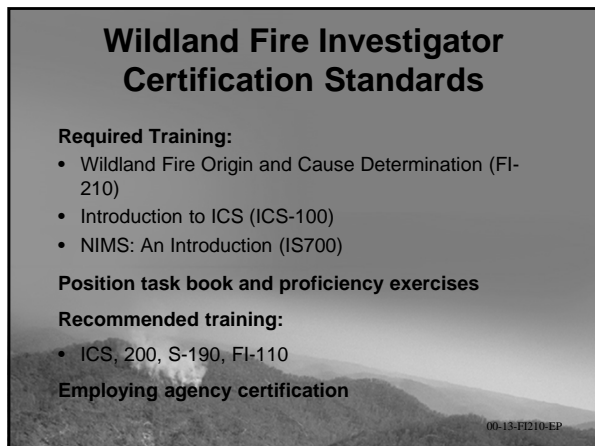
- Wildland Fire Origin and Cause Determination (FI-210)
- Introduction to ICS (ICS-100)
- NIMS: An Introduction (IS700)

Position task book and proficiency exercises

Recommended training:

- ICS, 200, S-190, FI-110


Employing agency certification



00-13-FI210-EP

Wildland Fire Investigator Team Member Certification Standards

- **Minimum skills:**
 - Intermediate fire behavior.
 - Complex origin and cause.
 - Managing investigation team.
 - Enhanced knowledge of civil and criminal processes.
 - Arson investigation.
 - Investigation methodologies beyond the preliminary level.
- FI-310 and ICS-200 training
- Position task book and proficiency exercise.
- Recommended training: ICS-300 and S-290
- Employee agency certification.



00-14-FI210-EP

Fire Investigation

- **Wildland fire investigation is a blend of skills:**
 - Fire service
 - Law enforcement
- **To effectively investigate a wildland fire, a team approach is encouraged.**
- **Cooperation, when appropriate, increases the effectiveness of the investigation.**

00-15-FI210-EP

The Fundamentals of Investigation

- Definition of an investigation.
- Components of an investigation.
- Relationship of an investigation to litigation.



00-16-FI210-EP

What is an Investigation?

- Application of systematic approach of examination.
- Factual documentation.
- Interaction with people.
- Assessing physical objects.
- Applied through technical skills and science.

00-17-FI210-EP

Objectives of an Investigation

Identify:

- Who
- What
- When
- Where
- How
- Why



00-18-FI210-EP

Professional Ethics

- Conduct investigations consistent with professional practices.
- Investigate in an unbiased manner.
- Avoid/report conflict of interest.
- Maintain confidentiality and investigative integrity.



Professional Performance

- Identify and mitigate hazards.
- Work in a safe manner.
- Follow agency policy.
- Protect the area of origin.
- Cooperate with other investigating agencies.
- Keep your supervisor informed.

00-20-FI210-EP

Professional Performance

- Request assistance if needed.
- Conduct a thorough examination of the scene.
- Identify, document, collect and preserve evidence.



00-021-FI210-EP

Professional Performance

- Identify, interview and treat all parties fairly and with respect.
- Make prompt referrals to other authorities or agencies.
- Identify follow-up actions.
- Self discipline to fully complete the documentation and reports in a timely manner.



00-22-FI210-EP

Professional Performance

Local area knowledge

- Road systems
- People
- Use patterns
- Fire history
- Weather patterns



00-23-FI210-EP

Professional Performance

- Local Fire Behavior
 - Burning conditions
 - Fuels
 - Fire indicators
- Sources of additional expertise
 - Other investigators
 - Accelerant detection and/or tracking K9
 - Electrical engineers
 - Metallurgists



00-24-FI210-EP

Professional Performance

Training first responders (FI-110):

- Observation skills
- Origin protection
- Witness identification
- Evidence protection



00-25-FI210-EP

Safety On Wildfire Investigations

Work Site Hazards:

- | | |
|---------------------------|----------------------|
| • Hostile subjects | • Downed power lines |
| • Tanker drops | • Peat moss |
| • Beetle kill trees/snags | • Railroads |
| • Tree on power line | • Vehicular traffic |
| • Stump holes | • Bad weather |
| • Explosive bunkers | • Wildlife |

00-26-FI210-EP

Safety On Wildfire Investigations

Unseen Work Site Hazards:

- Booby traps (e.g. marijuana grow ops)
- Illegal drug production dump sites (HAZMAT)
- Steep terrain (rolling rocks and debris)
- Snakes
- Stinging/biting insects (bees, wasps, mosquitoes)

00-27-FI210-EP

Safety On Wildfire Investigations

Hazards in coal bed methane fields.

Benzene

Hydrogen Sulfide (H₂S)

- Also called sour gas.
- Toxic, colorless gas.
- 21% heavier than air.
- In low concentrations has odor of rotten eggs.
- Deadens sense of smell and is flammable in higher concentrations.
- Could be present near well sites or in low lying areas.



00-28-FI210-EP

Safety On Wildfire Investigations

Hydrogen Sulfide (H₂S) Symptom Recognition

- Potentially deadly at concentrations above 100 PPM.
- Symptoms include:
 - Eye Irritation
 - Dryness/Irritation of throat
 - Irritation of respiratory system
 - Loss of sense of smell
 - Headache
 - Nausea



00-29-FI210-EP

Safety on Wildfire Investigations

Hazards in coal bed methane fields.

Methane (CH₄)

- Colorless
- Odorless
- 40% lighter than air.
- Principle component of Natural Gas.
- Flammable in higher concentrations.
- Naturally occurring in seeps and vents.



00-30-FI210-EP

Safety On Wildfire Investigations

Symptoms Recognition

Methane (CH₄)

- Lighter than air so exposure is typically not an issue.
- Main hazard is its flammability.
- Can cause explosion in high concentrations (typically those found only in confined spaces).
- Be aware that in rare situations a vehicle could act as a confined space.
 - Use caution before entering a vehicle by airing out if prolonged exposure has occurred.



00-31-FI210-EP

Safety On Wildfire Investigations

- **SAFETY WILL BE STRESSED THROUGHOUT THIS COURSE.**
- Agency requirements for Personal Protective Equipment (PPE) vary.
- **INVESTIGATORS SHOULD FOLLOW AGENCY PPE policy.**

00-32-FI210-EP

Unit 0 - Summary

Certification and additional training

- INV/INTM
- Position Task Books
- Agency certification

Fundamentals of an investigation

- Teamwork
- Systematic approach

Professional ethics and performance

- Safety
- Follow agency policy

00-33-FI210-EP

Notes:

FI-210, Wildland Fire Origin and Cause Determination

Unit 1 – Fire Pattern Indicators

Lesson 1A – Fire Patterns – Introduction

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Unit 1 Objectives

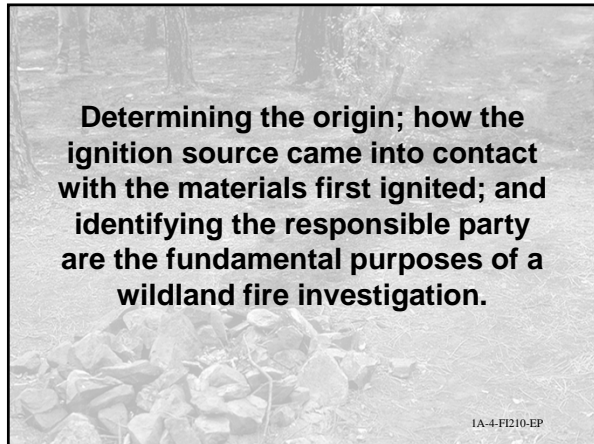
1. Describe the effects of fire on combustible and non-combustible objects
2. Describe and classify the various fire pattern indicator categories
3. Correctly assess vectors within the various fire pattern indicator categories
4. Explain the underlying fire science principles that govern fire initiation and progression

1A-2-FI210-EP

Unit 1 Objectives

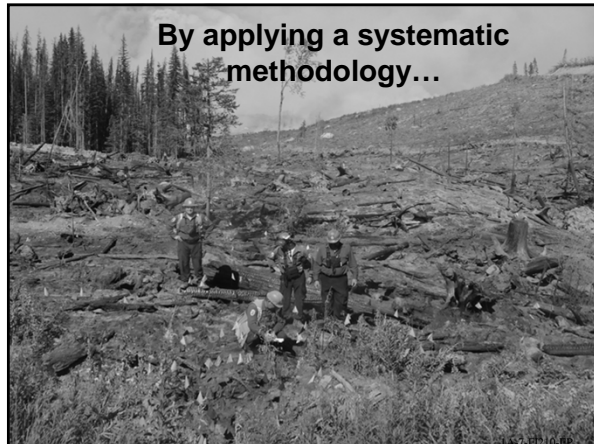
5. Apply a systematic methodology and use the various indicators to trace fire progression back to the specific origin area and ignition area
6. Describe the general appearance of the fire pattern indicator
7. Explain the fire behavior behind its formation
8. List general reliability and potential exceptions
9. Describe characteristics for each vector category within an indicator class

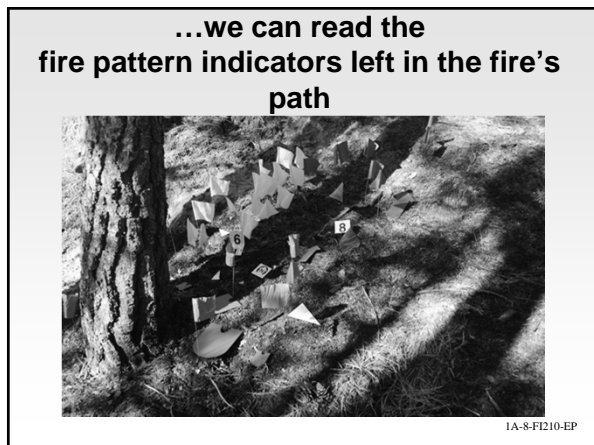
1A-3-FI210-EP













...back to the materials first ignited and the remains of the ignition source



1A-10-FI210-EP

To do this successfully, we need to correctly interpret the signs a fire leaves



1A-11-FI210-EP

Introduction

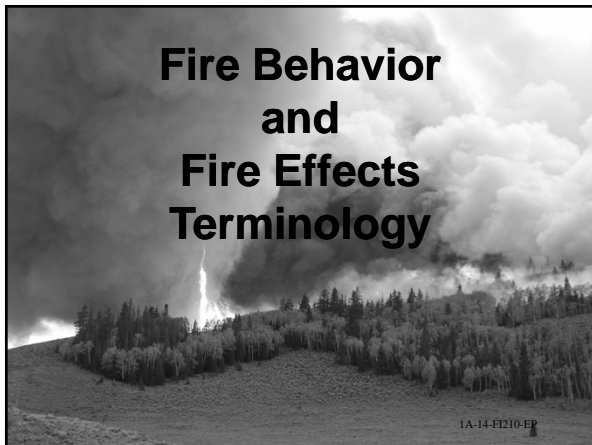
Fire burns according to set scientific principles.



Evidence of its progress takes the form of fire pattern indicators, also referred to as "fire effects."

1A-12-FI210-EP





Terminology

- The following terms are used in wildland fire investigation
- Each will be discussed in detail in the following slides

1A-15-FI210-EP

Terminology

- Fire pattern indicator
- Fire pattern
- Fire progression
- Fire vector
- Advancing fire
- Backing fire
- Lateral fire
- Transition zone
- Macroscale indicator
- Microscale indicator
- Indicator cluster
- Damage differential
 - Compare and contrast
- Systematic methodology

1A-16-FI210-EP

Fire Pattern Indicator



- A physical object that displays changes (fire effects) from exposure to heat, flame, and combustion byproducts.
- Accurate analysis can reveal fire progression at that precise location.
- A single component of the overall fire pattern.

1A-17-FI210-EP

Fire Pattern



- Analyzing the relationship of the majority of individual indicators reveals the overall fire pattern.
- This in turn will reveal overall fire progression.

1A-18-FI210-EP

Fire Progression



- Most fires start small.
 - Smoldering, glowing ignition
- Ultimately transitions to flaming ignition.
- Burns in all directions until influenced by:
 - Wind
 - Slope
 - Fuel
 - Suppression
 - Or combination of the above.

1A-19-FI210-EP

Fire Progression



- Once influenced, the fire will progress outward.
- Vector areas will become established.

1A-20-FI210-EP

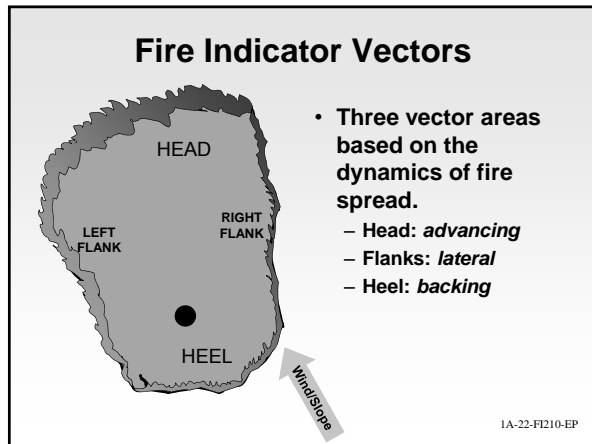
Fire Pattern Indicator Vectors

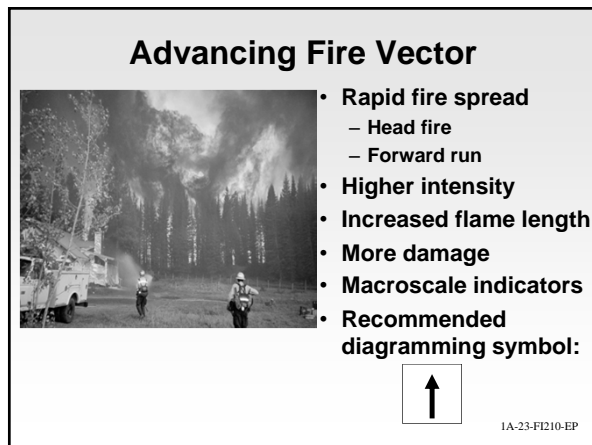
- Physical characteristics of an indicator that show direction of fire progression.
- Define fire spread based on direction.

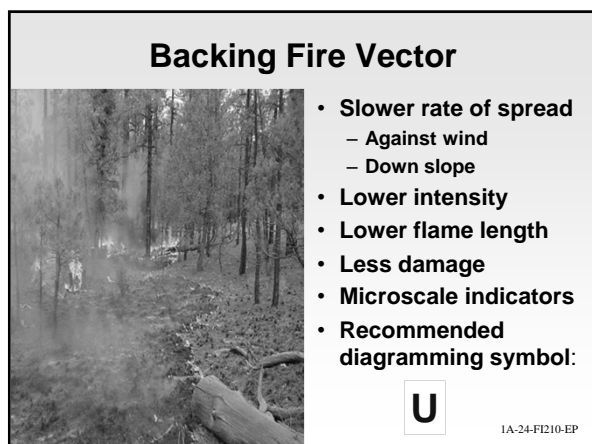


- Identify transition zones.
- Often subtle.

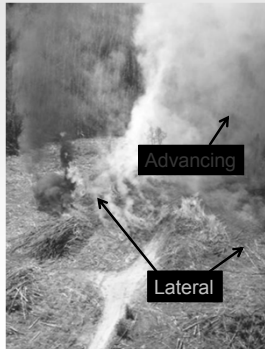
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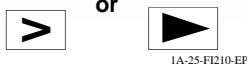




Lateral Fire Vector



- Rate of spread and intensity between advancing and backing.
 - Flank fire
 - Spread lateral to main fire
- Indicators can have characteristics of backing or advancing, depending on fire behavior circumstances
- Recommended diagramming symbol:



1A-25-FI210-EP

Lateral Fire Patterns and Indicators

- A higher intensity flank may leave indicators consistent with advancing fire spread:
 - Exhibits a more defined and narrower transition zone.
- A lower intensity flank may leave backing-type indicators:
 - Exhibits a more subtle and wider transition zone.
- Intensity on flanks may change with wind/slope/fuels.

1A-26-FI210-EP

Heat/Flame Exposure Lateral Indicators

- Sooting, staining, and white ash deposits appear on the exposed side.
- Protection indicators will appear on the non-exposed side.
- Generally 45° to 90° angle to the direction of advancing fire spread.

1A-27-FI210-EP



Wind Influenced Lateral Indicators

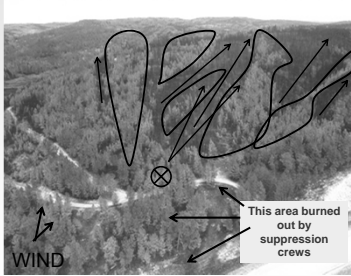
- Foliage freeze, grass stem, cupping, white ash deposits, and angle of char.
- Generally appear on the exposed side of the object.
- Usually aligned with advancing fire pattern indicators:
 - May be at 45° angle to advancing spread.
- Grass stems are intensity dependent:
 - May fall into the burned area at 45° to 90° angle and remain on ground.
 - May be consumed completely.

1A-29-FI210-EP



Lateral Fire Patterns and Indicators

- Flanks defined by strips of unburned or partially burned fuel.
- Influenced by change in wind and slope.



1A-31-FI210-EP

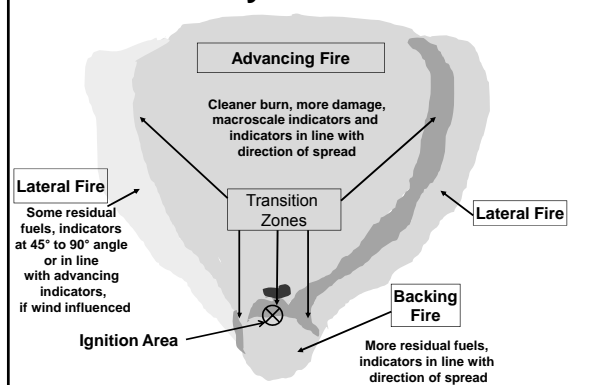
Transition Zone

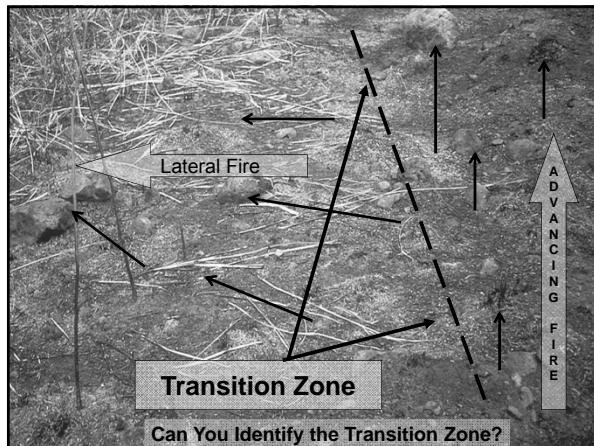


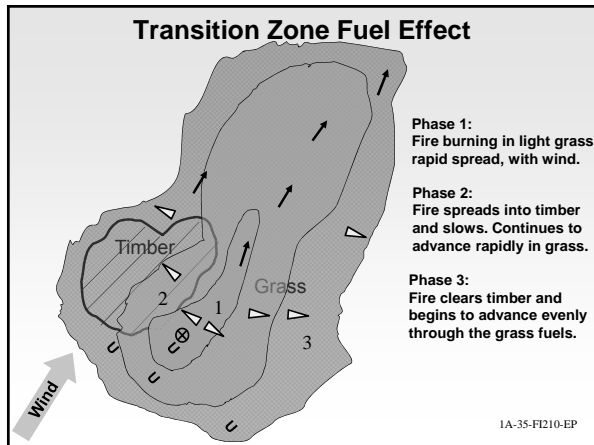
- Area of directional change based on variations in intensity.
 - Advancing to lateral.
 - Advancing to backing.
 - Backing to lateral.
- Change in appearance and characteristics of fire pattern indicators.
- Transition zones may outline specific origin area.
- A key to accurately interpreting fire patterns is identifying transition zones.

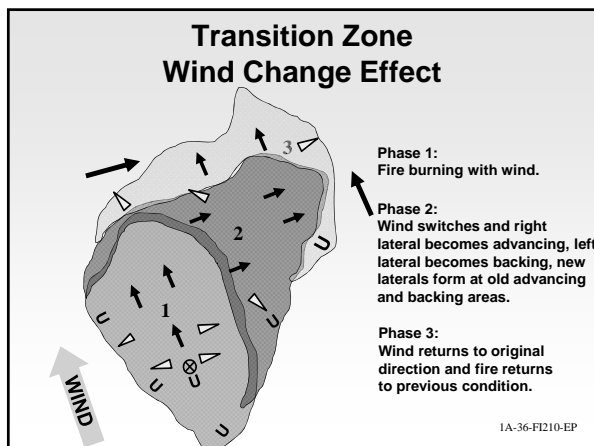
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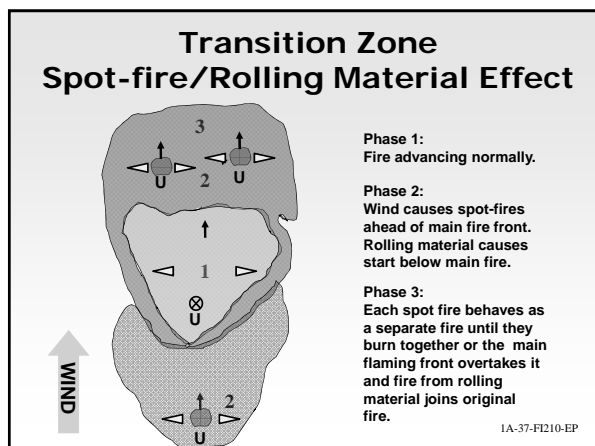
Anatomy of a Wildfire

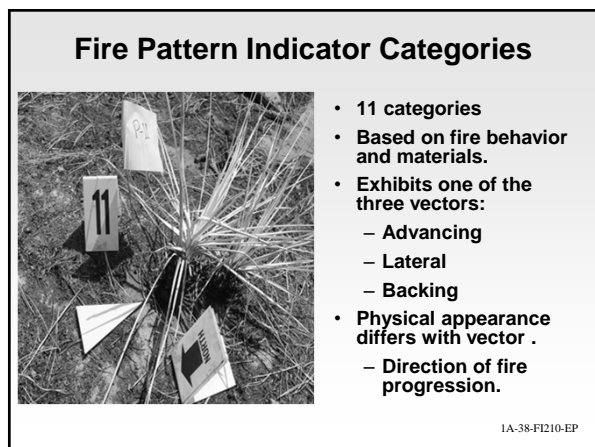


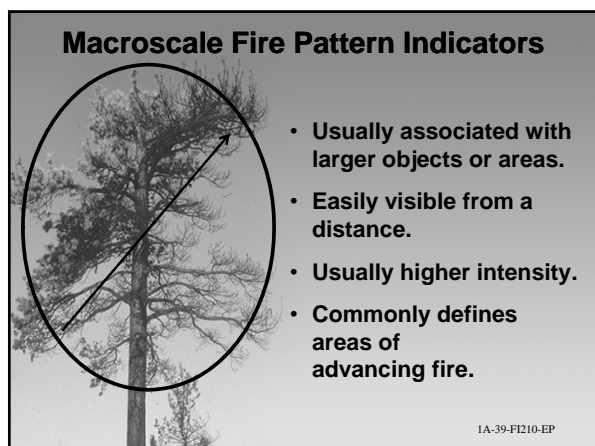




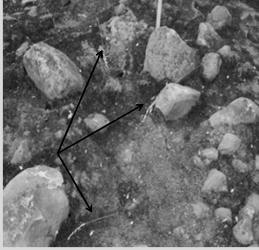








Microscale Fire Pattern Indicators



- Associated with smaller objects or areas.
- May not be as easily observed from a distance.
- Importance increases with proximity to the origin.

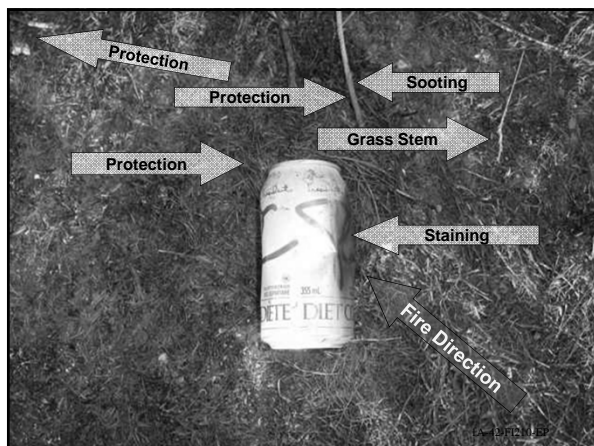
1A-40-FI210-EP

Fire Pattern Indicator Clusters



- Consistent vectors.
- Variety of indicator categories = greater reliability.
- In close proximity to each other.

1A-41-FI210-EP



Damage Differential



- Underlying principle that governs interpretation of most fire pattern indicators.
 - Individual indicators
 - Larger areas (V and U pattern)
- Change that occurs to combustible and non-combustible objects after interaction with fire.
- Amount of change will be based on relative fire intensities.
- Compare and contrast damage differential.

1A-43-FI210-EP

Damage Differential Compare and Contrast



- Possible characteristics to compare and contrast:
 - Amount of charring.
 - Amount of white ash.
 - Degree of loss of material.
 - Amount of sooting/staining.
 - Height and type of foliage freezing.
 - Degree and location of spalling.
 - Height and type of angle of char.
 - Location and extent of cupping.
 - Location and relative extent of general fire damage over larger area.

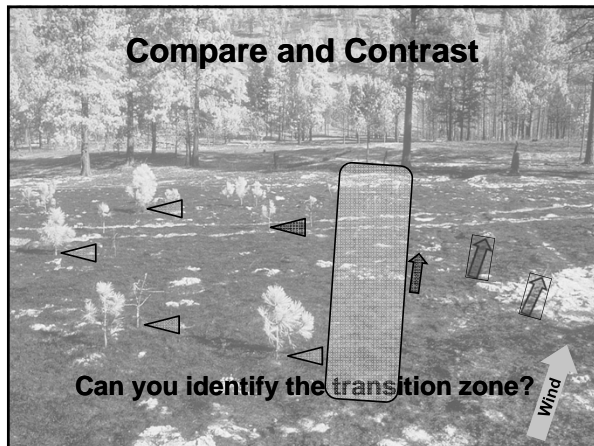
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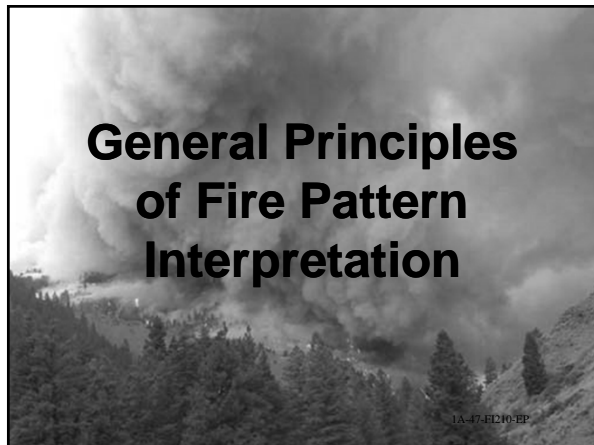
Damage Differential Compare and Contrast




- Same size
- Same category
- Separate locations
- Based on comparing and contrasting amount of damage.

1A-45-FI210-EP







General Principles of Fire Pattern Interpretation

- **Base your interpretation on the majority of the fire pattern indicators within and indicator category.**
 - Single indicators may be unreliable in the context of overall fire progression.
 - Reflects fire direction at a precise point.

1A-48-FI210-EP

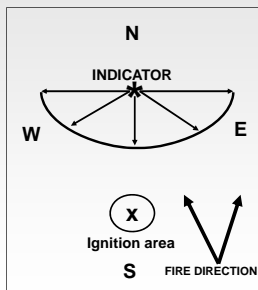
General Principles of Fire Pattern Interpretation

- Base your interpretation on the fire pattern indicators within a variety of categories.
 - 11 categories
 - Use as many categories as possible.
 - Systematic method.



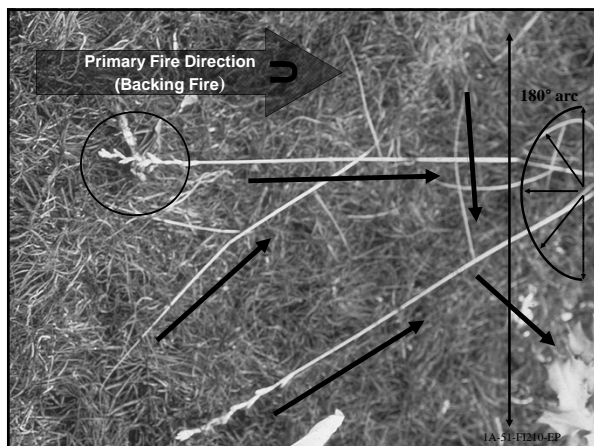
1A-49-FI210-EP

General Principles of Fire Pattern Interpretation



- A single indicator may be accurate within a 180° arc.
 - Fire does not burn in perfectly straight line.
 - Radical but brief directional changes.
 - Progression based on fuels, wind, and/or slope.
 - Fire pattern indicators align with progression.

1A-50-FI210-EP



1A-51-FI210-EP

General Principles of Fire Pattern Interpretation



- Interpret fire pattern indicators within the context of fire behavior principles.
- Determine fire behavior
 - Weather observations
 - Topography
- Reconstruct probable fuel conditions based on:
 - Unburned fuels
 - Burned remains

1A-52-FI210-EP

General Principles of Fire Pattern Interpretation

- Interview witnesses
 - First responders
 - Civilian witnesses



1A-53-FI210-EP

Fire pattern indicators will usually become less pronounced as you approach the ignition area.



- Most fires start small.
- Intensity usually increases as fire progresses.
- Microscale indicators may be subtle.

1A-54-FI210-EP

General Principles of Fire Pattern Interpretation

- Avoid attempts to prematurely locate the ignition area.
 - Fire pattern indicators become increasingly subtle the closer you get to the ignition area.
 - Closer attention to detail.
 - Avoid pressure to rush.
 - Patience is the key.



1A-55-FI210-EP

55 MPH WIND!



1A-55-FI210-EP

Where would you put the specific origin area?

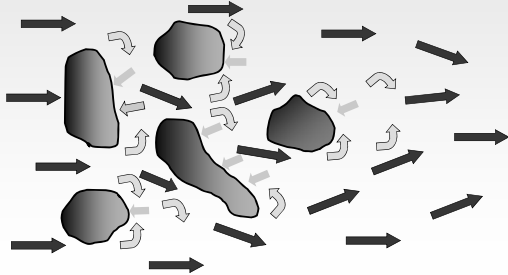
General Principles of Fire Pattern Interpretation



- Direction of fire travel will be influenced by obstacles.
 - Around and/or over.
 - Loss of intensity and speed.
 - Temporary direction change.

1A-57-FI210-EP

Obstacles will slow and alter the direction and intensity of fire spread.



1A-58-FI210-EP

FI-210, Wildland Fire Origin and Cause Determination

Unit 1 – Fire Pattern Indicators

Lesson 1B – Fire Pattern Indicator Categories

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Fire Behavior Indicator Categories

Unit 1B



1B-1-FI210-EP

Introduction

- Discuss in detail each of the 11 categories.
 - Description and general appearance.
 - Fire behavior behind formation.
 - General reliability and possible exceptions.
- Examine each fire pattern indicator within the three vector areas.
 - Advancing
 - Backing
 - Lateral (where applicable)

1B-2-FI210-EP

Fire Pattern Indicator Categories

- | | |
|------------------|----------------|
| • Protection | • Sooting |
| • Grass Stem | • Staining |
| • Foliage Freeze | • White Ash |
| • Angle of Char | • Cupping |
| • Spalling | • V/U Patterns |
| • Curling | |

1B-3-FI210-EP

Revised Indicator Category List

Currently there are 11 categories, reduced from 14.

Categories Revised:

- Die-Out
 - Tends to reflect fire intensity rather than direction.
- Depth of Char
 - Added as a sub-category of protection.
- Degree of Damage
 - Recognized in this course as a component of protection: essentially the obverse side of protection.
 - Side of an object exposed to the fire effects/side not exposed to fire effects

1B-4-FI210-EP

General Reliability and Possible Exceptions

- Indicators accurately reflect fire behavior.
- A single vector may not be consistent with general fire progression.
- Fire pattern indicators should be tested to determine reliability.

1B-5-FI210-EP

General Reliability and Possible Exceptions

- Certain circumstances occur that create possible exceptions that apply to most indicator categories.
- Other circumstances may occur creating possible exceptions that only apply to a specific fire pattern indicator category.
 - These will be addressed in each specific indicator category.

1B-6-FI210-EP

General Reliability and Possible Exceptions

- Heavy or uneven fuel loading.
- Long-term fire residence.
- High winds.
- Directional wind changes.
- Fire backing downslope against wind.
- Variation in sound and rotten fuel.
- Indicators that may have been moved.
- Previous fires in same area/reburns.

May apply to most fire pattern indicator categories.

1B-7-FI210-EP

General Reliability and Possible Exceptions

Assess fire pattern indicators for reliability.

- Indicator consistent with:
 - Fire behavior context.
 - Other indicators within a nearby pattern cluster.
 - General known fire progression.
 - Eye witness observations.
 - Video or photo evidence.
- Did any of the circumstances that can create exceptions exist during the fire's initial stages?
 - Test the reliability of fire pattern indicators with these exceptions in mind.

1B-8-FI210-EP

Fire Pattern Indicator Categories



1. Description
2. Fire behavior
3. Specific reliability and possible exceptions unique to the category.
4. By vector and by macroscale and microscale, where applicable.

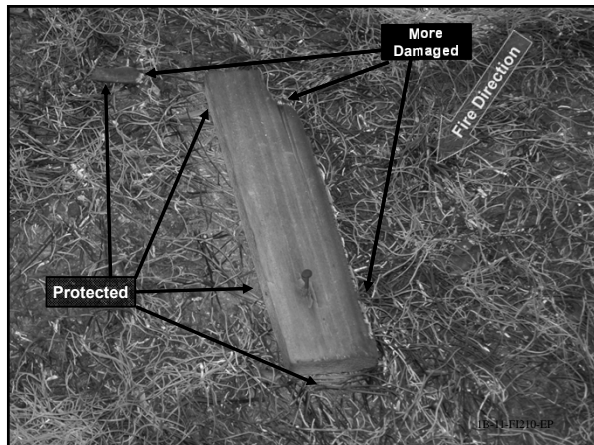
1B-9-FI210-EP

Protection Indicators: Description

- Objects are less damaged in appearance on the non-exposed side.
- The same object is more damaged on the exposed side.



1B-10-FI210-EP



Protection Indicators

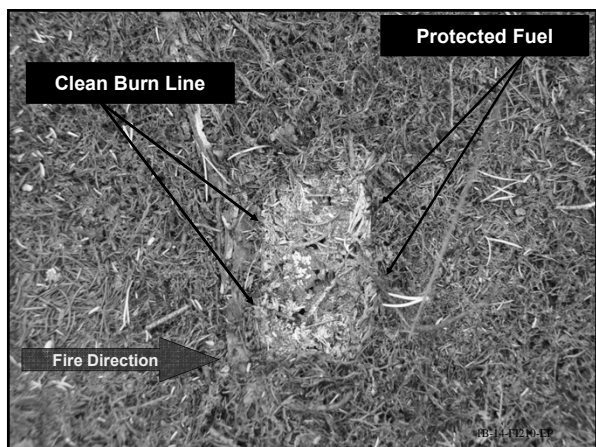
- Identified by:
 - Less charring.
 - Less staining and sooting.
 - Less white ash.
 - Clean burn lines under the object on the unprotected side of fuels.

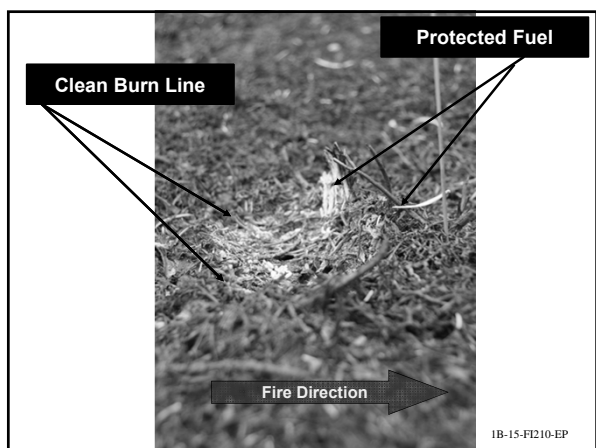


- Compare and contrast most damaged side to least damaged side

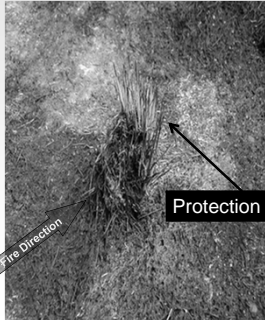
1B-12-FI210-EP







Protection Indicators: Description



- Object shields fuels from heat and flame.
- Both combustible and non-combustible objects can provide shielding.
- Same object may shield itself on non-exposed side.

1B-16-FI210-EP

General Reliability and Possible Exceptions *Protection*

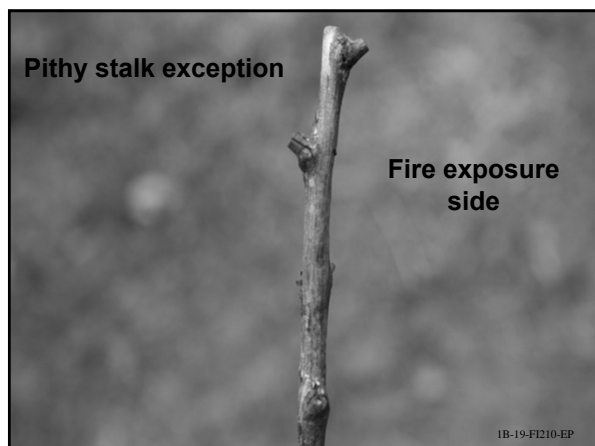
- Accurately shows fire direction.
- Low to moderate intensity fires most reliable.
- Possible exceptions:
 - Pithy stalks
 - Suspended fuel
- Damage may be on the opposing side or equally distributed on both sides under above conditions.

1B-17-FI210-EP

General Reliability and Possible Exceptions *Protection*

- Pithy stalks: a vascular plant that has a usually continuous central internal strand of spongy tissue in the stem.
 - May be annual or perennial.
- Because the outer sheathing is very thin, it may burn through on the non-exposed side due to flame wrap, with the fire becoming embedded in the soft, porous tissue.
- This may cause more damage on the non-exposed side of the stem.

1B-18-FI210-EP

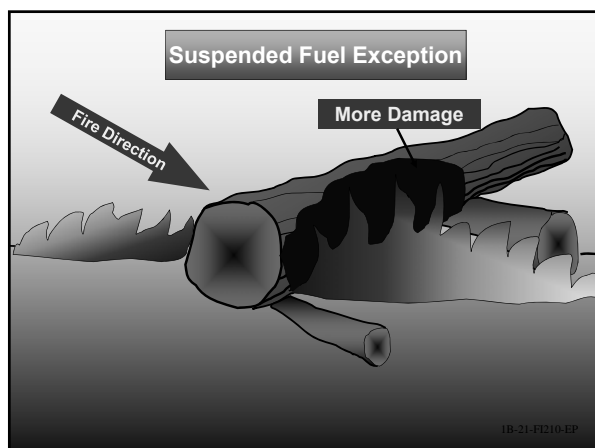


General Reliability and Possible Exceptions
Protection

Suspended Fuels:

- Limbs and tree trunks may be suspended by other fuels or objects such as rocks.
- Gap between the fuel and the ground causes vortex flame wrap on the non-exposed side of the object, creating more damage and leaving protection on the exposed side.
- It may appear that the fire came from the opposite direction, especially if the object falls to the ground after the fire has passed.

1B-20-FI210-EP








Advancing Fire Macroscale Fire Pattern Indicators *Protection*

- Clearer on larger objects.
- On smaller objects may be difficult to discern due to entire object being charred.
- Difference from exposed side to non-exposed side can still be determined (compare and contrast).



1B-24-FI210-EP

Advancing Fire Microscale Fire Pattern Indicators *Protection*



- Used to validate macroscale fire patterns.
- Use when macroscale fire patterns do not exist.
- Pattern clusters.

1B-25-FI210-EP

Advancing Fire Microscale Fire Pattern Indicators *Protection*



Fuels shielded from damage on non-exposed side:

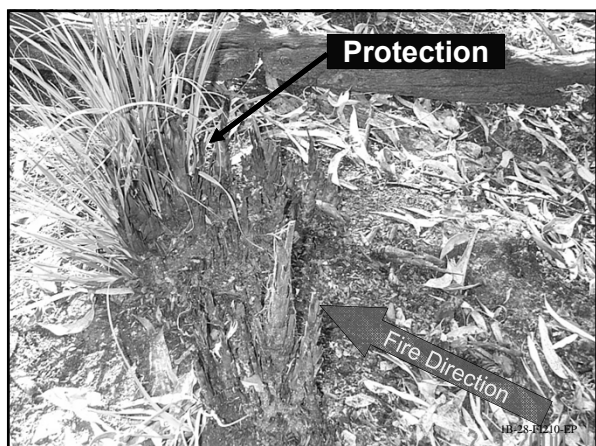
- Downed logs and tree limbs
- Foliage crowns
- Pine cones
- Grass clumps
- Small stumps
- Brush
- Deer/rabbit pellets

Protection

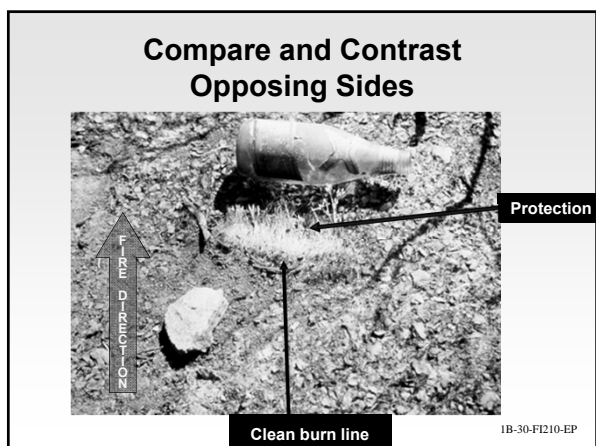
1B-26-FI210-EP



1B-27-FI210-EP







Backing Microscale Fire Pattern Indicators *Protection*



- Generally more protected fuels in backing area due to lower intensity.
- On smaller objects.
- Non-exposed side.

1B-31-FI210-EP

Lateral Macroscale Fire Pattern Indicators *Protection*



- Damage on side closest to advancing fire front.
- Presents at 45° - 90° angle to advancing fire progression.
- Protection more noticeable when contrasted against advancing area.

1B-32-FI210-EP

Compare and Contrast Opposing Sides

Exposed

Protected



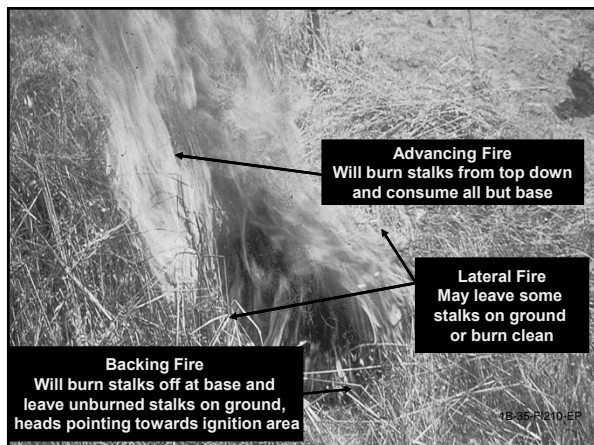
1B-33-FI210-EP

Grass Stem Fire Pattern Indicators: Description

- Condition of residual stems after fire passes.
- Fire intensity controls appearance of remains.



1B-34-FI210-EP



1B-35-FI210-EP

Grass Stem Fire Pattern Indicators: Description-Advancing


- Grass remains in advancing area will typically consist of only a small part of the stem base.
 - These stems may show cupping.
- Look for transition zones between backing and lateral.



1B-36-FI210-EP



**Grass Stem Indicators:
Description-Backing/Lateral**



Fire Direction
(Backing/Lateral)

- Backing fire weakens the side exposed and stem falls in direction fire came from.
 - Like undercut on tree.
- More reliable on lower intensity fires.
- Occurs primarily in backing areas, but may occur in lateral transition zones.

1B-38-FI210-EP



Grass Stem Transition Zone Patterns Near Origins

Grass stems may form recognizable patterns within the specific origin area:

- Backing to advancing transition zone.
- Lateral transition areas may be outlined with downed stems.

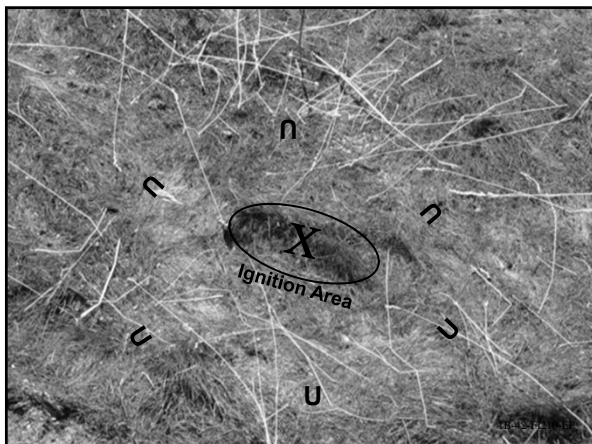
1B-40-FI210-EP

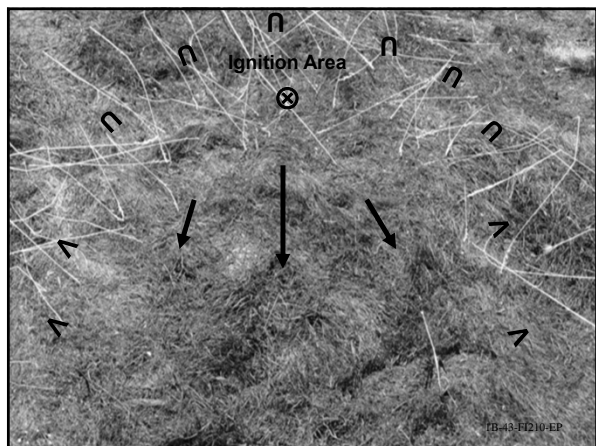
Grass Stem Transition Zone Patterns Near Origins

Circle Pattern:

- Generally, fire burns away from ignition area equally in all directions.
- No wind or slope influence in specific origin area.
- Grass stems fall inward toward ignition area and remain relatively intact.

1B-41-FI210-EP







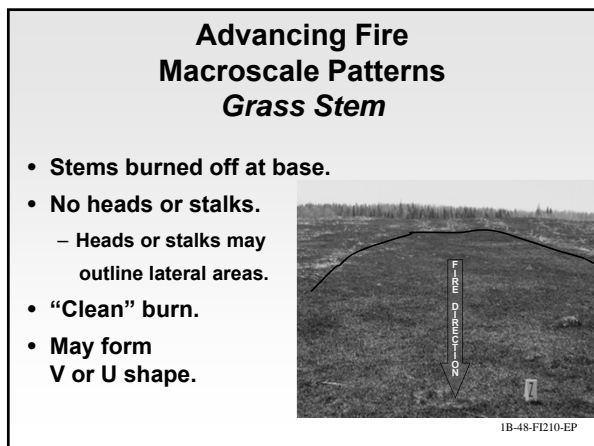
General Reliability and Possible Exceptions
Grass Stems

- Grass stem fire pattern indicators are usually very reliable.
- Segregate backing from advancing areas.
- Define lateral areas.
- Possible exceptions:

1B-45-FI210-EP







Advancing Microscale Fire Pattern Indicators *Grass Stem*

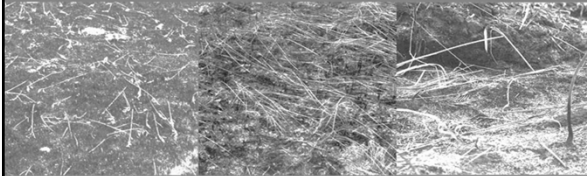
- Lack of residual stems.
- Stems and clumps burned off at/near base.
- Angle steeper than slope on clumps.
- Individual stems sharp/pointed on the non-exposed side.



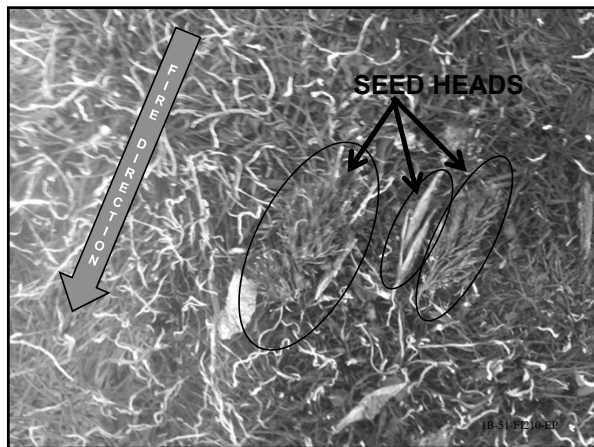
1B-49-FI210-EP

Backing Macroscale Patterns *Grass Stem*

- Littering of unburned/partially burned grass stems/seed heads.
- Majority of stems/seed heads will point in the direction the fire came from.



1B-50-FI210-EP



1B-51-FI210-EP

Backing Microscale Fire Pattern Indicators *Grass Stem*

- Individual head and stems point in the direction the fire came from.
- Remember 180° rule.



1B-52-FI210-EP

Foliage Freeze Indicators: Description

Green vegetation appears windswept and “frozen.”



Appearance depends on intensity and direction.

1B-53-FI210-EP

Foliage Freeze Fire Pattern Indicators: Fire Behavior

- Green vegetation softens.
- Vegetation bends with wind or gravity.
- Heat removes moisture from the vegetation.
- Vegetation “freezes” into a fixed position.



1B-54-FI210-EP

General Reliability and Possible Exceptions *Foliage Freeze*

- Accurate wind direction indicator.
- Possible exceptions:
 - Locations with a natural prevailing wind.
 - Pre-existing drought conditions in green hardwoods.



1B-55-FI210-EP

Advancing Fire Macroscale Fire Patterns *Foliage Freeze*

Indication of wind direction.

- Often points in direction of fire advance.
- Contrast and compare to backing areas.
- Reliable in advancing areas only.



1B-56-FI210-EP

Backing Macroscale Patterns *Foliage Freeze*

- Much less windswept when compared to advancing areas.
- Drooped appearance.
- May still be somewhat brittle and dried out.



1B-57-FI210-EP

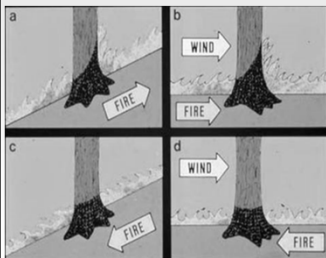
Backing Microscale Fire Pattern Indicators *Foliage Freeze*



- Generally not associated with backing fire.
- May be observed when fire backs into strong wind in heavy fuels.
- Compare/contrast.
- Will be on correspondingly lower shrubs and may appear drooped rather than windswept.

1B-58-FI210-EP

Angle of Char Fire Pattern Indicators: Description



- The angle of the char compared to both the unburned portion of the object and the slope.
- Angle differs with fire vector.

1B-59-FI210-EP

Angle of Char Fire Pattern Indicators: Description – Scorch vs. Char

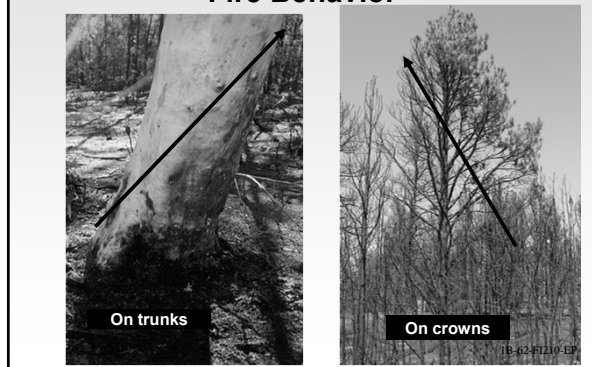
- Scorch and char are formed by the same process.
- Difference between the two is a matter of heat duration and/or fire intensity.
- Scorch typically appears on remaining crowns of trees or brush.
- Char is the result of the burning away of portions of the actual crown.

1B-60-FI210-EP

Angle of Char Fire Pattern Indicators: Description – Scorch vs. Char



Angle of Char Fire Pattern Indicators: Fire Behavior



General Reliability and Possible Exceptions *Angle of Char*

Generally reliable, especially for assessing advancing fire areas.

Possible exceptions:

- Flat surfaces/small diameters/short heights.
- Fuel accumulations - uphill side when fire is backing downhill.
- Old burns pre-existing char patterns.
- Thin barked conifers/hardwoods - evenly blackened on all sides.

1B-63-FI210-EP

Advancing Fire Macroscale Patterns *Angle of Char*



- Consistent pattern in advancing areas.
- Steeper than the slope.
- Low side - origin side.
- Enters low, comes out high.
- Clusters
- Contrast and compare to backing and lateral areas.

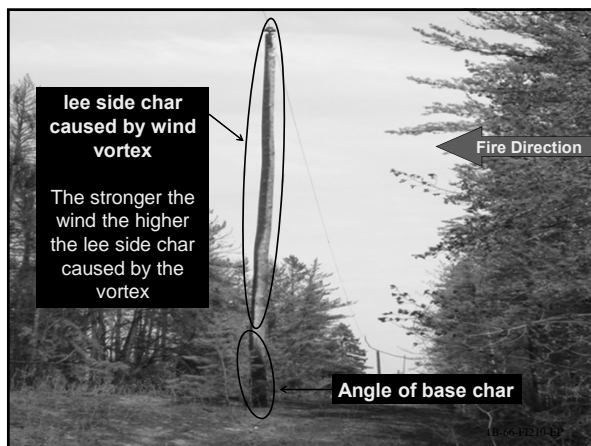
1B-64-FI210-EP

Advancing Fire Macroscale Patterns *Angle of Char*

- Due to the effects of wind, flame is drawn up the lee side of the pole-like object.
- Under high wind conditions this lee side char pattern can extend to great heights.
- The angle of the base char, however, will typically remain greater than the slope.



1B-65-FI210-EP



Advancing Microscale Fire Pattern Indicators
Angle of Char



- Angle steeper than slope
- Small shrubs/seedlings
- Grass clumps
- Low end on exposed side

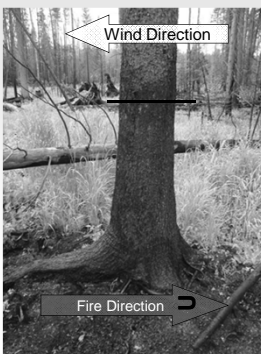
1B-67-FI210-EP

Advancing Microscale Fire Pattern Indicators
Angle of Char



1B-68-FI210-EP

Backing Macroscale Fire Patterns
Angle of Char



Parallel to slope on
vertical fuels and
foliage crowns.

1B-69-FI210-EP

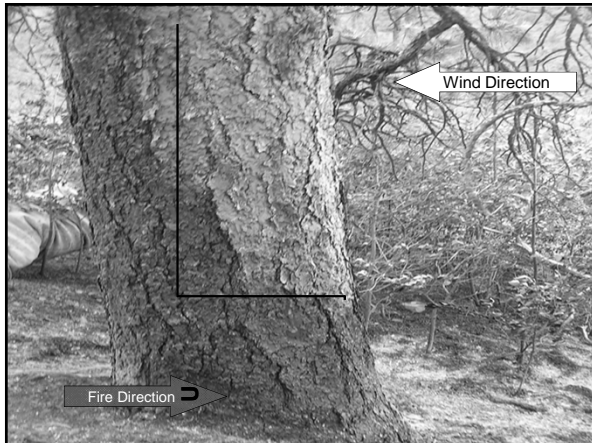
Backing Macroscale Fire Patterns *Angle of Char*



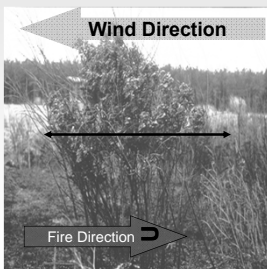
Char may sometimes form an “L” or barber chair burn pattern.

- Overall fire pattern remains parallel to the slope.
- Fuel accumulation, catface, exposure to other nearby fuels or backing into high wind can create this char pattern.

1B-70-FI210-EP



Backing Microscale Fire Pattern Indicators *Angle of Char*



Will be parallel to slope, whether backing down-slope on a hill or against the wind on flat ground.

1B-72-FI210-EP

Spalling Fire Pattern Indicators: Description

- Shallow craters or chips in the surface of rocks, with the exfoliated pieces laying on the ground.
- Area surrounding crater is usually sooted/stained.



1B-73-FI210-EP

Spalling Fire Pattern Indicators: Fire Behavior

- Also known as exfoliation.
- Heat/flame exposure:
 - Rock not efficient conductor of heat energy.
 - Outer most layer becomes hotter than the rock underneath .
 - Differential expansion causes sub-surface shear stress.
 - Thin layers of rock break off, usually after the fire front has passed.



1B-74-FI210-EP



1B-75-FI210-EP

General Reliability and Possible Exceptions *Spalling*

- Usually reliable for advancing fire areas.
- Not commonly encountered in backing areas.
- Compare and contrast opposite sides of the rock.
- Possible exceptions:
 - High fire intensity or long-term fire residency.
 - Mechanical damage.
 - Moisture in the rock or type of rock.
 - Pre-existing stress cracks.

1B-76-FI210-EP

Advancing Macroscale Fire Pattern Indicators *Spalling*



- On numerous large rocks within the run.
- Concentrated on exposed side.
- Absent/less evident on the protected side.

1B-77-FI210-EP

Advancing Microscale Fire Pattern Indicators *Spalling*



- On smaller rocks within advancing fire area.
- Concentrated on exposed side.
- Absent/less evident on the protected side.

1B-78-FI210-EP

Backing Microscale Fire Pattern Indicators *Spalling*

- Not usually associated with backing areas.
- May be result of fuel accumulations.
- Compare and contrast with spalling on the same type rocks in the advancing area.
- Should be on the exposed side unless due to fuel accumulation.



1B-79-FI210-EP

Curling Fire Pattern Indicators: Description

- Green leaves bend and curl inwards towards heat source.
- Not normally a macroscale indicator.
- May also exhibit wind influenced freezing.



1B-80-FI210-EP

Curling Fire Pattern Indicators: Fire Behavior



- Similar to foliage freezing.
- Heat exposure causes leaf to dry out and shrink on surface exposed to heat.
- Shrinkage causes edges to curl in towards the source of heat.

1B-81-FI210-EP

General Reliability and Possible Exceptions *Curling*

- Most reliable in low intensity/backing areas of the fire.
- Possible exceptions:
 - Degree of curing/long term drought.
 - Leaves may already be curled.
 - Direct flame impingement.
 - May impact leaves from a variety of different directions.
 - Thick leaves with strong central vein.
 - May not curl at all or may curl in towards vein.
 - Wind driven foliage freeze.
 - Leaves may curl towards approaching heat source, but then move and freeze with the wind.

1B-82-FI210-EP

Advancing Microscale Fire Pattern Indicators *Curling*



- Low intensity fire.
- Not commonly associated with advancing fire.
- Curling on the exposed side of vegetation.

1B-83-FI210-EP

Backing Microscale Fire Pattern Indicators *Curling*

- Small vegetation.
- Leaves will curl towards the fire exposure.



1B-84-FI210-EP

Sooting Fire Pattern Indicators: Description

- Black, carbon-based deposit.
- Side exposed to flame/smoke.



1B-85-FI210-EP

Sooting Fire Pattern Indicators: Description



- Can be rubbed off



1B-86-FI210-EP

Sooting Fire Pattern Indicators: Fire Behavior

- Airborne particulates resulting from the incomplete combustion of a carbon.
- Complex mixture of organic compounds.
- Adheres to:
 - Rocks, cans, fence wire, metal posts, some vegetation



1B-87-FI210-EP

General Reliability and Possible Exceptions *Sooting*

- Generally reliable.

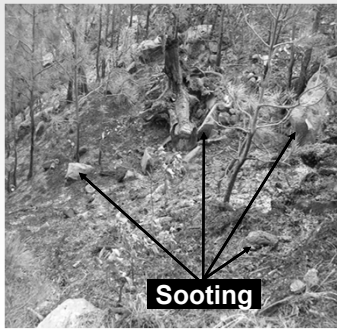
Possible exception:

- Accumulations of debris that generate large volumes of sooty smoke.



1B-88-FI210-EP

Advancing Macroscale Fire Pattern Indicators *Sooting*



- Look for noticeable soot deposits on large individual rocks and rock outcroppings or other similar objects.
- Consistency within the run.

1B-89-FI210-EP

Advancing Microscale Fire Pattern Indicators *Sooting*



- Deposits on exposed side of object.

1B-90-FI210-EP

Backing Microscale Fire Pattern Indicators *Sooting*

- Not as heavy in the backing areas.
- Exposed side of objects.
- Relatively small objects in comparison to advancing areas.



1B-91-FI210-EP

Staining Fire Pattern Indicators: Description



- Non-combustible objects.
- Glossy, varnish-like stain, light yellow-orange to dark brown, on the exposed side.
- May be tacky to touch.
- White ash and light-weight fire debris may adhere to it.

1B-92-FI210-EP

Staining Fire Pattern Indicators: Fire Behavior



- Vaporized volatile oils/ resins - in the flame and smoke column.
- Condensed onto cooler objects.
- Residue greater on exposed side.

1B-93-FI210-EP

General Reliability and Possible Exceptions *Staining*



- Generally reliable
- Possible exceptions:**
- Repositioning of lightweight objects by wind or suppression activities.
 - Accumulation of man-made debris.

1B-94-FI210-EP

Advancing Microscale Fire Pattern Indicators *Staining*



- Exposed side of objects.
- More pronounced in advancing than backing areas.

1B-95-FI210-EP

Backing Microscale Fire Pattern Indicators *Staining*



- Less noticeable in the backing areas, and may be very subtle.
- Examine small pebbles, rocks and other similar items.

1B-96-FI210-EP

Sooting vs. Staining

Sooting

- Dull black in color.
- Can be rubbed off with fingers.
- White ash will generally not adhere to it.

Staining

- Glossy pale yellow to dark brown in color.
- Cannot be rubbed off, but may be tacky to the touch.
- White ash may adhere to it.

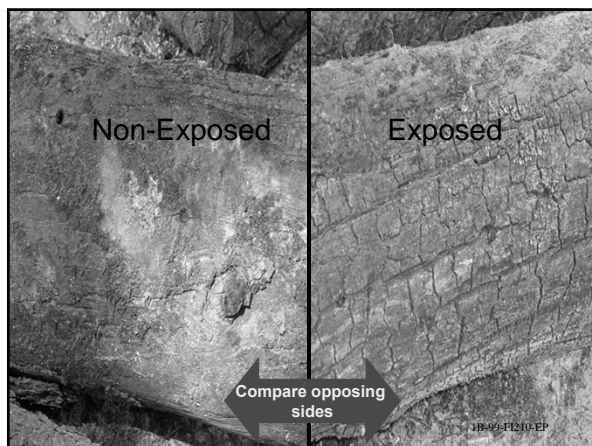
1B-97-FI210-EP

White Ash Exposure: Description

- White ash on exposed side of trees, logs, limbs, or brush.
- Exposed side:
 - Lighter (white ash)
 - More damage
- Protected side:
 - Darker
 - Texture difference
 - More color



1B-98-FI210-EP

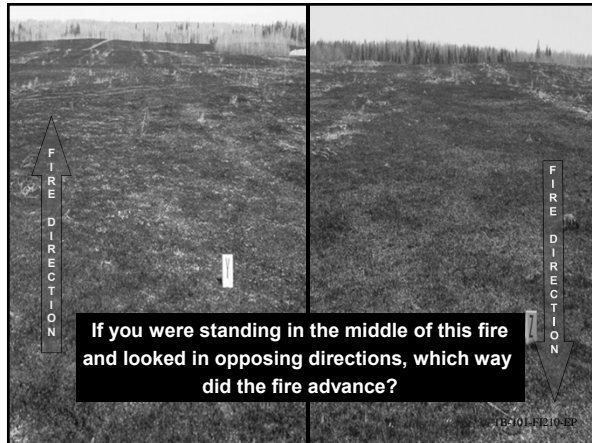


White Ash Exposure Description

- In grass stands, white ash may be more noticeable when looking away from the origin.
- Looking back towards the origin, the grass may appear darker and/or may have more “color” due to protection on the non-exposed side.



1B-100-FI210-EP



General Reliability and Possible Exceptions *White Ash Exposure*

- Thin-barked conifers/hardwoods may show more white ash on the protected side, particularly during strong winds.
- Long term fire residency.

1B-102-FI210-EP

Advancing Fire Macroscale Patterns

White Ash Exposure

- Compare and contrast opposing sides.
- Look for consistency on similar objects.



1B-103-FI210-EP

Advancing Microscale Fire Pattern Indicators *White Ash Exposure*



- May be on relatively small objects.
- May be closer to ground level.

1B-104-FI210-EP

Backing Macroscale Fire Patterns *White Ash Exposure*

- Less white ash overall, compared to advancing areas.
- Darker appearance of burned materials.
- Appearance of “color” when compared to advancing areas.
 - Due to unburned fuels.



1B-105-FI210-EP

Backing Microscale Fire Pattern Indicators *White Ash Exposure*



- Lack of, or less white ash than the advancing areas.
- Very fine fuels, and at levels that are generally closer to the ground on the exposed side.

1B-106-FI210-EP



White Ash Deposit: Fire Behavior

- Dispersed downwind and layered on fuels and non-combustible objects.
- Windblown white ash deposits.

1B-107-FI210-EP

General Reliability and Possible Exceptions *White Ash Deposits*

Possible exceptions:

- Reliability/presence decreases with time.
- Inconsistent dispersal under strong and variable wind conditions.

1B-108-FI210-EP

Advancing Fire
Macroscale Fire Patterns
White Ash Deposit



Windblown
transport – white
ash deposits on
similar objects
over wide area.

1B-109-FI210-EP

Advancing Fire
Microscale Fire Patterns
White Ash Deposit



White ash as a
result of complete
combustion of fuel.

1B-110-FI210-EP

Backing Microscale Fire Pattern Indicators
White Ash Deposit

White ash on the
non-exposed side
due to wind
direction.



1B-111-FI210-EP

Cupping Fire Pattern Indicators: Description



- Concave or cup-shaped char.
- Cup points to exposed side.
- Advancing fire area.
 - Exposed side, blunted or rounded off.
 - Charred branch tips on ground.
 - Non-exposed side pointed or cupped.

1B-112-FI210-EP

Cupping Fire Pattern Indicators: Fire Behavior



- Exposed side majority of damage.
- Fuels of 1/2" diameter or smaller most reliable.

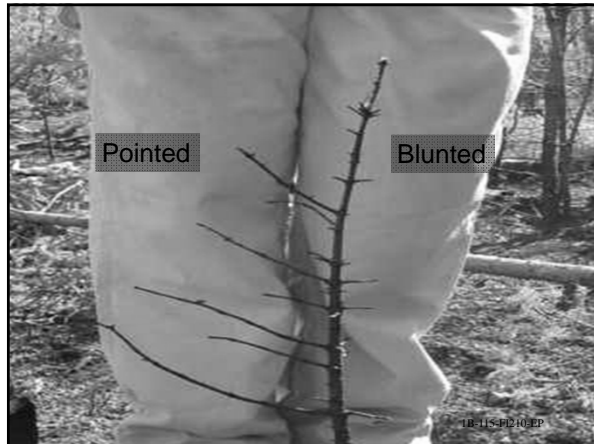
1B-113-FI210-EP

Advancing Fire Microscale Fire Pattern Indicators *Cupping*



- Ends of vegetation.
- Low end of the cup: exposed side.
- Pointed on the protected side.
- Blunted/rounded; exposed side on terminal twig ends.

1B-114-FI210-EP



General Reliability and Possible Exceptions -Cupping-

- Reliable in advancing areas.
- Possible exceptions:
 - Large diameter fuels - cup direction may be inconsistent with spread direction due to long term fire residency and possible change of wind direction.
 - Small diameter fuels - when wind is gusty and erratic.

1B-116-FI210-EP

Backing Microscale Fire Pattern Indicators *Cupping*

- Usually not associated with backing areas.
- When in backing areas - usually the result of high winds or long term fire residency.

1B-117-FI210-EP

V and U Fire Pattern Indicators: Description



- Exterior perimeter V or U shape.
- Cup of the U or apex of the V often contains the ignition area.
- View/document from aerial perspective, if possible.

1B-118-FI210-EP

V and U Fire Pattern Indicators: Fire Behavior

- U pattern
 - Light wind/flat ground
 - Origin on moderate slope
- V pattern
 - High wind/flat ground
 - Origin on steep slope
- Look below the canopy for pattern boundaries.



1B-119-FI210-EP

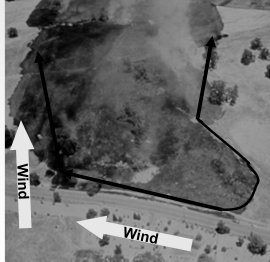
V and U Fire Pattern Indicators: Fire Behavior

- “V” shapes are predominately influenced by wind and/or steep slope.
- The stronger the wind, or the steeper the slope, the sharper the “V.”



1B-120-FI210-EP

V and U Fire Pattern Indicators: Fire Behavior



Consider:

- Suppression methods/barriers.
- Wind changes.
- Slope changes.

1B-121-FI210-EP

General Reliability and Possible Exceptions V and U Fire Patterns

- Can be very reliable
- Possible exceptions:
 - Rolling material
 - Wind shifts
 - Fuel type changes
 - Spot fires
 - Suppression activities
 - Man-made or natural barriers

1B-122-FI210-EP

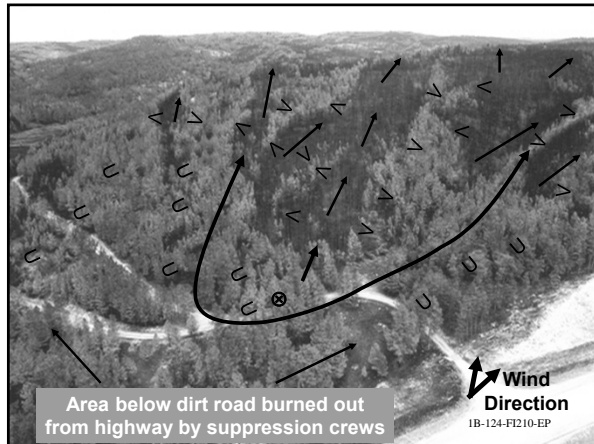
Advancing Fire Macroscale Pattern Indicators V and U Fire Patterns

Consider:

- Overall fire behavior context/environment.
 - Especially wind and slope interaction.
- Fire suppression actions may affect overall shape.



1B-123-FI210-EP



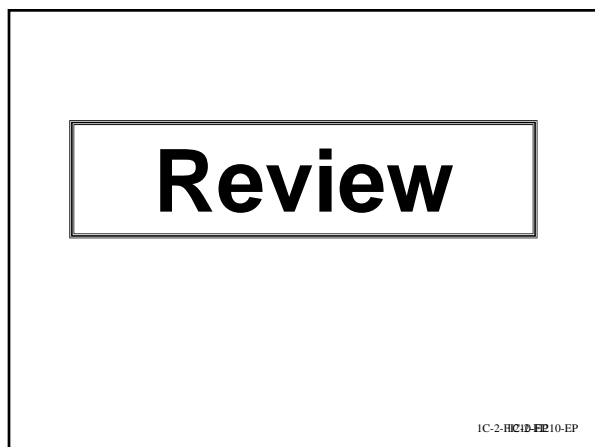
FI-210, Wildland Fire Origin and Cause Determination

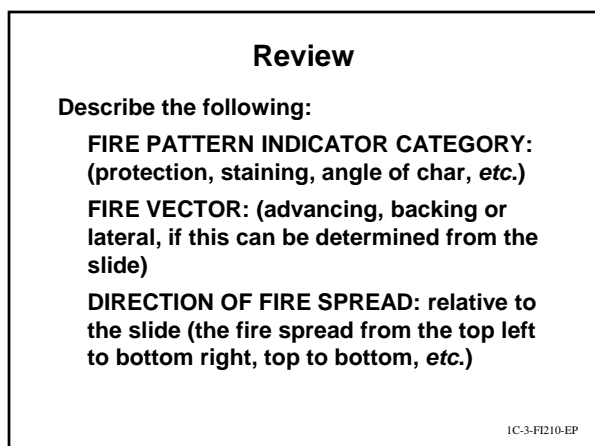
Unit 1 – Fire Pattern Indicators

Lesson 1C – Fire Pattern Indicator Classroom Review

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Review-Example



1C-4-FI210-EP



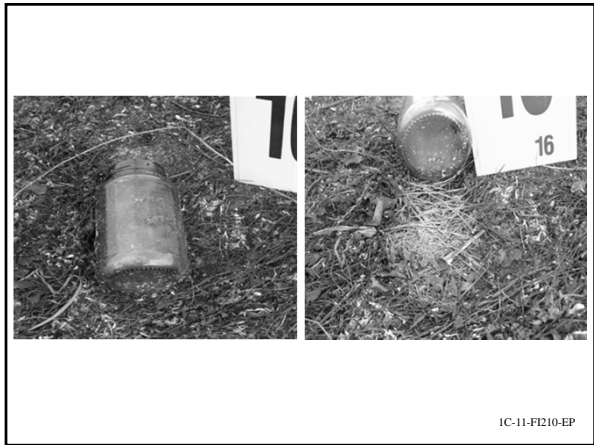






































Review 10



1C-25-FI210-EP

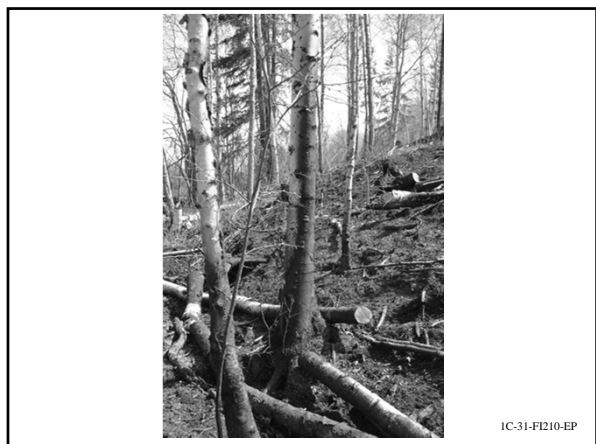
































Review Objectives

1. Describe the effects of fire on combustible and non-combustible objects.
2. Describe and classify the various fire pattern indicator categories.
3. Correctly assess vectors within the various fire pattern indicator categories.
4. Explain the underlying fire science principles that govern the formation of the indicators.
5. Apply a systematic method and use the fire pattern various indicators to trace fire progression back to the ignition area.

1C-42-FI210-EP

Review Objectives

6. Describe the general appearance of the fire pattern indicator.
7. Explain the fire behavior behind its formation.
8. List general reliability/possible exceptions.
9. Describe characteristics for each vector category.

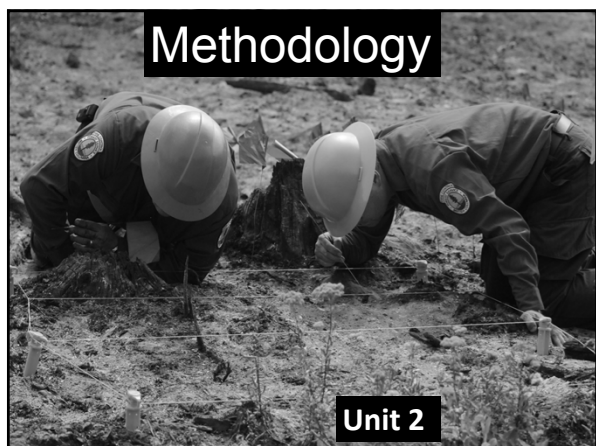
1C-43-FI210-EP

Notes:

FI-210, Wildland Fire Origin and Cause Determination

Unit 2 – Methodology

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Unit 2 Objectives

1. Describe methodology.
2. Define terms used in origin and cause methodology.
3. Identify the processes in origin and cause methodology.
4. Describe methods used to identify and process an "Ignition Area."

02-2-FI210-EP

Methodology

Stages of the Investigation

- Actions taken prior to the fire.
- Receiving the assignment.
 - Obtain weather data.
 - Check for aerial photos from detection/suppression aircraft.
- Actions taken en route to the fire.

02-3-FI210-EP

Methodology

Stages of the Investigation (cont.)

- Actions taken upon arrival.
- Determining the origin.
- Identifying the cause
(ignition source and ignition factors)
- Documenting the investigation.

02-4-FI210-EP

Methodology

The systematic application of a problem solving framework and the methods, procedures, and techniques common to the field of wildland fire investigation as applied to solve the problems of the specific scene conditions and needs.

It is the combination of a:

Framework (for problem solving) and **Methods**

02-5-FI210-EP

Methodology: Key Words

Systematic

Orderly, thoroughness, methodical, regularity

Methods

Practices, procedures, techniques

02-6-FI210-EP

Systematic

Methodical in procedure or plan, a systematic approach, marked by thoroughness and regularity, systematic efforts (Merriam-Webster).

02-7-FI210-EP

Methods

- Recommended procedures, practices, and techniques.
- Typically specific to a discipline.
- Peer reviewed.
- Generally accepted by profession.
- Applied to a specific scene.
- Resulting in the generation of data.



02-8-FI210-EP

Applying Systematic Method(s)

Facilitates investigative competency.

- Helps avoid premature conclusions.
- Helps avoid bias.
- Helps avoid use of rumor, conjecture, speculation.

Facilitates consistent approach.

- Investigation methods.
- Complete documentation.
- Applicable testing.

02-9-FI210-EP

Systematic Process

There is more than one systematic process, and numerous procedures, practices, and techniques (methods). Together, they form a “Methodology.”

- In this unit we will discuss the general systematic process called the “Scientific Method.”
- And recommended procedures, practices, and techniques associated with wildland fire investigation (investigative methods).

02-10-FI210-EP

Recognize the Need and Define the Problem

Collect Data

Scientific Method

Analyze the Data Develop a Hypothesis

Test the Hypothesis Select final Hypothesis

02-11-FI210-EP

Scientific Method

- “principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of hypotheses” (Merriam-Webster)
- While the process stays the same for each discipline, the techniques (methods) are specific to the discipline and scene conditions.

02-12-FI210-EP

Example

- Scientific Method - Collect Data
- Plan – Follow burn pattern to origin
- Method - Start at the most burned and work back to the least burned. (May include multiple methods to establish origin).

Example: The specific method of working from the most burned to the least burned is the opposite as the method prescribed in structure fire investigation, where it is typically the reverse.

02-13-FI210-EP

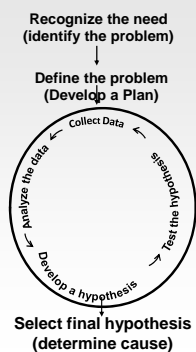
Scientific Method (Process)

- Recognize the need, define the problem (Need/Problem)
- Define the problem (Investigative Plan)
- Collect data (Facts)
- Analyze the data (Apply meaning)
- Form working hypotheses (Based only on data)
- Test the hypotheses/select the final hypothesis

Six parts, not necessarily sequential steps.

02-14-FI210-EP

SCIENTIFIC METHOD



02-15-FI210-EP

Example:

- I need to get to work (Need). Car will not start (Problem).
- I need to check the gas, battery, ignition, etc. (Plan and Data collection)
- I analyze the data and find I have no gas, the battery is charged, and the ignition is working. (Analyze the data)
- Based on analysis of the data, I form a hypothesis that my car will not start because I am out of gas. (Develop a hypothesis)
- Put gas into the car and it starts up. (Testing and final hypothesis)



02-16-FI210-EP

Scientific Method

The outline, which is the Scientific Method is applied to each part of the investigative process:

- Example: Applied to evaluate each indicator
- Applied to determination of origin
- Applied to determination of cause
- Continuous process

02-17-FI210-EP

Recognize Need, Define Problem

- Ex. Agency policy requires that an origin and cause investigation be done on each wildland fire which takes place within its jurisdiction. (Need)
- A wildland fire has ignited in the agencies jurisdiction and the origin and cause must be determined. (Problem)

02-18-FI210-EP

Define the Problem

- Applying the scientific method (process), clearly recognizing the **need and problem**, and specifically defining the **problem**, leads to the formation of an **investigative plan** which will assist in solving the problem and increase the potential of success.
- An investigative plan will focus on methods which generate **empirical data** (facts).

02-19-FI210-EP

Investigative Plan

- Define the problem. (Need to determine cause and responsibility).
- Establish the objectives. (Interview witnesses, establish fire behavior context, locate origin, determine ignition source(s), determine ignition sequence, etc.)
- List the tasks. (Read fire pattern indicators, etc.)
- List the assignments. (Investigator Smith, etc.)
- Timeline (By Wednesday noon)
- Adjust the plan according to new data.

02-20-FI210-EP

Collect Data -Investigative Plan-

As empirical data continues to be collected, the plan is modified to reflect the new information gained and new data collection needs

02-21-FI210-EP

Collect Data -Empirical Data-

- 1 : originating in or based on observation or experience
<empirical data>
- 2 : relying on experience or observation alone often without due regard for system and theory <an *empirical* basis for the theory>
- 3 : capable of being verified or disproved by observation or experiment <empirical laws>
(Merriam-Webster)

Verifiable, true, factual, relevant

02-22-FI210-EP

“It is a capital mistake to theorize before one has data. Insensibly, one begins to twist facts to suit theories, instead of theories to suit facts.”

Sherlock Holmes to Watson
A Scandal in Bohemia



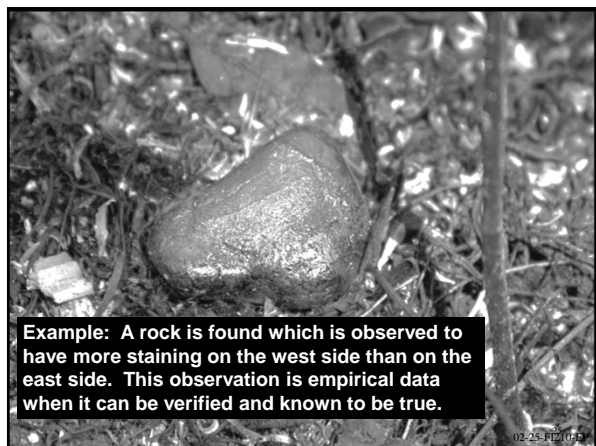
02-23-FI210-EP

Collect Data

Specific sources of empirical data include:

- Observations
- Witness Statements (indirect)
- Physical Evidence
- Experiments
- Experience
- Other data collection processes

02-24-FI210-EP



Collect Data -Empirical Data-

- Data collection starts upon the dispatch.
- Data collection and analysis often take place at nearly the same time and at all stages of the investigation:

Ex. 1- Analysis of each fire pattern indicator for reliability typically takes place at the time that the indicator is identified.

Ex. 2- Analysis of witness statements for accuracy and truthfulness may take place at the same time as the data is collected.

02-26-FI210-EP

Analysis of the Data

Part 1. Analysis for reliability: Takes place during the collection of the data to assure that it is factual and verifiable = empirical data.

- Must take place before data is used in forming a working hypothesis.
- Only empirical data, that which is based on observation or experience, which is verifiable or true is used to form working hypotheses. (Data collection may continue)

02-27-FI210-EP

Analyze the Data

Part 2. **Analyze all the empirical data to determine its meaning (explain the problem) and form the basis for working hypotheses.**

- Based on the knowledge, training, experience and expertise of the individual doing the analysis.
- Assists in forming working hypotheses by avoiding speculation and conjecture.
- Assistance in the analysis may be requested from someone more qualified.
- Data collection often continues during this process.

02-28-FI210-EP

Example: Data

- SOA is established to be 10' by 10.'
- Power line is on the ground at the SOA.
- Witness observed electrical arcing.
- Fulgurite was found in ignition area.



02-29-FI210-EP

Analyze:

(thought experiment)

Experience, training, and expertise indicate that energized power lines are a competent ignition source. Empirical data indicates that a working hypothesis of a downed power line as an ignition source should be considered.

02-30-FI210-EP

Ongoing Data Collection

- The process of empirical data analysis continues as new data is received, validated, and compared to existing working hypotheses.
- The ongoing analysis of new data may result in the reinforcing or modification of existing working hypotheses, falsification and exclusion of existing working hypotheses and/or the creation of new working hypotheses.

02-31-FI210-EP

Application of Data

- Empirical data collected is used to form working hypotheses using inductive reasoning.
- Empirical data is later used to test each working hypotheses in an effort to falsify them using deductive reasoning.

02-32-FI210-EP

Inductive Reasoning

- Inductive reasoning is based on experience or empirical data alone, often without regard for system or theory.
 - It is capable of being verified/falsified by observation (further empirical data) or experiment.
- The whole body of evidence (empirical data) is reviewed and considered.
- Objectively analyze the data and form working hypotheses for the fire.

02-33-FI210-EP

Inductive Reasoning

Example:

- I have investigated fifteen fires that were caused by a discarded cigarette.
- I recovered a discarded cigarette in the ignition area of all fifteen fires.
- I recovered a discarded cigarette within the ignition area of this fire
- Therefore, the cigarette caused the fire.
(Hypothesis)

You now have a working hypothesis that must be tested by deductive reasoning.

02-34-FI210-EP

Working Hypotheses

- **A hypothesis is a proposed explanation for a phenomenon:**
 - What were the weather conditions at the origin?
 - What the fire patterns indicate?
 - Where the ignition area is located?
 - What was the ignition sequence?
 - What may have caused the fire?
 - Who was responsible for igniting the fire?
- **Based on empirical data analysis.**

02-35-FI210-EP

At this point, can we form our final hypothesis as to the cause of the fire?



02-36-FI210-EP

Hypothesis

- Hypothesis: "...an interpretation of a practical situation or condition taken as the ground for action" (Merriam-Webster)
- "a tentative assumption made in order to draw out and test its logical or empirical consequences." (Merriam-Webster)

02-37-FI210-EP

Working Hypotheses

- Developed only when data has been collected and analyzed.
- Based on the empirical data.
- Not based on speculation, rumor, or conjecture.
- Empirical data may support only one hypothesis, or support development of multiple hypotheses.
- May start with one hypothesis and add others as additional empirical data is collected, analyzed, and supports other reasonably possible hypotheses.
- Hypothesis may be discarded if new data falsifies it.

02-38-FI210-EP

Working Hypotheses

No potential ignition source found.

There are times when no ignition source will be found, yet witness statements and/or other information indicates an ignition sequence indicative of an incendiary or accidental cause.

02-39-FI210-EP

Working Hypotheses

No potential ignition source found.

- The investigator may form a hypothesis and come to an opinion of cause based on this information as long as it is consistent with all other data and a well defined ignition area.
- Additional factors for incendiary or accidental caused fires may be used to establish a working hypothesis when the ignition area is clearly defined. (Not based on speculation, conjecture, or rumor).

02-40-FI210-EP

Incendiary Factors

- Lack of accidental ignition sources.
- History of incendiary fires in area.
- Geospatial clustering of incendiary fires.
- Temporal clustering of incendiary fires.
- Multiple fires not related to accidental cause.
- Modified fuel bed.
- Ignitable liquids present not associated with other uses.

02-41-FI210-EP

Incendiary Factors

- Remote location with view blocked.
- Roadside area with low detection risk.
- Access blocked (gate, cut tree, etc.).
- Normally blocked access is open (unlocked gates).
- Fire suppression equipment committed or disabled.
- Witness statements.

These factors are not all-inclusive, the investigator may consider other similar factors but should not rely on just one or two factors to determine a cause.

02-42-FI210-EP

Incendiary Factors - Examples

- Four fires in last three months on Mondays and Tuesdays between 2:00 AM and 4:00 AM with no ignition source found within a four mile stretch of dirt road.
- Three fires located behind locked gates or where a tree had fallen and blocked the road. Each fire was ignited in the middle of the night with a low risk of detection. The fuels in the ignition area were all piled pine needles. No ignition source was found.

02-43-FI210-EP

Accidental Factors - Examples

- Origin area clearly defined and searched.
- No reasonable accidental ignition source is found after a thorough search of origin.
- No reliable factors of incendiary cause.
- Witness statements support a specific cause.
- Video tape or photographic evidence supports a specific accidental cause.
- Data supports specific cause.

02-44-FI210-EP

Accidental Cause - Example

- Example: No ignition source evidence was recovered from a 5' by 5' specific origin area after a thorough search. Witness statements indicate that metal tracked equipment was working in the area just prior to the fire being reported
- A rock was found in the origin with evidence of rock to metal track contact and/or,
- Video from a nearby camera shows smoke coming from the area shortly after the equipment passed the point where the fire started.

02-45-FI210-EP

Test the Hypothesis

- Testing is conducted by comparing all the data (facts) and/or applicable scientific research in an effort to see if any of the hypotheses can be falsified.
- Valid hypotheses are those which can withstand serious tests when compared to all the known facts (empirical data) and scientific knowledge associated with the specific phenomena. (Deductive reasoning)

02-46-FI210-EP

Deductive Reasoning

- Reasoning from a hypothesis to account for specific empirical data, research or experimental results.
 - Must be supported by the facts.
 - Testing may be either cognitive or experimental.
 - Many fire causes will be tested cognitively, *i.e.*, based on knowledge, research and experience.
 - Others will lend themselves to further experimental testing.

02-47-FI210-EP

Deductive Reasoning

- Key analysis to this process is: “what other hypothesis could be supported by the same set of facts?”
 - If there are alternative hypotheses that are supported by the same facts, then the investigator may not have gathered sufficient data.
 - Gather more data and re-test.

02-48-FI210-EP

Deductive Reasoning

- Deductive reasoning begins with a general premise, (based on inductive reasoning), which leads to a specific conclusion
- The reasoning starts with a hypothesis, (Premise 1) moves to an observation, (Premise 2) and finishes with the findings. (Conclusion)

02-49-FI210-EP

Example:

- *Premise 1* – If a cigarette is discarded into finely-particulated fuels under certain environmental conditions, it is more likely than not to start a fire
- *Premise 2*- A cigarette was recovered within the specific origin area of the fire and the fuel bed and environmental conditions were consistent with known conditions, based on research and experience, that are conducive to a cigarette caused ignitions.
 - The cigarette was consistent in appearance with a recently discarded cigarette.
 - The fire direction indicators led back to within a few inches of the cigarette.
 - No other alternative hypothesis supports these facts.
- *Conclusion* - Therefore, it is more likely than not that the cigarette caused the fire.

02-50-FI210-EP

Deductive Reasoning

Typical analysis questions that should be considered:

- Does the hypothesis make sense in the context of all the facts?
- What facts support/contradict the hypothesis?
- Is there research that supports/contradicts the hypothesis?
- Can a peer review falsify/support the hypothesis?

02-51-FI210-EP

Deductive Reasoning

Typical analysis questions that should be considered:

- What interpretation may an opposing expert apply to falsify the hypothesis?
- What are the factual weaknesses of the hypothesis?
- Is there an alternative way to interpret the data?
- If so, why is your interpretation the correct one?

02-52-FI210-EP

Scientific Knowledge - Caution

- It is recognized that it is impossible to replicate the exact conditions present at the location of a specific fire at the time of ignition.
- Published scientific testing and experiments often address similar but not precise conditions as those present at the specific fire scene.

02-53-FI210-EP

Test the Hypothesis

- Testing can be completed by conducting “thought experiments” which apply known scientific principles to the hypothesis.
- Testing by “thought experiments” maybe augmented by various degrees of physical testing, at the same time or at a later date.

02-54-FI210-EP

Example

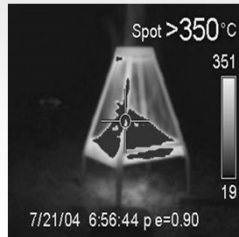
- You find remains of a cigarette near the ignition area.
- You develop a working hypothesis that the fire was started by a cigarette.
- How do you test the hypothesis?
 - Fire patterns do/don't lead back to the cigarette remains.
 - Weather information does/does not support the range conducive to cigarette ignition.
 - Examination of the cigarette remains reveals that it was/was not in place before the fire.

02-55-FI210-EP

Test the Hypothesis

Physical testing can (and often will) be conducted by the investigator and/or others more qualified.

For physical testing to be valid, it should closely represent the conditions and circumstances actually present and test all components of the item.



02-56-FI210-EP

Test the Hypothesis

Re-analysis of the data or analysis of new data collected may be applied to this process.

- If no hypothesis withstands the testing process, the cause should be "undetermined" at that time.
- The development of additional data or analysis may provide for the determination of cause on a fire previously classified as undetermined.



02-57-FI210-EP

Select Final Hypothesis

- If only one hypothesis withstands testing, that hypothesis typically becomes the final hypothesis.
- When two or more hypotheses withstand testing, the investigator must determine if the facts support one hypothesis to be probable, over others that are just reasonably possible.

02-58-FI210-EP

Level of Certainty

The investigator is being asked for their opinion.

Investigator's opinion is based on their confidence in the data, data analysis, and testing of the hypothesis.

How strong do you hold your opinion?

Two levels of certainty commonly used:

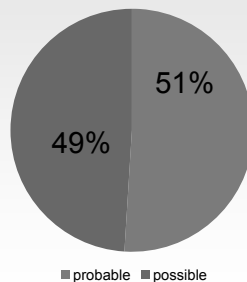
Probable

Possible

02-59-FI210-EP

Probable

- ***The investigator should know how certain they are of their expert opinions.***
- Likelihood hypothesis is true is greater than 50%.
- If only one hypothesis is determined to be "probable," then an opinion can be expressed.
- Even when there are other possibilities.



02-60-FI210-EP

- The investigator should clearly document the data which is used to form their opinion as to the “probable” cause of a fire.
- The investigator should be prepared to give testimony pertaining to the data upon which they relied for their opinion to determine probable cause of a fire.

02-61-FI210-EP

Possible

- *Hypothesis is feasible but not to the level of probable.*
- If two or more hypotheses are equally likely, then the level of certainty must be “possible” for both.
 - Undetermined
- Only when the level of certainty is considered “probable” should an opinion be expressed with reasonable certainty.



02-62-FI210-EP

Premature Assumptions

Expectation Bias

- Coming to a final conclusion without considering all relevant data (facts).
- Data developed by an investigator indicating certain activities or events does not indicate expectation bias.

For example: A witness provides a statement indicating a certain potential cause of the fire early in the investigation. This does not constitute expectation bias unless the investigator ignores factual data that could indicate other potential causes.

02-63-FI210-EP

Premature Assumptions

Confirmation Bias

- Using the data to prove a hypothesis rather than test it and attempt to disprove it.
- Test all hypotheses for which there is supporting data.

Follow all the investigative leads that the factual data identify.

"A man should look for what is, and not for what he thinks should be."

- Albert Einstein

02-64-FI210-EP

Methods



02-65-FI210-EP

Arrival at the Fire Scene

- Investigation Plan (Continuous Process)
- Faced with multiple priority tasks
- Each fire different
- Difficult for single investigator
 - Identify safety issues
 - Secure origin
 - Obtain on-scene weather
 - Identify witnesses
 - Locate and secure evidence

02-66-FI210-EP

Actions on Arrival at Fire

Preliminary area of protection

- Based on fire behavior context and witness statements.
- Determine the Investigative priority.
- Evaluate first responder protection area.
- Use barrier tape or flagging as appropriate.



02-67-FI210-EP

Actions on Arrival at Fire

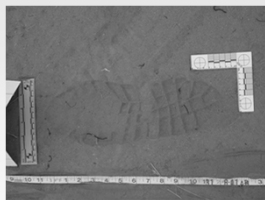
- **Suppression Witnesses**
 - First responders, lookouts, aerial observers
 - Size on arrival
 - Specific fire behavior
 - Fire progression
 - Suppression strategy
 - Weather
 - Evidence
 - Witnesses
- **Civilian Witnesses**
 - Identification
 - Preliminary statement
 - Re-contact information



68002-68-FI210-EP

Actions on Arrival at Fire

- **Physical Evidence**
 - Locate
 - Protect
 - Secure
- **Environmental Conditions**
 - Assess conditions: too hot or smoky, falling snags (beetle kill areas), rolling material, darkness, hazardous materials, other hazards
 - Secure and delay entry until scene is safe/acceptable.



02-69-FI210-EP

Actions on Arrival at Fire

- **Tasks**

- Interviews
- Scene Security
- Scene Examination
- Evidence Collection
- Scene Documentation

- **Additional**

- Resources**

- Other investigators
- Forensic specialists
- Experts

**The tasks drive the resource need.*

02-70-FI210-EP

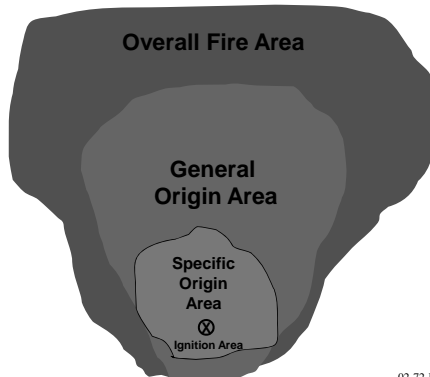
Evidence Protection Area

A reasonable expectation of where evidence may be found, based on experience, observation, location and specifics of that incident.

- Both outside and inside the burn.
 - Look up, down, and all around
- Be cognizant of where you put your feet and where resources drive and park.
- Minimize the impact.

02-71-FI210-EP

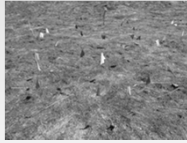
Areas of a Fire Scene



02-72-FI210-EP

Determining Origin and Cause

- **General Origin Area**
 - Macroscale indicators
 - Fire behavior context
 - Witness statements
 - Generally one-half acre or less



- **Specific Origin Area**
 - Fire progression first influenced by wind, slope or fuels.
 - Generally no smaller than 5'x 5'
 - May be smaller
 - Dependent upon indicators
 - Indicators become more subtle
 - Transition zone between advancing and backing indicators.

02-73-FI210-EP

Determining Origin and Cause

- **Ignition Area**
 - The smallest location which a fire investigator can define, within the specific origin area, in which a heat source and fuel interacted with each other and a fire began
 - Physical remains of ignition source may be present or in close proximity
 - Validate with fire pattern indicators. **No matter how obvious.**

02-74-FI210-EP

Determining Origin and Cause

- **Point of origin:** The exact physical location within the ignition area where a heat source and the fuel interact, resulting in a fire.
- Rarely located on a wildland fire.
- Not necessary to identify the “exact point” in order to determine a cause.

02-75-FI210-EP

Determining Origin and Cause

Determining the General Origin Area

- Examine burned area.
 - Recommend working from the advancing area.
 - » Exceptions
- Establish fire behavior context.
- Macroscale patterns
- Witness Statements
- Examine unburned area.
 - Reconstruction of probable fuel conditions in burn
 - Other evidence.
- Photograph as needed and consider aerial photography.

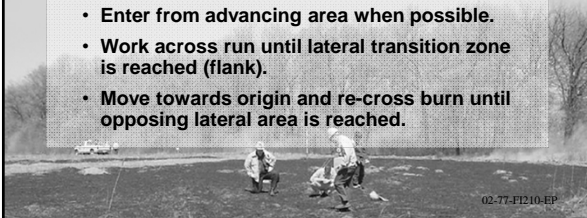


02-76-FI210-EP

Determining Origin and Cause

Examining the General Origin Area

- When transition zones, control lines, or other information indicates that it is safe to do so, walk the perimeter twice, once in each direction.
- Mark general origin area.
- Enter from advancing area when possible.
- Work across run until lateral transition zone is reached (flank).
- Move towards origin and re-cross burn until opposing lateral area is reached.



02-77-FI210-EP

Determining Origin and Cause

Examining the General Origin Area

- Identify fire pattern indicators with visible markers.

Recommended method:

Red: Advancing

Yellow: Lateral

Blue: Backing

White: Evidence (only)

Lime Green : areas, items, or points of interest



02-78-FI210-EP

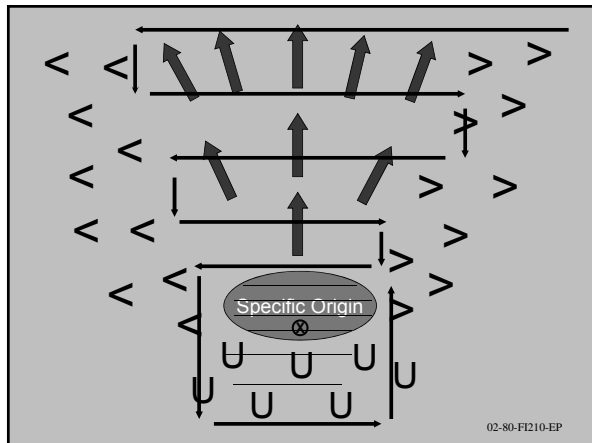
Determining Origin and Cause

Examine the General Origin Area

- Macroscale/microscale fire pattern indicators.
- Continue until specific origin area is reached.
- Marking evidence as you go.



02-79-FI210-EP



02-80-FI210-EP

Determining Origin and Cause

Identify the Specific Origin Area

- Mark specific origin area.
- Walk perimeter at least twice.
- Examine/photograph area prior to entering.
 - Indicators
 - Visible potential ignition sources.
 - Other evidence.



02-81-FI210-EP

Determining Origin and Cause

Specific Origin Area

- The manner in which you conduct the search of your specific origin area will be dependent upon the conditions that exist on scene.
- There are a number of suitable techniques available to conduct a search of a specific origin area.
- Whatever method is chosen, should reflect a systematic approach that protects scene integrity as much as practical.
- We will discuss tools that may or may not be applicable to your specific scene.

02-82-FI210-EP

Specific Origin Search Techniques

Perpendicular Lanes

- Lanes perpendicular to run.
- Work from advancing end of SOA.
- Stakes and strings
 - Suggest using bright color.
- Lanes 12"-18" width.
- Search each lane and then move closest string forward.



02-83-FI210-EP

Specific Origin Search Techniques

Parallel Lane

- Lanes are laid out parallel to advancing fire progression, towards suspected ignition area.
- Work lanes towards suspected ignition area.
- Ensure that far lane ends are established in the green or well into the backing area.
 - Do not disturb the specific origin area when laying out lanes.
- Works well with multiple investigators or narrow SOA.



02-84-FI210-EP

Specific Origin Search Techniques

Grid

- Squares/rectangles
 - Size is dependent upon scene circumstances.
- Useful when the locations of multiple pieces of evidence need to be documented or when you plan on collecting the debris for sifting/examination.
- Grids should be numbered/lettered for documentation.



02-85-FI210-EP

Determining Origin and Cause

Examine the Specific Origin Area

- Search lane visually.
 - Consider using magnification and/or straight edge to focus vision.



02-86-FI210-EP

Determining Origin and Cause



Magnet: to search for ferrous metal

- Pull-release best
- Sweep surface
- Check often



Metal detector: to search for non-ferrous metal

02-87-FI210-EP

Determining Origin and Cause

Continue to read and mark indicators and evidence in each lane or grid.

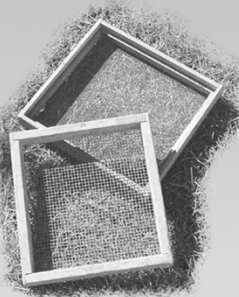
Remove top debris layers to expose indicators and/or ignition source.

- Brushing
- Blowing



02-88-FI210-EP

Determining Origin and Cause



- Sift debris with nested screens if necessary
 - 1/4 and 1/8 inch screen
- Move to next lane and repeat
- Bag debris for future analysis when appropriate

02-89-FI210-EP

Determining Origin and Cause

- Continue until ignition area is reached and/or evidence of ignition source is located.



Note backing indicators

- Secure and document evidence.
- Continue past evidence or ignition area until clear backing indicators are noted.
- Document/ photograph.

02-90-FI210-EP

Ignition Area

- Continue to work search pattern up to and through the ignition area.
- Identify and document the boundaries of the ignition area.
 - Reference points
 - Measurements
 - Photos



02-91-FI210-EP

Determining Origin and Cause

- Secondary Origin and Cause Determination
- Second opinion
 - Major case
 - No physical evidence of cause
- Origin should be kept secured and as undisturbed as possible.
 - Scene integrity
 - Contamination issues
 - May be several hours/days



02-92-FI210-EP

Determining Origin and Cause

Addressing potential ignition sources found in specific origin area.

- Data indicating ignition sources
 - Physical evidence
 - Witness statements
 - Personal observations
 - Fire history
 - Other data specific to the incident

02-93-FI210-EP

Summary

- Collect and analyze data.
- Base all hypotheses on empirical data. (Facts)
- Test all hypotheses against the empirical data.
- Reject those hypotheses which are falsified by the empirical data.
- Select a final hypothesis if it alone fits all the empirical data. (Probable v. Possible)
- Base your opinions on the empirical data.

02-94-FI210-EP

Summary

- The “Scientific Method” (framework) plus the specific methods used equals “methodology.”
- A systematic method of fire investigation assists the investigators in doing a thorough and complete job.
- Avoid bias, back opinions with data, and apply representative tests to the hypothesis.
- Apply accepted methods to the specific scene.

02-95-FI210-EP

Review Unit 2 Objectives

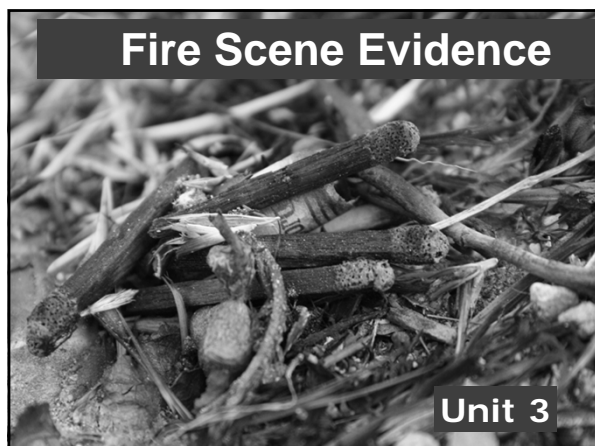
1. Describe Methodology.
2. Define terms used in origin and cause determination.
3. Identify the processes in origin and cause methodology.
4. Describe methods used to identify and process an “Ignition Area.”

02-96-FI210-EP

FI-210, Wildland Fire Origin and Cause Determination

Unit 3 – Fire Scene Evidence

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Unit 3 Objectives

1. Describe the types of physical evidence associated with a fire investigation.
2. Describe the legal requirements to maintain evidence admissibility.
3. Recognize how a variety of photographic techniques can be used in the collection and documentation of evidence.
4. Recognize the methods for documentation, collection, storage, and maintaining chain of custody.
5. Describe the various techniques of and differences between sketching and diagramming fire scenes.

03-2-FI210-EP

Types of Evidence

- Evidence is classified into two broad categories:
 - Direct
 - Circumstantial
- Evidence is further categorized by type:
 - Testimonial
 - Real: physical or documentary
 - Demonstrative and Judicial Notice

03-3-FI210-EP

Types of Evidence

Direct Evidence

- Testimony of witness who sees the criminal act.
 - A witness observes the defendant at the scene, setting the fire.
 - Other senses also apply.



03-4-FI210-EP

Types of Evidence

Circumstantial Evidence

- Tends to prove a fact in dispute indirectly.
 - Tire prints that match the defendant's vehicle are recovered at the scene.
 - DNA is recovered from an arson device.
- Eyewitnesses to wildland fires are an infrequent occurrence.
- Most cases will rest on circumstantial evidence.



03-5-FI210-EP

Types of Evidence

Testimonial Evidence

- Evidence which is testified to by a witness.
 - Firsthand knowledge
 - Observed or experienced
 - Witness observed defendant light burn barrel.
 - Witness smelled smoke.
 - Witness heard fireworks.
 - Witness saw tire tracks.
 - Direct or Circumstantial



03-6-FI210-EP

Types of Evidence

Real or Physical Evidence



- A tangible item or object
- Used to establish a fact
 - Footwear impression, ignition source, etc.

03-7-FI210-EP

Types of Evidence

Demonstrative Evidence

- Documentary
 - Burning permits, ownership maps, etc.
 - Models, charts, and graphic aids
 - Judicial Notice
 - Evidence substitute
 - Facts that are common knowledge
 - Independence Day always occurs on July 4th; a match applied to dry grass will likely ignite it.
- Most fire cases will rely primarily on physical and testimonial evidence.*

03-8-FI210-EP

Admissibility of Evidence

- Relevance
 - Evidence must have some connection to the facts of the case.
 - Must be pertinent to the issues of trial.
 - Must assist the trier of fact in proving facts in dispute.
- Authentication and Identification
 - Competent
 - Same item
 - Not tampered with, altered or contaminated

03-9-FI210-EP

Admissibility of Evidence

Methods to Ensure Competence

- Exclusive custody and control in a secured area.
- Maintain a complete written record of chain of custody.
 - Evidence tag
- Marked in a distinctive manner.



03-10-FI210-EP

Admissibility of Evidence

Evidence may be admissible provided it was obtained legally under one or more of the following circumstances:

- Non-private area
 - Evidence in open fields or public lands.
- Plain view
 - Immediately recognized as incriminating.
 - Observed by an official who was legally present.

03-11-FI210-EP

Admissibility of Evidence

- Exigent Circumstances
 - Emergency circumstances exist that could cause destruction or loss of evidence.
- Consent
 - Where there is an expectation of privacy, a person who has a controlling interest in the area to be searched may give their consent to authorities.

03-12-FI210-EP

Admissibility of Evidence

- Abandonment
 - Abandoned by owner
 - Not recommended, difficult to establish proof
 - Consult with prosecutors

03-13-FI210-EP

Admissibility of Evidence

- Warrant (Criminal or Administrative)
 - A court order directing the investigator to search for and seize specific items.
 - Preferred method
 - Some jurisdictions allow for an administrative warrant.
 - Legal justification needed is substantially less than a criminal warrant.

In most wildland fire investigations, the investigator can expect to recover the majority of evidence from private areas under the Plain View Doctrine and/or exigent circumstances.

03-14-FI210-EP

Admissibility of Evidence

Michigan V. Tyler (1978)

Supreme Court established legal authority for fire investigators to conduct a warrantless search for evidence of the cause and origin of a fire.

- Public safety concerns
- Exigent circumstances

03-15-FI210-EP

Admissibility of Evidence

Michigan v. Tyler (1978)

- Court held that while a fire is still burning and under control of fire department a warrantless entry to determine the cause of the fire is reasonable.
- Evidence in plain view may be seized.
- Temporary interruptions due to hazards, poor visibility, etc., allow for subsequent warrantless re-entry within "a reasonable time period" (no bright-line rule).
- Absent "exigency of sufficient proportion," re-entry must be by consent or warrant.

03-16-FI210-EP

Admissibility of Evidence

Michigan V. Taylor (1978)

How might Michigan v. Tyler affect wildland fire investigations?

- On public lands
- On private lands
- Curtilage

03-17-FI210-EP

Admissibility of Evidence

Michigan v. Clifford (1984)

The court further defined legal parameters regarding the legality of an origin and cause investigation conducted after an emergency or exigent circumstances cease.

03-18-FI210-EP

Admissibility of Evidence

Michigan v. Clifford (1984)

- Search was ruled unconstitutional and motion to suppress granted
- How might Michigan v. Clifford affect wildland fire investigations?
 - Public lands
 - Private lands
 - Curtilage

03-19-FI210-EP

Admissibility of Evidence

United States v. Jones (2013)

The court found for some of the evidence to be suppressed due to the GPS tracking device being considered a “search” and proper avenues were not obtained.

03-20-FI210-EP

Admissibility of Evidence

United States v. Jones (2013)

- Evidence garnered was ruled unconstitutional and motion to suppress granted.
- How might U.S. v. Jones affect wildland fire investigations?
 - Public lands or properties
 - Private lands or properties
 - Curtilage

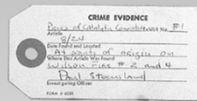
03-21-FI210-EP

Evidence Collection and Preservation Procedures

Non-Fragile Fire Cause Objects:

Items that are less subject to damage from heat, flame, or damage when collected:

- Metal fragments
- Catalytic converter matrices
- Welding slag
- Power line hardware



03-22-FI210-EP

Evidence Collection and Preservation Procedures

Non-Fragile Fire Cause Collection Procedures

- Carefully pick up and place in folded paper bindle or other suitable packaging.
- Place into hard sided container.
- Pack in cotton to keep fragile edges from breaking off.
- Seal and tag.



03-23-FI210-EP

Evidence Collection and Preservation Procedures

Fragile Fire Cause Objects:

Objects that can be easily damaged or destroyed during the collection process:

- Cigarette remains
- Matches
- Fusee slag
- Fireworks remains
- Arson devices
- Exhaust carbon



03-24-FI210-EP

Evidence Collection and Preservation Procedures

Basal Area Lift Technique

Prevents damage to fragile items.

- Shovel or trowel (clean)
- Thin piece of flexible sheet metal
- Score line through ash and duff, down to soil around the object
- Leave border of several inches surrounding the object



03-25-FI210-EP

Evidence Collection and Preservation Procedures

Liquid Accelerant Residue

- Obvious signs of trailers and pour patterns: puddles, deep seated burning, scorching or soot.
- Gasoline and diesel have strong odor.
- Deodorized kerosene, lighter fluid, alcohol and others may not be detectable by smell.
- Search perimeter areas.



03-26-FI210-EP

Evidence Collection and Preservation Procedures

Liquid Accelerant Residue Detection:

- Hydrocarbon detectors
- K-9 units



03-27-FI210-EP

Evidence Collection and Preservation Procedures

Sampling Locations for Liquid Accelerants:

- Focus on areas that had a lower intensity fire.
- Porous items such as deep compacted duff, punky logs, and stumps.
- Soil samples are also good.
- Tests determined detectable residues in soil could remain up to 162 hours after the fire.
- Microbial action may degrade sample quickly.

03-28-FI210-EP

Evidence Collection and Preservation Procedures

Liquid Accelerant Collection Procedures:

- Secure suspected charred wood or vegetation.
- Fill can approximately 2/3 full.
- Avoid cross-contamination.
- Clean tools.
- Try to use unlined cans if processed quickly.
- Have unused can available for control sample at lab.

03-29-FI210-EP

Evidence Collection and Preservation Procedures

Liquid Accelerant Collection Procedures:

- If delay of more than several hours in getting sample to lab, samples should be frozen.
 - Metal evidence containers or glass
- Familiarize yourself with servicing lab procedures.
- Containers found near, or at fire scene, should be collected.
- If liquid is still present, pour a small sample into a clean container with an airtight seal.

03-30-FI210-EP

Evidence Collection and Preservation Procedures

Liquid Accelerant Collection Procedures:

- Seal and mark the container, hand carry to lab.
- If it will be several hours, store in a cool place.
- Most crime labs will be able to isolate ignitable liquids by means of GC/MS analysis and other tests.

03-31-FI210-EP

Firearms



Evidence Collection and Preservation Procedures

Projectile Evidence

- If lodged in wood or other material, leave in material and take whole portion to lab.
- If bullet is recoverable, do not attempt to clean it.
- Wrap it separately in a paper bindle.
 - Place on cotton padding in a hard sided container
 - Seal and mark

03-33-FI210-EP

Evidence Collection and Preservation Procedures

Cartridge Cases

- Wrap each case in a separate paper bundle.
 - Seal in separate hard sided container
 - Mark accordingly
- If comparison to a firearm is necessary, submit both to lab.
- Never submit a loaded firearm to a lab unless it is delivered in person with advance approval of the lab.

03-34-FI210-EP

Shoe and Tire Impression Collection Procedures



03-35-FI210-EP

Evidence Collection and Preservation Procedures

Shoe and Tire Impression Collection Procedures

If possible, photograph with:

- Tripod to position the camera directly over the impression. Use a normal lens (50 mm).
- Linear scale next to and on the same plane as the impression.
- Set the f-stop on f/16 or f/22 for a greater depth of field.
- Flash at a very low angle (10-15 degrees) to the impression. This will enhance the detail of the impression.

03-36-FI210-EP

Evidence Collection and Preservation Procedures

Shoe and Tire Impression Collection Procedures

- Shoot several photos, move the flash two or more angles to the impression
- Cast with dental stone
- Shoe impressions should usually be cast
- Casting of a tire impression is problematic
 - Difficult to match impressions to an individual tire
 - Effort involved is significant

03-37-FI210-EP

Evidence Collection and Preservation Procedures

Shoe and Tire Impression Collection Procedures

- Most crime labs prefer photographic documentation of tire impressions.
- Once cast is made, do not clean it off. Wrap the cast in tissue, dirt and all. Place in a cotton padded box, pack securely, seal and mark accordingly.

03-38-FI210-EP

Evidence Collection and Preservation Procedures

Fingerprint Collection Procedures

- Fingerprint evidence may remain after fire.
- Prints have been recovered from beverage containers, food wrappers, cigarette packs, and arson devices.
- Handle object so as not to add extra prints to it.
- Package objects in a box so that they will not break or roll around.
- Do not package in plastic.

03-39-FI210-EP



Evidence Collection and Preservation Procedures

DNA Evidence Collection Procedures

- Polymerase Chain Reaction (PCR) test and mitochondrial DNA test have increased the likelihood of recovering usable DNA, even on heat-damaged items.
- Potential sources of DNA evidence:
 - Hair** → Denature DNA, and use to amplify nucleotides.
 - Semen** → Incubate with probe, then wash.
 - Blood** → Incubate with probe, then wash.
 - Saliva** → Expose x-ray film to membrane.

03-40-FI210-EP

Evidence Collection and Preservation Procedures

DNA Evidence Collection Procedures

- Consider anything that may have been contacted:
 - Beverage containers
 - Clothing
 - Cigarette/match devices
 - Food
- Collect in clean paper or envelope with sealed corners.

03-41-FI210-EP

Evidence Collection and Preservation Procedures

DNA Evidence Collection Procedures

- Do not use plastic containers.
- Avoid cross contamination.
- Collect each item with new gloves.
- Use sterile forceps/tweezers.
- Submit DNA evidence to the lab as soon as possible.

03-42-FI210-EP

Evidence Collection and Preservation Procedures

Miscellaneous Evidence

- Paint Transfers
- Blood stains
- Hair and fibers
- Glass fragments
- Soil
- Tool marks



03-43-FI210-EP

Photography

Provides:

- Facts and physical circumstances of evidence visually
- Preservation of perishable evidence
- Consideration of evidence which cannot be transported into a courtroom, because of immobility, size, weight, etc.
- Verification for your testimony
- Facts or evidence that you may have overlooked

03-44-FI210-EP

Evidence Collection and Preservation Procedures

Videography

Provides:

- Overall crime scene footage
- Surveillance
- Supplemental photographs
- Documentation of interviews and interrogations
- Exclusive use not recommended



03-45-FI210-EP

Review Unit 3 Objectives

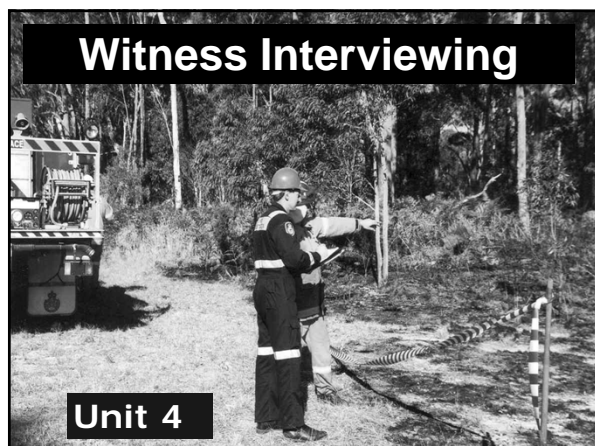
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5. Describe the various techniques of and differences between sketching and diagramming fire scenes.

03-46-FI210-EP

FI-210, Wildland Fire Origin and Cause Determination

Unit 4 – Witness Interviewing

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Unit 4 Objectives

1. Know the difference between an interview and an interrogation.
2. Understand when and where to conduct witness interviews.
3. List the various methods of obtaining witness information and statements.
4. Describe the witness interview process.
5. Know the guidelines for conducting witness interviews.

04-2-FI210-EP

Overview

- Physical evidence can only provide part of the overall investigation.
- At some point, it may be necessary to interview witnesses, victims, or suspects.
- Interviews add weight and meaning to evidence.
- Witnesses provide basis for further investigation.
- Conduct interviews in a professional manner.

04-03-FI210-EP

Overview

- As an origin and cause investigator, you may interview witnesses.
- Know your agency policy re: conducting witness interviews.
- The quality of interview technique governs quality of information obtained.



04-04-FI210-EP

Overview

- The interview can be an important tool in conducting the overall investigation.
- You may only get one chance to do it right, so do it right the first time!
- Take additional training courses on interviewing.
- **PLAN AND PREPARE FOR THE INTERVIEW.**



04-5-FI210-EP

Interview vs. Interrogation

- The main responsibility of an INVF is to establish origin and cause.
- Need for interrogation may arise during this process.
 - Consider requesting a qualified law enforcement investigator.
 - Legal and strategic complexities involved that are likely to fall beyond the scope of your training and experience.

04-6-FI210-EP

Interview vs. Interrogation

- **Interview**
 - Detailed questioning of a subject, most often a witness.
 - No Miranda warnings required.
- **Interrogation (also called 'Forensic Interview')**
 - Process of inquiry that seeks admissions or confessions to establish guilt.
 - Miranda warning may need to be addressed.
 - Obtain qualified help to conduct an interrogation.

04-7-FI210-EP

Interview vs. Interrogation

Legal Miranda Requirements

A suspect being questioned by law enforcement regarding a crime they may have committed, AND the subject is or perceives they are in custody and/or being detained.



Investigators should follow their agency guidelines regarding the questioning and interrogation of subjects!

04-8-FI210-EP

Witnesses

Who Can Be a Witness?

In most cases witnesses can take the form of:

- Voluntary witness (reports the incident)
- Unknowing and voluntary witness (saw/heard something but did not realize there was any offense)
- Reluctant witness (doesn't really want to be involved for variety of reasons)
- Hostile witness (won't speak to you)

04-9-FI210-EP

Witnesses

Possible Witnesses:

- First responders (fire, medical, LE)
 - By-standers
 - Reporting party
 - Local residents
 - Property owners
 - Recreationists
 - Local resource users
 - Dispatchers
 - Workers in area (Postal employees)
 - Airborne personnel, lookouts
- 



04-10-FI210-FP

Witnesses

Format to Record Witness Information

- **Written**
 - Pure version then follow up with Q & A's for clarification.
 - Agency witness statement form.
- **Digital Recorder**
- **Videotaped**
- **Investigator's field notes of conversation with witness.**
 - Least preferred if that's the only record of the interview.

[illegible]

04-11-FI210-EP

Interviews

What is a Witness Interview?

- Information gathering
- Permanent record of witness' recollection—less likely to alter/recant.
- Non-accusatory
- From witnesses, victims (and sometimes suspects)
- Any person who may have evidence surrounding circumstances of the fire.



04-12-FI210-EP

Interviews

What is a Witness Interview?

- Finding out the 5W's and How.
- Low time factor, usually 20-40 minutes.
- Can be used by witness later to refresh memory.
- Purpose is to elicit usable information to assist in the investigation.



04-13-FI210-EP

Interviews

When to conduct a witness interview:

Witness statements should normally be taken as soon as possible to ensure that:

- Events are still fresh in the mind of the witness.
- Evidence is recorded before the witness' version of events is "tainted" by discussing their evidence with others.

04-14-FI210-EP

Interviews

Location of Interview

- Variable environments, e.g., in the field, vehicle, office, subject's house.
- Interview privately and separately (no "group interviews").
- Reduce distractions (choose appropriate location).
- Not in presence of co-workers or friends.
- Make it as easy for the witness as possible—his/her schedule not yours.

04-15-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews

Interviewer:

"The purpose of this interview is to see what you have to contribute to this investigation. I wasn't there. You were. I need you to tell me exactly what happened."



04-16-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews

- Identify yourself.
- Explain purpose of interview.
- Know your agency protocol for interviewing persons of the opposite gender.
- Record identification and contact information before beginning the interview.

04-17-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews

- Ask witness not to guess—personal observation only.
- Investigator should control the interview.



04-18-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews



- Establish rapport/trust.
- Allow subject to talk (80/20 principle).
- “Art of active listening.”
- Let them tell their story, without influence from the investigator.

04-19-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews



- Ask witness to mentally recreate circumstances, chronological timeline is best.
- Questions may be interjected to get them back on track.
- Ask if witness has photos or video of the incident.

04-20-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews

If witness saw wildfire, ask specific details re: fire behavior upon arrival:

- Fire perimeter size
- Exact location
- Wind direction
- Color of smoke
- Material fire was burning in (i.e., grass, brush, timber)



04-21-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews

Obtain pure version, then Q + A's for clarification.

Use open-ended questions.

Have witness draw out sketch or map.

Consider taking witness back to event scene.



04-22-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews

Avoid:

- Being in a rush.
- Being authoritative or overbearing.
- Using leading questions.
- Asking compound questions.
- Using questions that elicit short answers.
- Interrupting the subject.
- Negative questioning.
- Leading the witness in any direction or force them to stay on one subject.

04-23-FI210-EP

Interviews

Guidelines for Conducting Witness Interviews

- The investigator may assist the subject in drafting the written statement .
- Have the witness review and acknowledge corrections.
- Start and end times.



04-24-FI210-EP

Interviews

Interview Summary and Closure:

- Summarize, review, and re-affirm key responses.
- Ask specific questions on key points witness did not voluntarily provide.



04-25-FI210-EP

Interviews

Interview Summary and Closure:

- At end of interview ask “Is there anything else important that we’ve missed or that you haven’t told me about?” or “What else should I have asked you about that I haven’t asked?”
- At end of interview ask “Who else may have additional knowledge?”
- Leave contact information in case they recall something important.

04-26-FI210-EP

Interviews

Impaired or Hostile Witness:

- Witness impaired by alcohol or drugs should be interviewed later.
- Angry or hostile subjects may escalate the interview into a more aggressive encounter .
 - Have an additional investigator or law enforcement officer accompany you during such contacts.

04-27-FI210-EP

Interviews

Non-English or Mentally Challenged:

- Non-English speaking subjects will require a translator.
- Mentally challenged individuals may require special interview techniques and assistance.

04-28-FI210-EP

Interviews

Field Notes:

Investigator should summarize key points of each witness interview in field notebook.



04-29-FI210-EP

Interviews

Juveniles as Witnesses:

- You may have contact with juveniles on wildfire investigations.
- Knowledge and consent of the parent or legal guardian may be required.
- Follow agency policy in handling juveniles as witnesses or suspects.

04-30-FI210-EP

Interviews

Witness List:

- Investigator should develop and maintain witness list.
- Follow agency guidelines and format.



04-31-FI210-EP

Interviews

Witness Now a Suspect?

If for various reasons you believe your witness is now a suspect, follow agency policy on referring this information to LE for follow-up.



04-32-FI210-EP

Unit 4 Objectives

1. Know the difference between an interview and an interrogation.
2. Understand when and where to conduct witness interviews.
3. List the various methods of obtaining witness information and statements.
4. Describe the witness interview process.
5. Know the guidelines for conducting witness interviews.

04-33-FI210-EP

Notes:

FI-210, Wildland Fire Origin and Cause Determination

Unit 5 – Documentation

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Objectives

1. Recognize what needs to be documented in a wildland fire investigation and when to document it.
2. Determine appropriate methods to document.
3. Determine the items that may be included in an investigative/case file.
4. Understand how to fully complete an origin and cause report.
5. Understand the roles of an INVF and/or case agent/case manager and how they interact.

05-2-FI210-EP

Purpose

- True and accurate representation of the investigation.
 - Sufficient detail
 - Describes findings and explains conclusions.
- Memorializing the facts.
- Allows the investigator to recall and communicate their observations at a later date.

05-3-FI210-EP

Possible Outcomes:

- Administrative
- Civil
- Criminal
- Continuing investigation

Approach the documentation so that it is sufficient for all possible outcomes or applications.

05-4-FI210-EP

Documentation

Could be used in the future by:

- The investigator
- Other investigators
 - Participating and/or follow-up investigators
 - Expert/Peer Reviews
- Prosecutors and Defense
- Third party interests
- Agency administrators

05-5-FI210-EP

Documentation - Terminology

- Recommended use of terminology, such as “General Origin Area,” “Specific Origin Area,” and “Ignition Area.”
- If a term is not being used in the recommended context, or if another term is being used, define it in your report.
- Be consistent in how you use terms in your notes, sketches, diagrams, and reports.

05-6-FI210-EP

Documentation

Categories:

Field Notes

Interviews/Statements

Sketches/Diagrams

- Photo points and direction
- Fire patterns
- Fire progression vectors
- Measurements

Photography

- Photos, video and photo log
- Metadata

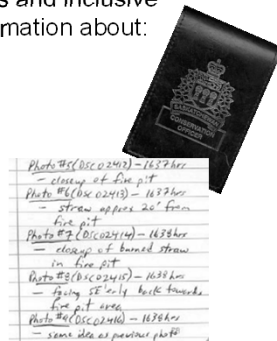
Report

05-7-FI210-EP

Documentation - Field Notes

Field Notes is a continuous and inclusive process that includes information about:

- Photographs
- Sketches
- Measurements
- Evidence Log
- Witness Statements
- Other data



05-8-FI210-EP

Documentation - Field Notes

Receive the Assignment

- Timeline (chronology)
- When you got the call/responded.
- What is your assignment and responsibility?
 - Reports you are expected to produce.
- Who notified you?
- What is reported to you/dispatch/suppression information?
 - Time fire first reported.
 - Reporting party(s) (Witness/Responsible)

05-9-FI210-EP

Documentation - Field Notes

As practical, document the following while enroute to scene (chronology).

- Reports on fire condition/initial attack report.
- Observations
 - Suppression activity
 - Ingress/egress routes (e.g. ,gates, tire tracks)



Notes = basis for report

05-10-FI210-EP

Documentation - Field Notes

Observations (cont.)

- Vehicles/Witnesses
- Activities in area
- Smoke column, size, color, direction of drift, changes (photograph)
- Wind conditions
Changes in weather
- Evidence: gates, tire tracks, foot impressions



05-11-FI210-EP

Documentation - Field Notes

Arrival at Scene

As practical document the following:

- Fire perimeter
- Location
- Suppression activities/
Land use activities
- Direction of spread
- Fire intensity



05-12-FI210-EP

Documentation - Field Notes

Arrival at Scene (cont.)

- Fuels
- Topography
- Witness information
- Weather:
 - Most valuable when taken soon after ignition and near the origin
 - Obtain weather data from IA personnel



05-13-FI210-EP

Documentation - Field Notes

Scene Security

Once the investigator has defined the area to be protected:

- Various methods and levels of securing the area may apply.
- Document what type of activities have occurred in that area prior to securing it.
- Document the time the area was secured, how, and by whom.



05-14-FI210-EP

Documentation - Field Notes

General Origin Area documentation:

- Fire behavior
- Activities that have affected the area
- The fire indicators
- The witness statements
- Methodology utilized to work the general origin area (e.g., entering from the advancing area, working between the lateral spread indicators...)

05-15-FI210-EP

Documentation - Field Notes

Specific Origin Area documentation:

- Indicator categories identified
- Representative fire pattern indicators
- Any evidence located
- Fire behavior
- Fuel components, depth, and compactness
- Barriers to fire spread

05-16-FI210-EP

Documentation - Field Notes

- Be able to articulate what you did, how you did it, and why you did it a particular way.
- Field documentation is generally scene specific, depending on the circumstances.
- There is no standard sequence for scene documentation.

For example: work the general origin area and document it before moving on to the specific origin area vs. work the general origin area and the specific origin and then document both.

05-17-FI210-EP

Field Notes

- Maintenance of field notes is an agency specific procedure.
- Retention of notes may differ depending on the type of action being taken.
- Check with and follow your agency protocols for retention of notes.

05-18-FI210-EP

- **Notes**
- **Written Statement (signed)**
- **Recorded interviews**
- **Memorandum of Interview**
- **Supporting documents**

[illegible]

- **Sketches are created in the field as part of scene documentation.**
- **Diagrams (when needed) are created from the field sketches and other data.**
- **May be appropriate to create multiple sketches:**
 - **Photographs**
 - **Evidence**
 - **General origin area**
 - **Specific origin area**
 - **Fire progression**

[illegible]

- Final narrative report
- Field notes
- Photos
- Witness statements
- Diagrams
- Lab results

Documentation - Sketches

Sketching fire progression

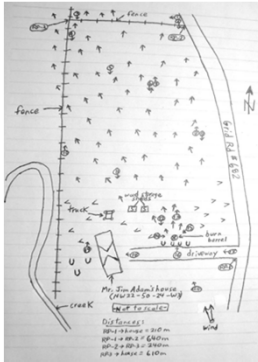
- Outline general origin area
- Landmarks for orientation and to refresh memory
- Map general fire progression using:

Backing **U** Advancing **↑**

Lateral **>** or **▶**

05-22-FI210-EP

Documentation - Sketches



05-23-FI210-EP

Documentation - Sketches

Sketching fire progression

Specific origin area

- Indicate its location within the general origin area.
- Recommend including boundary measurements of specific origin area.
- Continue to show fire progression based on indicators (e.g., micro indicators).
- Indicate the boundaries of the ignition area.



Symbol for Ignition Area = **⊗**

05-24-FI210-EP

Documentation - Sketches

Sketching fire progression

- Photo points
- Evidence locations
- Reference points



Photo



Evidence



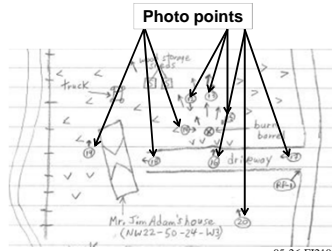
Reference Point

05-25-FI210-EP

Documentation - Sketches

Photo points

- No standard addressing how many photos should be taken to document a scene.
- Consider how photos are intended to be used.



05-26-FI210-EP

Documentation - Sketches

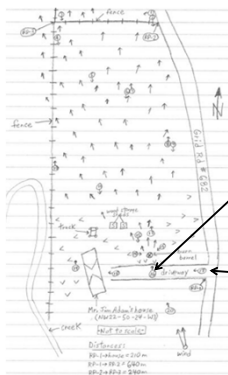


Photo #16 (DSC_0878), of burn barrel, facing North

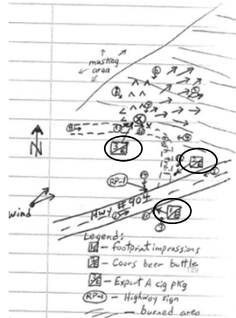


Photo #17 (DSC_0879), of driveway, facing West

Documentation - Sketches

Evidence

- Both inside and outside general origin area.
- Document relevant items, not just what you think started the fire.
- Ensure proper evidence handling.



05-28-FI210-EP

Documentation - Sketches

Field Measurements

- Reference points
 - Likely included on previous sketches, not a stand alone sketch.
 - Consider indicating on the sketch which measurement method utilized.



05-29-FI210-EP

Documentation - Sketches

Measurement Techniques

- Right angle transect
- Azimuth
- Intersecting arcs (Triangulation)



05-30-FI210-EP

Documentation - Sketches

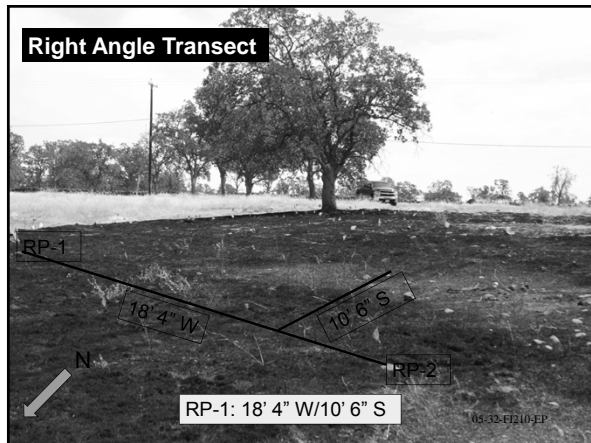
Right Angle Transect

- Mark reference points on ground with locatable marker (e.g., nail, rebar, paint-mark).
- Recommend use of N/S and E/W bearings.
- Utilize the units shown on your measuring tape (e.g., feet/inches, meters/centimeters). Do not estimate smaller dimensions.
- Use a steel tape.
- Can use multiple reference points.



05-31-FI210-EP

Right Angle Transect



05-32-FI210-EP

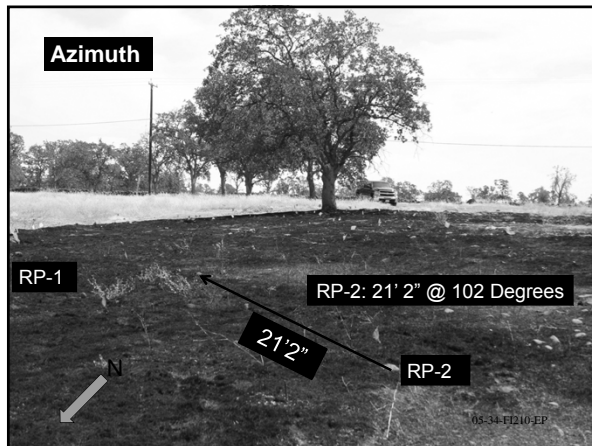
Documentation - Sketches

Azimuth

Useful for short distance measurements at a scene that does not have many obstacles.

- Mark reference points on ground with locatable marker (e.g. nail, rebar, paint).
- Record compass declination used.
- Utilize the units shown on your measuring tape (e.g. feet/inches, meters/centimeters).
- May be difficult on steep ground and in heavy brush or timber.

05-33-FI210-EP

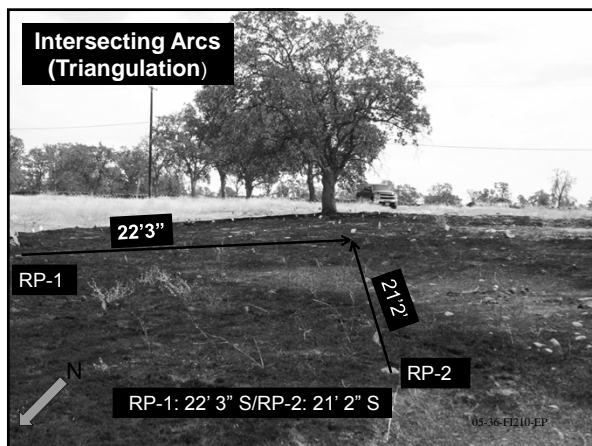


Documentation - Sketches

Intersecting Arcs (Triangulation)

- Mark reference points on ground with locatable marker (e.g., nail, rebar, paint-mark).
- Utilize the units shown on your measuring tape (e.g., feet/inches, meters/centimeters) and reference to a general compass bearing.
- May be difficult on steep ground and in heavy brush or timber.
- Recommend use of N/S and E/W bearings.

05-35-FI210-EP



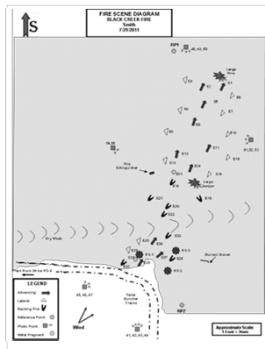
Documentation - Diagrams

May contain some or all components of the sketch:

- Final diagram is to “near” scale.
- Contains a legend.
- Can be hand drafted or computer generated.
- Guidance and examples are in the student handouts.
- Agency/Investigator decision to create one .

05-37-FI210-EP

Documentation - Diagrams



05-38-FI210-EP

Documentation

GPS

- Consider using GPS to record key data points.
- Be sure to note datum setting and rate of error in your notes and reports.
- Some GPS units will take geo-tagged photos.
- Consider contacting your agency GIS staff to generate map products for your reports.



05-39-FI210-EP

Documentation

GPS

- **Specific Origin Area:** Hand held GPS units with error rate of more than + or - 1' are generally not recommended.
- **General Origin Area:** Hand held GPS units with error rate of more than + or - 5' are generally not recommended.
- **General Fire Area:** The use of hand held GPS units in the area outside the general origin area, to position macroscale indicators etc. may be an effective tool for plotting those features.

05-40-FI210-EP

Documentation - Photography

Recommendations:

- Consider formatting the SD card before beginning investigation photos.
- Confirm the correct date and time on the camera(s) used.
- Check the picture format (jpeg, RAW, etc.)
- Downloading the photos is discussed later in the evidence handling section.
- This is not meant to be a photography class, you will need to understand the limitations of your photography equipment.

05-41-FI210-EP

Documentation - Photography

Start a photo log

- Examples of photo logs are in the student handout
- Use an image (photo) numbering system you can understand when you download the images later
 - May use image number
- Include a description of each photo in your log
 - Can be brief in your notes, more detailed on final log
- Photo number is documented on sketch with photo points

05-42-FI210-EP

Documentation - Photography

Storing Digital Photos to CD/DVD

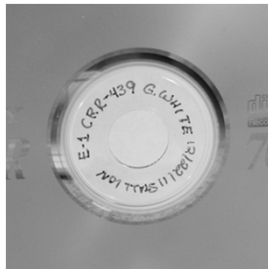
- Be aware of “Auto-load” software effects on the image files.
- Do not open or delete original photo files.
- If possible, copy files directly from camera card to CD/DVD.
 - Mark and secure 1st downloaded copy .
 - When appropriate, store a 2nd copy as your backup.
 - Copy a set of working files to PC hard drive.

05-43-FI210-EP

Documentation - Photography

Marking Photo CD/DVDs

- Permanent marker
- Write in spindle area
- Labeling
 - Case /incident number
 - Date photos taken
 - Brief identifier or fire name
 - Name of photographer



05-44-FI210-EP

Documentation - Photography

Fire Direction - Photo log components

- Incident identifying information
- Camera used and time stamp corrections
- Photo identification number
- Date photo taken
- View direction (N, NW, ENE, etc.)
- Person taking the photo

05-45-FI210-EP

Documentation - Photography

Fire Direction – Photo log (cont.)

- Vector (advancing, lateral, backing)
- Category of Indicator (Staining, angle of char, protection, etc.)
- Direction of fire travel in the photograph
- Photo point coordinates
- General description

05-46-FI210-EP

Field Notebook Photo Log

WILDFIRE PHOTO, INDICATOR, & EVIDENCE FIELD RECORD									
Continued From South Park & Denali									
PROJECT NAME		PROJECT #		DATE		LOCATION		PHOTOGRAPHER	
S. 23, 13-12-03		3013-C-73		9/11/03		DUNGEON LAKE, SUTTER COUNTY, CA		S. 23, 13-12-03	
PHOTO #	FLAME VECTOR	NUMBER	POSITION	INDICATOR CATEGORY	LOCATION	REMARKS			
1						FD Camp			
2						Fireline G.C.A.			
3									
4									
5									
6									
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Documentation - Photography

Investigative Photographic Documentation:

- Enroute
- Arrival
- Scene Orientation/Overview
- Relationship
- Identification
- Examination
- Other Considerations, (e.g., witness perspective)

We will now discuss in detail each of these categories.

05-48-FI210-EP

Documentation - Photography

Enroute photos

- Smoke column
- Fire progression
- Condition of access



05-49-FI210-EP

Documentation - Photography

Arrival photos

Documents scene before it changes.

- Persons present
- Condition of evidence (e.g., power line)
- Macro Indicators
- Landmarks



05-50-FI210-EP

Documentation - Photography

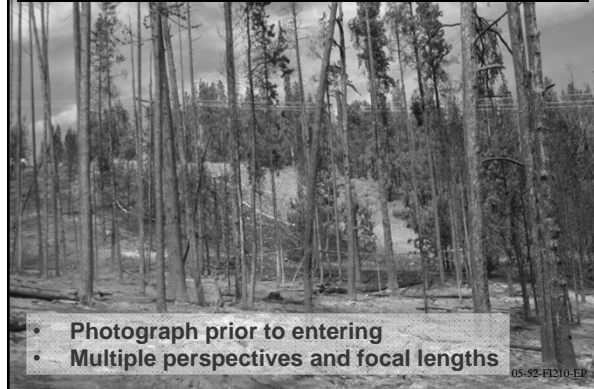
Scene Orientation/Overview Photos

- Show integrity and relationship of scene to overall environment.
- Taken from a distance
- Displays the overall relationship between physical evidence or burn pattern indicators and the scene.



05-51-FI210-EP

Overview of General Origin Area



Photograph comparison fuels



Documentation - Photography

Relationship photos

- Shows the relationship between various items
- Taken at medium range
- Shows specific views of subject matter
- Begins to focus on specific portions of the area or scene



Photo 1029.jpg, Taken 09/12/2011, 9:42 AM
View from east to west showing the specific origin area

05-54-FI210-EP

Documentation - Photography



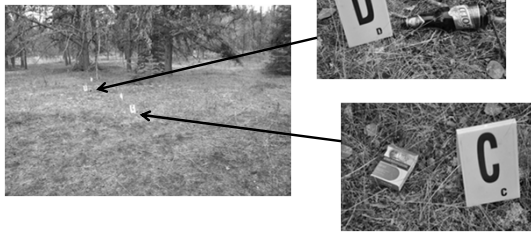
Relationship photographs

05-55-FI210-EP

Documentation - Photography

Relationship photos

Consider using evidence markers to show locations of evidence .



05-56-FI210-EP

Documentation - Photography

Identification Photos

- Shows detail of a specific item of evidence or an indicator.
- Taken close up.
- Shows detail of subject matter.



05-57-FI210-EP

Documentation - Photography

Identification Photos

Written and photographic documentation of sample, comparison samples, and exemplar collection and retention:

- Rock
- Metal
- Insulators
- Soil
- Fuel



05-58-FI210-EP

Documentation - Photography

Identification Photos

- The general origin area may contain thousands of indicators.
- Mark/flag enough to establish overall fire progression and origin.
- Document representative sample of those that you mark/flag.
 - No minimum or maximum number.
 - Enough to show the methodology relied on.
 - Illustrate the scene at a later date .



05-59-FI210-EP

Documentation - Photography

Identification Photos

- Document more than one indicator of multiple indicator categories – don't rely on just one.
- It is better to over document the indicators rather than under document them .



05-60-FI210-EP

Documentation - Photography

Identification Photos

Fire progression

- Color-coded flags can be used to demonstrate overall fire progression.
- Directional interpretation of an individual indicator.
- Advancing, lateral or backing.



05-61-FI210-EP

Documentation - Photography

Identification Photos

Vector Documentation

Options for documenting fire progression of individual indicators:

- Memory/good photos
- Old school
- Flags only
- Fire direction arrows
- Vector symbols
- Use the recommended symbols/colors

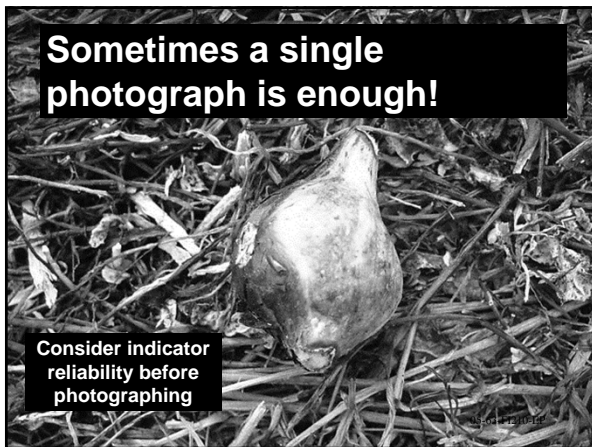


05-62-FI210-EP

Regardless of how you do it, be consistent.

Sometimes a single photograph is enough!

Consider indicator reliability before photographing



**Sometimes it takes two views,
or more...**

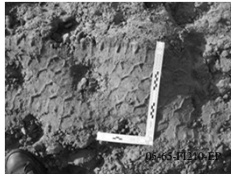


05-64-FI210-EP

Documentation - Photography

Examination Photos

- Photographs taken close-up, with a scale designed for evidence photography.
- Scaling
 - May help with examination if a positive examination is made later.
 - Is not always necessary but is recommended.
 - Consider using special lenses and/or lighting techniques.



05-64-FI210-EP

Documentation - Photography

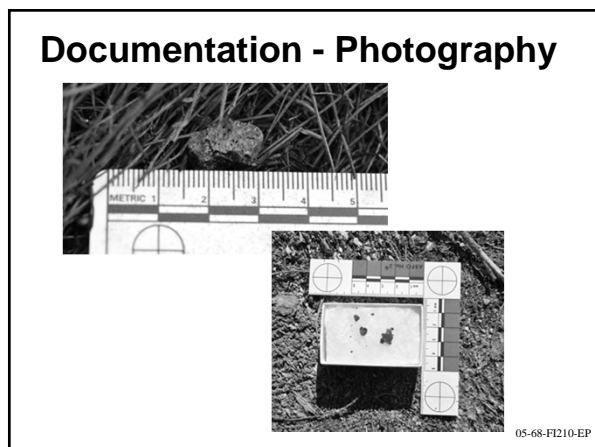
Examination Photos

- Photo details of evidence in secure location.
- With and without scale
- Identify evidence item in photo.



05-66-FI210-EP



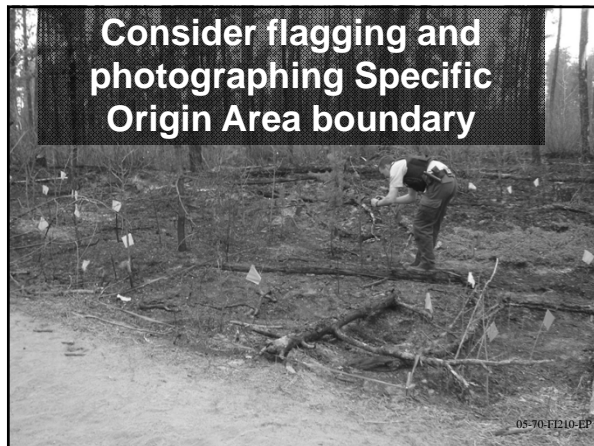


Documentation - Photography

Other Considerations

- Specific origin area boundary
- Planning for photo exhibits
- Storing Digital photos to CD/DVD/Flash Drive
- Marking photo evidence

05-69-FI210-EP



Documentation - Photography

Photo Exhibits

- Plan ahead for possible exhibits by taking photographs which document your investigation.
- Document and photograph damages and values at risk.


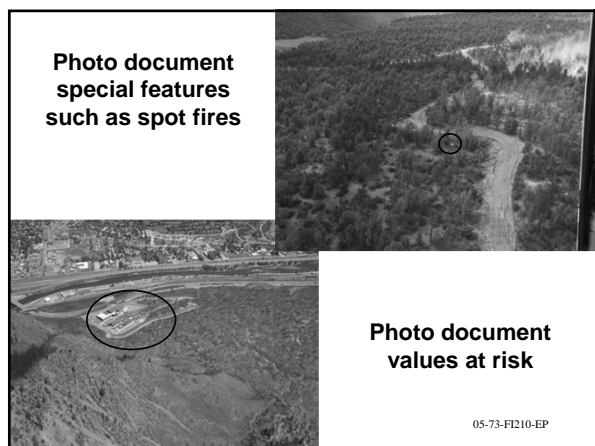


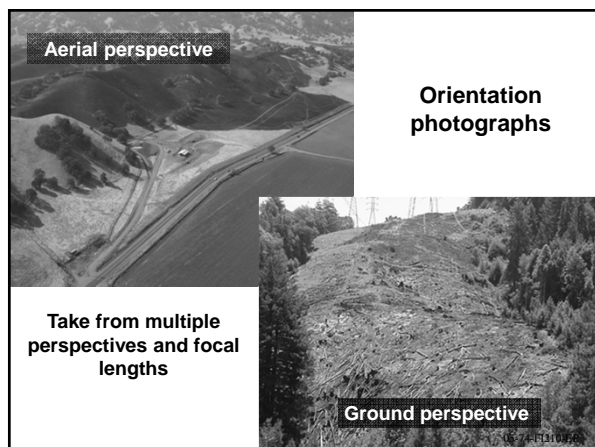
Photo Exhibits – Fire Patterns

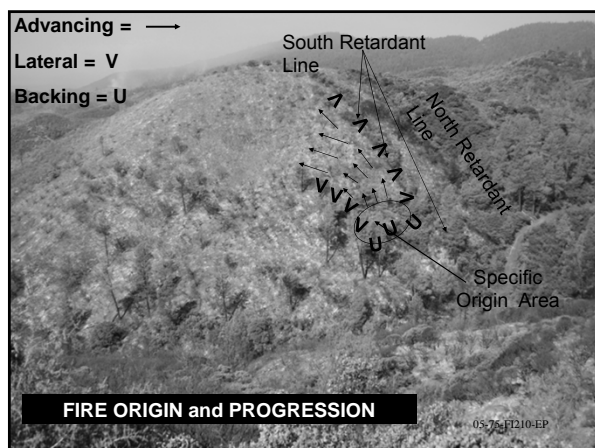


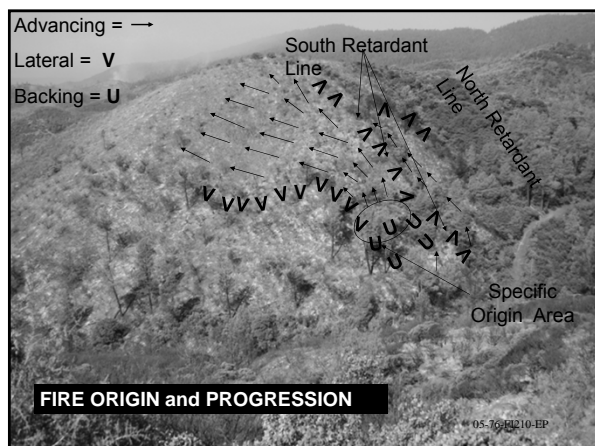

Recommend Noting:

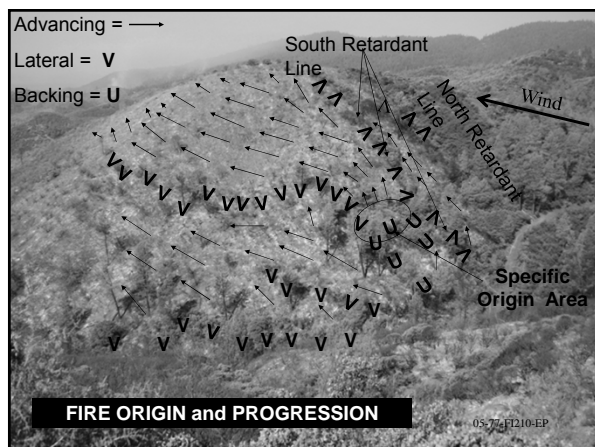
- Direction photo taken
- Indicator category
- Vector (advancing, lateral or backing)
- Fire direction in photo
- Location photo is taken











Documentation - Report

INVF role versus Case Agent/Case Manager (INTM) role:

- This is agency dependent.
- May change by incident.
- Make sure you are clear about your responsibility for each assignment.
- Your role may change over time.
- INVF is the first line of investigation.

Ask questions if you are not sure!

05-78-FI210-EP

Documentation - Report

Investigative/Case File consisting of electronic and/or hard copies may include:

- Origin and Cause report(s)
- Reports of Interview
- Sketches/diagrams/measurements
- Maps
- Weather data
- Miscellaneous reports and documents (e.g., forensic, expert, other agency)

05-79-FI210-EP

Documentation - Report

Investigative/Case File consists of: (cont.)

- Photographs/Photo logs
- Evidence Log
- Investigative Notes (per agency policy)
- Correspondence (e.g., emails, texts)
- Supporting exhibits

05-80-FI210-EP

Documentation - Report

Origin and Cause Report

- Format is agency or prosecutor specific (examples in appendix)
- Basis for INVf testimony
- Becomes an attachment to final case report

Consider adding a disclaimer: "I reserve the right to change my opinion or conclusions based on any additional data received."

05-81-FI210-EP

Documentation - Report

Origin and Cause Report (cont.)

- Narrative Format
- Chronological order of incident
- Tell the story from start to finish in the order in which the fire events occurred
 - What was the fire behavior context?
 - What fire pattern indicators were relied upon?
 - What evidence of the cause was located and collected?

05-82-FI210-EP

Documentation - Report

Origin and Cause Report (cont.)

Narrative section explains:

- Facts from witnesses and other sources.
- How data was used to develop hypothesis.
- How hypothesis was tested and final hypothesis was selected.
- Conclusions.
- Attachments and supporting documents/photos.

05-83-FI210-EP

Documentation - Report

Origin and Cause Report - Narrative

1. Call and Response
2. Arrival on Scene
3. Methodology/Data Collection
4. Data Analysis and Application
5. Working Hypotheses Development
6. Hypotheses testing
7. Conclusion/Selection of Final Hypothesis

05-84-FI210-EP

Documentation - Report

Origin and Cause Report

Call and Response:

- Time of call, time of response, who requested you, information/data gained
- Assignment/instructions

Example: At 2:35 PM I was contacted by the Wildfire Dispatch center and assigned to investigate the origin and cause of the North Fork fire. I responded from my office at 2:47 PM. I traveled to the fire scene by way of ... The dispatch center provided me with the following information... I observed the following enroute...

05-85-FI210-EP

Documentation - Report

Origin and Cause Report

Arrival at Scene:

- Describe the scene on your arrival
 - Time of arrival and location
 - Location and perimeter of fire
 - Surrounding area
 - Activities taking place
 - Observed fire behavior
 - Security in place (or not)
 - Witnesses, reporting party present
 - Data collected (Weather, statements etc.)

05-86-FI210-EP

Documentation - Report

Origin and Cause Report

Methodology/Data Collection:

- Witness statements and interviews
 - Suppression personnel; Reporting party; Civilian witnesses
- Fire behavior context
- General Origin - Describe your actions in detail
- Specific Origin - Describe your actions in detail
- Ignition Area – Potential ignition sources
- Documentation – Evidence, sketches & photographs
- Other observations and sources of information
 - Weather, lightning data, 911 call logs, etc.

05-87-FI210-EP

Documentation - Report

Origin and Cause Report

Data Analysis and Application:

At this point in the narrative report, most if not all of the pertinent data has been documented and the process of analysis has begun.

- Document why certain data was rejected.
- Document why certain data was relied upon.
- Describe the meaning applied to the data during the analysis process.

05-88-FI210-EP

Documentation - Report

Origin and Cause Report

Working Hypotheses Development:

Document a hypothesis for each reasonably possible origin/cause supported by the data/fact analysis.

EXAMPLE:

Smoking: The fresh cigarette butt found adjacent to the specific origin was discarded while still burning and ignited the surrounding dry grass.

05-89-FI210-EP

Documentation - Report

Origin and Cause Report

Hypotheses testing:

- Describe how you “tested” each hypothesis.

EXAMPLE

Smoking: The relative humidity measured at the scene at the time of the fire was 37%. Scientific research (Countryman 1983) has shown that discarded cigarettes will not ignite dry grass at humidity levels above 22 to 25%. Therefore, smoking is excluded as a potential cause of the North Fork fire.

05-90-FI210-EP

Documentation - Report

Origin and Cause Report

Conclusion/Select Final Hypothesis:

List the ignition source, material first ignited, and the ignition sequence.

EXAMPLE

On August 14th, 2011 Mr. Smith lit a fire in his burn barrel. He did not place a screen on the barrel to prevent the escape of embers, and he had not cleared flammable grass and vegetation from around the barrel. In addition, Mr. Smith did not stay to watch the fire and he did not have tools or water available to put out the fire. A burning ember was lofted out of the burn barrel by hot gasses and landed in the dry grass, igniting it. The fire then spread from Mr. Smith's property to the surrounding forest causing the West Canyon Fire.

05-91-FI210-EP

Documentation - Report

Origin and Cause Report - Summary

- The person responsible for the case file will include the O&C report into the case file along with all other pertinent information..
- The investigative case file is the compilation of all investigative documentation not just the Final Report or Origin and Cause report.

05-92-FI210-EP

Review Unit 5 Objectives

1. Recognize what needs to be documented in a wildland fire investigation and when to document it.
2. Determine an appropriate method to document.
3. Recognize various items that may be included in an investigative file/case file.
4. Understand how to fully complete an origin and cause report.
5. Understand the roles of an INVF and/or case agent/case manager and how they interact.

05-93-FI210-EP

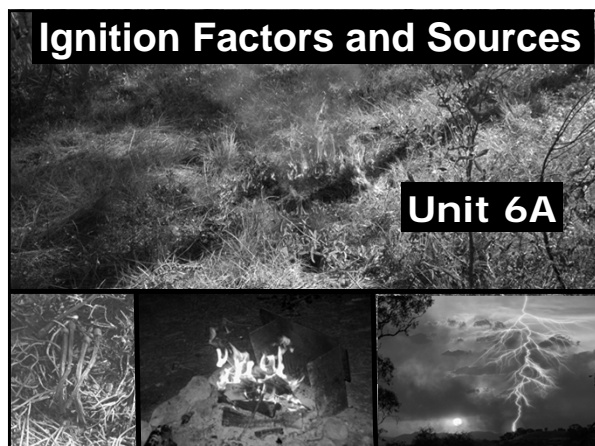
Notes:

FI-210, Wildland Fire Origin and Cause Determination

Unit 6 – Ignition Factors and Sources

Lesson 6A – Lightning, Campfires, Smoking, Debris Burning

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Unit 6 Objectives

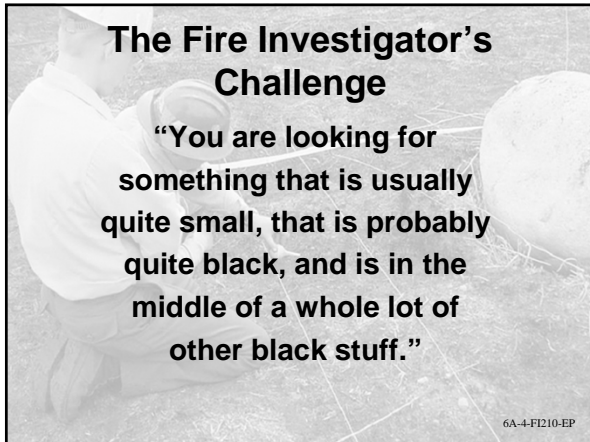
1. Define various terms associated with fire causes.
2. List the general cause categories.
3. Describe the ignition factors and sequences that are normally associated with each cause.

6A-2-FI210-EP

Unit 6 Objectives

4. Describe the various indicators and physical evidence associated with each cause.
5. Outline specific investigation methods unique to each cause.

6A-3-FI210-EP



The Fire Investigator's Challenge

“You are looking for something that is usually quite small, that is probably quite black, and is in the middle of a whole lot of other black stuff.”

6A-4-FI210-EP

Introduction

Meeting this challenge can be difficult for the following reasons:

- **Origin incorrectly identified.**
- **Ignition source:**
 - Destroyed by suppression
 - Small and not readily visible
 - Buried under ash and debris
 - Unfamiliar and therefore overlooked
 - Arson “hot set” and removed
 - Remains consumed by the fire

6A-5-FI210-EP

Fire Cause Terminology

The following documents contain fire management terms that wildland fire investigators should be familiar with:

- **Guide to Wildland Fire Origin and Cause Determination Handbook (PMS 412)**
- **NWCG glossary of wildland fire terminology**
- **NFPA 921**

6A-6-FI210-EP

Fire Cause Terminology

Ignition Factors

Ignition factors make up the ignition sequence:

- Competent ignition source.
- The type and form of first fuel ignited.
- The circumstances or human actions that allowed the factors to come together.

6A-7-FI210-EP

Fire Cause Terminology

Competent Ignition Source

The source of heat that kindles a wildfire.

- Mechanical spark or electrical arc
- Glowing ember
- Open flame
- Chemical reaction
- Friction



Fire Cause Terminology

Ignition Source Location

May tend to rest on top of the ash surface or burrow or settle due to weight, temperature, velocity, or degradation of the fuel.



6A-9-FI210-EP

Fire Cause Terminology

Ignition Source Location

Examples:

- On the surface of the ash
match, cigarette butt, flat metal fragments, etc.
- Below the surface of the ash
Welding slag, exhaust particles, large metal fragments, etc.



6A-10-FI210-EP

Fire Cause Terminology

Material First Ignited

- The host fuel bed that the ignition source first comes into contact with and sustains combustion.
- Ground or surface fuels.
- One hour FDFM category
- High surface-to-volume ratio, i.e., duff, grass chaffs, etc.



6A-11-FI210-EP

Fire Cause Terminology

Ignition Sequence

The existing conditions, subsequent actions and sequence of events that bring a competent ignition source into contact with the materials first ignited.

- Also referred to as the “Cause” of the fire.



6A-12-FI210-EP

Fire Cause Terminology

Ignition Sequence

- **Conditions:**
 - Burn barrels without screens or clearance
 - Adjacent flammable vegetation
 - Fire weather
 - Slope
- **Sequence of events/actions:**
 - Ignition of the material in the barrels
 - Airborne ember
 - Failure to attend



6A-13-FI210-EP

Fire Cause Terminology

Fire Cause Categories



A general list of fire cause categories used for statistical reporting and fire prevention purposes.

6A-14-FI210-EP

Fire Cause Terminology

Fire Cause Categories:

- *Lightning*
- *Campfires*
- *Smoking*
- *Debris burning*
- *Incendiary*
- *Equipment*
- *Railroad*
- *Children*
- *Miscellaneous*

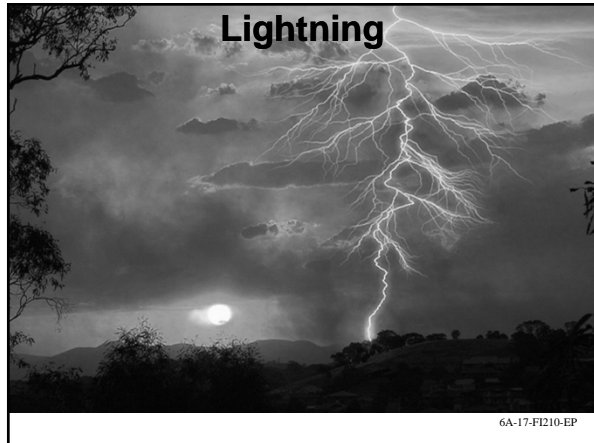
6A-15-FI210-EP

Wildfire Cause

Examine each of the general fire cause categories.

- **Ignition sequence:** The conditions, actions and events.
- **Circumstances:** Evidence or things typically associated with the cause, including potential ignition source remains.
- **Investigation techniques:** Specific investigation methods that may assist in establishing evidence of the cause.

6A-16-FI210-EP



6A-17-FI210-EP

Lightning: Ignition Factors

- Discharged static electricity.
- Associated with thunderstorm activity.
- Series of short bursts approximately two inches in diameter, lasting for one-half second.
- Cloud-to-Ground Strikes:
 - 100 million volts
 - 200,000 amperes
 - 54,000° F

6A-18-FI210-EP

Lightning: Ignition Factors

- Possess either positive or negative charge.
 - Positive charge: 10% of all strikes
 - Negative charge: 90% of all strikes
- Positively charged strokes have greater fire starting potential.
 - Long single stroke, continuing current
- Damage is the result of electrical resistance and current.
- Stroke duration = likelihood of ignition

6A-19-FI210-EP

Lightning: Circumstances

- Recent electrical storm (hours/days/weeks)
- “Sleepers” and “holdovers”
- Scarring on trees and/or snags
- Precipitated sap
- “Needle shower”
- Ballistic penetration of adjoining vegetation by needles and small twigs or splinters
- “Blow-holes” at base of tree
- Fulgurites
- Splintered wood or vegetation

6A-20-FI210-EP

Lightning: Circumstances

Lightning Strike Scar

May be very visible

or

May be difficult to see



6A-21-FI210-EP

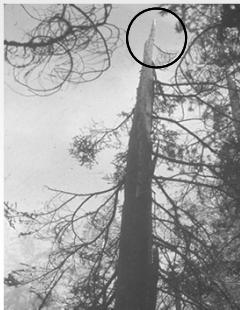
Lightning: Circumstances

Lightning Strike Scar

Tree may not always be standing



Lightning: Circumstances



- Spike top or blunted snags with no visible scar.
- Top is blown off and scattered.
- Remains consumed in fire.
- Charring in top of tree or visible damage that appears recent.

6A-23-FI210-EP


Lightning: Circumstances

Striking low vegetation or directly into ground




Splintered limbs,
needle shower,
blowholes, disturbed
soil, shattered rocks,
fulgurites

6A-24-FI210-EP



Lightning: Circumstances

Look for blowholes at or near the base of trees.




6A-25-FI210-EP

Lightning: Circumstances

Lightning may also strike a fence, sending electrical current down the fence wires for some distance.

- Ignites wooden posts.
- Ignites flammable vegetation in contact with wire.




6A-26-FI210-EP

Lightning: Circumstances

Fulgurites

- Fused soil or rock at location strike discharges to ground.
- Fulgurites may be found on the surface to more than 16 feet below surface.
- Range in size from ¼ inch to two inches in diameter.
- Color, size and shape may vary.

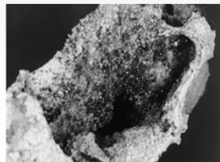


6A-27-FI210-EP

Lightning: Circumstances

Fulgurites

- Generally resemble fused glass, but may have a sandy or rough exterior.
- Usually hollow and fragile.
- Branch-like



6A-28-FI210-EP

Lightning: Investigation Techniques

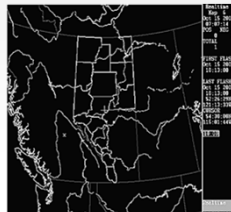
- Historic activity patterns
- Remote area/no human activity
- Physical evidence
- Recent storm activity/weather conditions
- Absence of other reasonable causes
- Remains consistent with a holdover

6A-29-FI210-EP

Lightning: Investigation Techniques

Lightning detection systems

- Occurrence map can assist with confirmation/elimination.
- Obtain through dispatcher.
- Should not be completely relied upon.
- Accuracy is approximately 500 meters with an 80% to 90% detection rate.



6A-30-FI210-EP

Lightning: Investigation Techniques

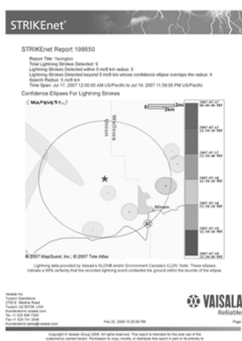
Lightning Detection Networks

- **National Lightning Detection Network, Vaisala:**
 - www.vaisala.com / 520 806 7300
- **Total Lightning Network, Earth Networks:**
 - www.earthnetworks.com / 800-544-4429
- **US Precision Lightning Network, WSI:**
 - uspln@wsi.com / 978-983-6648

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Lightning: Investigation Techniques

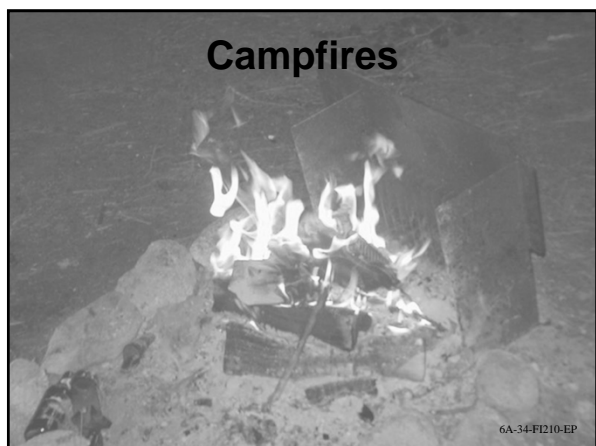
Sample lightning data report



Lightning: Investigation Techniques

- Lightning should only be considered as a working hypothesis, when you have data that supports it.
- Data should be collected and analyzed to determine if a working hypothesis of lightning can be formed.

6A-33-FI210-EP



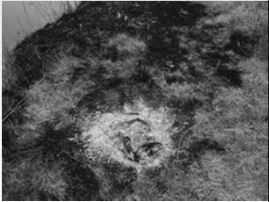
Campfire: Ignition Factors

- Fire that is kindled for:
 - Heat, light, warmth, cooking, religious or ceremonial purposes
- Regulations address:
 - Attendance, clearance, periods of use, suppression tools and proper extinguishing
- Violations often cause escaped fire and have history of large, damaging fires (e.g. Tahoe, Wallow)

6A-35-FI210-EP

Campfire: Ignition Factors

- Failure to properly extinguish
- Lack of attendance
- Improper clearance/construction
- Careless placement
- Fire play
- Improper discarding of coals/ash
- Improper use of accelerants
- Careless discarding of matches
- Camp stove malfunction



6A-36-FI210-EP

Campfire: Ignition Factors

Primary ignition mechanisms

- Aerial sparks or rolling materials
- Creeping
- Improper disposal of coals/ash
- Radiant heat
- Convection
- Exploding rocks
 - Examine each rock in detail



6A-37-FI210-EP

Campfire: Ignition Factors

Sparks or rolling material

- Origin downwind/downhill
- Typically fairly close
- Paper or cardboard is prime aerial firebrand material.
- Origin in punky material or fine fuels.
- Origin from sparks that emanate from rapid vapor expansion in wood will be close to fire.



6A-38-FI210-EP

Campfire: Ignition Factors

Creeping escapes

- Uncleared duff to edge of ring.
- Smoldering type escape.
- May appear as a “finger” burn pattern.
- Underground root system or other ignitable material.
- Unattended, abandoned or improperly extinguished fires .



6A-39-FI210-EP

Campfire: Ignition Factors

Discarded coals/ash

- Origin near original campfire
- Coals/ash present at origin
- May be exposed or buried under soil
- Heat may be retained for hours/days



6A-40-FI210-EP

Campfire: Circumstances

- Recently used fire at or near origin
- Signs of human activity at or near the origin
- Residual heat in campfire may remain
- Not all campfires will be within rock rings



6A-41-FI210-EP

Campfire: Investigation Techniques

Documentation

- Origin and ignition factors
 - Construction of the fire ring
- Any regulation violations
- Improper or lack of extinguishment



6A-42-FI210-EP

Campfire: Investigation Techniques

Improper Extinguishment

Inadequate amount of water used

- Fire smolders under crust
- Residual heat often detectable
- Fire escapes through creeping/embers
- May be a lack of white ash on surface where water was applied.



6A-43-FI210-EP

Campfire: Investigation Techniques

Improper Extinguishment (cont.)

Fire smothered with soil/rocks

- May smolder for hours or days
- Presence of hot coals
- Vent fumaroles may appear on surface
- Organic matter may contribute to smoldering
- Soil moisture/mineral content may extend smoldering period



6A-44-FI210-EP

Campfire: Investigation Techniques

No Extinguishment

Fire abandoned

- Fine, white ash may be present on surface
- Ash has fluffy, fragile appearance
- Odor of fresh burning
- Sift burned debris for evidence.



6A-45-FI210-EP

Campfire: Investigation Techniques

- High temperature thermometer or other method to establish residual heat levels.
- Wildfires burning over old campfire rings will not generally re-ignite coals.
- Witnesses, trail registers, permits, contracts may provide leads
- Physical evidence.



6A-46-FI210-EP

Smoking



6A-47-FI210-EP

Smoking

Smoking caused fires are not limited to manufactured cigarettes. They can include fires caused by:

- Cigarettes
- Matches
- Cigars
- Pipe tobacco
- Illegal substances



6A-48-FI210-EP

Smoking

- Redsicker and O'Connor observed in *Practical Fire and Arson Investigation*, "Cigarettes have long been the scapegoat in cases where no other cause could be determined"
- To effectively assess the probability of a cigarette as a competent ignition source, consider the following:
 - Physical characteristics of the cigarette
 - Environmental factors
 - Physical placement factors

6A-49-FI210-EP

Smoking

Physical Characteristics of manufactured cigarettes

- Chemically treated tobacco wrapped in paper
- Cellulon, plastic or charcoal filter
- Weight: 2/3 gram
- Length: 45-90 mm
- Interior core temp. of 1361-1541° F
- Exterior tip temp. of 572-1200° F



6A-50-FI210-EP

Smoking

Fire Safe Cigarettes

- Designed primarily for safety with interior upholstery
- Informal research shows they may continue to burn in a wildland environment
- The tobacco itself is not chemically treated, the paper has two thicker bands to retard burning unless actively being smoked

6A-51-FI210-EP

Smoking: Ignition Factors

Physical Characteristics

- Ash content varies and will affect temperature
- Up to 20% shrinkage
- Lifts up and away from fuel bed
- Heat transfer primarily conduction and radiation unless suspended in fuel
- Linear progression limits exposure to 1-2 minutes
- Total burn time approximately 12-15 minutes

6A-52-FI210-EP

Smoking: Ignition Factors

Environmental Factors

- Finely particulated fuel bed
- Loose fuel arrangement
- FDFM of <14%
- 80°+ ambient temperature (F)
 - Micro climate location (temp at ground level vs temp at higher level)
- RH of 22% or less



6A-53-FI210-EP

Smoking: Ignition Factors

Physical Placement Factors (cont.)

- 30%+ of the glowing tip in contact with fuel bed
- Tip oriented into wind
- Tip burrowed or downslope



6A-54-FI210-EP

Smoking: Ignition Factors

Physical Placement Factors (cont.)

- Roadside starts will generally be on or within few feet of road edge because the vortex effect pulls cigarette back toward pavement.
- Next car blows cigarette to road edge.
- Trajectory testing supports maximum thrown distance of approximately 20 feet.



6A-55-FI210-EP

Smoking: Ignition Factors

- Cigarettes are limited as a competent ignition source.
 - Formal and informal research
- Very narrow window of ignition factors
- Example:
RH: 21%,
Temp: 68° F
Wind: 10 mph



6A-56-FI210-EP

Smoking: Circumstances

- Weather
- Fuel bed
- Physical placement
- Human activity in origin area



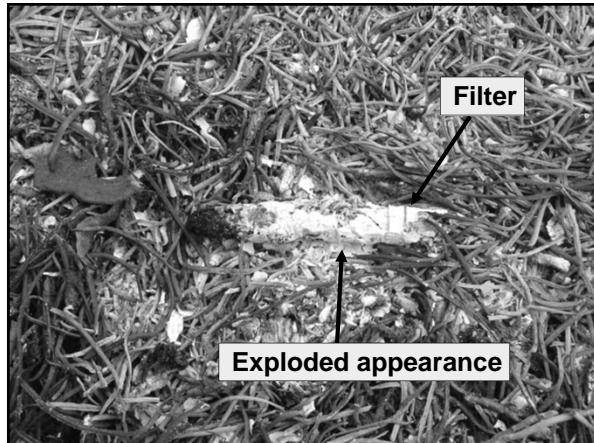
6A-57-FI210-EP

Smoking: Circumstances

- Rounded or pointed tip may indicate active smoking.
- Flat tip may indicate prior extinguishment.
- Exploded appearance on ash column.
- Old remains may have a bent, weathered or mangled appearance.



6A-58-FI210-EP



Debris Burning



6A-60-FI210-EP

Debris Burning

Residential

- Pile burning
- Burn barrel

Industrial

- Logging operations
- Land clearing
- Agricultural
- Forestry

6A-61-FI210-EP

Debris Burning: Ignition Factors

- Factors are similar to escaped campfires.
- Windblown embers or creeping into un-cleared vegetation.
- Rely on fire indicators.



6A-62-FI210-EP

Debris Burning: Circumstances

- Discernible spread pattern
- Windblown embers generally within 40'
- Cardboard and paper competent aerial firebrand
- Debris pile or burn barrel at or upwind of ignition area
- Defective or no screen
- Defective barrel
- Inadequate clearance
- Lack of attendance/suppression tools
- Holdovers - days/weeks/months



6A-63-FI210-EP

Debris Burning: Investigation Techniques

- Documentation of burn pattern/ conditions
- Aerial firebrand sources usually upwind of ignition area
- Examine source:
 - residual heat
 - violations
 - evidence of attempted extinguishment
- Interviews



6A-64-FI210-EP

Incendiary



6A-65-FI210-EP

Incendiary

- Fires that are willfully set without authorization.
- Fires that are deliberately set to cause damage or to defraud: Arson.
- Will be addressed later in separate unit.



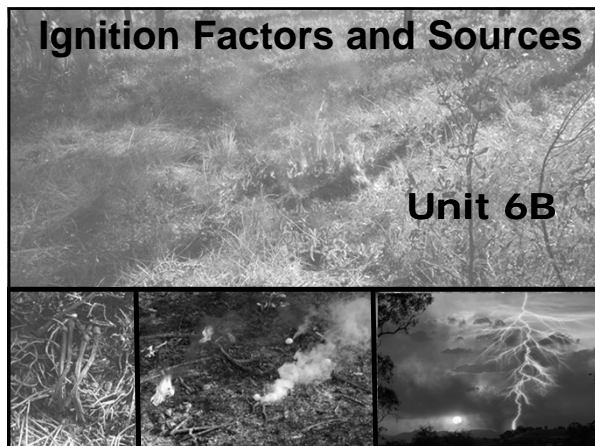
6A-66-FI210-EP

FI-210, Wildland Fire Origin and Cause Determination

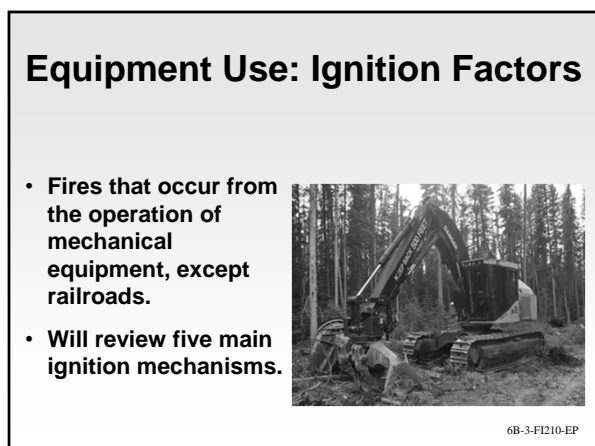
Unit 6 – Ignition Factors and Sources

Lesson 6B – Equipment Use, Railroad

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Equipment Use: Ignition Factors

- Exhaust system particles
- Friction and sparks
- Fuel, lubricant, fluids
- Mechanical breakdown or other malfunction
- Radiant or conductive heat transfer

6B-4-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

- Originate from any internal combustion engine
- Carbon, catalytic converter and metal fragments
- Common ignition source



6B-5-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

System Configuration

- Header
- Converter
- Exhaust pipe
- Muffler
- Tail pipe



6B-6-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

Exhaust Carbon Particles

- Materials from incomplete combustion of hydrocarbon fuels.
 - Engine carbon, trace metals
- Lubricants serve as binder.
- Heat content equivalent to a similar sized piece of hardwood.



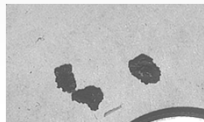
6B-7-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

Exhaust Carbon Particles

- Volatile hydrocarbons may extend the time particle is thermally active.
- Larger particles may auto-ignite upon ejection.
- Diesel engines more prone to ejecting competent ignition sources.



6B-8-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

Gasoline Carbon

- Generally smaller particles than diesel.
- Granular or flakes
- May be either shiny or dull, but will usually be sooty.
- May be recoverable with a magnet if sufficient ferrous material present.



6B-9-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

Diesel Carbon

- Generally larger than gasoline carbon.
- Granular particles or spongy, pumice-like chunks.
- Shiny or dull
- Usually black and sooty
- Rarely recoverable with magnet



6B-10-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

- Particles originate from:
 - Combustion chamber (3,000° F)
 - Ports and manifolds (1,600° F)
- Max. horizontal flight distance 45 feet
- Most fires will be much closer to source
- Competent ignition source:
 - Min. particle size of .023 in. (Fairbanks and Bainer)
 - Usually particles - 0.06 to 0.08 in. or larger (Riverside Fire Lab)
- Particles up to 0.5 in. and larger not uncommon

6B-11-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

Exhaust Carbon Particles are usually ejected under following conditions:

- Idling prior to peak level operation
- Engine is pulling load
- Piston ring or valve seal failure
- Engine overheating
- Jake brake operation, compression braking or shift point

6B-12-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

Exhaust Carbon Particles

- Low RH and high temperatures
- Variations in particle size make establishing minimums difficult
- Large particles start fires up to 80% RH
 - Riverside Fire Lab
- Host fuelbed finely particulated
- FDFM generally low, but no known upper threshold

6B-13-FI210-EP

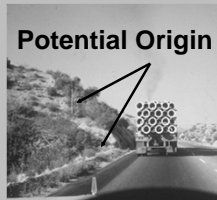
Equipment Use: Ignition Factors

Exhaust System Particles

Exhaust Carbon Particles

Origins:

- Cutbanks, slopes, tunnel portals
- Downgrades and at shift points on upgrades
- Road conditions that contribute to thermal or mechanical stress



6B-14-FI210-EP

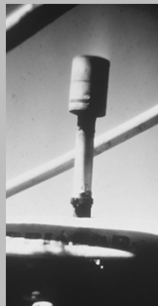
Equipment Use: Ignition Factors

Exhaust System Particles

Exhaust Carbon Particles

Spark Arrestors and turbochargers

- Designed to limit carbon ejection
- One or other may be required by law
- Presence does not preclude fire due to malfunction, modification, or wrong model



6B-15-FI210-EP

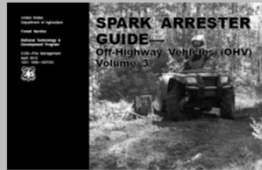
Equipment Use: Ignition Factors

Exhaust System Particles

Exhaust Carbon Particles

Spark Arrestors and turbochargers

- Two categories
 - Attrition
 - Retention
- Must meet standards
- Spark Arrestor Field Guide



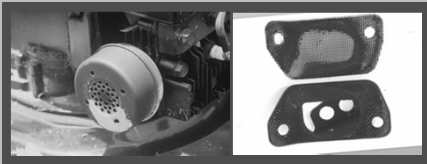
http://www.fs.fed.us/t-d/programs/fire/spark_arrestor_guides/

6B-16-FI210-EP

Equipment Use: Ignition Factors

Exhaust System Particles

- Loose housing bolts, loose or warped flange
- Separated exhaust port screen
- Some mufflers look like spark arrestors



6B-17-FI210-EP

Equipment Use: Indicators

Exhaust Carbon

Small equipment : Chainsaws, ATV, lawn equipment, portable power equipment

- Evidence of use near ignition area
- Perform inspection of exhaust system



6B-18-FI210-EP

Equipment Use: Indicators

Exhaust Carbon

Heavy Equipment

- Dozers, dump trucks, logging trucks, tractors, graders, skidders, etc.
- Many turbo-charged but may still pose threat if system is damaged
- Indicators may be obvious

Damaged Exhaust System



Missing spark arrestor

6B-19-FI210-EP

Equipment Use: Investigation Techniques

Exhaust Carbon

- Evidence/witnesses suggest carbon
- Difficult to recover actual particle
- Aided visual exam, magnet, debris removal, sifting
- Forensic evaluation of equipment/evidence

6B-20-FI210-EP

Equipment Use: Ignition Factors

Catalytic Converter Particles

Composed of ceramic matrix

- Honeycomb monolith
- Small ceramic beads (older vintage vehicles)



Honeycomb monolith

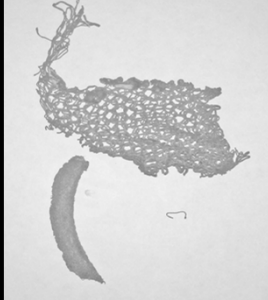


Ceramic beads

6B-21-FI210-EP

Equipment Use: Ignition Factors

Catalytic Converter Particles



Particles of wire mesh may also eject from catalytic converter and ignite fire.

Equipment Use: Ignition Factors

Catalytic Converter Particles

- Operating temperature can reach up to 1,380° F.
- Malfunctions usually caused by electronic ignition failure.
 - Converter overheats
 - Matrix degrades and breaks apart
 - 2,400° to 2,800° F
 - Hot ceramic particles discharged from exhaust system.

6B-23-FI210-EP

Equipment Use: Ignition Factors

Catalytic Converter Particles

Origins

- Horizontal trajectory approximately 35 feet maximum
- Close to road shoulder
 - No correlation to cutbanks or grades
- Multiple ignition areas or multiple fires along same road system
- Tailpipe height limits trajectory

6B-24-FI210-EP

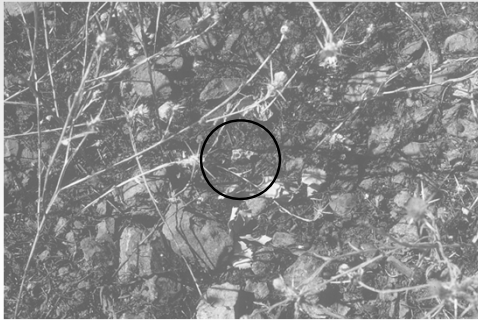
Equipment Use: Indicators Catalytic Converter Particles

- Particle(s) in ignition area
- Particles may vary in size, up to diameter of tailpipe
- Lightweight ignition source
- Non-magnetic
- Ricochet effect
- Resembles melted plastic



6B-25-FI210-EP

Equipment Use: Indicators Catalytic Converter Particles

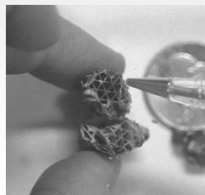


Particle at origin of one of five fires
(Note the grass stem indicators)

6B-26-FI210-EP

Equipment Use: Indicators Catalytic Converter Particles

- Grey color
- Dull or metallic sheen
- May be scorched
- Honeycomb matrix may be visible
- Small beads



6B-27-FI210-EP

Equipment Use: Investigation Techniques Catalytic Converter Particles

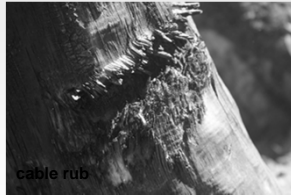
- Multiple ignition areas
- Walk roadside
- Interview vehicle driver/owner
- Approx. 33% of vehicles stopped running within a few miles of fire(s)
- Inspection of converter
 - Look for holes, rust, cracks, loose mounts



6B-28-FI210-EP

Equipment Use: Ignition Factors Friction

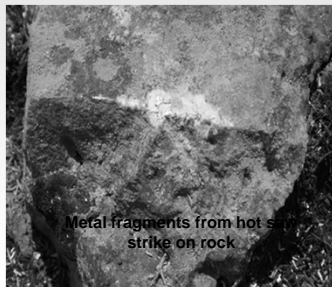
- Heat generated by moving object (s)
 - Sparks and/or high temperature particles
- Can be associated with a mechanical malfunction



6B-29-FI210-EP

Equipment Use: Ignition Factors Friction

- Spark temperature
 - May reach several thousand degrees
- Larger particles shear off
 - 700° to 1500° F
- Combustible object is contacted by rapidly moving object



6B-30-FI210-EP

Equipment Use: Ignition Factors Friction

Examples of potential ignition sources:

- Cable rub
- Tracked equipment
 - Roller pins bind
 - Slip/spin on rock
- Grader strikes
- Rotary saws/hydro axes
 - Contact rocks
 - Misaligned shaft
 - Vegetation buildup



6B-31-FI210-EP

Equipment Use: Investigation Techniques Friction

- Evidence of equipment use at ignition area.
- Use a magnet.
- Fire may start after operators left area.
- Over-aggressive operation
- Examine cutting teeth for damage.
- Friction charring on stumps
- Submit metal particles /control samples for forensic evaluation



6B-32-FI210-EP

Equipment Use: Ignition Factors Fuel/Lubricant/Fluids

Ignites from heat source and spreads to wildland.

- Refueling
- Fuel line leaks
- Hydraulic line leaks
- Combustible debris accumulations
 - Engine compartment
 - Near exhaust system



6B-33-FI210-EP

Equipment Use: Ignition Factors Fuel/Lubricant/Fluids

- Hydrocarbon/fluid residue
- Trails of burned vegetation
- Burned equipment at origin
- Witness statements



6B-34-FI210-EP

Equipment Use: Ignition Factors Mechanical Breakdown

- Tire/wheel/bearing failure
- Hydraulic line failure, fluid release
- Brake failure
- Transmission failure
- Electrical system failure
- Dragging tow chains, binders, exhaust systems, driveline, etc.

6B-35-FI210-EP

Equipment Use: Ignition Factors Mechanical Breakdown

- Failed turbocharger
 - Metal fragments
- Seized bearings
 - Metal fragments
- Misaligned axle
 - Tire ignites



6B-36-FI210-EP

Equipment Use: Investigative Techniques

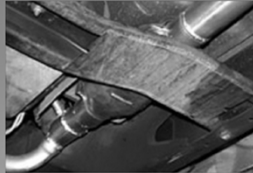
Mechanical Breakdown

- Evidence of equipment use near ignition area.
 - Locate vehicle
- Metal particles
 - Use magnet and/or metal detector
- Burned tire fragments
 - Match to original
- Gouge or drag marks on road surface

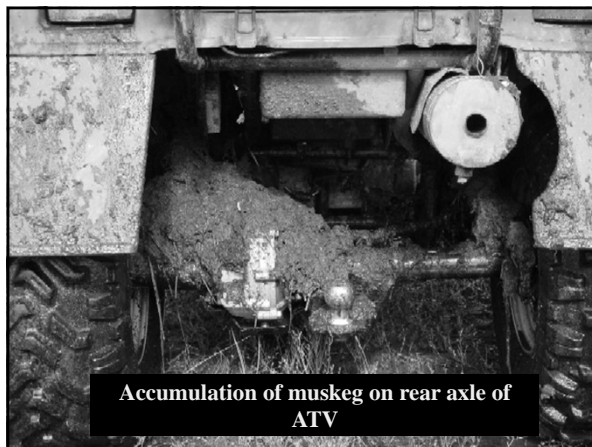
6B-37-FI210-EP

Equipment Use: Ignition Factors Radiant or Conductive Heat Transfer

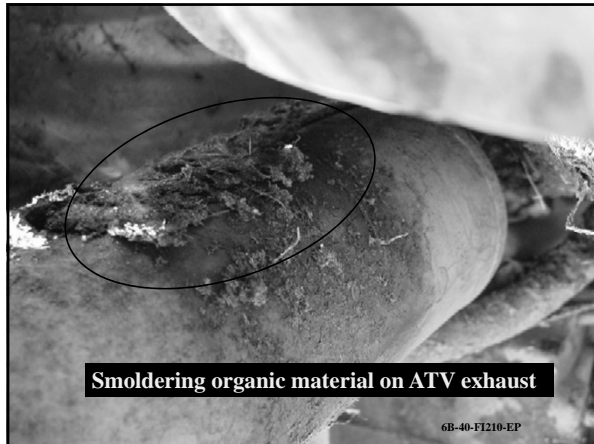
- Radiant or conductive heat
- Vegetation accumulation
 - Burning vegetation
- Vegetation contact with hot engine or exhaust surfaces



6B-38-FI210-EP




Accumulation of muskeg on rear axle of
ATV




Equipment Use: Ignition Factors
Radiant or Conductive Heat Transfer

- Equipment activity in area
- Possible trail of charred vegetation
- Burned equipment
- Charred vegetation
 - Exhaust system
 - Engine compartment



6B-41-FI210-EP

Railroads



6B-42-FI210-EP

Railroad: Ignition Factors

- Railroad fires include fires from any railroad operations, personnel, or rolling stock.
- Historically, railroad fires are significant.
- Aggressive prevention has reduced occurrences.



6B-43-FI210-EP

Railroad: Ignition Factors

RR fire ignition mechanisms:

- Exhaust carbon particles
- Brake shoe metal backing plate particles
- Track maintenance (MOW)
- Right-of-way maintenance
- Dynamic grid failure
- Signal flares
- Wheel slip
- Wheel bearing failure (hotbox)
- Transients



6B-44-FI210-EP

Railroad: Ignition Factors Exhaust Carbon Particles

- Highly competent ignition source
- Diesel carbon is bound together with polymeric lubricant resins
- Pumice-like appearance but may be granular or flaky
- Often sooty/oily
- Range in size
- Rarely retrievable with magnet



6B-45-FI210-EP

Railroad: Ignition Factors Exhaust Particles

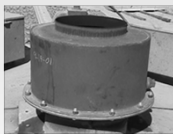
- Auto-ignition creates flaming projectiles.
- Thermally active for 30 seconds or longer.
- Swirling air from passing train aids in ignition of vegetation and ejection distance of the carbon particles along with any wind that maybe present.
- Riverside Fire Lab research puts maximum in-flight distance at approximately 45 feet or more.

6B-46-FI210-EP



Infrared video of locomotive discharging exhaust carbon particles. Note the number of particles, trajectory and distance they travel.

Locomotive Exhaust Systems



Normally aspirated
– Blower type
– External spark
arrester



Normally aspirated
– Blower type
– Internal spark
arrester



Turbo-charged

6B-48-FI210-EP

Carbon Traps



Cup type trap



Bin type trap

Both style of traps become ineffective when about 1/2 to 2/3 full

6B-49-FI210-EP

Carbon caused fire from a turbocharged locomotive



6B-50-FI210-EP

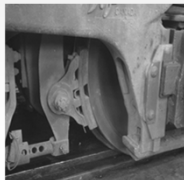
Railroad: Ignition Factors Brake Shoe Particles

Majority of trains are diesel-electric combination.

- air brakes and dynamic braking (electrical)
- non-metallic composition brake shoe pads

Fires may occur when brakes are applied.

- Metal backing plate particles shear off and land on ties or vegetation
- Malfunctioning brakes start fires at any location
 - Stuck brakes
 - Set brakes



6B-51-FI210-EP

Railroad: Investigation Techniques Brake Shoe Particles

- Use magnet to assist in recovering particle.
- Stop train immediately.
 - May be stopped by hotbox or dragging equipment detector.
- Obtain necessary maintenance records.
 - Hotbox detector records
- Forensic evaluation as necessary.



6B-52-FI210-EP

Railroad: Ignition Factors Track Maintenance

- Track wear requires regular maintenance.
- Includes:
 - Standard welding and cutting
 - Thermal chemical catalyst welding
 - Grinding



6B-53-FI210-EP

Railroad: Investigation Techniques Track Maintenance

- Evidence of recent maintenance operation
 - Fresh welds/grinds
 - Recent tire impressions on right-of-way.
- Welding/cutting/grinding slag and debris
- Discarded molds
- Supply boxes
- Campfires/debris burns



6B-54-FI210-EP

Railroad: Ignition Factors Right-of-Way Maintenance

- Burning
- Mowing
- Tree trimming
- Brush removal
- Maintaining the Right-of-Way with mechanical equipment



6B-55-FI210-EP

Railroad: Investigation Techniques Right-of-Way Burning

- Physical evidence
- Thorough documentation of actual escape location
- Obtain records
 - Permits
 - Work records
- Interview work crews

6B-56-FI210-EP

Railroad: Ignition Factors Dynamic Grid Failure

- Traction motors converted to generators when dynamic brakes applied.
- Energy turned into electrical current, routed to resistor grid on locomotive.
 - Resembles large toaster elements.
 - Location on engines varies.
- Excess heat vented through fans.
- May overheat/fail with spectacular arcing and violent ejection of hot metal fragments.
- Downgrade
 - Where dynamic or blended braking is applied.

6B-57-FI210-EP

Dynamic Brake Grid Failure



Railroad: Ignition Factors Signal Flares

Signal Flares

- Train stops at unregulated crossing
- Hot slag
- Carelessly discarded flare





Rail Car Axle Bearings



6B-61-FI210-EP

Rail Car Wheel Bearing Hub Failure



6B-62-FI210-EP

PERSONAL PROTECTIVE EQUIPMENT(PPE)

- Hard hat
- Eye protection
- Hearing protection
- Approved footwear and leather gloves
- High visibility reflective vest



6B-63-FI210-EP

Rail Safety

- Blue Flag (Signal)
- Always step over the rail
- Switch Safety
- The “Red Zone”



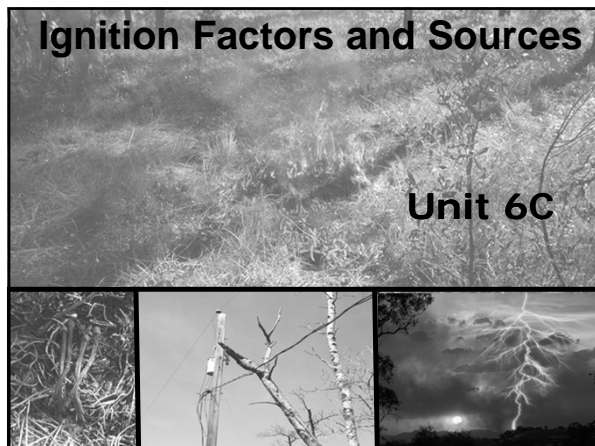
6B-64-FI210-EP

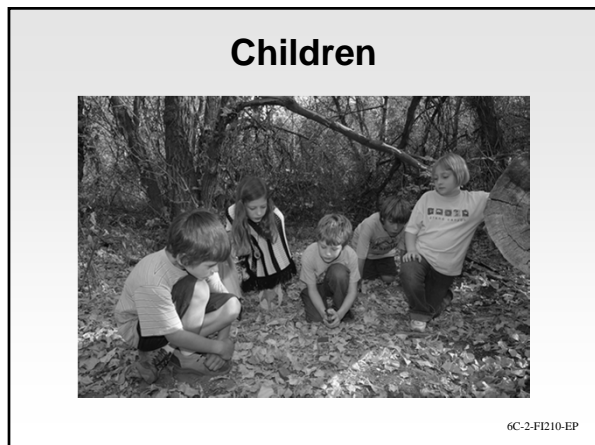
FI-210, Wildland Fire Origin and Cause Determination

Unit 6 – Ignition Factors and Sources

Lesson 6C – Children, Miscellaneous

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Children: Indicators

- **Appearance of fire play**

- numerous matches or matchbooks
- burned toys
- cigarettes
- paper
- boxes



- **Origins away from adult supervision**

- Hidden or “secret” areas
- Forts
- Locations frequented by children

6C-4-FI210-EP

Children: Indicators

- **Children responsible will often flee scene.**

- May return later to watch suppression.
- Uninvolved children are curious and sometimes go towards fire.



6C-5-FI210-EP

Children: Investigation Techniques

- May be corresponding pattern of fires associated with structures, schools, or playgrounds.
- Attempted suppression in early stages by civilians.
- Children in area with charred clothing or shoes.

6C-6-FI210-EP



Children: Investigation Techniques

- Neighborhood canvass for witnesses.
- Children who frequent area.
- Other incidents of fire play.
- Involve/not involve parents.
- Skillful interview techniques.
- Children can lie effectively.
 - Most will be truthful through effective interviewing.
- Consider referral to juvenile authorities.
 - Early juvenile fire setter intervention programs.

6C-8-FI210-EP



Miscellaneous: Ignition Factors

Power lines

- Power lines may start major fires due to:
 - Weather conditions
 - Remote locations
- Grid forms a complex web.
- Regulations govern fire prevention.
- Investigator should be familiar with basic power transmission systems.

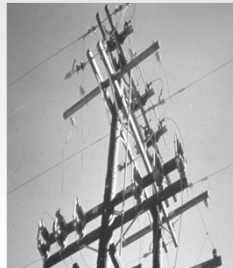


6C-10-FI210-EP

Miscellaneous: Ignition Factors

Power lines

- Transmission lines
 - Generation facility to sub-station
- Distribution lines
 - Carries power from sub-stations to the consumer.
 - Statistically more likely to cause fires than transmission lines.



6C-11-FI210-EP

Miscellaneous Ignition Factors

Power lines

- Various hardware used
 - Switches
 - Splices
 - Fuses
 - Insulators
 - Connectors
 - Reclosers
- Failure of conductors and hardware
- General familiarity important
- CAL FIRE Power line Equipment Identification Pocket Guide



6C-12-FI210-EP

Miscellaneous: Ignition Factors

Power lines

Will look at commonly encountered ignition factors.

- Conductor failure/faulting
- Insulator failure
- Miscellaneous hardware failure
- Birds/small mammals
- Mylar balloons



6C-13-FI210-EP

Miscellaneous: Ignition Factors

Power lines

Conductor failure or faulting

- Breaks, falls to the ground, arcs, and starts fire
 - Splice or connector fails
- Contacts or comes close to adjacent phase or vegetation and faults/arcs.
 - Line sag due to increased load, high winds, heat, bird flocks.
- Initial fault may not start fire; may occur with automatic reclosing of the circuit.



6C-14-FI210-EP

Miscellaneous: Ignition Factors

Power lines

Conductor failure or faulting is usually obvious.

- Charred vegetation
- Line down or intact
- Pitting and staining on conductor
- Blowholes at base of tree
- Resistance scarring on tree
- Fulgurites at point of discharge



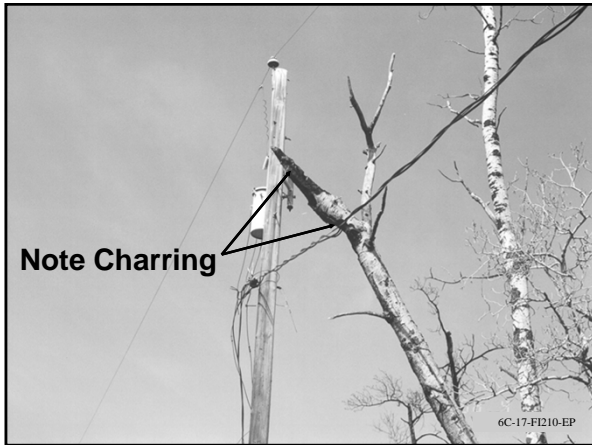
6C-15-FI210-EP

Arc Charring on Branch



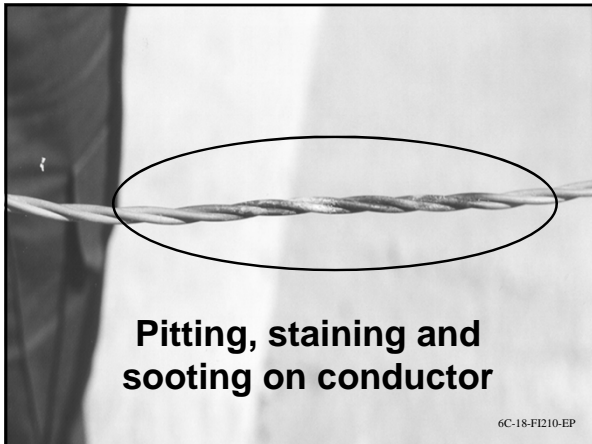
6C-16-FI210-EP

Note Charring



6C-17-FI210-EP

**Pitting, staining and
sooting on conductor**



6C-18-FI210-EP

Blowhole near base of tree



6C-19-FI210-EP

Electrical resistance scar on tree trunk



6C-20-FI210-EP

Miscellaneous: Indicators

Power lines - Conductor Failure

Fulgurites

- Power line discharges to ground may leave fulgurites.
- Shape and size may be different than lightning fulgurites.



6C-21-FI210-EP

Miscellaneous: Indicators

Power line - Insulator Failure

- Variety of insulators.
- Keep conductor from making grounding contact.
- Failure can result in arcing to the pole or other hardware.
- Fire often on crossarm and/or pole.



6C-22-FI210-EP

Miscellaneous: Indicators

Power line - Insulator Failure

- Dirt
- Bird manure
- High humidity
- Salt deposits (sea air)
- Lightning strikes
- Over-voltage
- Deliberate damage
- Current arcs
- Insulators or crossarm fail and drop conductor



6C-23-FI210-EP

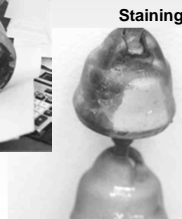
Power line Insulator Failure



Voltage tracking



Blown Insulators



6C-24-FI210-EP

Miscellaneous: Indicators

Power lines - Other Hardware

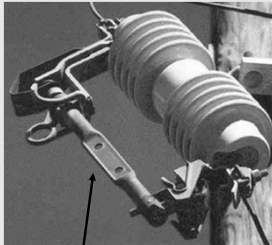
Non-exempt

- Fuses
- Disconnects
- Lightning arrestors
- Clamps
- Connectors

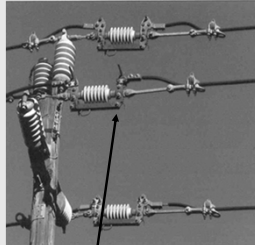


6C-25-FI210-EP

Disconnects



Solid blade disconnect



Inline disconnect

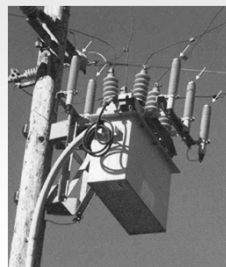
6C-26-FI210-EP

Miscellaneous: Indicators

Power lines - Other Hardware

Lightning Arrestors

- To protect equipment
- Hot fragments



6C-27-FI210-EP

Miscellaneous: Indicators

Power lines - Other Hardware

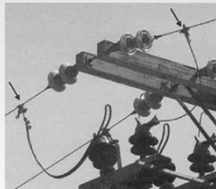
Connectors and clamps

- Connect conductors and jumpers
- Arc potential when loose
 - Hot tap clamps
 - Split bolt connectors
 - LM connectors
 - Fargo connectors



6C-28-FI210-EP

Connectors and Clamps



Hot tap clamps

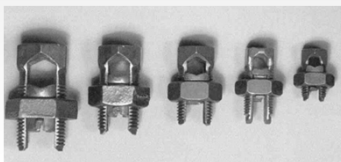


Hot tap clamps

6C-29-FI210-EP

Connectors and Clamps

Split bolt connectors

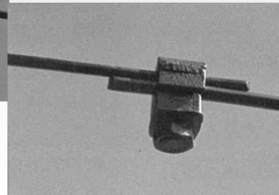
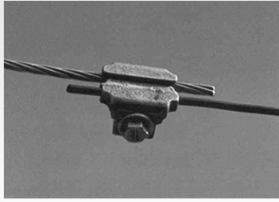


Split bolt connectors

6C-30-FI210-EP

Connectors and Clamps

LM connector



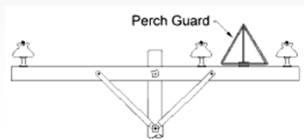
Fargo connector

6C-31-FI210-EP

Miscellaneous: Indicators

Power lines - Birds and Small Mammals

- Contact with two phases or transformer and jumper
- Arc and catch fire
- *Is the utility company responsible for fires started by animals or birds?*



6C-32-FI210-EP

Miscellaneous: Investigation Techniques

Power lines

General Investigation Considerations

- Documentation and validation - critical
 - Photographs
 - Physical evidence
 - Measurements
- Repair crews might leave with evidence
 - Consent or warrant if necessary
- Most line crews will cooperate
 - Interview



6C-33-FI210-EP

Miscellaneous:

Investigation Techniques

Power lines

General Investigation Considerations

- Collect all evidence.
 - Hardware
 - Forensic evaluation
- Secure all relevant records from utility company.
 - Consider sending preservation letter
 - Maintenance
 - Current flow/faults
 - Hazard reduction
 - » Poles are numbered and coded for reference.




6C-34-FI210-EP

Miscellaneous:

Investigation Techniques

Power lines

General Investigation Considerations

- Document any violations of vegetation clearance.
 - Establish right-of-way boundaries.
- Obtain Forensic Electrical Engineer
 - Specializes in powerline related analysis.

6C-35-FI210-EP

Miscellaneous

Power line Safety

- Use extreme caution working under lines.
- Assume conductor is charged.
- Smoke and/or water spray can cause arcing.
- Never climb a pole.
- Wait for the arrival of utility crews to make line safe.
- Look up, look out and stay away.

6C-36-FI210-EP

FI-210, Wildland Fire Origin and Cause Determination

Unit 6 – Ignition Factors and Sources

Lesson 6D – Miscellaneous (continued)

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Miscellaneous: Ignition Factors

Fireworks

- May be classified in several different ways.
 - Depending upon jurisdiction
- Examine function and ignition.
 - Ground based and hand-held
 - Aerial
 - Explosive



6D-3-FI210-EP

Miscellaneous: Ignition Factors

Fireworks

- Ground based and handheld
 - Emit flame and sparks
 - Adjacent flammable vegetation can easily ignite.
- Types:
 - Base fountains
 - Cone fountains
 - Sparklers
 - Roman candles
 - Wheels and spinners
 - Smoke bombs



6D-4-FI210-EP

Miscellaneous: Ignition Factors

Fireworks

- Aerial
 - Explode or aerial flash
 - May land in flammable vegetation.
 - May ignite vegetation at launch site.
 - May start a fire some distance from launch site.
- Types:
 - Bottle rockets
 - Parachutes
 - Wings
 - Mortars



6D-5-FI210-EP

Miscellaneous: Ignition Factors

Fireworks

- Explosives
 - Flash powder charge
 - Can start fires.
 - Flaming paper particles may start fire immediately adjacent to blast area.
 - Strings or bricks of firecrackers or larger devices more likely:
 - Firecrackers
 - M-80 types
 - Cherry bombs



6D-6-FI210-EP

Fireworks Evidence



Sparklers



Base fountain



Firecracker fragments

6D-7-FI210-EP

Miscellaneous: Investigation Techniques Fireworks

- Ignition area and perimeter search
- Identify responsible party
- Witnesses
- Forensic examination
- Possibility of deliberate arson



6D-8-FI210-EP

Firearms and Ammunition



6D-9-FI210-EP

January 2013 U.S. Forest Service Testing

- Tests conducted using fourteen different rifle rounds, including steel, lead, and copper bullet components.
- Target was hardened steel plate with oven-dried peat moss.
- Ignitions were consistently observed with bullets made from steel components (core or jacket) and solid copper.
- Bullet weight did not effect the likelihood of ignition.
- Some bullet fragments exceeded 1,400° F.
- Lead core/copper jacket less likely to cause ignition.

6D-10-FI210-EP

Miscellaneous: Ignition Factors Firearms and Ammunition

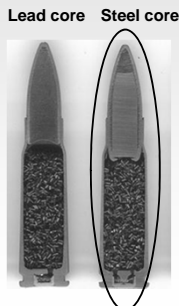
- **Blackpowder**
 - Direct discharge into flammable vegetation
 - Flaming patch material
- **Projectiles**
 - Steel core AP
 - Incendiary
 - Tracer
 - Steel component
 - Lead core/copper jacket
 - Shotgun shells/flame
 - Other



6D-11-FI210-EP

Miscellaneous: Ignition Factors Firearms and Ammunition

- **Steel core (AP)**
 - Chinese or Russian surplus
 - .223/ 5.56 and 7.62x39 mm most common
 - Interior steel shank
 - Strike metal or rocks
 - True AP black or silver tip
 - Copper plated steel jackets
 - Magnet may not detect due to copper jacketing
 - X-ray



6D-12-FI210-EP

Miscellaneous: Ignition Factors Firearms and Ammunition

- **Incendiary**
 - Start fire upon impact
 - Phosphorous auto-ignites
 - Competent ignition source
 - Military incendiary
 - Purple or blue tip
 - Available commercially
 - Various calibers
 - Dragon's Breath



6D-13-FI210-EP

Miscellaneous: Ignition Factors Firearms and Ammunition

- **Tracer**
 - Chemical mixture that burns briefly when fired.
 - Magnesium, strontium nitrate and oxidizer (calcium peroxide)
 - Available commercially
 - Military tracer
 - Red or orange tip



6D-14-FI210-EP

Miscellaneous: Indicators Firearms and Ammunition

- **Exploding Targets**
 - Explode upon impact of projectile sending out hot particles.



Investigator Safety Issues



6D-15-FI210-EP

Miscellaneous: Indicators Firearms and Ammunition

Exploding Targets

Examples of brand names that may be at ignition area or in possession of shooters:

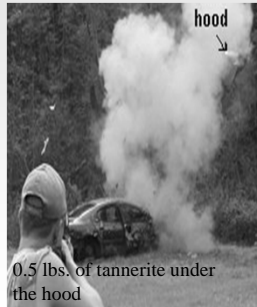
- Tannerite
- Star Targets
- Sure Shot
- Kick-Ass exploding targets

6D-16-FI210-EP

Miscellaneous: Indicators Firearms and Ammunition

• Exploding Targets

- Physical Evidence at Scene
 - Debris field
 - Tiny white pellets
 - Container fragments
 - Packaging material
 - Pieces of plastic
 - Blast damage
 - Shell casings
 - Duct tape
 - Plastic baggies
 - Soda bottles



6D-17-FI210-EP

Miscellaneous: Indicators Firearms and Ammunition

Evidence of shooting activity:

- Metal appliances
- Car bodies
- Rocks near ignition area
- Ammo boxes
- Cartridge cases
- Spent rounds
- Bullet strikes
- Targets



6D-18-FI210-EP

Miscellaneous: Investigation Techniques Firearms and Ammunition

- Physical evidence at scene
 - Locate spent casings
 - Metal detector
 - Laboratory evaluation
- Witnesses



6D-19-FI210-EP



Cutting, Welding and Grinding

6D-20-FI210-EP

Miscellaneous: Ignition Factors Grinding, Cutting, Welding

- Industrial operation
 - May be residential
- Hot metal fragments or sparks
- Finely particulated fuelbed
- Particles will often burrow
 - Smoldering fire
- Welder may be unaware
- Welding particles generally within 10 feet
- Grinding particles may exceed 40 feet
- Larger particles more competent ignition source



6D-21-FI210-EP

Miscellaneous: Indicators Grinding, Cutting, Welding

- Physical evidence at origin:

- Slag
- Flux rods
- Metal fragments
- Discarded grinder discs
- Welding cart wheel impressions
- Fire extinguisher discharge residue or other evidence of attempted suppression



6D-22-FI210-EP

Miscellaneous: Investigation Techniques Grinding, Cutting, Welding

- Evidence of welding
- Interview
 - Witnesses and employees
- Document weather conditions
- Permit compliance (if required)
- Magnet or metal detector to locate fragments



6D-23-FI210-EP

Spontaneous Heating



6D-24-FI210-EP

Miscellaneous: Ignition Factors
Spontaneous Heating

Three categories:

- 1) Material with low ignition temperature that will ignite when exposed to air.
- 2) Material that undergoes rapid oxidation at normal temperatures and generates heat.
- 3) Organic materials ignite as result of biological and chemical reaction.

6D-25-FI210-EP

Miscellaneous: Ignition Factors
Spontaneous Heating

- Wood residue piled to 24" or greater
- Moist/green material
- Bacterial inoculation through soil mixing
- Compacting
- Bacterial process raises core temperature to approximately 100 °F.



6D-26-FI210-EP

Miscellaneous: Ignition Factors
Spontaneous Heating

- High air temperature
- High relative humidity
- Bacterial die-off raises core temperature to 160 °F.
- Chemical reaction
- Thermal feedback causes pile collapse, oxygen intake.



6D-27-FI210-EP

Miscellaneous: Indicators Spontaneous Heating

- Pile of green material at ignition area.
- Direct exposure to sun.
- Witnesses reporting bad odors and/or steam.
- Slime/mold/toadstools
- Creosote-like substance oozing out of bottom of pile.



6D-28-FI210-EP

Miscellaneous: Investigation Techniques Spontaneous Heating

- Interview witnesses/workers.
- Examine other unburned piles in area.
- Forensic evaluation



6D-29-FI210-EP

Miscellaneous

Coal Seam Fires

- Coal seam may be ignited by lightning, wildfires, or other ignition sources.
- Fire burns slowly along the seam.
- Resurfaces when seam nears surface and surface cracks, oxygen reaches the burning seam.
- Dangerous to investigate.
- Visible in winter with steam plumes and random bare patches in snow.
- Dead vegetation.



Electric Fences



6D-31-FI210-EP

Miscellaneous: Ignition Factors Electric Fences

- “Weed-clipper” type most likely to ignite fire.
- Late-spring/early summer occurrence.
 - Vegetation contacts wire.
- Wire is wrapped around or contacts tree limb or wooden fence post.
- Fires can occur from both braided wire as well as solid wire.



6D-32-FI210-EP

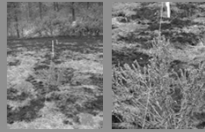


Wire wrapped around tree trunk

6D-33-FI210-EP

Miscellaneous: Circumstances Electric Fences

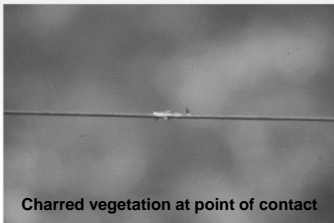
- Burned-off stubble
- Vegetation contact
- Underwriter Lab approved control heads are not as likely to start fires.



6D-34-FI210-EP

Miscellaneous: Circumstances Electric Fences

- Ignition area near or along fence line.
- Wire contact with vegetation.
- Non UL approved control head.



Charred vegetation at point of contact

6D-35-FI210-EP

Miscellaneous: Investigation Techniques Electric Fences

- Forensic evaluation at scene by qualified electrical engineers before dismantling.
- Additional lab testing.



6D-36-FI210-EP

Reflective Glass and Magnifying Objects



6D-37-FI210-EP

Miscellaneous: Ignition Factors Reflective/Magnifying

- Objects known to have caused fires
 - Cut crystal
 - Clear glass bottles filled with clear liquid
 - Headlight lenses
 - Mirrors
 - Old window glass (bubbled)
 - Unfrosted aerosol can bottoms
 - Polished metal



Cut-crystal wine glass base

6D-38-FI210-EP

Miscellaneous: Investigation Techniques Reflective/Magnifying

- Determine probable ignition time.
- Document precise location, periods of exposure and orientation of the object to the sun.
- Test object for its ability to focus sun's rays.
- Recreate placement and fuelbed to determine ignition probability.

6D-39-FI210-EP

Miscellaneous: Ignition Factors
Blasting

- Fire started by flaming debris associated with blasting activity.
- Near or in blast perimeter
- Fire start may be delayed due to smoldering combustion.



6D-40-FI210-EP

Miscellaneous:
Investigation Techniques
Blasting

- Establish presence of blasting activity prior to fire.
- Permits/fire suppression requirements.
- Attempt to recover foreign debris/material at ignition area.

6D-41-FI210-EP

Miscellaneous: Ignition Factors
Flares

- Mishandled or improperly placed
- Hot cast-off material
- Chemical compound contained in cardboard tube
- Highly competent ignition source
- Sometimes used as ignition source by arsonists



6D-42-FI210-EP

Miscellaneous: Ignition Factors Flares

- **Aerial signal flares**
 - Sold as emergency signaling device.
 - Some use standard caliber firearms.
- **Flare guns**
 - Military surplus
 - Boating use
 - Used for prescribed fire by some agencies.



6D-43-FI210-EP

Miscellaneous: Investigation Techniques Flares

- Multiple flares along road edge.
- Grayish-white slag
- Ignition area adjacent to road edge.
- Slag will test positive for strontium nitrates.



6D-44-FI210-EP

Miscellaneous: Ignition Factors Oil and Gas Fires



- **Petroleum product flare stack/flare pit**
 - Natural gas/oil
 - Wells and processing facilities
 - Flares fired to ignite gas can start fire
 - Stack can “burp” and start fire
 - Flames and/or carbon particles ignite adjacent fuels

6D-45-FI210-EP

Miscellaneous: Ignition Factors Oil and Gas Fires

- Crude oil storage tank fires
 - Crude oil storage tanks
 - Carbon particles ignite adjacent wildland fuels.



6D-46-FI210-EP

Miscellaneous: Investigation Techniques Oil and Gas Fires

- Evidence of burning on stack
- Ignition area in adjacent vegetation
- Lack of clearance
- Carbon soot particles
- Records
- Igniter flare residue
- Ignition area may be downwind
- Forensic evaluation of material in ignition area



6D-47-FI210-EP

Flying Lanterns

- Miniature hot air balloon made from paper, bamboo and wire with a solid fuel package.
- Capable of traveling great distances when released.
- Commercial and homemade



6D-48-FI210-EP

Miscellaneous: Investigation Techniques Flying Lanterns

- **Physical Evidence**

- Wire frame
- Pieces of bamboo
- Paper remains or ash
- Fuel package



6D-49-FI210-EP

Miscellaneous Ignition Factors Wind Turbines

- **Common Failures**

- Lightning strikes
- Gear box failures
- Brake failure
- Bearing failure
- Blade failure
- Generator failure
- Construction and maintenance
- Bird Strikes



6D-50-FI210-EP

Miscellaneous

- **Home outdoor wood burning furnaces.**
- **Two major causes:**
 - Discarded ash.
 - Lack of maintenance of the chimney.



6D-51-FI210-EP

Review Unit 6 Objectives

- 1. Define various terms associated with fire causes.**
- 2. List the nine national standard cause categories.**
- 3. Describe the ignition factors and sequences that are normally associated with each cause.**

6D-52-FI210-EP

Review Unit 6 Objectives

- 4. Describe the various indicators and physical evidence associated with each cause.**
- 5. Outline specific investigation methods unique to each cause.**

6D-53-FI210-EP

FI-210, Wildland Fire Origin and Cause Determination

Unit 7 – Arson Recognition

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Unit 7 Objectives

1. Define arson.
2. Describe the difference between arson and incendiary.
3. List the reasons why it may be difficult to solve wildland arson.
4. Identify arson investigation objectives.
5. Describe the indicators that identify an arson incident.
6. Recognize and describe a variety of arson ignition sources.

07-2-FI210-EP

Unit 7 Objectives

7. Identify the six arson motive categories and their subsets.
8. Describe the psychology of arson.
9. Describe the classification of arsonists.
10. Identify the general profiles and behavioral characteristics of the serial arsonist.
11. Describe how to identify and preserve evidence at the scene.
12. Describe notification and referral procedures to law enforcement.

07-3-FI210-EP

Definitions

Arson vs. Incendiary: Is there a difference?

***ARSON:** The intentional and wrongful burning of someone else's property or one's own property (as to fraudulently collect insurance).

***INCENDIARY:** Deliberately and unlawfully set fire to property.

**Black's Law Dictionary, 9th Ed. 2009*

NOTE: *These terms are often used interchangeably, but it depends on jurisdictional interpretation.*

07-4-FI210-EP

Definitions

Arson is a Criminal Act

A Felony, punishable by:

- Imprisonment of one year or more
- Fine



07-5-FI210-EP

Introduction

- Arson may account for over 20% of all human-caused wildland fires.
- 70% in some jurisdictions.
- Probable that many arson fires are going unrecognized.
- "Undetermined cause" should not be categorized as arson.

07-6-FI210-EP

Introduction

- **Mythology surrounding serial wildland fire-setting.**
 - Based on anecdotal information not supported by research.
 - Institutionalized through “war stories” and training.
 - Myth vs. Reality.

07-7-FI210-EP

Introduction Serial Arson

Myths:

- Numerous big fires that occur in rapid succession over short period.
- Elaborate and sophisticated devices.
- No physical evidence at the scene.
- Random and unpredictable incidents.
- Highly skilled and sophisticated offenders.

Reality:

- Small fires that may escalate in both frequency and severity.
- No ignition source or a single match.
- Physical evidence at the scene.
- Recognizable and predictable patterns.
- Unskilled and unsophisticated offenders.

07-8-FI210-EP

Introduction

- The average serial arsonist is charged with 2.7 counts and convicted on 2.5 counts.
- Suspected of setting an average of 35 fires before being apprehended.

WHY????

- Origin and cause determination
- Evidence collection
- Linkage blindness

07-9-FI210-EP

Introduction

Early identification of an arson series is critical because:

- Every fire set has potential for tragic consequences.
- Fires may tend to escalate in frequency and/or severity.
- Fires increase resource drawdown.



07-10-FI210-EP

Introduction

Arson may be a challenging crime to solve and prosecute due to a number of factors.

Arsonists:

- Work alone.
- Conceal their activities to avoid detection.
- Flee the scene.
- Leave little obvious physical evidence.
- Rarely confide in others regarding their activities.
- Appear to function in a random and unpredictable manner.



07-11-FI210-EP

Introduction

Factors continued:

- The commission of the crime is short in duration.
- Fire suppression activity may destroy or obscure evidence.
- Eyewitnesses to the crime are uncommon.
- Many prosecutors have little or no experience with wildland arson cases.
- Arson motives may appear to be unfathomable.



07-12-FI210-EP

Introduction

**“The real problem occurs when...
investigators accept this bleak
outlook as though it were fact...
It has been our experience that most
arson fires are not only possible to
solve, in many cases, average arson
fires are very easy to solve.”**

(Corry and Vottero 1997)

07-13-FI210-EP

Introduction

Arson Investigation Objectives

- The role of the origin and cause determination investigator (INVF) is normally different than that of the investigator responsible for case development (INTM).
- Understand your agency policy.



07-14-FI210-EP

Introduction

Case Developer's Role (INTM)

- Link apparently unconnected fires together.
 - Physical evidence
 - Pattern analysis
- Develop investigation plan to identify the person responsible.
 - Forensic evidence
 - Behavioral evidence
 - Observation of fire setting
- Arrest and charge.
- Bring them to trial.

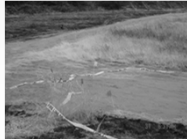


07-15-FI210-EP

Introduction

Wildland Fire Investigator's Role (INVF)

- Examine and analyze the fires you respond to for an indication of arson.
- Protect and secure the area of origin, surrounding area and evidence.
- Notification.
- Confidentiality.
- Assist as requested.



07-16-FI210-EP

Introduction

Indication of an Arson Incident

- Many arson fires go unrecognized.
 - Lack of overt evidence
 - Linkage blindness
- The INVF is in the best position to detect arson pattern in early stages.
 - Awareness of indicators
 - Familiar with fire occurrence patterns

07-17-FI210-EP

Introduction

Indication of an Arson Incident

Often multiple sets may occur:

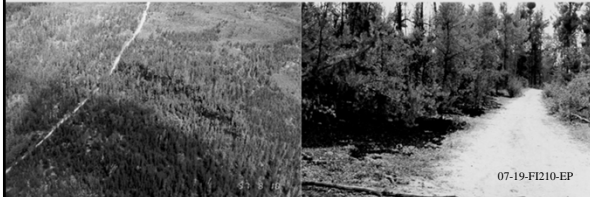
- In same day.
 - Spree arson
- Over weeks or months or even years.
 - Serial arson
- In close proximity to each other.
- Long distance apart.
- In same or different agency jurisdictions.

07-18-FI210-EP

Introduction

Indications of an Arson Incident

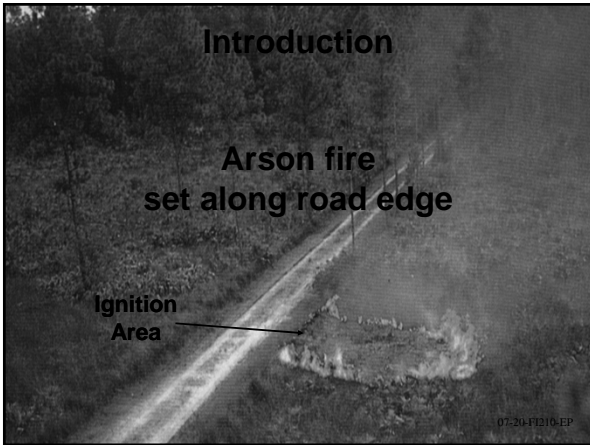
- Majority are accessed by motor vehicle.
 - Roads, ATV trails, power line ROW, etc.



Introduction

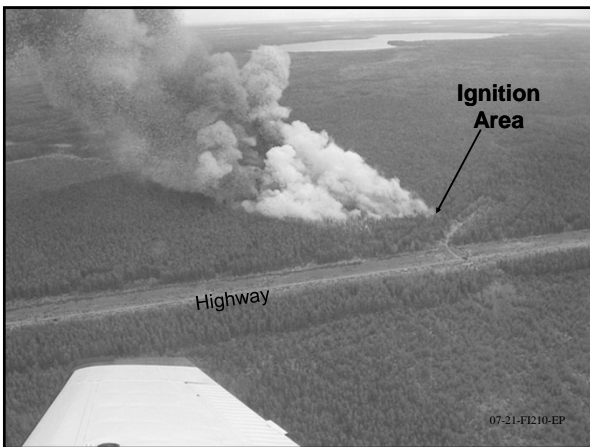
Arson fire set along road edge

Ignition
Area



Ignition
Area

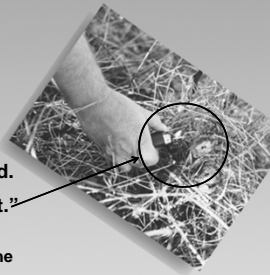
Highway



Introduction

Indications of an Arson Incident

- Recent occurrence of undetermined cause fires in area exceeding normal fire history.
- Fires with no evidence of an ignition source.
- Delayed ignition devices found.
- Many arson starts are “hot-set.”
 - Investigator must address other potential reasonable causes in the area of the origin.



07-22-FI210-EP


Introduction

Patterns and Linkages


- Fires may be connected by common patterns.
- Linking factors:
 - Chronological
 - Geographical
 - Target Selection
 - MO
- *Example: Five fires occurring on Tuesdays and Saturdays, between 1400 and 1600 hours, on the same road system, paper match recovered on two of them.*
- *Are they all connected?*

07-23-FI210-EP


First fire...




Second fire...



Third fire...



Fourth fire...



Can you identify common denominators that link these fires?

07-24-FI210-EP

Introduction

Arson Ignition Sources

- Determination of the ignition source is an important aspect of the investigation.
- Investigators should be aware of the various ignition sources.

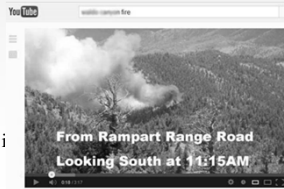


07-25-FI210-EP

Introduction

Arson Ignition Sources of Information:

- Publications
- Internet
- Social Media



Google



07-26-FI210-EP

Introduction

Arson Ignition Sources

Ignition sources may be characterized by how they are ignited:

- Electrical reaction
- Chemical reaction
- Mechanical reaction

Use origin and cause determination methodology to locate ignition devices located in ignition area.

07-27-FI210-EP

Introduction

Arson Ignition Sources

Electrical and chemical arson devices

- Relatively uncommon in wildland arson cases.

Mechanical devices are much more common.




07-28-FI210-EP

Introduction

Ignition sources may be further characterized by:

- Ignition Function
 - Hot set
 - Timed
- Delivery Method
 - Direct
 - Remote




07-29-FI210-EP

Introduction

Ignition Function

Hot Set



- Any open flame applied directly to available fuels.
- May be left at origin or removed.
- Recent USFS research:
 - Approximately 80% of the offenders studied used a hot set device.
 - Offender may add to rearrange or modify fuels to aid in ignition.

07-30-FI210-EP

Ignition Function



07-31-FI210-EP



Not all arson
fires are lit on
the ground

Branch
ignited 5' off
ground

07-31-FI210-EP

**Draped moss makes excellent host
fuel material for hot set**



07-31-FI210-EP

Introduction

Ignition Function

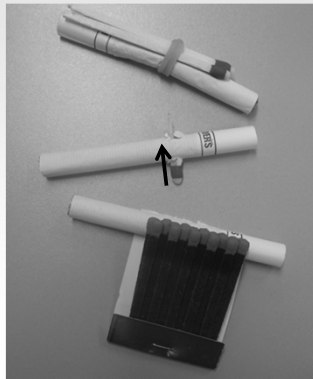
Timed Ignition Sources

- Incorporates a timer or delay mechanism.
- Provides opportunity for the offender to flee scene (time-delay).
- Cigarette and match or matchbook.
 - (Slow match)
 - Most common wildland time-delay device



07-34-FI210-EP

Arson – Cigarette Match Device



07-35-FI210-EP

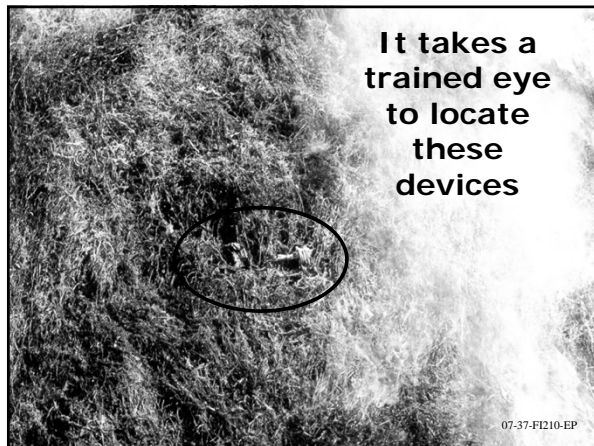
Introduction

Ignition Function

Timed Ignition Sources

- Device may be weighted to enhance remote delivery.
- Weight may be hidden under ash or lying nearby.
- Examine area carefully.
- Objects used as weights can include: coins, rocks, nails, nuts, bolts, washers, or any other small, heavy object.

07-36-FI210-EP





Introduction

Ignition Delivery Method

- Remote
 - Launched from a distance by hand or mechanical means.
 - Hot set or timed ignition source.
- Direct
 - Hand-carried and placed.
 - Hot set or timed ignition source.

07-39-FI210-EP

Introduction

Less Common Arson Ignition Sources

- Charcoal briquettes
- Cotton rope
- Incense sticks
- Firework punks
- Mosquito coils
- Paper wrapped around a rock
- Punky logs or stumps
- Exploding targets
- Ping pong ball/gunpowder

07-40-FI210-EP

Introduction

Less Common Arson Ignition Sources

- Concave shaving mirror
- Commercial slash burning or backfiring devices
- Magnifying Glass
- Railroad or highway flares
- Candles
- Tracer/incendiary bullets

07-41-FI210-EP

Introduction

Less Common Arson Ignition Sources

Accelerant

- Ignitable liquid used to accelerate fire spread and intensity.
- Not common in wildland arson cases.
 - 23% of convicted arsonists used it at least once.
- Should be looked for routinely.



07-42-FI210-EP

Introduction

Arson Motives

- **Motive:** The reason why someone commits a crime.
 - Does not need to be proven.
 - Motive is often relevant to the investigation and prosecution .
- Motive is an emotional, psychological or material need that impels and is satisfied by a specific behavior, *i.e.*, setting fires.
- Most wildland fire setting is motivated by an emotional or psychological need.

07-43-FI210-EP

Introduction

Arson Motives

FBI classifies arson into six major motive categories, with seven subsets:

- Retaliation/Revenge
- Excitement
- Profit
- Vandalism
- Crime Concealment
- Extremism/Terrorism

07-44-FI210-EP

Introduction

Arson Motives

Retaliation/Revenge

- Retaliation for a perceived injustice or wrong against the offender.
- Subsets include:
 - Individual
 - Societal
 - Institutional
 - Group



07-45-FI210-EP

Introduction

Arson Motives

Excitement

- Fires set to satisfy an emotional need to create excitement.
- Subsets include:
 - Thrills
 - Attention
 - Recognition
 - Primary motive for firefighter arson.



07-46-FI210-EP

Introduction

Arson Motives

Profit

- Planned to maximize property damage and not hurt people.
- Insurance fraud.
- Fireline arson.
- Fire-setting firefighter or contractor motive.



*"The blacker the forest,
the greener the wallet."*

07-47-FI210-EP

Introduction

Arson Motives

Vandalism

- Nuisance type fires.
- Simply for destructive purposes.
- Young male offenders.
- May have an accompanying pattern of nuisance or school related fires in nearby town.
- Equipment in woods may be targeted.



07-48-FI210-EP

Introduction

Arson Motives

Crime Concealment

- Fire set to destroy the evidence of the primary crime.
 - Homicide
 - Vehicle theft
- Scene security and evidence protection is particularly vital.



07-49-FI210-EP

Evidence of the primary crime should be identified and protected.



07-50-FI210-EP

Introduction

Arson Motives

Extremism/Terrorism

- Fires motivated by political agendas.
- In U.S., radical environmentalists have been associated with this activity.
- Potential for non-domestic terrorism.



07-51-FI210-EP

Introduction

Arson Motives

Mixed Motives

- Serial arsonists may have a mixture of motives. Power maintenance and anger may be underlying motivations for many arsonists.
- Investigators should consider both primary and secondary motives.

07-52-FI210-EP

Introduction

Miscellaneous Fire Setters

While not actually motives, the following groups often act with consistent motives. Indicators associated with these groups may also appear consistently.

- Firefighter
- Juvenile
- Mentally disturbed
- Female
- Cultural



07-53-FI210-EP

Introduction

Psychology of Arson

- Many mental health experts disagree on the mental state of arsonists.
- Motivated by:
 - Criminal intent
 - Manifestation of an underlying mental illness
- Investigator should focus on identifiable criminal motives.
- Investigator should not attempt to diagnose the mental state of the offender.

07-54-FI210-EP

Introduction

Psychology of Arson

- Many offenders state they would have continued lighting fires even if they had known they were going to be apprehended.
- Fire setting may restore a feeling of power and control to offender who has little of either in his or her life.

07-55-FI210-EP

Introduction

The themes that consistently appear in psychological research and evaluations:

- Poor social adjustment skills.
- Anger expressed as retaliation.
- Feeling of helplessness/lack of power.
- Low self-esteem in general.
- Victimized by society.
- The fire-setting behavior is a response learned at an early age.
- Compulsive behavior.

07-56-FI210-EP

Introduction

Classification of Arsonists

- Single Arsonist - an offender who sets a single fire then ceases.
- Spree Arsonist - an offender who sets fires at three or more separate locations with no emotional cooling-off period in between the fires.
- Serial arsonist - a person who sets three or more fires, at either the same or different locations, with an emotional cooling-off period between the incidents.

07-57-FI210-EP

Introduction

Behavior Characteristics of Serial Wildland Arsonists

- Will normally set fires primarily to vegetation, but may set fire to vehicles and structures.
- 90+% operate within their comfort zone.
- Often a precipitating stressor prior to fires.
- Approximately 40% set fires exclusively in daylight.
- Most drive to scene.
- May remain on scene to watch fire or participate.
- May remain nearby and watch from vantage point.
- May return to crime scene.

07-58-FI210-EP

Introduction

Your Role as an INVF at a Suspected Arson Scene

- Follow agency policy.
- Scene security and protection.
- Request additional investigative resources as necessary.
- Conduct origin investigation.
- Collect evidence in accordance with agency policy.
- Determine cause and ignition sequence.

07-59-FI210-EP

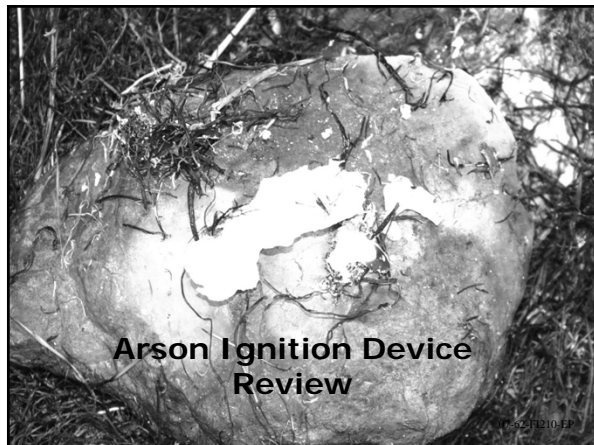
Introduction

Arson Ignition Device Review

The following slides show various ignition devices as they were discovered at the scene, followed by photos of the pre-fire ignition device.

07-60-FI210-EP










Introduction

Flare

- **Normally very obvious**
 - May be buried under ash debris.
- **Hot set**
 - Can be thrown from vehicle or hand carried.
- **Time delay**
 - Balanced on rock or placed in partially cleared area.



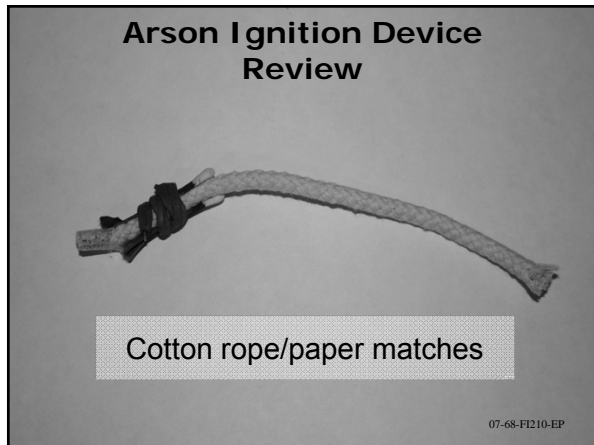
07-65-FI210-EP



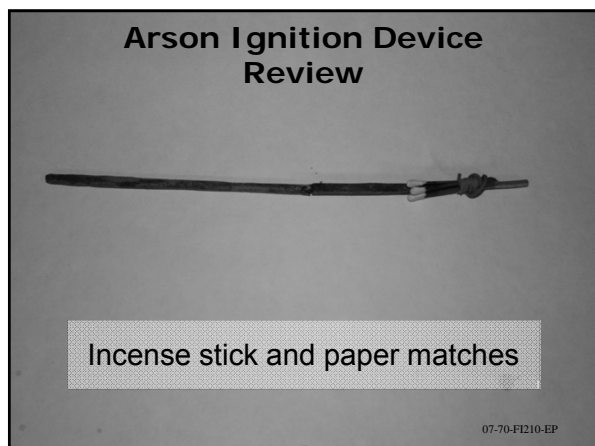
Suspect may have burn holes/residue on car upholstery or on clothing/shoes from flare/fusee slag.

07-66-FI210-EP

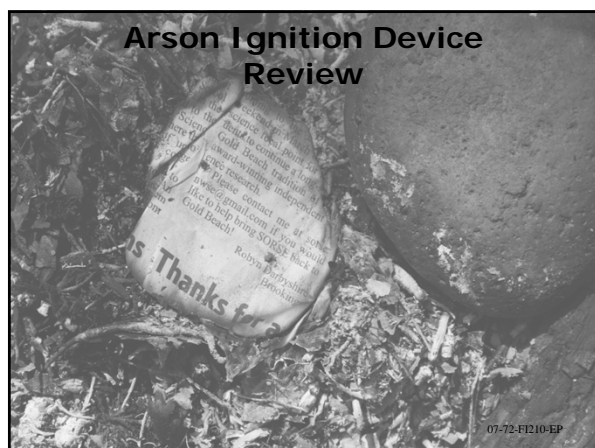














Determination of Arson

Determination of Arson

- Once a determination of arson is made, proceed within the limitations of your role and authorities.
- Make the necessary referrals according to your agency policy.
- Remember to maintain strictest confidentiality: "Need to know."
- Do not release any information to the public, media, or non-assisting agency.

07-74-FI210-EP

Review Unit 7 Objectives

1. Define arson.
2. Describe the difference between arson and incendiary.
3. List the reasons why it may be challenging to solve wildland arson.
4. Identify arson investigation objectives.
5. Describe the indicators that identify an arson incident.
6. Recognize and describe a variety of arson ignition sources.

07-75-FI210-EP

Review Unit 7 Objectives

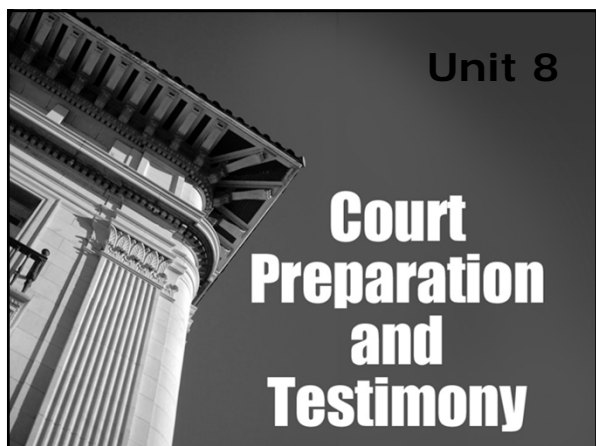
- 7. Identify the six arson motive categories and their subsets.**
- 8. Describe the psychology of arson.**
- 9. Describe the classification of arsonists.**
- 10. Identify the general profiles and behavioral characteristics of the serial arsonist.**
- 11. Describe how to identify and preserve evidence at the scene.**
- 12. Describe notification and referral procedures to law enforcement.**

07-76-FI210-EP

FI-210, Wildland Fire Origin and Cause Determination

Unit 8 – Court Preparation and Testimony

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Review Unit 8 Objectives

1. Identify key steps in the civil and criminal litigation processes.
2. Explain the relationship between the investigation report and testimony.
3. Define "expert witness" and "fact witness."
4. Describe the role of an expert witness.
5. Describe the "expert witness" *voir dire* process.
6. List the elements of a *curriculum vitae*.
7. List the principles an investigator should follow when testifying.

08-2-FI210-EP

DISCLAIMER & CAUTION

- NFPA 921 and FI-210 are only suggested guidelines; they are not required procedures.
- Every case will be different and requires professional judgment on what investigative techniques will be used.

08-3-FI210-EP

This Could Happen to You!

- Witness for prosecution.
- Witness for defense.
- Witness in lawsuit between 3rd parties that relied on your report.
 - Check with agency as to being a witness when the agency is not a party.
 - Many federal agencies have Touhy regulations prohibiting employees from testifying absent:
 - Specific government interest; and
 - With written permission of agency head.

08-4-FI210-EP

Example – EPA’s *Touhy* Regulations

40 C.F.R. § 2.404

Procedures when an employee is subpoenaed:

- (a) Copies of subpoenas must immediately be sent to the General Counsel . . . , with the recommendations of the employee's supervisors. The General Counsel determines whether compliance with the subpoena would clearly be in the interests of EPA. . . .
- (b) If the General Counsel . . . denies approval to comply with the subpoena. . . the employee must appear at the stated time and place . . . , produce a copy of these regulations and respectfully refuse to provide any testimony or produce any documents.

08-5-FI210-EP

Federal Employees Acting In Official Capacity:

- If you receive a subpoena regarding matters within the scope of your official duties.
- Fact and jurisdiction driven criteria.
- Do not assume subpoena is valid.
- Do not ignore it either.
- Contact your supervisor and your legal staff before taking any action.

08-6-FI210-EP

The Civil Process

Pre-Trial

- **Complaint**
 - Plaintiff presents theory of case and hoped for remedy.
- **Answer**
 - Defendant's Response.
 - Affirmative Defenses.
- **Discovery**
 - Both sides exchange all non-privilege relevant evidence.
 - *Over 90% of contested cases do not get past the Discovery stage.*

08-7-FI210-EP

The Civil Process

Discovery

- **Interrogatories**
 - List of written questions.
- **Requests For Production**
 - Request to produce all documentary and physical evidence.
- **Requests for Admissions**
 - Used to narrow the contested issues in a case.

08-8-FI210-EP

The Civil Process

Discovery

Depositions (Examinations)

- Questioning is similar to trial.
- Direct questions and cross examination.
- Under oath and before a Court Reporter.
- No finder of fact present.
- Counsel's objections are for the record only (you still have to answer the question –unless instructed not to answer).

08-9-FI210-EP

The Civil Process

- **Subpoenas**
 - A command by the court to present yourself for formal questioning at a deposition or for trial.
- **Subpoena duces tecum**
 - A command by the Court to bring with you to the above questioning all requested documentation.
- **Know your agency’s policy on responding to subpoenas.**

08-10-FI210-EP

The Civil Process

Trial

- **Settlement Conference**
 - Local rules
 - Court ordered
 - Required by law
- **Pre-Trial Motions**
 - Summary Judgment
 - Dismiss
 - Suppress evidence

08-11-FI210-EP

The Civil Process

Trial

- **Voir Dire**
 - Qualifying expert witnesses.
 - Selecting a jury if jury trial.
- **Opening Statements**
- **Testimony**
 - **Plaintiff first, then Defendant**
 - Direct - No leading questions.
 - Cross - Leading Questions “should” be limited to subject of direct.
 - Re-Direct – Damage Control.

08-12-FI210-EP

The Civil Process

Trial

- Final Motions
- Closing Arguments
- Jury Instructions
- Finder of Fact (Judge or Jury) issues verdict (judgment)
- Appeal
 - Appeals generally limited to issues of law, not findings of fact.
 - Federal system – mandatory mediation.

08-13-FI210-EP

The Criminal Process

Pre-Trial

- Indictment or Information
 - Grand jury issues “indictment.”
 - Prosecutors issue an “information.”
 - Charging crimes and the theory of case.
- Arraignment
 - Accused pleads guilty/not guilty/*nolo contendere*.
- Discovery (Generally only Prosecutor has to share evidence and information).

08-14-FI210-EP

The Criminal Process

Trial

- Pre-trial Motions
 - Suppress evidence
- *Voir Dire* (selecting a jury and/or qualifying expert witnesses)
- Opening Statements
- Testimony
- Final Motions
- Jury Instructions
- Finder of Fact (Judge or Jury) Issues Verdict

08-15-FI210-EP

The Criminal Process

Appeals

- Prosecutor can appeal almost any issue of law, but cannot appeal a verdict of not guilty, e.g., the Judge dismisses case without verdict.
- Defense can appeal any issue of law.

08-16-FI210-EP

Witnesses and Their Roles



08-17-FI210-EP

Criminal Process

Types of Evidence

- Direct (“I saw him do it”)
 - Documents
 - Eyewitnesses
- Circumstantial or indirect
 - Proof of a chain of circumstances pointing to the existence or non-existence of certain facts.
 - “Footprints in dirt now matched shoes worn by suspect.”
- Judicial Notice (“tires are round”)

08-18-FI210-EP

Criminal Process

Fact Witnesses

- Testimony based on factual observations.
- Opinions or conclusions generally not allowed.
- Most cases require fact witnesses.



08-19-FI210-EP

Criminal Process

Expert Witnesses

- Qualified by education, knowledge, skill, or experience.
- Allowed to draw inferences, form conclusions, and testify as to opinions.
- Most fire cases will require expert testimony.
- Trial court judge determines expert witness qualifications.
 - In federal court, conclusions and methodology are examined using FRE 702 (*Daubert*) criteria.

08-20-FI210-EP

Criminal Process

Federal Rules of Evidence: Rule 702 (2011 revision)

A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

- a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
- b) the testimony is based on sufficient facts or data;
- c) the testimony is the product of reliable principles and methods; and
- d) the expert has reliably applied the principles and methods to the facts of the case.

08-21-FI210-EP

Criminal Process

***Daubert v. Merrell-Dow
Pharmaceutical Company
US Supreme Court 1993***

- Testimony must be relevant.
- Testimony must be reliable.

08-22-FI210-EP

Criminal Process

Daubert v. Merrell-Dow Pharmaceuticals

To determine reliability, the trial judge acting as a “gatekeeper” may apply many factors, including but not limited to, the following tests to decide a proffered expert testimony’s “reliability.”

- Can the theory or technique be tested?
- Has the theory or technique been subjected to peer review?

08-23-FI210-EP

Criminal Process

Daubert v. Merrell-Dow Pharmaceuticals

“Reliability” tests (cont.)

- Is there a known or potential rate of error associated with this theory or technique?
- Does this theory or technique have a general acceptance in that particular discipline’s community?

08-24-FI210-EP

Criminal Process

Michigan-Miller's Mutual v. Benfield (11th circuit -1998)

- Fire investigation case in federal court.
- Tendered expert's testimony excluded:
 - Failure to meet FRE 702 (*Daubert* test) standard.
 - Did not perform any tests or take any samples.
 - No scientific basis for opinion.

08-25-FI210-EP

Criminal Process

Voir Dire: Qualifying Expert Witnesses

- First step in qualifying a proposed witness as an expert.
 - Trial within a trial.
 - Generally does not occur before jury, if a jury trial.
- Prosecution/plaintiff and defense counsel have significant freedom to question the proposed expert's qualifications.
- Expert's qualifications must be established prior to giving expert testimony.

08-26-FI210-EP

Criminal Process

Voir Dire: Qualifying Expert Witnesses

- Prosecution/plaintiff and defense counsel establishes qualifications of their respective proposed expert witnesses.
- Opposing counsel cross examines to reduce credibility of proposed expert witness.
- Expert testimony allowed by judge if minimum "*Daubert*" qualifications are met.
 - Some jurisdictions do not use *Daubert*.
- Trier of fact decides weight and credibility given to each expert's testimony.

08-27-FI210-EP

Criminal Process

Voir Dire - Curriculum Vitae

- *All proposed expert witnesses should possess an accurate and up to date "curriculum vitae."*
- *Curriculum vitae* should include:
 - Employment history
 - Training received (and passed)
 - Training conducted
 - Professional affiliations
 - Papers or publications written
 - Additional qualifications

08-28-FI210-EP

Criminal Process

Implications for Wildland Fire Investigators

- Know Your Qualifications.
 - Training or experience.
 - Do not exceed your qualifications.
- Use a systematic approach.
- Document actions and findings.
- Are your conclusions corroborated and supported scientifically?
 - Have the other reasonable potential causes been addressed, if not why not?

08-29-FI210-EP

Criminal Process

Investigation Report and Testimony

- Review case files, notes, documents, and evidence prior to testimony.
- Obtain transcripts of prior testimony to ensure consistency with other cases.
- You may use the investigative report to refresh your memory on the stand.
 - With the judge's permission.
- Be prepared!

08-30-FI210-EP

Criminal Process

Principles of Effective Testimony

For Trials and Depositions:

- **Always be on time.**
 - Actually come a little early in case there have been any legal or other developments.
- **Wear proper attire.**
 - Check with your counsel, uniforms or no uniforms.
- **Be physically and mentally prepared.**
- **Sit comfortably, but erect without slouching.**

08-31-FI210-EP

Criminal Process

Principles of Effective Testimony

For Trials and Depositions:

- **Listen and respond carefully only to the question asked.**
 - Do not volunteer information.
- **Avoid unintentional, non-verbal communications.**
- **Pause a second before answering.**
 - Allows your counsel to object if necessary.
- **Do not try to outsmart, or argue with, opposing counsel.**

08-32-FI210-EP

Criminal Process

Principles of Effective Testimony

For Trials and Depositions:

- **Provide responsive answers on direct examination (*i.e.*, answer the question asked).**
- **On cross examination, if the question cannot be answered with a yes or no, you may explain your answer.**
- **If the answer is incorrectly stated, correct it immediately or clarify it.**
- **Avoid police or fire jargon, acronyms, or legalese.**

08-33-FI210-EP

Criminal Process

Principles of Effective Testimony

For Trials and Depositions:

- If you don't know the answer to a question, say "I don't know."
- Do not exaggerate or make overly broad statements.
 - Never say "never," or "always," etc.
- Be serious and avoid smiling or laughing.
- When an attorney objects to a question, allow judge to rule.

08-34-FI210-EP

Criminal Process

Principles of Effective Testimony

For Trials and Depositions:

- When questioned by opposing counsel do not look to your counsel for help.
- Do not leave the stand until excused.
- Do not leave the courtroom or courthouse without consulting your attorney.
- Anything you look at while testifying can and will be examined by opposing counsel.
- Refer to reports rather than notes, if possible.

08-35-FI210-EP


Criminal Process

Principles of Effective Testimony

For Trials and Depositions:

- Opposing counsel may attempt to impeach you for seemingly conflicting Deposition and Trial Testimony.
- Seemingly different answers can often be reconciled.
 - Is the question different?
 - Are the underlying facts different?
 - Have you come upon new information?
- Clarify without becoming defensive.
- If you cannot explain the difference simply state which response is correct.

08-36-FI210-EP



Criminal Process

Electronic Discovery

Electronically Stored Information (“ESI”)

- When a federal agency reasonably expects litigation in federal court.
- All ESI that may relate to that expected litigation must be “frozen” (preserved).
 - Format
 - Place
- The process is often initiated by in-house counsel “Litigation Hold” letters.
- ESI must be frozen until conclusion of litigation.

08-37-FI210-EP

Criminal Process

Electronic Discovery

- Err on the side of retention.
- If in doubt - consult DOJ/agency counsel prior to altering, deleting, or discarding.
- Court ordered sanctions available for improper deletion/alteration.

08-38-FI210-EP

Criminal Process

Principles of Effective Testimony

The most important principle is to always tell the TRUTH.

08-39-FI210-EP

Review Unit 8 Objectives

1. Identify key steps in the civil and criminal litigation processes.
2. Explain the relationship between the investigation report and testimony.
3. Define “expert witness” and “fact witness.”
4. Describe the role of an expert witness.
5. Describe the “expert witness” *voir dire* process.
6. List the elements of a *curriculum vitae*.
7. List the principles an investigator should follow when testifying.

08-40-FI210-EP
